DSA APPROVAL

CHAFFEY COLLEGE CHINO INSTRUCTIONAL BUILDING

5009006

Chaffey Community College District

5855 Haven Ave., Rancho Cucamonga, CA 91737

August 5, 2021

HMC Architects

CHAFFEY COLLEGE
CHINO INSTRUCTIONAL BUILDING
CHAFFEY COMMUNITY COLLEGE DISTRICT
CHINO, CA

August 2, 2021

HMC # 5009006

LICENSED ARCHITECT
KENNETH SALYER
NO. C-19082
REN. 11-30-21
STATE OF CALIFORNIA

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

APP: 04-119722 INC:

REVIEWED FOR

SS ☑ FLS ☑ ACS ☑

DATE: 08/19/2021

HMC ARCHITECTS
Architect

REGISTERED PROFESSIONAL ENGINEER
M. SAIFUL ISLAM
S4083
Exp. 06/22/22
STRUCTURAL
STATE OF CALIFORNIA

SAIFUL / BOUQUET
Structural Engineer

REGISTERED PROFESSIONAL ENGINEER
EHSAN DARYARAM
M 38661
MECHANICAL
STATE OF CALIFORNIA

INTEGRAL GROUP
Mechanical/Plumbing Engineers

REGISTERED PROFESSIONAL ENGINEER
COREY EMMIT LYONS
No. E18240
Ex 12/31/21
ELECTRICAL
STATE OF CALIFORNIA

INTEGRAL GROUP
Electrical Engineer

REGISTERED PROFESSIONAL ENGINEER
STEVEN P. BISHOP
NO. FP 1556
REN. JUNE 30, 2022
FIRE PROTECTION
STATE OF CALIFORNIA

PACIFIC FIRE
Fire Protection

2019 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 (2019 CBC).

****NOTE:** Undefined section and table references found in this document are from the CBC, or California Building Code.

KEY TO COLUMNS

1. TYPE	2. PERFORMED BY
Continuous – Indicates that a continuous special inspection is required **Periodic** – Indicates that a periodic special inspection is required **Test** – Indicates that a test is required	**GE** – Indicates that the special inspection shall be performed by a registered geotechnical engineer or his or her authorized representative. **LOR** – Indicates that the test or special inspection shall be performed by a testing laboratory accepted in the DSA Laboratory Evaluation and Acceptance (LEA) Program. See CAC Section 4-335. **PI –** Indicates that the special inspection may be performed by a project inspector when specifically approved by DSA. **SI** – Indicates that the special inspection shall be performed by an appropriately qualified/approved special inspector.

Geotechnical Reports: Project has a geotechnical report, or CDs indicate soils special inspection is required by GE

	1. GENERAL:	**Table 1705A.6**		
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Verify that: • Site has been prepared properly prior to placement of controlled fill and/or excavations for foundations. • Foundation excavations are extended to proper depth and have reached proper material. • Materials below footings are adequate to achieve the design bearing capacity.	**Periodic**	**GE***	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)

	2. SOIL COMPACTION AND FILL:	**Table 1705A.6**		
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Perform classification and testing of fill materials.	**Test**	**LOR***	* Under the supervision of the geotechnical engineer.
☑	**b.** Verify use of proper materials, densities and inspect lift thicknesses, placement and compaction during placement of fill.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative. (Refer to specific items identified in the Appendix for exemptions where soils SI and testing may be conducted under the supervision of a geotechnical engineer or LOR's engineering manager. In such cases, the LOR's form DSA 291 shall satisfy the soil SI and test reporting requirements for the exempt items.)

☑	**c.** Compaction testing.	**Test**	**LOR***	* Under the supervision of the geotechnical engineer. (Refer to specific items identified in the Appendix for exemptions where soils testing may be conducted under the supervision of a geotechnical engineer or LOR's engineering manager. In such cases, the LOR's form DSA 291 shall satisfy the soil test reporting requirements for the exempt items.)

	3. DRIVEN DEEP FOUNDATIONS (PILES):	**Table 1705A.7**		
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Verify pile materials, sizes and lengths comply with the requirements.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative.
☐	**b.** Determine capacities of test piles and conduct additional load tests as required.	**Test**	**LOR***	* Under the supervision of the geotechnical engineer.
☐	**c.** Inspect driving operations and maintain complete and accurate records for each pile.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative.
☐	**d.** Verify locations of piles and their plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and record any pile damage.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative.
☐	**e.** Steel piles.	Provide tests and inspections per STEEL section below.		
☐	**f.** Concrete piles and concrete filled piles.	Provide tests and inspections per CONCRETE section below.		

☐	**g.** For specialty piles, perform additional inspections as determined by the registered design professional in responsible charge.	*	*	* As defined on drawings or specifications.

	4. CAST-IN-PLACE DEEP FOUNDATIONS (PIERS):	**Table 1705A.8**		
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Inspect drilling operations and maintain complete and accurate records for each pier.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
☐	**b.** Verify pier locations, diameters, plumbness, bell diameters (if applicable), lengths and embedment into bedrock (if applicable); record concrete or grout volumes.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
☐	**c.** Confirm adequate end strata bearing capacity.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
☐	**d.** Concrete piers.	Provide tests and inspections per CONCRETE section below.		

	5. RETAINING WALLS:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Placement, compaction and inspection of backfill.	**Continuous**	**GE***	**1705A.6.1.** * By geotechnical engineer or his or her qualified representative. (See Section 2 above).

☐	**b.** Placement of soil reinforcement and/or drainage devices.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative.
☐	**c.** Segmental retaining walls; inspect placement of units, dowels, connectors, etc.	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative. See DSA IR 16-3.
☐	**d.** Concrete retaining walls.	Provide tests and inspections per CONCRETE section below.		
☐	**e.** Masonry retaining walls.	Provide tests and inspections per MASONRY section below.		

	6. OTHER SOILS:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Soil Improvements	**Test**	**GE***	Submit a comprehensive report documenting final soil improvements constructed, construction observation and the results of the confirmation testing and analysis to CGS for final acceptance. * By geotechnical engineer or his or her qualified representative.
☐	**b.** Inspection of Soil Improvements	**Continuous**	**GE***	* By geotechnical engineer or his or her qualified representative.
☐	**c.**			

	7. CAST-IN-PLACE CONCRETE			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
Material Verification and Testing:				
☑	**a.** Verify use of required design mix.	**Periodic**	**SI**	**Table 1705A.3 Item 5, 1910A.1.**
☑	**b.** Identifiy, sample, and test reinforcing steel.	**Test**	**LOR**	**1910A.2;** ACI 318-14 Section 26.6.1.2; DSA IR 17-10. (See Appendix for exemptions.)
☑	**c.** During concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	**Test**	**LOR**	**Table 1705A.3 Item 6**; ACI 318-14 Sections 26.5 & 26.12.
☑	**d.** Test concrete (f'_c).	**Test**	**LOR**	**1905A.1.15;** ACI 318-14 Section 26.12.
Inspection:				
☑	**e.** Batch plant inspection: **Continuous**	**See Notes**	**SI**	Default of **'Continuous'** per **1705A.3.3**. If approved by DSA, batch plant inspection may be reduced to **'Periodic'** subject to requirements in Section **1705A.3.3.1,** or eliminated per **1705A.3.3.2.** (See Appendix for exemptions.)
☑	**f.** Welding of reinforcing steel.	Provide special inspection per STEEL, Category 19.1(d) & (e) and/or 19.2(g) & (h) below.		

	8. PRESTRESSED / POST-TENSIONED CONCRETE (in addition to Cast-in-Place Concrete tests and inspections):

	Test or Special Inspection	Type	Performed By	Code References and Notes
☐	**a.** Sample and test prestressing tendons and anchorages.	**Test**	**LOR**	**1705A.3.4, 1910A.3**
☐	**b.** Inspect placement of prestressing tendons.	**Periodic**	**SI**	**1705A.3.4, Table 1705A.3 Items 1 & 9.**
☐	**c.** Verify in-situ concrete strength prior to stressing of post-tensioning tendons.	**Periodic**	**SI**	**Table 1705A.3 Item 11.** Special inspector to verify specified concrete strength test prior to stressing.
☐	**d.** Inspect application of post-tensioning or prestressing forces and grouting of bonded prestressing tendons.	**Continuous**	**SI**	**1705A.3.4, Table 1705A.3 Item 9;** ACI 318-14 Section 26.13

	9. PRECAST CONCRETE (in addition to Cast-in-Place Concrete tests and inspections):			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Inspect fabrication of precast concrete members.	**Continuous**	**SI**	ACI 318-14 Section 26.13.
☐	**b.** Inspect erection of precast concrete members.	**Periodic**	**SI***	**Table 1705A.3 Item 10.** * May be performed by PI when specifically approved by DSA.

	10. SHOTCRETE (in addition to Cast-in-Place Concrete tests and inspections):			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**

☐	**a.** Inspect shotcrete placement for proper application techniques.	**Continuous**	**SI**	**1705A.19, Table 1705A.3 Item 7, 1908A.6, 1908A.7, 1908A.8, 1908A.9, 1908A.11, 1908A.12.** See ACI 506.2-13 Section 3.4, ACI 506R-16.
☐	**b.** Sample and test shotcrete (f'_c).	**Test**	**LOR**	**1908A.5, 1908A.10.**

	11. POST-INSTALLED ANCHORS:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Inspect installation of post-installed anchors	**See Notes**	**SI***	**1617A.1.19, Table 1705A.3 Item 4a (Continuous) & 4b (Periodic), 1705A.3.8** (See Appendix for exemptions). ACI 318-14 Sections 17.8 & 26.13. * May be performed by the project inspector when specifically approved by DSA.
☑	**b.** Test post-installed anchors.	**Test**	**LOR**	**1910A.5.** (See Appendix for exemptions.)

	12. OTHER CONCRETE:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.**			

	17. STRUCTURAL STEEL, COLD-FORMED STEEL AND ALUMINUM USED FOR STRUCTURAL PURPOSES			
Material Verification and Testing:				
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Verify identification of all materials and: • Mill certificates indicate material properties that comply with requirements. • Material sizes, types and grades comply with requirements.	**Periodic**	*	**Table 1705A.2.1 Item 3a–3c.** 2202A.1; AISI S100-16 Section A3.1 & A3.2, AISI S240-15 Section A3 & A5, AISI S220-15 Sections A4 & A6. * By special inspector or qualified technician when performed off-site.
☑	**b.** Test unidentified materials	**Test**	**LOR**	**2202A.1.**
☑	**c.** Examine seam welds of HSS shapes	**Periodic**	**SI**	DSA IR 17-3.
Inspection:				
☑	**d.** Verify and document steel fabrication per DSA-approved construction documents.	**Periodic**	**SI**	Not applicable to cold-formed steel light-frame construction, except for trusses (**1705A.2.4**).

	18. HIGH-STRENGTH BOLTS: RCSC 2014			
Material Verification and Testing of High-Strength Bolts, Nuts and Washers:				
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the DSA-approved documents.	**Periodic**	**SI**	**Table 1705A.2.1 Items 1a & 1b, 2202A.1;** AISC 360-16 Section A3.3, J3.1, and N3.2; RCSC 2014 Section 1.5 & 2.1; DSA IR 17-8 & DSA IR 17-9.

☑	**b.** Test high-strength bolts, nuts and washers.	**Test**	**LOR**	**Table 1705A.2.1 Item 1c, 2213A.1**; RCSC 2014 Section 7.2; DSA IR 17-8.
Inspection of High-Strength Bolt Installation:				
☑	**c.** Bearing-type ("snug tight") connections.	**Periodic**	**SI**	**Table 1705A.2.1 Item 2a, 1705A.2.6, 2204A.2**; AISC 360-16 J3.1, J3.2, M2.5 & N5.6; RCSC 2014 Section 9.1; DSA IR 17-9.
☑	**d.** Pretensioned and slip-critical connections.	*	**SI**	**Table 1705A.2.1 Items 2b & 2c, 1705A.2.6, 2204A.2;** AISC 360-16 J3.1, J3.2, M2.5 & N5.6; RCSC 2014 Sections 9.2 & 9.3; DSA IR 17-9. * "Continuous" or "Periodic" depends on the tightening method used.

	19. WELDING:	**1705A.2.5, Table 1705A.2.1 Items 4 & 5;** AWS D1.1 and AWS D1.8 for structural steel; AWS D1.2 for Aluminum; AWS D1.3 for cold-formed steel; AWS D1.4 for reinforcing steel; DSA IR 17-3 (See Appendix for exemptions.)		
Verification of Materials, Equipment, Welders, etc.:				
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Verify weld filler material identification markings per AWS designation listed on the DSA-approved documents and the WPS.	**Periodic**	**SI**	DSA IR 17-3.
☑	**b.** Verify weld filler material manufacturer's certificate of compliance.	**Periodic**	**SI**	DSA IR 17-3.
☑	**c.** Verify WPS, welder qualifications and equipment.	**Periodic**	**SI**	DSA IR 17-3.

	19.1 SHOP WELDING:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Inspect groove welds, multi-pass fillet welds, single pass fillet welds > 5/16", plug and slot welds.	**Continuous**	**SI**	**Table 1705A.2.1 Items 5a.1–4;** AISC 360-16 (and AISC 341-16 as applicable); DSA IR 17-3.
☑	**b.** Inspect single-pass fillet welds ≤ 5/16", floor and roof deck welds.	**Periodic**	**SI**	**1705A.2.2, Table 1705A.2.1 Items 5a.5 & 5a.6;** AISC 360-16 (and AISC 341-16 as applicable); DSA IR 17-3.
☑	**c.** Inspect welding of stairs and railing systems.	**Periodic**	**SI**	**1705A.2.1**; AISC 360-16 (and AISC 341-16 as applicable); AWS D1.1 & D1.3; DSA IR 17-3.
☑	**d.** Verification of reinforcing steel weldability other than ASTM A706.	**Periodic**	**SI**	**1705A.3.1**; AWS D1.4; DSA IR 17-3. Verify carbon equivalent reported on mill certificates.
☑	**e.** Inspect welding of reinforcing steel.	**Continuous**	**SI**	**Table 1705A.2.1 Item 5b, 1705A.3.1, Table 1705A.3 Item 2, 1903A.8;** AWS D1.4; DSA IR 17-3.

	19.2 FIELD WELDING:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Inspect groove welds, multi-pass fillet welds, single pass fillet welds > 5/16", plug and slot welds.	**Continuous**	**SI**	**Table 1705A.2.1 Items 5a.1–4;** AISC 360-16 (AISC 341-16 as applicable); DSA IR 17-3.
☑	**b.** Inspect single-pass fillet welds ≤ 5/16".	**Periodic**	**SI**	**Table 1705A.2.1 Item 5a.5;** AISC 360-16 (AISC 341-16 as applicable); DSA IR 17-3.

☑	**c.** Inspect end-welded studs (ASTM A-108) installation (including bend test).	**Periodic**	**SI**	**2213A.2**; AISC 360-16 (AISC 341-16 as applicable); AWS D1.1; DSA IR 17-3.
☑	**d.** Inspect floor and roof deck welds.	**Periodic**	**SI**	**1705A.2.2, Table 1705A.2.1 Item 5a.6;** AISC 360-16 (AISC 341-16 as applicable); AWS D1.3; DSA IR 17-3.
☑	**e.** Inspect welding of structural cold-formed steel.	**Periodic**	**SI***	**1705A.2.5; AWS D1.3; DSA IR 17-3.** The quality control provisions of AISI S240-15 Chapter D shall also apply. * May be performed by the project inspector when specifically approved by DSA.
☑	**f.** Inspect welding of stairs and railing systems.	**Periodic**	**SI***	**1705A.2.1;** AISC 360-16 (AISC 341-16 as applicable); AWS D1.1 & D1.3; DSA IR 17-3. * May be performed by the project inspector when specifically approved by DSA.
☑	**g.** Verification of reinforcing steel weldability.	**Periodic**	**SI**	**1705A.3.1**; AWS D1.4; DSA IR 17-3. Verify carbon equivalent reported on mill certificates.
☑	**h.** Inspect welding of reinforcing steel.	**Continuous**	**SI**	**Table 1705A.2.1 Item 5b, 1705A.3.1, Table 1705A.3 Item 2, 1903A.8;** AWS D1.4; DSA IR 17-3.

	20. NONDESTRUCTIVE TESTING: **1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16**			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Ultrasonic	**Test**	**LOR**	**1705A.2.1, 1705A.2.5;** AISC 341-16 J6.2, AISC 360-16 N5.5; ANSI/ ASNT CP-189, SNT-TC-1A; AWS D1.1, AWS D1.8; DSA IR 17-2.

☑	**b.** Magnetic Particle	**Test**	**LOR**	**1705A.2.1, 1705A.2.5;** AISC 341-16 J6.2, AISC 360-16 N5.5; ANSI/ ASNT CP-189, SNT-TC-1A; AWS D1.1, AWS D1.8; DSA IR 17-2.
☐	**c.**	**Test**	**LOR**	

	21. STEEL JOISTS AND TRUSSES: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Verify size, type and grade for all chord and web members as well as connectors and weld filler material; verify joist profile, dimensions and camber (if applicable); verify all weld locations, lengths and profiles; mark or tag each joist.	**Continuous**	**SI**	**1705A.2.3, Table 1705A.2.3;** AWS D1.1; DSA IR 22-3 for steel joists only. **1705A.2.4;** AWS D1.3 for cold-formed steel trusses.

	22. SPRAY APPLIED FIRE-PROOFING: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Examine structural steel surface conditions, inspect application, take samples, measure thickness and verify compliance of all aspects of application with DSA-approved documents.	**Periodic**	**SI**	**1705A.14.**
☑	**b.** Test bond strength.	**Test**	**LOR**	**1705A.14.6.**

☑	**c.** Test density.	**Test**	**LOR**	**1705A.14.5.**

	23. ANCHOR BOLTS AND ANCHOR RODS:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☑	**a.** Anchor Bolts and Anchor Rods	**Test**	**LOR**	Sample and test anchor bolts and anchor rods not readily identifiable per procedures noted in DSA IR 17-11.
☐	**b.** Threaded rod not used for foundation anchorage.	**Test**	**LOR**	Sample and test threaded rods not readily identifiable per procedures noted in DSA IR 17-11.

	Other Steel			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.**			

	26. OTHER:			
	Test or Special Inspection	**Type**	**Performed By**	**Code References and Notes**
☐	**a.** Load test for identified product(s):	**Test**	**LOR**	**1709A.2, 1709A.3**. Testing is not required for: 1) a product with a valid evaluation service report per DSA IR A-5, or 2) a product that can be justified by structural calculation.
☐	**b.** Installation torque for non-HS bolts	**Continuous**	**SI***	Applicable to communication towers identified as Essential Service Facility Projects (ESFP). Calibrated wrench use required, verified by SI during installation. DSA Policy PL 18-01: Communication Towers, Poles and Buildings Utilized by State Agencies for Essential Services Communications.*EXCEPTION: Non-ESFP may use PI without need for notification to DSA.
☐	**c.**			

Exempt items given in DSA IR A-22 or the 2019 CBC (including DSA amendments) and those items identified below with a check mark by the design professional are NOT subject to DSA requirements for the structural tests **/** special inspections noted. **Items marked as exempt shall be identified on the approved construction documents**. The project inspector shall verify all construction complies with the approved construction documents.

	SOILS:
☐	1. Deep foundations acting as a cantilever footing designed based on minimum allowable pressures per CBC Table 1806A.2 and having no geotechnical report for the following cases: A) free standing sign or scoreboard, B) cell or antenna towers and poles less than 35'-0" tall (e.g., lighting poles, flag poles, poles supporting open mesh fences, etc.), C) single-story structure with dead load less than 5 psf (e.g., open fabric shade structure), or D) covered walkway structure with an apex height less than 10'-0" above adjacent grade.
☐	2. Shallow foundations, etc. are exempt from special inspections and testing by a Geotechnical Engineer for the following cases: A) buildings without a geotechnical report and meeting the exception item #1 criteria in CBC Section 1803A.2 supported by native soil (any excavation depth) or fill soil (not exceeding 12" depth per CBC Section 1804A.6), B) soil scarification/recompaction not exceeding 12" depth, C) native or fill soil supporting exterior non-structural flatwork (e.g., sidewalks, site concrete ramps, site stairs, parking lots, driveways, etc.), D) unpaved landscaping and playground areas, or E) utility trench backfill.

	CONCRETE/MASONRY:
☐	1. Post-installed anchors for the following: A) exempt non-structural components (e.g., mechanical, electrical, plumbing equipment **-** see item 7 for "Welding") given in CBC Section 1617A.1.18 (which replaces ASCE 7-16, Section 13.1.4) or B) interior nonstructural wall partitions meeting criteria listed in exempt item 3 for "Welding."
☐	2. Concrete batch plant inspection is not required for items given in CBC Section 1705A.3.3.2 subject to the requirements and limitations in that section.

☐	3. Non-bearing non-shear masonry walls may be exempt from certain DSA masonry testing and special inspection items as allowed per DSA IR 21-1.16. Refer to construction documents for specific exemptions accordingly for each applicable wall condition.
☐	4. Epoxy shear dowels in site flatwork and/or other non-structural concrete.
☐	5. Testing of reinforcing bars is not required for items given in CBC Section 1910A.2 subject to the requirements and limitations in that section.

	Welding:
☐	1. Solid-clad and open-mesh gates with maximum leaf span or rolling section for rolling gates of 10' and apex height less than 8'-0" above lowest adjacent grade. When located above circulation or occupied space below, these gates are not located within 1.5x gate/fence height (max 8'-0") to the edge of floor or roof.
☐	2. Handrails, guardrails, and modular or relocatable ramps associated with walking surfaces less than 30" above adjacent grade (excluding post base connections per the 'Exception' language in Section 1705A.2.1); fillet welds shall not 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 Sections 19, 19.1 and/or 19.2 of listing above).
☐	5. Manufactured components (e.g., Tolco, B-Line, Afcon, 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 Sections 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 located in the Steel/Aluminum category).
☐	7. Any support for exempt non-structural components given in CBC Section 1617A.1.18 (which replaces ASCE 7-16, Section 13.1.4) meeting the following: A) when supported on a floor/roof, <400# and resulting composite center of mass (including component's center of mass) ≤4' above supporting floor/roof, B) when hung from a wall or roof/floor, <20# for discrete units or <5 plf for distributed systems.

DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS(SIGNATURE), 2019 CBC

Application Number: 04-119722	**School Name:** CHAFFEY COLLEGE CHINO CAMPUS	**School District:** Chaffey Community College District
DSA File Number: 36-C1	**Increment Number:**	**Date Created:** 2021-06-18 13:47:08

Name of Architect or Engineer in general responsible charge:

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

SAIFUL ISLAM

Signature of Architect or Structural Engineer: M. Saiful Islam

Date: 06/18/2021

REGISTERED PROFESSIONAL ENGINEER
SAIFUL ISLAM
No. S4083
Exp. 6/30/22
STRUCTURAL
STATE OF CALIFORNIA

Note: To facilitate DSA electronic mark-ups and identification stamp application, DSA recommends against using secured electronic or digital signatures.

DSA STAMP

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

APP: 04-119722 INC:

REVIEWED FOR

SS ☑ FLS ☑ ACS ☑

DATE: 08/19/2021

1. Soils Testing and Inspection: Geotechnical Verified Report Form DSA 293
2. Structural Testing and Inspection: Laboratory Verified Report Form DSA 291
3. Concrete Batch Plant Inspection: Laboratory Verified Report Form DSA 291
4. Post-installed Anchors: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
5. Shop Welding Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
6. Field Welding Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
7. High-Strength Bolt Installation Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292
8. Fire-Proofing Application Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292

TABLE OF CONTENTS

DIVISION 08 - OPENINGS

DIVISION 09 - FINISHES

DIVISION 10 - SPECIALTIES

DIVISION 11 - EQUIPMENT

DIVISION 12 - FURNISHINGS

DIVISION 14 - CONVEYING EQUIPMENT

DIVISION 21 - FIRE SUPPRESSION

DIVISION 22 - PLUMBING

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING(HVAC)

DIVISION 25 - INTEGRATED AUTOMATION

DIVISION 26 - ELECTRICAL

DIVISION 27 - COMMUNICATIONS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

DIVISION 31 - EARTHWORK

DIVISION 32 - EXTERIOR IMPROVEMENTS

DIVISION 33 - UTILITIES

END OF TABLE OF CONTENTS

SECTION 01 35 42

CALGREEN REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes general requirements and procedures for compliance with 2019 CALGreen nonresidential mandatory requirements.

B. Related Sections:
   1. Divisions 01 through 33 Sections, as applicable, for CALGreen requirements specific to the work of each of those Sections.

1.02 SUBMITTALS

A. CALGreen submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated CALGreen requirements.

B. Contractor shall develop a spreadsheet to track submittals required by CALGreen.

C. CALGreen Submittals:
   1. Furnish documentation showing verification of CALGreen compliance as required by Division of the State Architect - Structural Safety (DSA-SS).
   2. Section 5.106.1 – Storm Water Loss Prevention Plan: Newly constructed projects and additions which disturb less than one acre of land shall prevent the pollution of stormwater runoff from the construction activities through one or more of the following measures:
      a. Local ordinance, 5.106.1.2.
      b. Best management practices (BMP) complying with Section 5.106.1.2.
   3. Section 5.106.10 – Grading and Paving: Furnish drawing showing grading and paving designed to keep surface water from entering buildings.
   4. Section 5.408.1.4 – Construction Waste Management Plan: Furnish a construction waste management plan complying with specified requirements.
   5. Section 5.504.4.3.2 Verification - Contractor to verify if this section is requested by DSA. Documentation may include, but is not limited to, the following:
      1. Manufacturer's product specification, and
      2. Field verification of on-site product containers.
   6. Section 5.504.4.5.3– Composite Wood Products: Furnish documentation showing compliance with Section 5.504.4.5.
   7. Section 5.504.5.6.1 – Resilient Flooring: Furnish documentation showing resilient flooring materials meet the pollutant emission limits.

1.03 SUMMARY OF CALGREEN REQUIREMENTS

A. Division 5.1 – Planning and Design:
1. Section 5.106.4 - Bicycle Parking: Comply with Section 5.106.4.2, as applicable, for short-term and long-term bicycle parking.
2. Section 5.106.8 – Light Pollution Reduction: Comply with Section 5.106.8.1 for outdoor lighting systems.

B. Division 5.3 – Water Efficiency and Conservation:
1. Section 5.304.6 - Outdoor potable water use in landscape areas: Comply with Section 5.304.6.1 and 5.304.6.2, California Department of Water Resources Model Water Efficient Landscape Ordinance (MWELO).

C. Division 5.4 – Material Conservation and Resource Efficiency:
1. Section 5.407 - Water Resistance and Moisture Management: Comply with requirements specified in Section 5.407 for Weather Protection and Moisture Control.
2. Section 5.408 - Construction Waste Reduction, Disposal and Recycling: Comply with requirements specified in Section 5.408.1.
   a. Recycled and/or salvage for reuse a minimum of 65-percent of the nonhazardous construction and demolition waste or meet a local construction and demolition waste management ordinance, whichever is more stringent.
   b. Where the local jurisdiction does not have a construction and demolition waste management ordinance, submit a construction waste management plan with the following:
      1) Identify the materials to be diverted from disposal by efficient usage, recycling, reuse on the Project or salvage for future use or sale.
      2) Determine if materials will be sorted on-site or mixed.
      3) Identify diversion facilities where material collected will be taken.
      4) Indicate the amount of materials diverted, calculated by weight or volume, but not by both.
   c. Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with Section 5.408.1.2.
   d. The combined weight of new construction disposal that does not exceed 2-pounds per sq. ft. of building area may be deemed to meet the 65-percent minimum requirement.
   e. Documentation shall be provided to the enforcing agency which demonstrated compliance with Section 5.408.1 thru 5.408.1.3. The waste management plan shall be updated as required and shall be accessible during construction for examination by the enforcing agency.
   f. 100-percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled.
   g. 5.408.1.4 - Documentation: Documentation shall be provided to DSA which demonstrates compliance with Sections 5.408.1.1 through 5.408.1.3.

3. Section 5.410 - Building Maintenance and Operation: Comply with the requirements specified in Section 5.410.
   a. Provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of non-hazardous materials for recycling, including paper, corrugated cardboard, glass, plastics and metals.
   b. For new buildings of 10,000-sq. ft. or more, comply with the commissioning requirements specified in Section 5.410.2. Commissioning shall be performed by trained personnel with experience on projects of comparable size and complexity. General commissioning requirements include the following. The specific requirements of each item are specified in Section 5.410.2.1 thru 5.410.2.6.
      1) Owner's or Owner Representative's project requirements.
      2) Basis of design.
      3) Commissioning measures shown in the Construction Documents.
      4) Commissioning plan.
      5) Functional performance testing.
      6) Documentation and training.
      7) Commissioning report.
   c. For new buildings less than 10,000-sq. ft., test and adjust systems as specified in Sections 5.410.4.2 thru 5.410.4.5.

D. Division 5.5 – Environmental Quality:
   1. Section 5.504 - Pollutant Control: Comply with the requirements specified in Section 5.504.
      a. Cover duct openings and protect mechanical equipment during construction as specified in Section 5.504.3.
      b. Finish materials shall comply with the requirement specified in Sections 5.504.4.1 thru 5.504.4.4, as follows:
         1) Adhesives, adhesive bonding primers, adhesive primers and caulks shall meet the following requirements:
            a) Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable or SCAQMD Rule 1168 VOC limits as shown in Tables 5.504.4.1 and 5.504.2..
            b) Aerosol adhesives and smaller unit sizes of adhesives, and sealant or caulking compounds shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of CCR Title 17, commencing with Section 94507.
         2) Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3 unless more stringent local limits apply.

a) Aerosol paints and coatings shall meet the PWMIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, ion Sections 94522(c)(2) and (d)(2) of CCR, Title 17, commencing with Section 94520 and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8 Rule 49.

3) Carpet shall meet the testing and product requirements of one of the following, as required by Section 5.504.4.4:
   a) Carpet and Rug Institute's Green Label Plus Program.
   b) California Department of Public Health Standard Practice for the testing of VOCs (Specification 01350).
   c) NSF/ANSI 140 at the Gold level.
   d) Scientific Certifications Systems Sustainable Choice.
   e) California Collaborative for High Performance Schools (CA-CHPS) and listed in the CHPS High Performance Product Database.
4) Carpet cushion shall meet the requirements of the Carpet and Rug Institute Green Label program.
5) Carpet adhesive shall meet the requirements of Table 5.504.4.1.
6) Composite wood products, including hardwood plywood, particleboard and medium density fiberboard, used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et seq.) by or before the dates specified in those sections, as shown in Table 5.504.4.5.
7) For 80% of floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:
   a) Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program.
   b) Compliant with the VOC emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
   c) Compliant with California Collaborative for High Performance Schools (CA-CHPS) Criteria Interpretation for EQ2.2 dated July 2012 and listed in CHPS High Performance Product Database.
   d) Compliant with CDPH criteria as certified under the Greenguard Children's & Schools Programs.

c. Provide regularly occupied areas of the building with air filtration media for outside and return air prior to occupancy that provides at least a MERV of 13 as specified in Section 5.504.5.3.
d. Where outdoor areas are provided for smoking, prohibit smoking within 25-feet of building entries, outdoor air intakes and operable windows and in buildings; or as enforced by ordinances, regulations or policies of any city or county, whichever are more stringent. Post signage to inform building occupants of the prohibitions.

2. Indoor Moisture Control: Comply with the requirements specified in Section 5.505.
3. Indoor Air Quality: Comply with the requirements specified in Section 5.506.
4. Environmental Comfort: Comply with the requirements specified in Section 5.507.
5. Outdoor Air Quality: Comply with the requirements specified in Section 5.508.]

E. Summary:
1. Certain CALGreen Measures needed to comply with code are dependent on material selections, documentation and means and methods of the work. Each item related to CALGreen may not be specifically identified as CALGreen requirements in this Section. Refer to CALGreen Code, CCR Title 24, Part 11 for complete descriptions of measures and submittal requirements.
2. Designate an onsite field staff person contact for all CALGreen prerequisites and credit documentation, subcontractor supervision and submittal coordination and to manage the Contractor's portions of the CALGreen submittal process.
3. Documentation for CALGreen Measures shall be submitted in the format required by the CALGreen code.
4. A copy of the CALGreen code, CCR Title 24, Part 11 shall be available on-site at all times.
5. Additional information on CALGreen can be found at http://www.bsc.ca.gov.

F. Meetings:
1. Contractor shall conduct CALGreen compliance meetings as required. Contractor personnel who shall attend CALGreen compliance meetings include, but are not limited to:
   a. Contractor's project manager.
   b. Owner's Representative.
   c. Other attendees designated by Owner's Representative.
   d. Subcontractor representatives as appropriate to stage of work.
2. At a minimum, CALGreen compliance issues shall be discussed at the following meetings:
   a. Preconstruction meetings.
   b. Progress meetings.
   c. Subcontractor meetings.
   d. Meetings shall be scheduled as part of regularly scheduled job meetings on-site.

PART 2 – PRODUCTS

NOT USED.

PART 3 – EXECUTION

NOT USED.

END OF SECTION

SECTION 01 91 13

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.02 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 01340 "Submittals" for submittal procedure requirements for commissioning process.
2. Section 01700 "Completion and Closeout" for construction-phase commissioning process completion submittal requirements.
3. Section 01730 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
4. Section 23 08 00 "Commissioning of HVAC" for technical commissioning requirements for HVAC.

1.03 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

B. Basis-of-Design Document: A document prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project

Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority: An entity engaged by Owner to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.

E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.

F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 01700 "Completion and Closeout" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.

1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:

   a. Completion of tests and acceptance of test results.
   b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
   c. Comply with user training requirements in as specified.
   d. Completion and acceptance of submittals and reports.

G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Architect or Commissioning Authority.

H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.04 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Commissioning Authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning process.
2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning process.

1.05 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 01340 "Submittals" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 01310 "Contractor’s Construction Schedule" for the Construction Schedule general requirements for commissioning process.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal

of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

a. Make inspections required for commissioning process.
b. Coordinate, schedule, and manage commissioning process of Contractor, subcontractors, and suppliers.
c. Obtain documentation required for commissioning process from Contractor, subcontractors, and suppliers.
d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of three previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

G. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:

a. Calibration agency, including name and contact information.
b. Last date of calibration.
c. Range of values for which calibration is valid.
d. Certification of accuracy.
e. Certification for calibration equipment traceable to NIST.
f. Due date of the next calibration.

H. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

I. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.06 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Approved test procedures.
c. Test data forms, completed and signed.
d. Progress reports.
e. Commissioning issue report log.
f. Commissioning issue reports showing resolution of issues.
g. Correspondence or other documents related to resolution of issues.
h. Other reports required by commissioning process.
i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
j. Report shall include commissioning work of Contractor.

B. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.

B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
2. Calibrated and certified.

    a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
    b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.02 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

PART 3 - EXECUTION

3.01 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.02 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.

1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:

    a. Location according to Drawings and approved Shop Drawings.
    b. Configuration.
    c. Compliance with manufacturers' written installation instructions.
    d. Attachment to structure.
    e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
    f. Utility connections are of the correct characteristics, as applicable.
    g. Correct labeling and identification.
    h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.03 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.

   a. General Inspection: Level I.
   b. Acceptance Quality Limit (AQL) of 1.5.

2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.04 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.
2. Obtain, assemble, and submit commissioning documentation.
3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 01040 " Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with training requirements as specified.
11. Track commissioning issues until resolution and retesting is successfully completed.
12. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
13. Assemble and submit commissioning report.

3.05 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:

1. Complete construction checklists as Work is completed.
2. Distribute construction checklists to installing contractors before they start work.
3. Installers:

    a. Verify installation using approved construction checklists as Work proceeds.
    b. Complete and sign construction checklists weekly for work performed during the preceding week.

4. Provide Commissioning Authority access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

    a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
    b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.

6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 10 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.

    a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

    a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the

level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:

   a. Identify deferred tests by number and title.
   b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least one week (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:

   a. Identify delayed tests by test number and title.
   b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least one week (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.

2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:

    a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
    b. Submit commissioning compliance issue report form within 24 hours of the test.
    c. Determine the cause of the failure.
    d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

    a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
    b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
    c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
    d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.

6. Diagnose and correct failed test demonstrations as follows:

    a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
    b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
    c. Record the results of each step of the diagnostic procedure.
    d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
    e. Determine and record corrective measures.
    f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.

7. Retest:

   a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
   b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.

   a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than fifteen minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form marked "Retest," shall be initiated after the resolution has been completed.

3.06 COMMISSIONING MEETINGS

A. Schedule and conduct commissioning meetings. Comply with requirements in Section 01040 " Coordination."

3.07 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

   1. Construction Checklists:

      a. Material checks.
      b. Installation checks.
      c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
      d. Performance Tests:

         1) Static tests, as appropriate.
         2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
         3) Equipment and assembly performance tests.
         4) System performance tests.
         5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.08 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 01310 "Contractor’s Construction Schedule."

1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
2. Schedule the start date and duration for the following commissioning activities:

   a. Submittals.
   b. Preliminary operation and maintenance manual submittals.
   c. Installation checks.
   d. Startup, where required.
   e. Performance tests.
   f. Performance test demonstrations.
   g. Commissioning tests.
   h. Commissioning test demonstrations.

3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.

3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Architect.
2. Notify Architect of commissioning schedule changes at least three work days in advance for activities requiring the participation of Owner's witness.

3.09 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

   a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
   b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
   c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
   d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
   e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

   a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
   b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
   c. Signatures of individuals performing and witnessing tests.
   d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue

report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
b. Action distribution list.
c. Report date.
d. Test number and description.
e. Equipment identification and location.
f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

a. Completed data forms.
b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
c. Activities scheduled but not conducted per schedule.
d. Commissioning compliance issue report log.
e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
b. Attach to the data form printed trend log data collected during the test or test demonstration.
c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running,

operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

   a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all wrecking and demolition, including the removal and disposal of items, as shown on the drawings and as specified, complete.

1.02 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Traffic.
      a. Obstruction. Do not close, obstruct, or store material or equipment in street, sidewalks, alleys or passageways on campus in accordance with the requirements of the codes listed in DIVISION 1.

1.03 JOB CONDITIONS

A. Environmental Requirements:
   1. Wrecking and Demolition. Accomplish wrecking and demolition in a manner that provides for the safety of the public and all workmen and provides for the protection of all property not to be wrecked or demolished. Methods shall be subject to approval of College Project Manager.
   2. Surface Water. After the existing landscape has been removed, protect the resulting excavation or open area from surface water. Promptly remove any water which accumulates in the excavation or opening. The method of dewatering and the disposal of the water is subject to approval by College Project Manager.
      a. Prevent surface water from running into the excavated areas. Water which accumulates in the excavation shall be removed promptly. Provide and maintain all necessary bailing, draining, pumping and sheathing.
      b. Contractor shall be responsible for all additional Work required if ingress of ground or surface water softens excavated areas.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION

3.01 INSPECTION

A. Condition of Premises: Accept the premises as found and clear the Project site as specified.

3.02 PREPARATION

A. Utilities: Prior to disconnecting, removing, plugging or abandoning existing utilities serving the buildings being removed, obtain Campus Project Manager's approval. A minimum 48-hour advance notification is required for all utility shutdowns.

3.03 PERFORMANCE

A. Performance:
1. Wrecking and Demolition. Dismantle and remove all items and obstructions as shown on the Drawings or called out in these Specifications. Remove all foundations completely. Remove all pavement, curbs and sidewalks and other concrete slabs as required to execute the work. Do not damage adjacent remaining pavement or sidewalks. Make cut in such a manner that a clean vertical joint remains. Turn over all light poles and fixtures removed as part of the project to the College.
2. The ends of abandoned utilities shall be capped or plugged as approved.
3. Removal. Unless otherwise specified, all materials removed shall become the property of Contractor and shall be removed completely away from the Project site for disposal at a legal dumping site. Secure and pay for required hauling permits and pay dumping fees and charges.
4. Salvaged Items. Unless otherwise specified, salvaged items shall be returned to the Owner in a condition accepted by the College Project Manager. Items to be salvaged by the contractor shall be coordinated with the Owner and/or CPM prior to demolition and/or construction.
5. A 48 hour notice shall be provided to the College for any utility shut downs.

3.04 FIELD QUALITY CONTROL

A. Workmanship:
1. Demolition Work. Execute in an orderly manner with due consideration for adjacencies and the public. Execute the Work to insure adjacent properties and the public against damages incurred by falling debris or other causes.
2. Burning of Materials. Burn no materials or debris on the premises.
3. Dust Control. Sprinkle all rubbish and debris to keep down the dust.

B. Traffic:
1. Interference. Conduct operations with minimum interference with roads, streets, driveways, alleys, sidewalks and other facilities. Flagmen shall be used as necessary for traffic control. Maintain safe access to public at all time.

3.05 ADJUSTMENT AND CLEANING

A. Repairs and Replacements: Clean up, repair, or replace at no cost to Owner all property damaged by reason of required Work, including restoring all disturbed areas, surfaced and unsurfaced, to their original condition on completion of the Work as approved. All patchwork shall match existing. Painted surfaces shall be painted to match the adjacent areas.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 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. Latest edition of American Concrete Institute, ACI 318 and Manual of Concrete Practice (inclusive of all Parts).

C. If conflict occurs between the Contract Drawings, the Project Manual, ACI 318, and the Manual of Concrete Practice, the most stringent takes precedence.

1.02 SUMMARY

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

B. Related Sections:
1. Division 32 Section "Concrete Paving" for concrete pavement and walks.
2. Section 03 35 35 “Concrete Sealer”.

1.03 DEFINITIONS

A. Architectural Concrete: Concrete that is exposed as an interior or exterior surface in the completed structure and is designated as architectural concrete in the Contract Documents; contributes to visual character of the completed structure and therefore requires special care in the selection of the concrete materials, forming, placing and finishing to obtain the desired architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

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

D. Strength Test: The average of the strengths of at least two 6 by 12 inch cylinders or at least three 4 by 8 inch cylinders made from the same sample of concrete and tested at 28 days or at test age designated for determination of specified compressive strength of concrete.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Include qualified strength test records if design mixture is based on field experience.
3. Include results of trial mixtures if design mixture is based on trial mixtures.
4. Include results of modulus of elasticity tests on trial mixtures.
5. Design mixture to be signed and sealed by a professional Civil or Structural Engineer licensed in the State in which the Project is constructed.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Any deviations from the DSA approved documents shall be clearly identified in the shop drawing submittals.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installers.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Vapor retarders, including subbase materials.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

D. Material Test Reports: For the following, from a qualified Testing Agency, indicating compliance with requirements:
1. Aggregates.

E. ICC ES and IAPMO Evaluation Reports: For evidence of Building Code compliance:
1. Mechanical splices and connectors for reinforcing steel.

F. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect and Structural Engineer.
2. Re-entrant corners shall be avoided.

H. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. 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.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7 for “Lightweight Concrete”.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent Testing Agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at Project site.
1. Review special inspection and Testing Agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

H. Field-Constructed Mockups: Cast mockups of size required (or as specified below) to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship for Cast-in-Place concrete:
1. Notify Owner’s Representative/Landscape Architect following a minimum of 7 days concrete curing time prior to applying Top Cast finish to mock-up. Apply Top Cast finish in the presence of Owner’s Representative/Landscape Architect

and adjust finish as required by the Owner's Representative/Landscape Architect.

2. Concrete Bench - contractor to provide mockup of bench, minimum 5' in length, for approval by Landscape Architect prior to starting construction. Mock-up shall include all bench components (radial edge, joints, etc,), as required to receive approval.
3. Concrete Stairs – contractor shall provide mockup of concrete stairs (3 tread min.) and shall include all stair components for approval by Landscape Architect prior to proceeding with construction.
4. Retaining Wall – contractor to provide mockup of Retaining Wall (4' ht. x 4' wide min.) for approval by Landscape Architect prior to proceeding with construction.
5. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference:
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
2. Review concrete finishes and finishing, forms and form removal limitations, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Structurally sufficient to support weight of plastic concrete and other superimposed loads.
   1. Expanded polystyrene (EPS); ASTM C578, Type XI.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips (19 by 19 mm).

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.02 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 60 percent.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, Grade 60, deformed.

D. Plain-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.03 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Dowel Bar Sleeves: Circular PVC sleeve, sealed one end, dowel bar embedment plus 1 inch in length, and 1/16 inch annular space inside diameter.

C. Deformed Bar Anchors: ASTM A1064/A1064M, deformed steel wire; AWS D1.1/D1.1M, Type C.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

E. Mechanical Splices and Connectors: Comply with ACI 318 and ACI 439.3R, Type II.
1. Furnish splicing and connector system with current ICC ES or IAMPO Evaluation Report.

2.04 CONCRETE MATERIALS

A. Regional Materials: Provide concrete that has been manufactured within 500 miles of Project site from aggregates and/or cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C150/C150M, Type II or Type V UNO on the drawings. Supplement with the following:
a. Fly Ash: ASTM C618, Class F.

C. Normal-Weight Aggregates: ASTM C33/33M, Class 1N coarse aggregate, well-graded. Provide aggregates from a single source.
1. Maximum Coarse Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M, expanded shale, presize before firing, 3/4-inchnominal maximum aggregate size.

E. Water: ASTM C 94/C94M.

2.05 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260/C260M.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will 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 C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

2.06 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E1745, Class A, 15 mil. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C33/C33M for fine aggregates.

2.07 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of Portland cement, graded quartz aggregate, and plasticizing admixture.

2.08 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Refer to Section 03 35 35, Concrete Sealer.

2.09 CURING MATERIALS

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

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D2240.

C. Reglets: Fabricate reglets in concrete to receive flashing from other trades of not less than 0.022-inch thick galvanized-steel sheet. See Division 07 Section “Sheet Metal Flashing and Trim”. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Provide as shown on Drawings. Hot-dip galvanized-steel sheet, not less than 0.034-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

E. Waterstops: Flexible PVC type, factory-installed metal eyelets for embedding in concrete to prevent passage of fluids through joints, factory-fabricated corners, intersections and directional changes. Flat serrated or dumbbell without centerbulb for contraction (non-working joints) [for expansion (working joints)] joints, 6 inches, 1/4 inch thick, unless noted otherwise on drawings. By Greenstreak/Sika, Inc. St. Louis, Missouri, BoMetals Inc. Powder Springs, GA or equal.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.

C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.12 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent Testing Agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   2. Concrete mix designs shall be stamped by a California licensed Civil or Structural Engineer.

B. Modulus of Elasticity: Modulus of elasticity tests (ASTM C469/C469M) shall be performed on laboratory trial mixtures for each concrete strength, each concrete mix design and for each aggregate source. Modulus of elasticity to be tested using servo controlled electromechanical United machines or servo controlled hydraulic Satec machines. Maintain rate of loading to 35 ± 4 psi in lieu of that specified in ASTM C469/C469M.
   1. The modulus of elasticity (psi) at 28 days shall be a minimum of 100 percent of the target modulus of elasticity.
   2. Target modulus of elasticity (psi):
      a. For $f'_c \leq 6{,}000$ psi: $57{,}000\ (f'_c)^{1/2}$
      b. For $f'_c > 6{,}000$ psi: $40{,}000\ (f'_c)^{1/2} + 1\text{x}10^6$,
      c. f'_c is the specified concrete strength in psi at 28 days.
   3. A modulus of elasticity test shall be the average modulus of elasticity from a set of two (minimum) specimens obtained from same sample.
   4. Use a qualified independent Testing Agency for preparing and reporting results of modulus of elasticity tests.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
   1. Fly Ash: 25 percent maximum

D. Water-soluble chloride ion content shall be determined by ASTM C1218/C1218M at age between 28 and 42 days. Submit documentation verifying compliance. Limit water-soluble, chloride-ion content in hardened concrete to:
   1. 1.00 percent by weight of cement for mild-reinforced concrete.
   2. 0.06 percent by weight of cement for post-tensioned concrete.

E. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, unless specified otherwise in the Contract Documents.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.
   2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise indicated on Drawings.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

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.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."

3.03 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.
   1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Granular Course: Place vapor retarder over 4-inch bed of granular fill, material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch unless noted otherwise in the geotechnical report.

3.05 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.06 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 Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

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 tool 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 will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
      a. Perform saw-cutting before concrete starts to cool, as soon as the concrete surface is firm enough not to be torn or damaged by the blade, and before

random drying-shrinkage cracks can from in the concrete slab. Joints produced by conventional dry- or wet-cut process shall be made within 4 hours in hot weather and within 12 hours in cold weather after the slab has been finished.

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.
   2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint or use PVC dowel bar sleeve.

3.07 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Deviation from cross sectional thickness of suspended slabs shall not exceed ±1/4 inch.

5. Slope surfaces uniformly to drains where required.
6. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.08 FINISHING FORMED SURFACES

A. Refer to drawings for specific finishes.

B. 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 that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to view.

C. 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 defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

D. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until

producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

E. 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.

3.09 FINISHING FLOORS AND SLABS

A. Refer to drawings for specific finishes.

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

C. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
   1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

D. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, or built-up or membrane roofing.

E. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to 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.
   2. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:
      a. Specified overall values (SOV) of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values (MLV) of flatness, F(F) 17; and of levelness, F(L) 15.
      b. Specified overall values (SOV) of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values (MLV) of flatness, F(F) 24; and of levelness, F(L) 17; for surfaces to receive thin-set flooring.

   3. For floor installations 10,000 sq. ft. or less in total project area, finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (90 percent compliance) in accordance to ACI 117 Section 4.8.

F. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

G. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

H. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
   1. Uniformly spread 25 lbs./100 sq. ft. of dampened slip-resistive aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
   2. After broadcasting and tamping, apply float finish.
   3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.

I. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
   1. Uniformly apply dry-shake floor hardener at a rate of 100 lbs./100 sq. ft. unless greater amount is recommended by manufacturer.
   2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
   3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.11 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 ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, 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:
      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.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
      c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
   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.

3.12 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply liquid to concrete sooner than that recommended by manufacturer.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
   4. Repair technique shall be tested on a mockup or surface to be concealed later, before repairing surfaces exposed to view, for approval by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
   4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
   5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
   7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified Testing Agency to perform field tests and inspections and prepare test reports.

B. Inspections: Verify and inspect concrete Work as shown on Drawings.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one random composite sample for each 150 cu. yd. of concrete or 5,000 sq. ft. of surface area of slabs of walls, or fraction thereof, of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; [ASTM C173/C173M, volumetric method, for structural lightweight concrete;]one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C567/C567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31/C31M.
   a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Cast and laboratory-cure five standard cylinder plus one spare standard cylinder specimens for each composite sample.
      1) Cast and field-cure additional standard cylinder specimens to verify concrete strength for removal of shoring and reshoring in multistory construction. Number of field-cured cylinder specimens to be determined by Contractor.
      2) Cast and field-cure additional standard cylinder specimens to verify concrete strength for stressing of tendons in post-tensioned construction. Number of field-cured cylinder specimens to be determined by Contractor.
   b. Shear Walls and Columns: Cast and laboratory-cure five standard cylinder plus one spare standard cylinder specimens for each composite sample.
   c. Other Concrete Elements: Cast and laboratory-cure four standard cylinder plus one spare standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M.
   a. Mild-Reinforced Concrete Slabs and Beams: Test one laboratory-cured specimen at 4 days; one laboratory-cured specimen at 7 days or upon formwork stripping, whichever comes first; one laboratory-cured specimen at 14 days; and two laboratory-cured specimens at 28 days.
   b. Post-Tensioned Concrete Slabs and Beams: Test one laboratory-cured specimen at age determined by contractor for tendon stressing; one laboratory-cured specimen upon formwork stripping or 7 days, whichever comes first; one laboratory-cured specimen at 14 days; and two laboratory-cured specimens at 28 days.
   c. Shear Walls, Columns and concrete pilaster: Test one laboratory-cured specimen at 7 days, one laboratory-cured specimen at 56 days and one laboratory-cured specimen at 90 days; and two laboratory-cured specimens at 28 days.

d. Other Concrete Elements: Test two laboratory-cured specimens at 7 days and two laboratory-cured specimens at 28 days.
e. A compressive-strength test at shall be the average compressive strength from a set of two specimens obtained from same composite and tested at the age indicated.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
   a. If 28-day compressive-strength test falls below satisfactory levels, strength test the spare cylinder at age determined by the Contractor and average with the strength of the 28-day specimens. The average strength of the three cylinders shall be considered one compressive-strength test.
9. Modulus of Elasticity Test Specimens: ASTM C31/C31M.
   a. Shear walls, columns and concrete pilasters: Cast and field-cure eight two standard cylinder specimens plus two spares for each composite sample.
      1) Composite samples (consisting of 10 standard field-cured cylinder specimens) for each concrete strength, each concrete mix design and for each aggregate source, shall be randomly selected from every five floors, with two random composite samples minimum per building.
10. Modulus of Elasticity Tests: ASTM C469/C469M. Modulus of elasticity to be tested using servo controlled electromechanical United machines or servo controlled hydraulic Satec machines. Maintain rate of loading to 35 ± 4 psi in lieu of that specified in ASTM C469/C469M.
    a. Mild-Reinforced and Post-Tensioned Slabs and Beams: Test two field-cured specimens at 2 days, 4 days, 7 days, 14 days, and 28 days.
    b. Columns and Shear Walls: Test two field-cured specimens at 7 days, 28 days, 56 days, and 90 days.
    c. A modulus of elasticity test shall be the average modulus of elasticity from a set of two specimens obtained from same composite sample and tested at age indicated.
    d. If modulus of elasticity of two specimens varies by more than 15 percent a spare cylinder shall be tested. The average modulus of elasticity of three specimens shall be considered the modulus of elasticity.
    e. Modulus of elasticity tests are required for each concrete strength, each concrete mix design and for each aggregate source.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing.
    a. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete Testing Agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for each age tested.
    b. Reports of modulus of elasticity tests shall contain Project identification name and number, mix identification number, specimen identification number, curing and environmental history of specimen, date of test, name of Testing Agency, and plot of the results with age of concrete as the abscissa and modulus of elasticity as the ordinate.

12. Nondestructive Testing: Impact hammer, Sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing Agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of finishing.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

SECTION 03 35 35

CONCRETE SEALER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Penetrating floor sealer hardener and densifier, at all interior exposed concrete floors.

B. Related Sections:
   1. Section 03 30 00, Cast-In-Place Concrete.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM C779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.

C. ASTM C1353 - Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser.

D. ANSI - American National Standards Institute / NFSI - National Floor Safety Institute
   1. B101.3 - Measuring Wet DCOF of Common Hard Surface Floor Materials

1.03 PERFORMANCE REQUIREMENTS

A. 1/8 - 1/4 inch minimum penetration of existing concrete floors.

B. Dustproofing

C. Hardener, sealer, densifier.

1.04 SUBMITTALS

A. Product data for coating materials.

B. Samples

C. Manufacturers' installation instructions.

D. Maintenance data. Include maintenance and cleaning requirements for coatings, and re-coating techniques.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture of concrete sealers with five years' experience.

B. Applicator: Company specializing in applying work of this Section with three years' experience and approved by manufacturer.

C. Field Samples
1. Provide field sample panel, 48 inch long by 48 inch wide, illustrating surface sheen.
2. Locate where approved by Architect.
3. Accepted sample may remain as part of the Work.

D. Mock-up
1. Install minimum 5 feet by 5 feet mock-up of sealed concrete with surface treatment specified.
2. Install mock-up one month prior to installation.
3. Locate as approved by the Architect.
4. Use identical products as specified for installation.
5. Architect approval required.
6. Mock-up may be used in final installation.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Division 01, General Requirements.

B. Store and protect products under provisions of Division 01, General Requirements.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Sealer: 5 gallons of each material.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Non-toxic, non-flammable material.

B. Restrict traffic from area where coating is being applied or is curing.

C. Do not apply materials when humidity is above 90 percent.

1.09 WARRANTY

A. Provide 10-year application warranty and 20-year material warranty submittals under provisions of Division 01.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
1. Curecrete Chemical Co., Springville, UT; ASHFORD FORMULA
2. Paul M. Wolff Co., Inc., Orange, CA; SHUR-SEAL

3. Prosoco, Inc., Lawrence, KS; Consolideck LS/CS
4. W.R. Meadows, Pomona, CA; LIQUI-HARD

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

B. Combination Hardener and Sealer:
1. ASHFORD FORMULA. Waterbase, inorganic silicate material.
2. SHUR-SEAL, silicate blend.
3. CONSOLIDECK LS/CS, lithium silicate.

C. Verify all curing compounds have been removed.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive Work of this Section as instructed by manufacturer. Surfaces shall be clean, dry and free of substances that could affect penetration and finish.

B. Do not begin installation until unsatisfactory conditions are corrected. Beginning installation means acceptance of existing conditions and preparatory work of others.

3.02 PROTECTION

A. Protect elements surrounding and work of this Section from damage or disfiguration.

3.03 PREPARATION

A. Mask and protect adjacent surfaces and materials not receiving coating materials. Repair damage.

3.04 APPLICATION - COATING

A. Apply two coatings in accordance with manufacturer's instructions.

B. Brush, mop or spray apply solution at rates recommended by manufacturer (approximately 400 square feet per gallon). Patch test required to determine coverage rate.

3.05 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Division 01, General Requirements.

B. Completed floor coefficient of friction shall be tested using ANSI/NFSI B101.3.

C. Do not allow water on surface for 30 days.

3.06 CLEANING

A. Clean surfaces of overspray or splatter and excess material.

3.07 PROTECTIONS

A. Protect finished installation. Prevent construction traffic by use of suitable covering for 5 hours.

B. Protection. There is no known satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Protect the finished floor until the Date of Substantial Completion.
   1. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
   2. No trade shall park vehicles on interior slabs. If necessary to complete their scope of work, drop cloths shall be placed under vehicles at all times.
   3. No pipe cutting machine shall be used on interior slabs.
   4. Steel shall not be placed on interior slabs to avoid rust staining.
   5. All equipment must be equipped with non-marking tires.

END OF SECTION

SECTION 03 48 00

PRECAST CONCRETE SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Architectural precast concrete exterior components, splash blocks.

B. Supports, anchors and attachments.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM C33 - Concrete Aggregates.

C. ASTM C150 - Portland Cement.

D. ASTM C494 - Chemical Admixture for concrete.

E. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

F. PCI MNL 117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete.

1.03 SUBMITTALS

A. Shop Drawings: Indicate unit identification marks, connection details, support items, show all joint and connection details and their relation to supporting structure, dimensions, openings and relationship to adjacent materials.

B. Three samples, illustrating surface finish, color, profile and texture.

C. Maintenance Data: Indicate surface cleaning instructions.

1.04 QUALITY ASSURANCE

A. Qualifications
   1. Fabricator: Company specializing in performing the work of this Section with minimum five years' experience.

B. Pre-installation Conference
   1. Convene two weeks prior to commencing work of this Section.

1.05 DELIVERY, STORAGE AND HANDLING

A. Protect units to prevent staining, chipping or spalling of concrete.

1.06 FIELD MEASUREMENTS

A. Verify field measurements.

1.07 WARRANTY

A. Provide under provisions of Division 01, General Requirements.

B. Warranty shall state that all work is free from defects in materials and workmanship for a period of two years from the date of Certified Completion. Contractor shall agree to repair or replace defective materials and workmanship during the warranty period at no additional cost to the Owner.

C. Defective materials and workmanship is hereby defined to include evidence of abnormal deterioration, aging or weathering of the work, structural failure resulting from exposure to normal loads and forces, sealant failures, deterioration or discoloration of finishes in excess or normal weathering and aging.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form the basis for design and quality intended.
   1. Dura Art Stone, Fontana, CA.
   2. Wausau Tile, Wausau, WI
   3. Architectural Molded Products, Los Angeles, CA.
   4. Concrete Designs, Inc., Tucson, AZ.
   5. Stepstone Inc. Gardena, CA
   6. Moonlight Molds, Inc. Gardena, CA.

B. Or equal as approved in accordance with Division 01 General Requirements for substitutions.

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I or II, white-gray mix for natural finish, white for coloring.

B. Concrete Materials: ASTM C33; water and sand.
   1. Coarse Aggregate: maximum size 3/4”.

C. Integral color: ASTM C979, natural mineral-oxide type, limeproof and nonfading.

D. Admixtures: ASTM C494, Type A, water reducing, manufacturer's recommended type.

E. Surface Finish and Color: As selected by Architect, .

2.03 ACCESSORIES

A. Sealant: Two component polyurethane, as specified in Section 07 92 00.

2.04 MIX

A. Concrete: Minimum 5,000 psi, 28 day strength.

2.05 FABRICATION

A. Use rigid molds, constructed to maintain precast unit uniform in shape, size and finish.

B. Maintain consistent quality during manufacture.

C. Fabricate connecting devices, plates, angles, inserts, bolts and accessories. Fabricate to permit initial placement and final attachment.

D. Embed anchors, inserts plates, angles or other cast-in-place items as required for the component configuration.

2.06 FINISH - PRECAST UNITS

A. Finish: Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance and identical to approved samples.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that substrate, structure, anchors, devices and openings are ready to receive work of this Section.

3.02 APPLICATION

A. Remove all traces of deleterious materials from substrate.

B. Arrange units for similar - appearing assemblies and spacing.

C. Field cut units for proper sizing and placement. Utilize Diamond Blade equipment only.

D. Install precast architectural concrete units level, plumb, square, and true.

3.03 ADJUSTING

A. Adjust units so that joint dimensions are within tolerances.

3.04 PROTECTION

A. Protect work from damage.

3.05 CLEANING

A. Clean exposed facings to remove dirt and stains that may be on units after erection and completion of joint treatment. Wash and rinse in accordance with manufacturer's recommendations. Protect other work from damage due to cleaning operations. Do not use cleaning materials or processes that could change the character of exposed finishes.

3.06 REPAIRS

A. Conduct inspections, perform testing and make repairs or replace unsatisfactory precast units.

B. Limitations as to the amount of patching that will be permitted is subject to approval of Architect.

C. In addition to above, units may be rejected for anyone of the following:
   1. Exceeding the specified installation tolerances.
   2. Damaged during construction operations.
   3. Exposed-to-view surfaces that develop cracks or surface finish deficiencies.

3.07 SCHEDULE

A. As indicated on Drawings.

B. Splash blocks

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

B. Related Sections:
   1. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
   2. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
   3. Division 05 Section "Metal Stairs."
   4. Division 09 90 00 Painting Sections for "High-Performance Coatings" for surface-preparation and priming requirements.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SFRS" or elements along grid lines designated as "SFRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:
   1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
   2. Welded built-up members with plates thicker than 2 inches (50 mm).
   3. Column base plates thicker than 2 inches (50 mm).

D. Protected Zone: Structural members or portions of structural members of the SFRS indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
   5. Identify members and connections of the seismic-load-resisting system.
   6. Indicate locations and dimensions of protected zones.
   7. Identify demand critical welds.
   8. Any deviations from the DSA approved documents shall be clearly identified in the shop drawings.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing. For demand critical welds include the following:
   1. One or more combination of welding variables (e.g. power source, volt, amp, travel speed, etc.) that produces heat input within the range used for the WPS Heat Input Envelope Test.
   2. Electrode manufacturer and trade name.

D. Mock-ups: Where indicated in architectural drawings, for steel exposed to view in the completed structure, construct mockups for each form of construction and finish required to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
   1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect one week in advance of the dates and times when mockups will be constructed.
   3. Demonstrate the proposed range of aesthetic effect and workmanship of steel surfaces and welded and bolted connections.
      a. Coordinate finish-painting requirements of mockups with Division 09 Section "Painting."
   4. Obtain Architect's approval of mockups before start of final unit of Work.
   5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
      a. When directed, demolish and remove mockups from Project site.
      b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength bolt-nut-washer assemblies.
   4. Shear stud connectors.
   5. Shop primers.
   6. Non-shrink grout.

F. Source quality-control reports.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 358.
   4. AISC 360.
   5. RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   6. AWS D1.1/D1.1M.
   7. AWS D1.8/D1.8M.

E. Preinstallation Conference: Conduct conference at Project site.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and

spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's Testing Agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.08 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
1. W-Shapes: 60 percent.
2. Channels, Angles, M, S-Shapes: 60 percent.
3. Plates and Bars: 25 percent.
4. Cold-Formed Hollow Structural Sections: 25 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M-, S-Shapes: ASTM A 36/A 36M.

D. Plates and Bars: ASTM A 36/A 36M, typical; ASTM A 572/A 572M, Grade 50, when used in SLRS connection.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C typical & ASTM A1085 where specifically indicated.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
1. Finish: Black [except where indicated to be galvanized].

G. Welding Electrodes: Comply with AWS requirements.

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

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish; where indicated on Drawings.
   1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip or mechanically deposited zinc coating. All threaded components of the fastener assembly must be galvanized by the same process. Mixing high-strength bolts that are galvanized by one process with nuts that are galvanized by the other is not permitted.
   2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.

E. Shear Connectors: ASTM A 29, Grades C1010 through C1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, typical; ASTM F 1554, Grade 105, weldable, when used in SFRS; straight.
   1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
   2. Plate Washers: ASTM A 36/A 36M carbon steel.
   3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   4. Finish: Plain.

G. Threaded Rods: ASTM A 36/A 36M.
   1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
   2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   3. Finish: Plain.

H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.03 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers", including 2004 Addenda.

B. Primer: Comply with Division 09 painting Sections and Division 09 Section "High-Performance Coatings."

C. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.

D. Galvanizing Repair Paint: ASTM A 780.

2.04 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

H. Steel that will be exposed to view in the completed structure:
   1. The fabricator shall handle the steel with care to avoid marking or distorting the steel members:
      a. Slings shall be nylon type or chains or wire rope with softeners.
      b. Care shall be taken to minimize damage to any shop paint or coating.
      c. Tack welds, temporary braces, backing, and fixtures used in fabrication shall be shown in the fabrication documents.
      d. When temporary braces or fixtures are required during fabrication or shipment, or to facilitate erection, care shall be taken to avoid blemishes or unsightly surfaces resulting from the use or removal of such temporary elements.
      e. Tack welds not incorporated into final welds shall be treated consistently with requirements for final welds.
      f. All backing and runoff tabs shall be removed and the welds ground smooth.
      g. All bolt heads in connections shall be on the same side and consistent from one connection to another.
   2. Members fabricated of unfinished and galvanized steel shall not have erection marks, painted marks or other marks on surfaces in the completed structure.
   3. The permissible tolerances for member depth, width, out of square, and camber and sweep shall be as specified in ASTM A6 and ASTM A500.
   4. Weld spatter exposed to view, if any, shall be removed.
   5. Weld projection up to 1/16 in (2mm) is acceptable for butt and plug welded joints.
   6. Weld show-through shall be acceptable as produced.
   7. Surface shall be prepared to meet the requirement of SSPC-SP 6. Prior to blast cleaning:
      a. Grease or oil, if any is present, shall be removed by solvent cleaning to meet the requirements of SSPC-SP 1.
      b. Weld spatter, slivers, and similar surface discontinuities shall be removed.
      c. Sharp corners resulting from shearing, flame cutting, or grinding shall be eased.
   8. Seams of hollow structural sections shall be acceptable as produced.

9. Delivery of Materials: The standard for acceptance of delivered and erected members shall be equivalent to the standard employed at fabrication. Fabricator shall use special care to avoid bending, twisting or otherwise distorting steel members that will be exposed to view in the completed structure. All tie downs on loads shall be nylon straps or chains with softeners to avoid damage to edges and surfaces of members.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened unless noted otherwise on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   3. Top flange of beams supporting steel decking.
   4. Surfaces to be high-strength bolted with slip-critical connections.
   5. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   6. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.02 PREPARATION

A. Determine, furnish and install all temporary supports, such as temporary guys, beams, braces, falsework, cribbing or other elements required for the erection operation. These temporary supports shall be sufficient to secure the bare structural steel framing or any portion thereof against loads that are likely to be encountered during erection, including those due to wind and those that result from erection operations. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
   4. On welded construction exposed to view or weather, remove erection bolts, fill holes with plug welds or filler and grind smooth at exposed surfaces.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

I. Steel members that will be exposed to view in completed structure: The erector shall use special care in unloading, handling and erecting steel members that will be exposed to view in the completed structure to avoid marking or distorting. The erector shall plan and execute all operations in such a manner that allows the appearance of these members to be maintained:
   1. Slings shall be nylon type or chains or wire rope with softeners.
   2. Care shall be taken to minimize damage to any shop paint or coating.
   3. When temporary braces or fixtures are required to facilitate erection, care shall be taken to avoid any blemishes, holes or unsightly surfaces resulting from the use or removal of such temporary elements.
   4. Tack welds not incorporated into final welds shall be ground smooth.
   5. All backing and runoff tabs shall be removed and the welds ground smooth.
   6. All bolt heads in connections shall be on the same side and consistent from one connection to another.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened unless noted otherwise on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified independent Testing Agency to inspect field welds and high-strength bolted connections and prepare test reports.

B. Inspections: Verify and inspect structural steel Work as shown on Drawings.

C. Bolted Connections: Bolted connections will be tested and inspected according to RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at Testing Agency's option:

      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.

E. SFRS Connections: Test and inspect SFRS connection elements as indicated in accordance to AISC 341, AWS D1.1/D1.1M and AWS D1.8/D1.8M.

F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Testing Agency, where warranted, may select a reasonable number of additional studs to be subjected to the bend tests.

G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

SECTION 05 12 10

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes requirements regarding the appearance and surface preparation of Architecturally Exposed Structural Steel (AESS)

B. This Section applies to any members noted on Architectural and Structural Drawings as (AESS) and in the areas defined as AESS below.

C. Related Sections:
1. Section 01 40 00, Quality Requirements
2. Section 05 12 00, Structural Steel
3. Section 05 50 00, Metal Fabrications
4. Section 09 90 00, Painting

1.02 SUBMITTALS

A. General: Submit each item below according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of AESS components.
1. Provide erection drawings clearly indicating which members are considered as AESS members.
2. Include details that clearly identify all of the requirements listed in Article 2.03 Fabrication and Article 3.03 Erection of this specification. Provide connections for exposed AESS consistent with concepts shown on the Architectural or Structural Drawings.
3. Indicate welds by standard AWS Symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined herein.
4. Indicate type, size, finish and length of bolts distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Orient Bold heads on same surface exposed to view
5. Clearly indicate which surfaces or edges are exposed and what class of surface preparation is being used.
6. Indicate special tolerances and erection requirements as noted on the drawings or defined herein.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of Architects and Owners, and other information specified.

1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 12 00, Structural Steel, engage a firm experienced in fabricating AESS similar to that indicated for this Project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the Work.

B. Erector Qualifications: In addition to those qualifications listed in Section 05 12 00, Structural Steel, engage an experienced Erector who has completed AESS work similar in material, design and extent to that indicted for this Project and with a record of successful in-service performance.

C. Comply with applicable provisions of the following specifications and documents:
   1. AISC Code of Standard Practice, latest edition Section 10
   2. Structural steel framing indicated on drawings as "AESS" shall be designated as:
      a. AESS-1: Basic elements.
      b. AESS-2: Feature elements viewed at a distance greater than 20ft.
      c. AESS-3: Feature elements viewed at a distance less than 20ft.

D. Mockups: At least four weeks prior to fabricating AESS, the Contractor shall construct mockups to demonstrate aesthetic effects as well as qualities of materials and execution. A mockup for each of the following elements shall be constructed: Build mockups to comply with the following requirements, using materials indicated for final unit of Work:
   1. Locate mockups on-site or in the fabricator's shop as directed by Architect. Mockups shall be full-size pieces unless the Architect approves smaller models.
   2. Notify the Architect one week in advance of the dates and times when mockups will be available for review.
   3. Demonstrate the proposed range of aesthetic effects regarding each element listed under the fabrication heading below.
   4. Mockup will have finished surface (including surface preparation and paint system).
   5. Obtain Architect's approval of mockups before starting fabrication of final units.
   6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
      a. Approved mockups in an undisturbed condition at the time of Substantial completion may become part of the completed work.

E. Pre-installation Conference: The General Contractor shall schedule and conduct conference at the project site to comply with requirements of Division 01 Section "Project Meetings." As a minimum the meeting shall include the General Contractor, Fabricator, Erector, the finish-painting subcontractor, and the Architect. Coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing, touch up painting and other requirements for AESS.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver AESS to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

C. Erect pre-painted finish pieces using padded slings or other methods such that they are not damaged. Provide padding as required to protect while rigging and aligning member's frames. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Architect during the pre-installation meeting. Methods of removing temporary erection devices and finishing the AESS members shall be approved by the Architect prior to erection.

1.05 PROJECT CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.06 COORDINATION

A. Coordinate installation of anchors for AESS members that connect to the work of other trades. Furnish setting drawings, templates, and directions for installing anchors, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to the project site in time for installation. Anchorage concepts shall be as indicated on drawings and approved on final shop drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Meet requirements in Section 05 12 00 Structural Steel. As amended below.

B. High Strength Bolts, Nuts and Washers: Per Section 05 12 00 heavy hex heads and nuts. Provide standard carbon steel finish.

2.02 PRIMERS

A. Compatibility: The General Contractor shall submit all components/procedures of the paint system for AESS as a single coordinated submittal. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable) and finish coat. All of the items shall be coordinated with the finish coat specified in Division 09.

B. Primer: Per High Performance Coatings as specified in Section 09 90 00.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for galvanizing welds and repair-painting galvanized steel, with dry-film coating not less than 90 percent zinc dust by weight.

2.03 FABRICATION

A. Fabricate and assemble AESS in the shop to the greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by the Architect. Detail AESS assemblies to minimize field handling and expedite erection.

B. Fabricate AESS With exposed surfaces smooth, square and of surface quality consistent with the approved mock up. Use special care in handling and shipping of AESS both before and after shop painting.

C. Architecturally Exposed Structural Steel: Reference AISC 303 Section 10
   1. AESS-1:
      a. The permissible tolerances for member depth, width, out of square, and camber and sweep shall be as specified in ASTM A6/A6M-204, ASTM A500/A500M, and ASTM A1085/A1085M.
      b. Fabricate and assemble AESS in the shop to the greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by the Architect. Detail AESS assemblies to minimize field handling and expedite erection.
      c. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures
      d. Remove all backing and run out tabs.
      e. Grind all sharp edges smooth, including all sheared, punched or flame cut edges.
      f. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.
      g. Provide bolt type and finish as noted herein.
      h. Welded Connections: Comply with AWS D1.1 and as noted herein. Appearance and quality of welds shall be consistent. Assemble and weld built-up Sections by methods that will maintain alignment of members without warp exceeding the tolerance of this Section.
      i. Install all bolts on the same side of the connection. Oriented uniformly in the direction indicated Consistent from one connection to another.
      j. Remove all weld spatter, slivers, and similar surface discontinuities.
      k. Grind off projections larger than 1/16" at butt and plug welds.
      l. Continuous Weld Appearance: Where continuous welding is noted on the drawings, provide welds of a uniform size and profile.
      m. Seal Welds: Seal weld open ends of round and rectangular hollow structural Section with 1/8" closure plates. Provide venting as required for galvanized members.
   2. AESS-2:
      a. Fabricate to requirements of 3.02.C.1 and as follows:
      b. The as-fabricated straightness tolerance shall be one half that specified in ASTM A6/A66M, ASTM A500/A500M, or ASTM A1085/A1085M.
      c. For curved structural members, whether composed of a single standard structural shape or built-up, the as-fabricated variation from the theoretical curvature shall be equal to or less than the standard camber and sweep tolerances permitted for straight members in the applicable ASTM standard.
      d. The tolerance on overall profile dimensions of welded built-up members shall be one-half of that specified in AWS D1.1/D1.1M.

e. Provide hidden part marks or piece marks that may be fully removed after erection.

3. AESS-3:
   a. Fabricate to requirements of 3.02.C.2 and as follows:
   b. Fabricate AESS with exposed surfaces smooth, square and of surface quality consistent with the approved mock-up.
   c. Grind projections at butt and plug welds to be smooth with the adjacent surface.
   d. Orientation of HSS scams shall be as indicated on Drawings.
   e. Copes, miters, and cuts in surfaces exposed to view shall have a maximum gap of 1/8" in an open joint. If the gap is shown to be in contact, the contact shall be uniform within 1/16".
   f. Mill marks shall not be exposed to view. If it is not possible to hide mill marks, then the mill marks are to be removed by appropriate length cutting of mill material. If this is not possible, the fabricator shall remove the mill mark, grind, and fill the surface to be consistent with the approved mock-up.
   g. The matching of abutting cross Sections is required.

2.04 SHOP CONNECTIONS

A. Bolted Connections: Make in accordance with Section 05 12 00. Provide bolt type and finish as noted herein and align bolt heads as indicated on the approved shop erection drawings.

B. Weld Connections: Comply with AWS D1.1 and Section 05 12 00. Appearance and quality of welds shall be consistent with the mock up. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerance of this section.

2.05 SHOP PRIMING

A. Shop-prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2".
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections, if primer does not meet the specified AISC slip coefficient.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC Specifications as follows:
   1. SSPC-SP 6 "Commercial Blast Cleaning"
   2. Coordinate the required blast profile with the approved paint submittal prior to beginning surface preparation.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.06 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to AESS indicated for galvanizing according to ASTM A 123. Fabricate such that all connections of assemblies are made in the field with bolted connections. Provide galvanized finish or members and assemblies within the range of color and surface textures presented in the mock ups.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The erector shall check all AESS members upon delivery for twist, kinks, gouges or other imperfections which might result in rejection of the appearance of the member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

A. Provide connections for temporary shoring, bracing and supports only where noted on the approved shop drawings. Temporary connections not shown shall be made at locations not exposed to view in the final structure or as approved by the Architect. Handle, lift and align pieces using padded slings and/or other protection required to maintain the appearance of the AESS through the process or erection.

3.03 ERECTION

A. Set AESS accurately in locations and to elevations indicated, and according to AISC specifications referenced in this Section.

B. Architecturally Exposed Structural Steel: use special care in unloading, handling and erecting the steel to avoid marking or distorting the steel members. Minimize damage to any shop paint. When temporary braces or erection clips are used. Avoid unsightly surfaces upon removal. Tack welds: Ground smooth and holes filled with weld metal or body solder and smoothed by grinding or filing. Plan and execute all operations in such a manner that the close fit and neat appearance of the structure will not be impaired. Refer to ANSI/AISC 303, Section 10.
   1. Erection AESS-1:
      a. Place weld tabs for temporary bracing and safety cabling at points concealed from view in the completed structure or where approved by the Architect during the pre-installation meeting. Methods of removing temporary erection devices and finished the AESS members shall be approved by the Architect prior to erection.
      b. AESS erection tolerances: Erection tolerances shall meet the requirements of standard frame tolerances for structural steel per Chapter 7 of ANSI/AISC 303.
      c. Set AESS accurately in locations and to elevations indicated and according to AISC specifications referenced herein.

d. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
e. Remove all backing and run out tabs.
f. When temporary braces or fixtures are required to facilitate erection, care shall be taken to avoid any blemishes, holes or unsightly surfaces resulting from the use or removal of such temporary elements.
g. Bolted Connections: align bolt heads on the same side of the connection as indicated on the approved fabrication or erection documents.
h. Weld Connections: Comply with AWS D1.1 and as specified herein. Appearance and quality of welds shall be consistent. Employ methods that will maintain alignment of members without warp exceeding the tolerance of this Section.
i. Remove all weld spatter exposed to view.
j. Grind off projections larger than 1/16" at field butt and plug welds.
k. Continuous Welds: Where continuous welding is noted on the drawings, provide continuous welds of a uniform size and profile.
l. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replacement connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
m. Splice members only where indicated.
n. Obtain permission for any torch cutting or field fabrication from the Architect. Finish Sections thermally cut during erection to a surface appearance consistent with the mock-up.

2. Erection AESS-2
   a. Erect to the requirements of 3.03.B.1 and as follows.
   b. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of ANSI/AISC 303.
3. Erection AESS-3
   a. Erect to the requirements of 3.03.B.2 and as follows.
   b. Field Welding: Weld profile, quality, and finish shall be consistent with mock-ups approved prior to fabrication.
   c. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

C. Field welding: Weld profile, quality, and finish shall be consistent with mock-ups approved prior to fabrication.

D. Splice members only where indicated.

E. Obtain permission for any torch cutting or field fabrication from the Architect. Finish sections thermally cut during erection to a surface appearance consistent with the mock up.

F. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable finial appearance.

3.04 FIELD CONNECTIONS

A. Bolted Connections: Install bolts of the specified type and finish in accordance with Section 05 12 00 Structural Steel.

B. Welded Connections: Comply with AWS D1.1 for procedures, and appearance. Refer to Section 05 12 00 Structural Steel for other requirements.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp. Verify that weld sizes, fabrications sequence, and equipment used for AESS will limit distortions to allowable tolerances.
   2. Obtain Architects approval for appearance of welds in repaired or field modified work.

3.05 FIELD QUALITY CONTROL

A. Structural requirements: The Owner will engage an independent testing and inspecting agency to perform field inspections and test and to prepare test reports. Refer to Section 05 12 00 Structural Steel for detailed bolt and weld testing requirements.

B. AESS acceptance: The Architect shall observe the AESS steel in place and determine acceptability based on the mockup. The testing Agency shall have no responsibility for enforcing the requirements of this Section.

3.06 FINISH

A. Paint per Section 09 90 00 Painting with High Performance Coatings.

3.07 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint shall be completed to blend with the adjacent surfaces of AESS. Such touch up work shall be done in accordance with manufacturer's instructions as specified in Section 09 90 00 Painting.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Composite floor deck.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
   2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
   3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. ICC-ES Evaluation Reports: For steel deck.

1.05 QUALITY ASSURANCE

A. AISI “North American Specifications for the Design of Cold-Formed Steel Structural Members” (S100).

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Required fire-resistive ratings are as indicated.
   2. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.02 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (350), G60 (Z180) zinc coating.
   2. Deck Profile: As indicated.

3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more where possible.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.03 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (350), G60 (Z180) zinc coating.
   2. Deck Profile: As indicated.
   3. Profile Depth: As indicated.
   4. Design Uncoated-Steel Thickness: As indicated.
   5. Span Condition: Triple span or more where possible.
   6. Side Laps: Overlapped or interlocking seam at Contractor's option.
      a. Uncoated steel deck 0.0474 inch thick (18 gage) or thicker shall not be overlapped where welded shear studs are attached through deck to supports.

2.04 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Vent Tabs: Provide factory punched vents projecting upwards in interior low flutes approximately 6 inches on center and providing 1-1/2 percent open area.

C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 50,000 psi (350 MPa), not less than 0.0593-inch (0.91-mm) (16 gage) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 50,000 psi (350 MPa), not less than 0.0593-inch (0.91-mm) (16 gage) design uncoated thickness, of same material and finish as deck, and of profile indicated.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, minimum yield strength of 50,000 psi (350 MPa), not less than 0.0593-inch (0.91-mm) (16 gage) design uncoated thickness, of same material and finish as deck unless otherwise indicated.

G. Galvanizing Repair Paint: ASTM A780/A780M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
   1. Warp deck permitted only where indicated.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.03 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
   1. Weld Diameter: 5/8 inch minimal (1/2 inch effective).
   2. Weld Spacing: Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (914 mm), and as follows:
   1. Mechanically clinch or button punch.
   2. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.04 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. Weld Diameter: 5/8 inch (16 mm), nominal (1/2 inch effective).
   2. Weld Spacing: Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows:
   1. Mechanically clinch or button punch.
   2. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:
   1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.05 FIELD QUALITY CONTROL

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

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06 PROTECTION

A. Do not use deck units for storage or working platforms until permanently secured in position.

B. Construction loads must not exceed carrying capacity of deck.

C. Concrete must be placed with care, avoiding impacts by dropping or dumping. Runways must be planked if using buggies or wheelbarrows. Heavy concentrated loads of concrete or crew and uniform loads exceeding 20 psf must be investigated for shoring construction.

D. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

E. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 40 00

COLD FORMED METAL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Non-load-bearing cold-formed structural steel studs.

B. Interior wall framing using Cold Formed Metal Framing at plumbing walls, wall openings and cabinet-supporting walls and at lead-lined gypsum board framing.

C. Formed steel accessories.

D. Related Sections
1. Section 07 21 00, Insulation.
2. Section 07 92 00, Joint Sealers.
3. Section 09 22 16, Non-Structural Metal Studs.
4. Section 09 29 00, Gypsum Board.

1.02 REFERENCES

A. AISI – American Iron and Steel Institute
1. S100 – Design of Cold-Formed Steel Structural Members.
2. S200 – Cold-Formed Steel Framing – General Provisions.
3. S211 – Wall Stud Design.
4. S212 – Header Design.
5. S213 – Lateral Design.

B. ASTM International
1. A 1003 – Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated.
2. C 645 – Nonstructural Steel Framing Members.
3. A653/A653M - Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy - Coated (Galvannealed) by the Hot-Dip Process.
4. C 754 – Installation of Steel Framing Members.
5. C955 - Load-Bearing Steel Studs, Runners, and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
6. C 1513 – Steel Tapping Screws for Cold-Formed Steel Framing Connections.

C. AWS D1.3 – American Welding Society, Structural Welding Code, Sheet Steel.

D. CBC California Building Code 2019, Chapter 22A

1.03 SUBMITTALS

A. Provide product data on standard framing members. Describe materials and finish, product criteria, limitations and properties.

B. Mill certificates: signed by the steel sheet producer indicating steel sheet complies with requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in steel studs framing and components with five years minimum experience.

B. Welding: welders certified by AWS.

PART 2 - PRODUCTS

2.01 FRAMING MATERIALS

A. Studs: ASTM A1003, Structural Grade 50, Type H (ST50H), sheet steel, formed to "wide flange" shape or "C" shape, punched web, 16 gauge (0.056 inch, SSMA designation 54) thick unless noted otherwise on drawings, 50 ksi steel unless noted otherwise on drawings, sizes required to conform to details and scheduled wall thicknesses, and as required for structural performance. Studs shall be rolled from new sheet steel and shall not be produced from re-rolled steel.
   1. Properties: As listed in manufacturer's standard tables for applicable grade of steel and sizes.
   2. Conform to AISI S100 and AISI S200.
   3. Coating: Zinc coated per ASTM A653, G60.

B. Track: ASTM A1003, Structural Grade 50, Type H, sheet steel, channel shaped, deep leg, 16 gauge (0.056-inch, SSMA designation 54) thick unless noted otherwise on drawings, 50 ksi steel unless noted otherwise on drawings, solid web, long leg at ceilings, profile to produce snug fit over adjacent components.
   1. Conform to S100 – Design of Cold-Formed Steel Structural Members.
   2. Approved pre-fabricated slotted slip track for top of wall: CEMCO Slotted Track (CST) 16 gauge (unless a larger size is indicated on the drawings), ICC ESR-2012 or equal as approved in accordance with Division 01, General Requirements for substitutions.
   3. Provide stand-off washers for fasteners.
   4. Install in accordance with manufacturer’s recommendations and fire rating requirements.
   5. Coating: Zinc coated per ASTM A653, G60 [prime painted].

C. Slotted Fire Track: CEMCO FAS Track ASTM A1003, Structural Grade 33, Type H, cut steel channel shaped, deep leg, 16 gauge (0.056”) thick unless noted otherwise on drawings, 33 ksi steel unless noted otherwise on drawings, solid web, long leg at ceilings, profile to produce snug fit over adjacent components. Track is designed with intumescent fire proofing on both sides of the track. Intumescent material to lap over the top of the track by 0.25 inch on each side of the track and down each leg 1.18 inches to an external groove. Slotted fire track shall be listed by UL Fire Resistance Directory as a firestop for the application used.

D. Fire Strap: CEMCO FAS Strap ASTM A653, Grade 33 with a minimum 33 ksi yield strength to span between flutes of metal decking. Fire strap to have a minimum of a 1-inch wide continuous strip of intumescent running parallel and along each edge of the

strap. Fire strap shall be listed by UL Fire Resistance Directory as a firestop for the application used.

E. Header and Jambs: As noted on the drawings.

F. Stiffener U- Channels and Angles: Minimum Weights as Follows:
1. 3/4 inch - .3 pound per foot, cold- or hot-rolled channel.
2. 1-1/2 inches - .475 pound per foot, cold-rolled channel.
3. 1-1/2 inches - 1.12 pounds per foot, hot-rolled channel.
4. 2 inches - 1.26 pounds per foot, hot-rolled channel.
5. 2 inches - .59 pound per foot, cold-rolled channel.
6. 1-1/2 x 1-1/2 x 3/16 inch angle.

2.02 ACCESSORIES

A. Fastening: Self-drilling, Self-tapping Screws, ASTM C954, galvanized, Buildex/Tomarco Type S-12 point, low profile head screws #10 or equal, 1/2 inch long for two layers 16 gauge metal for non load-bearing framing, welded connections for load-bearing framing and for framing of 16 gauge studs and thicker.
1. Welding: In conformance with AWS D1.3, minimum weld size 3/32 inches.

B. Anchorage Devices, Powder Actuated:
1. Install to conform to the load requirements of this Section and Tables 1, 2, 3 and 4 of ICC-ESR 1663 Hilti. Minimum diameter: 0.145” diameter.
   a. Utilize tools as recommended by the manufacture in compliance with ICC numbers.
   b. ICC-ESR 1663 Hilti Inc., Fasteners – Manual, Pneumatic, or Powder-Driven Steel Studs and Nails
2. Allowable Loads: Limited 100 lbs. Maximum or 80 percent of ICC approved values. Testing required, refer to Division 01.
3. Use of Powder actuated fasteners for tension loads is limited to support of minor loads such as suspended acoustical ceilings, ductwork and conduit. Permissible Loads for Ceiling Clip Assembly:
   a. Normal-Weight Concrete: Ceiling Clip Assembly, minimum 0.177 inch diameter, minimum penetration 1 inch. Required Allowable Loads: 100 lbs. or 80 percent of values listed in ICC Report whichever is less: ICC ES-2184.
      1) Type X-CX ALH32 w/DX KWIK, by Hilti, Inc., Tulsa, OK.
   b. Lightweight Concrete: Ceiling Clip Assembly, minimum 0.177 inch diameter, minimum penetration 1 inch. Required Allowable Loads: 100 lbs. or 80 percent of values listed in ICC ES-2184:
      1) Type X-CX-ALH32, by Hilti, Inc., Tulsa, OK.

C. Anchorage Devices, Drilled Expansion Anchors:
1. Wedge Type: KWIK Bolt TZ Concrete Anchor, 3/8 to 3/4 inch diameter, ICC ESR-1917, by Hilti Inc., Tulsa, OK.
   a. Eyebolt HHDCA drill-in anchor for suspended ceilings. Provide minimum ¼-inch size anchor, requires testing refer to Division 01.
2. Adhesive Anchors System:

a. For fully grouted CMU, lightweight concrete, construction per ICC ES-1385, Hilti Kwik Bolt 3 (KB3).
b. For Normal Weight concrete with min. compressive of 2000 psi or 4000 psi. Per ICC ESR-2322, Hilti HIT-RE 500-SD Adhesive Anchor System.

D. Masonry Anchors: 1/4" diameter, Tapcon with Advance Threadform Technology, heat-treated steel, by Illinois Tool Works/Buildex, ICC-ESR-1671. Slotted Hex Washer Head.

E. Gypsum Sheathing: 5/8 inch thick, ASTM C 1177, moisture and fire resistant, gypsum board with Type X core and inorganic glass fiber mat facing one side. Furnish boards 48 inches wide in lengths that will minimize end-to-end joints with tapered edges and square cut ends.
1. Acceptable Products
a. GP, DensGlass Gold Exterior Sheathing
b. USG, Securock Glass-Mat,
c. National Gypsum, Gold Bond e²XP
d. Or equal, approved in accordance with Division 01 requirements for substitutions.

F. Sheathing Joint Tape: self-adhering glass-fiber mesh tape, minimum 2-inches wide, 10-by-10 or 10-by-20 threads-per-inch as recommended by both the sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board.
1. Acceptable Products
a. Perma-Tite Tape--PGM 207A; PermaGlas-Mesh, Inc.
b. Quik-Tape; Quik-Tape, Inc.
c. Or equal

G. Sheathing Joint Sealant: siliconized, acrylic-latex sealant approved by both sheathing and sheathing tape manufacturers.
1. Acceptable Products
a. Dow Corning 795
b. Pecora 895
c. Or equal

H. Backings: Located and as indicated on drawings or 6 inches x 1-1/4 inches x 14 gauge flush mount backing, preformed with pre-punched screw holes, FLUSH-MOUNT BACKING by Metal-Lite, Inc., Anaheim, CA.

I. Track Bedding Sealant: Per Section 07 92 00.

J. Wall finishes: Per Division 09 Finishes.

2.03 FINISHES

A. Galvanized Finish: Zinc coated per ASTM A653, G60.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that substrate surfaces and building framing components are ready to receive work.

B. Beginning of installation means acceptance of existing conditions.

C. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

3.02 ERECTION OF STUDDING

A. Perform work in accordance with, AISI and SSMA/ICC ES - 3064P.

B. Align floor and ceiling tracks; locate to wall or partition layout. Secure in place with specified fasteners at spacing as indicated on drawings or maximum 32 inches on centers.
   1. Set floor track on continuous sealant, each side of track for exterior walls. Sealant type: Butyl Rubber per ASTM C920.
   2. Track Splices: notch flanges to allow sliding tracks past each another 12 inches. Attach as approved by manufacturer of system.

C. Place studs at 16 inches oc typically, or 12 inches oc in plumbing walls or as noted on drawings. Connect studs to tracks using fastener or welding method.

D. No flame (oxyacetylene) torch cutting is permitted, use Plasma Arc cutting to make penetrations for conduit or piping where required.

E. Construct corners using minimum three studs.

F. Install double (boxed) studs at each head, jamb and sill of each exterior and interior door and window opening. Extend studs from floor to underside of structure above. Weld all boxed jamb and header members with interrupted 1/8 inch welds, one inch long at 12 inches on center.

G. Install 1-1/2 inch standard steel furring channels at right angles to king stud at each door hinge point as permitted by perforations. Weld channel to four studs where possible.

H. Stiffeners: Install 3/4 inch standard steel furring channel stiffeners within 24 inches of top and bottom runners and at mid height of walls eight feet high. At higher walls, install stiffeners spaced maximum 48 inches on centers. Weld stiffeners to each stud and at laps.

I. In areas where a finish material occurs on one side of wall only, provide full width bridging or bracing. Two systems permitted:
   1. Install 3/4 inch x 16 gauge continuous brace through stud punch-outs, fastened to studs with angle clips welded or screw fastened, spaced as scheduled below.
   2. Install 1-1/4 inch x 16 gauge strap, 3/4 inch x 16 gauge or cold-rolled channel continuous across unrestrained edges of studs spaced as scheduled below, screw fastened or welded to each stud, and connected to one blocking member screw fastened or welded to adjacent studs.

J. Bridging or Bracing Schedule:

Stud Size AISI/SSMA	Min. bracing spacing unless noted otherwise on structural drawings.
3-5/8 or 4 in, S-Sections ("c")	2'-6"
3-5/8 or 4 in, T-Sections ("w")	3'-0"
6 in, S-Sections ("c")	2'-6"
6 in, T-Sections ("w")	3'-0"

K. Erect studs one piece full length. Splicing of studs is not permitted, except where detailed.
   1. Where studs have been cut to receive piping conduits and equipment, weld on two 3/4 inch furring channels to restore stability of weakened stud unless noted otherwise on the drawings.

L. Erect studs, brace and reinforce full strength to meet design requirements.

M. Extend stud framing through ceiling to underside of floor or roof structure above unless detailed otherwise.

N. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

O. Install intermediate studs above and below openings to match wall stud spacing.

P. Provide deflection allowance of 1/2 inch minimum in stud track, directly below horizontal building framing for non-load bearing framing.

Q. Attach backing as detailed on the drawings for attachment of fixtures anchored to walls.

R. Install framing between studs for attachment of mechanical and electrical items and to prevent stud rotation.

S. Touch-up field welds and damaged primed surfaces with primer.

T. Erect 2 stud construction at expansion joints, 20 feet on center or as indicated on Drawings.

3.03 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness:
      a. 20 GA (0.0329 inch) (0.84 mm).
      b. 18 GA (0.0428 inch) (1.09 mm).
      c. 16 GA (0.0538 inch) (1.37 mm).
      d. 14 GA (0.0677 inch) (1.72 mm).
      e. 12 GA (0.0966 inch) (2.45 mm).
   2. Flange Width: 1-5/8 inches (41 mm), minimum unless noted otherwise on structural drawings.

3. Install per drawings and conform to SSMA.

3.04 INSTALLATION - GYPSUM SHEATHING

A. Erect exterior gypsum sheathing with long joints perpendicular to framing, with edges butted tight and ends occurring over framing. Install sheathing with glass-mat face exposed to exterior. Install with screws in accordance with ASTM C754 and C840 and GA 216.

3.05 TOLERANCES

A. Maximum Variation from True Position: 1/8 inch in 10 feet.

B. Maximum Variation of any Member from Plane: 1/8 inch.

3.06 CLEANING

A. Clean substrate; remove dirt, oil, grease, construction markings, and foreign matter that could adversely affect final floor finish appearance or performance.

3.07 QUALITY CONTROL

A. Inspection of all field-welding operations shall be performed by qualified and certified Welding Inspector approved by the Structural Engineer and DSA.

B. Welding Inspector shall check materials, equipment, procedures, welds and certification of welders. Furnish the Owner with reports verified by the Inspector that welding has been performed in accordance with the Contract Documents.

END OF SECTION

SECTION 05 45 00

METAL SUPPORT SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Prefinished and galvanized steel support members and fittings.

B. Prefabricated support components.

C. Anchorage

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C. ASTM A653/A653M-98 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc - Iron Alloy Coated by the Hot-Dip Process.

D. ASTM A575 - Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

E. ASTM B117 - Method of Salt Spray (Fog) Testing.

F. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

G. AWS D1.1 - Structural Welding Code.

H. Fed. Std. 595C - Colors used in Government Procurement.

1.03 QUALITY ASSURANCE

A. Manufacturer shall have been active in metal framing business for at least five years and shall maintain quality assurance program that will permit manufacturer, if requested, to submit mill test reports for material furnished to assure that material meets specification criteria.
   1. Specifications for Design of Cold Formed Steel Structural Members: AISI.
   2. Manual of Steel Construction: AISC.
   3. Resistance welding: AWS-C1.1-2006.
   4. Welding sheet steel in structures: AWS-D1.3-2008

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners and accessories. Submit three samples of each channel member specified, indicating finish.
   1. Prepare shop drawings and calculations under the direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of California.

1.05 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Unistrut Corporation, Ann Arbor, MI.
   2. Kin-Line, Inc., Oakland, CA.
   3. B-Line Systems, Inc., Cerritos, CA.
   4. Midland Ross Co., Oakland, CA.
   5. Elcen Metal Products Co., Franklin Park, IL.
   6. Tolco Inc.
   7. Erico International Corporation/Caddy - Electrical

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Unistrut Systems
   1. SERIES P1000, P3000, P4100, P5000, and P5500 Channel and Combinations , 12 gauge steel, widths of 1-5/8 inch, 1-1/4 inch and 13/16 inch as required to conform to details. Straps, clamps and accessories for systems. Hole Pattern Styles where required.
   2. Finish:
      a. Uniform prefinish coat of rust inhibiting acrylic enamel paint, applied by electro-deposition and baked, color PERMA-GREEN per Fed. Std. 595C, color Number 14109.
   3. Fittings: Punch press, hot rolled, pickled and oiled steel plates or strip, conforming the ASTM A575, free from scale.
   4. Nuts and Screws: Case hardened, ASTM A307, zinc coated by electroplating process in accordance with ASTM B633.
   5. Galvanizing: G90 thickness, conforming to ASTM A653/A653M-98, acrylic enamel painted, required for all framing components installed in wet areas or exterior.

B. General Fittings

1. Beam clips (clamps), Brackets and fittings: Unistrut P2824-6, 2-1/2" for flange width, P2824-9, 5-1/2" for flange width, P2824-12 for 8-1/2" flange width. Design Load 500 lbs., ASTM A575 or ASMT A36, ASTM A1011 SS GR 33. Factory coated: PERMA-GREEN per Fed. Std. 595C, color Number 14109.

C. Concrete Anchorage Devices, Drilled Expansion Anchors:
1. Wedge Type: KWIK Bolt TZ Concrete Anchor, 3/8 to 3/4 inch diameter, ICC ESR-1917, by Hilti Inc., Tulsa, OK.
2. Adhesive Anchors System:
a. For Normal Weight concrete with min. compressive of 2000 psi or 4000 psi. Per ICC ESR-2322, Hilti HIT-RE 500-SD Adhesive Anchor System.

2.03 FABRICATION

A. Fit and shop assemble components in largest practical sizes for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

C. Verify manufacturer's identifying stamps on components.

3.02 PREPARATION

A. Clean and strip prefinished steel items to bare metal where site welding is required.

B. Supply setting templates to appropriated Sections.

C. Supply shop-fabricated telescoping tubing assemblies where detailed.

3.03 INSTALLATION

A. Install items plumb and level, with the tolerances indicated, with no more than 1/720th of the span maximum deflection in either plane, when maximum loading conditions are applied due to equipment operation. Accurately fitted, free from distortion or defects.

B. Allow for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field-weld components indicated on shop drawings.

D. Perform field-welding in accordance with AWS D1.1

E. Obtain Architect approval prior to making adjustments not scheduled in shop drawings.

F. Provide anchors, plates angles and fittings required for connection in accordance with manufacturer's standards.

G. Provide leveling adjustment mechanisms for fine leveling.

H. Allowances and adjustments of framing system to accommodate interferences with structural framing, mechanical systems, plumbing components and other obstructions shall be performed under this section at no additional cost to Owner.

I. Coordinate sequencing of operations with other sections.

J. Do not permit loading on horizontal systems until all anchorage is in place and tested to required compliance.

3.04 TOLERANCES

A. Horizontal Systems: Maximum variation from flat and level surfaces shall be no more than 1/8 inch in 10 feet.

B. Maximum Deflection, Horizontal Systems: 1/720 of span when loaded.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated ferrous metal items, galvanized and prime painted.

B. Stainless steel metal items.

C. Aluminum metal items.

D. Related Sections:
1. Section 05 52 00, Handrails and Railings.
2. Section 09 90 00, Painting.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society of Mechanical Engineers (ASME)
1. ASME B18 -Fasteners

C. ASTM International
1. ASTM A36/A36M Carbon Structural Steel
2. ASTM A48/A48M Gray Iron Castings
3. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless
4. ASTM A123 Zinc (Hot-Dip Galvanized) on Coatings on Iron and Steel Products
5. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A240 Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
7. ASTM A276 Stainless Steel Bars and Shapes
8. ASTM A283/A 283M Low and Intermediate Tensile Strength Carbon Steel Plates
9. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
10. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/105ksi Minimum Tensile Strength
11. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes
12. ASTM A513 - Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
13. ASTM A563 - Carbon and Alloy Steel Nuts
14. ASTM A653/A 653M Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
15. ASTM A666 Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar (non magnetic).

16. ASTM A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
17. ASTM A786/A 786M Rolled Steel Floor Plates
18. ASTM A793 Rolled Floor Plate, Stainless Steel.
19. ASTM A992 Structural Steel Shapes
20. ASTM B26 Aluminum-Alloy Sand Castings
21. ASTM B308 Aluminum-Alloy 6061-T6 Standard Structural Profiles
22. ASTM B209/B209M Aluminum and Aluminum-Alloy Sheet and Plate
23. ASTM B221/B221M Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
24. ASTM B455 Copper-Zinc-Lead Alloy (Leaded Brass) Extruded Shapes
25. ASTM B632/B632M Aluminum-Alloy Rolled Tread Plate
26. ASTM B633 - Electrodeposited Coatings of Zinc on Iron and Steel
27. ASTM C1107 - Packaged Dry Hydraulic - Cement Grout (Non-Shrink
28. ASTM D520 ASTM D520 - Zinc Dust Pigment
29. ASTM F 593 - Stainless Steel Bolts, Hex Cap Screws, and Studs
30. ASTM F 594 Stainless Steel Nuts
31. ASTM F 738M Stainless Steel Metric Bolts, Screws, and Studs
32. ASTM F 836M Stainless Steel Metric Nuts
33. ASTM F1554 - Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

D. American Welding Society (AWS)
1. AWS A2.4 - Standard Symbols for Welding, Brazing and Non-Destructive Examination
2. AWS A5.1 - Carbon Steel Covered Arc-Welding Electrodes

E. ASCE/SEI 7-16 - American Society of Civil Engineers, Structural Engineers Institute, ASCE Standard.

F. California Code of Regulations (CCR)
1. Title 8, Chapter 3.2
2. Title 8, Division 1, Subchapter 7, Group 1, Article 4, Section 3277, Fixed Ladders
3. Cal/OSHA, Subchapter 4 Construction Safety Orders
4. Title 24, Part 2, 2019 California Building Code (CBC), Chapter 22A.
5. Title 24, California Fire Code Chapter 35 Welding and Other Hot Work.

G. National Ornamental & Miscellaneous Metals Association (NOMMA)
1. NOMMA Guidelines - Guideline 1 Joint Finishes

H. SSPC - The Society for Protective Coatings
1. Paint 20 - Zinc-Rich Coating (Type 1 Inorganic and Type II Organic)
2. SP-2 - Steel Preparation

I. MIL - Military Specifications, United States Department of Defense
1. P-21035 - Paint, High Zinc Dust Content, Galvanizing Repair

J. MPI - Master Painters Institute Approved Products List
1. 18 - Primer, Zinc Rich, Organic
2. 19 - Primer, Zinc Rich, Inorganic

1.03 SUBMITTALS

A. Shop Drawings. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories. Include erection drawings, elevations and details where applicable. Indicate welded connections using standard AWS A2.4 Welding Symbols. Indicate net weld lengths.

B. Welder Certifications.

C. Manufacturer's Certificates certifying welders employed on the work have been AWS qualified within the previous 12 months, in accordance with AWS-WHB-1.

D. Written Welding Procedure Specification (WPS)

1.04 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following
1. AWS D1.1, Structural Welding Code--Steel.
2. AWS D1.3, Structural Welding Code--Sheet Steel.
3. AWS D1.8, Structural Welding Code – Seismic Supplement.
4. AWS Certified welders.
5. AWS D1.6, Structural Welding Code--Stainless Steel.
6. AWS D1.2, Structural Welding Code--Aluminum.
7. AWS - American Welding Society
8. AWS A2.4 Standard Symbols for Welding, Brazing and Non Destructive Examination
9. DSA-Projects: All welding shall be specially inspected by an AWS-CWI Qualified Inspector.

B. Coating applicator - Galvanized Metal Fabrications: Company specializing in hot-dip galvanizing after fabrication and following the procedures in the Quality Assurance Manual of the American Galvanizers Association.

1.05 FIELD MEASUREMENTS

A. Verify field measurements.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Steel Sections: ASTM A992 for W-Shape sections and ASTM A36 for all other members.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Bending or cold-formed steel: ASTM A283, Grade C.

D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars ASTM A666, Type 304L, No. 4 satin finish, 16 gauge minimum, unless otherwise indicated.

E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars ASTM A240, Type 304L, Commercial Grade No. 4 finish, 16 gauge minimum, unless otherwise indicated. Stretcher-leveled standard of flatness for countertops.

F. Stainless-Steel Bars and Shapes ASTM A276, Type 304L.

G. Rolled-Stainless-Steel Floor Plate ASTM A793.

H. Steel Round Structural Tubing: ASTM A500, Grade C, minimum yield strength, 46 ksi.

I. Structural Tubing: Hollow Structural Sections (HSS), ASTM A500, Grade B, minimum yield strength, 42 ksi.

J. Pipe: ASTM A53, Grade B, Type E or S, Schedule 40, galvanized where indicated.

K. Cast Iron: ASTM A48/A48M, Class 30, unless another class is indicated or required by structural loads.

L. Cast steel: ASTM A27, Grade 65-35.

M. Square and rectangular steel tubing structural: carbon steel conforming to ASTM A500 or ASTM A36.

N. Mechanical Tubing: ASTM A 513 hot- or cold-rolled carbon steel for non-structural tubing, electric welded tubing.

2.03 NONFERROUS METALS

A. Aluminum Standard Structural Profiles: ASTM B308, Alloy 6061-T6.

B. Aluminum Plate and Sheet ASTM B209/, Alloy 6061-T6.

C. Aluminum Extrusions ASTM B221/, Alloy 6063-T6.

D. Aluminum-Alloy Rolled Tread Plate ASTM B632/B632M, Alloy 6061-T6.

E. Aluminum Castings ASTM B26/B26M, Alloy 443.0-F.

2.04 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 and ANSI B18.2.1; and, where indicated, flat washers and ASTM A325 as indicated on drawings.

C. Stainless-Steel Bolts and Nuts - Corrosion Grade: Regular hexagon-head annealed stainless steel bolts, nuts and, where indicated, flat washers; ASTM F593 for bolts and ASTM F594/ for nuts, Alloy Group 1 [Group 2].
   1. Stainless Steel Fastenings and Fittings at Food Preparation areas:
      a. Bolts and screws with countersunk flat heads at interior and exterior visible or accessible surfaces.
      b. Use concealed fastenings where possible.

D. High Strength Bolts ASTM A325.

E. Anchor Bolts ASTM F1554, Grade 36.

F. Machine Screws ASME B18.6.3.

G. Lag Bolts ASME B18.2.1.

H. Wood Screws Flat head, carbon steel, ASME B18.6.1.

I. Plain Washers Round, carbon steel, ASME B18.22.1.

J. Lock Washers Helical, spring type, carbon steel, ASME B18.21.1.

K. Eyebolts: for wood, steel or concrete construction, Stainless steel Type 304. 1/4" shoulder pattern, rated 500 lbs. minimum. Epoxied in Concrete where indicated.

L. Threaded rods, steel yokes and plates.

M. Self-drilling, self-tapping screws, ASTM C954, galvanized, minimum #10 unless noted otherwise on drawings. By Buildex/Tomarco or equal.

N. Anchorage Devices, Drilled Expansion Anchors Minimum 5/8-inch diameter with 3 inch embedment unless noted otherwise on drawings. Allowable shear and tension values as permitted in ICC-ES, ESR-1917 Hilti Kwik Bolt TZ Concrete Anchor or Hilti Kwik Bolt 3, ESR-1385 for masonry anchors, by Hilti Inc., Tulsa, OK, or in ICC-ES 2502, DeWalt Power-Stud+SD2 concrete anchor or DeWalt Power-Stud+ SD1, ESR-2966 for masonry anchors, by Dewalt, Towson, MD.

2.05 MISCELLANEOUS MATERIALS

A. Shop Primer: Fabricator’s rust inhibitive primer suitable for finish scheduled in Section 09 90 00 equal to L69 Hi Build Epoxoline II @ 3-4 mils DFT primer, red color, air dried, by Tnemec.

B. Galvanizing Repair Compound: ASTM D520 Type III, MIL-P-21035, SSPC-Paint 20, or MPI #18 or 19. Touch-Up products for Galvanized Surfaces Ready mixed Zinc rich galvanizing compound, 95% zinc.

1. Finish: Galvilite by ZRC Products Company, Marshfield, MA or equal. Reflective Metallic Sheen for exposed galvanized finish.
2. Finish: ZRC Products Company, Marshfield, MA or equal. Primer for repaired galvanized to receive a painting finish.

C. Zinc-Based Solders/Alloys: Solder Zinc Alloy for Repair ASTM A780 Annex A1; Welco Gal-Viz self-fluxing solder alloy, Galvalloy, Galvabar or equal, ASTM A780, paragraph A1. Repair Using Zinc-Based Alloys.

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

E. Grout ASTM C1107, Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 8,000 psi at 7 days; of consistency suitable for application and a 30 minute working time.

F. Safety Stair Nosings: At pre-cast stairs and landings, aggregate integral warning stripe extruded aluminum, 2" inches wide Model H-225 by Balco Inc., Wichita Kansas, or Type WP 24A Wooster Products Inc., Wooster, OH. Provide 2" strip in contrasting color (70 percent contrasting) full width of step, 1" maximum from edge of nosing of each exterior tread and top landing (upper approach), and top and bottom steps of interior stairs unless nosings are indicated at all steps in drawings. Colors to be selected by Architect.

2.06 FABRICATION

A. Fit and shop assemble in largest practical sections for delivery to site.

B. Ease exposed edges to small uniform radius.

C. Fabricate items with joints tightly fitted and secured.

D. Welded Joints. Seal joined members by continuous welds. Dress welded joints, leaving no burrs, or sharp or abrasive corners, edges or surfaces.
1. Where exposed to view, dress welds in accordance with NOMMA Guidelines for Finish 1.
2. Where concealed, dress welds in accordance with NOMMA Guidelines for Finish 3.

E. Exposed Mechanically Fastened Joints. Make exposed, mechanically fastened joints hairline-tight, flush, butt joints. Secure with flush-mount, countersunk, screws or bolts; unobtrusively located; consistent with design of component, except where specifically indicated otherwise.

F. Provide components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as related metal fabrication, unless expressly indicated otherwise.

2.07 FINISHES

A. Steel and Iron
   1. Clean surfaces of rust, scale, grease and foreign matter prior to finishing. Prepare in accordance with SSPC SP-2.
   2. Galvanize steel items to zinc coating thickness in accordance with ASTM A123, minimum Coating Grade 80 (1.9 oz/sq. ft.). Surfaces shall be free of icicles, spangles and puddling. Provide venting holes at all enclosed sections, "V" notch, and drilled holes are acceptable. Locate to prevent rainwater from entering enclosed sections at exterior galvanized items. For sheet steel items, galvanize per ASTM A653 G60 Coating Designation.
   3. Galvanized items to be painted: Do not use quenching solutions or treatments immediately after galvanizing. Refer to individual sections for galvanized items to be painted and to Section 09 90 00.
   4. Do not prime surfaces in direct contact with concrete or where field welding is required.
   5. For painted surfaces, prime items with two coats in accordance with requirements of primer specified herein.
   6. Color Coated with Finish Special Coatings in accordance with Section 09 90 00 Painting for exposed surfaces.

B. Stainless Steel Finishes
   1. Remove tool and die marks and stretch lines or blend into finish.
   2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
   3. Bright, Directional Satin Finish No. 4.

C. Aluminum
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   2. Class I, Clear Anodic Finish AA-M12C22A41 (Mechanical Finish nonspecular as fabricated; Chemical Finish etched, medium matte; Anodic Coating Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

D. Apply two coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious materials or between dissimilar metals. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Do not begin installation until unsatisfactory conditions are corrected. Beginning installation means acceptance of existing conditions including the preparatory work of others, if any.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on shop drawings.
   1. Weld joints using shielded metal-arc welding (SMAW) method. Use coated welded rods, not fluxed, or type recommended by manufacturer for use with parent metal. Use only certified welders for structural construction.
   2. Grinding: Grind welds on surfaces subject to traffic or contact to smooth flush joints.
   3. Peening: Remove flux and weld spatter as necessary to eliminate unsightly conditions and grind off sharp projections.
   4. Permanently Concealed Welds: No treatment required other than preparation for painting or galvanizing.

D. Perform field welding in accordance with AWS standards and procedures for metal alloy welded.

E. Obtain Architect approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions and surfaces not shop primed except surfaces to be in contact with concrete.

G. Repair of Galvanized Surfaces: Ready mixed, zinc-rich galvanizing compound, ASTM A780 - A2. Repair Using Paints Containing Zinc Dust, minimum thickness 5 mils.

H. Repair of Galvanized Surfaces: ASTM A782 Annex A1, apply Gal-Viz while metal is still hot. Tin surface with Gal-Viz with wire brush. Do not direct flame on alloy. Minimum thickness, 5 mils.

I. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of alkali-resistant bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.04 ERECTION TOLERANCE

A. Maximum Variation From Plumb 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment 1/4 inch.

3.05 FINISHES

A. Paint with Gloss Polyurethane High Performance Coatings in Special Coatings per Section 09 90 00 Painting.

3.06 SCHEDULE

A. Schedule is list of principal items only. Refer to Drawing details for items not specifically scheduled.

B. Fasteners: Provide fasteners and connectors of approved types, whether indicated or not.

C. Interior Vertical Access Ladder: minimum 16 inch ID wide tread surface on rungs.
   1. Side Rails: 3/8 inch by 2 inch steel bar.
   2. Rungs: 3/4-inch diameter solid steel rod spaced 12 inches on center vertically with knurled or skid-resistant surface.
   3. Mounting Brackets: 3/8-inch thick L-bent plate 8-1/2-inches by 3-inch legs, 4-inches deep, fabricated to provide 7 inches clearance from wall surface. Furnish steel wall backing plates, brackets, and anchors required for 48 inches, maximum on center spacing.
   4. Ladder safety post: Bilco LadderUP Safety Post Model LU-2, hot-dip galvanized steel or equal, telescoping tubular section with automatic lock when extended. Upward and downward movement controlled by stainless special alloy steel spring balancing mechanism. Secure to ladder rungs with manufacturer's fasteners.
   5. Ladder Safety Device Saf-T-Climb manufactured by North Safety Products or approved equal. Provide according to Code of Federal Regulations 29 CFR 1910.27 and ANSI A14.3.
   6. Cage for Ladder over 20 feet 1/4 by 2 inch hoops at 4 feet on centers, 7-3/16 by 1-1/2 inch vertical bars, solid riveted. Per Title 8, CCR, Construction Safety Orders.
   7. Elevator pit ladders shall have rungs spaced 7 inches from wall .
   8. Finish: paint per Section 09 90 00.

D. Miscellaneous Framing and Supports , Equipment Enclosures and as indicated on Drawings..
   1. Provide steel framing, or aluminum framing if indicated, and panels and supports as indicated in Drawings and as necessary to complete Work.
   2. Fabricate units from structural or hollow steel shapes, plates, structural supports, sheet metal and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   3. Hinges: Heavy-duty weld-on l type. Minimum 3 per leaf rated at 1000 lbs. each hinge.
   4. Enclosures and Gates As indicated on Drawings:
      a. Refer to Section 07 46 21, Equipment Screens.
   5. Refer to drawings for custom fabrication per details.

E. Railing and Handrails as detailed, refer to Section 05 52 00 for additional requirements.

END OF SECTION

SECTION 05 51 00

METAL STAIRS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Steel stairs framed of structural sections, with closed risers.

B. Steel stair pans to receive concrete fill.

C. Cast-in-place safety stair nosings.

D. Products Furnished But Not Installed Under this Section.
1. Anchors: Section 03 30 00 - Cast-In-Place Concrete: Placement of metal anchors and stairs.
2. Section 05 50 00 - Metal Fabrications: Placement of metal anchors in concrete.

E. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete
2. Section 05 50 00 - Metal Fabrications
3. Section 09 90 00 - Painting

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society for Testing and Materials
1. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A 123 Zinc (Hot-Dip Galvanized) on Coatings on Iron and Steel Products.
3. ASTM A283 - Carbon Steel Plates, Shapes, and Bars.
4. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
5. ASTM A325 - High Strength Bolts for Structural Steel Joints.
6. ASTM A36A/ 36M - Structural Steel.
7. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
8. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
9. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

C. American Welding Society
1. AWS A2.0 - Standard Welding Symbols.
2. AWS D1.1 - Structural Welding Code.

D. ADA - Americans with Disabilities Act of 1990 as amended
1. ADA/Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

E. CBC - 2019 California Building Code

F. SSPC - Steel Structures Painting Council.

1.03 REGULATORY REQUIREMENTS

A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

B. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of Structural Engineer experience in design of this work and licensed in the State of California.

B. Welders' Certificates: Submit under provisions of Division 01, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.06 FIELD MEASUREMENTS

A. Verify field measurements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Sections: ASTM A36/36M.

B. Steel Plates and Bars: ASTM A6 and A36. Bending or cold-formed steel ASTM A283, Grade C.

C. Round Structural Tubing: ASTM A500, Grade C, for railings and guardrails refer to Section 05 52 00.

D. Pipe: ASTM A53, Grade B, Schedule 40.

E. Mebac ladder rungs: aluminum oxide grit bonded to metal base "Grip Tight", "Mebac", painted finish by McNichols Co. or equal.

F. Plates: ASTM A786 [with bonded aluminum anti-slip coating, "Grip Tight", "Mebac" Finish for Stair treads] [with SlipNOT finish for stair treads] by McNichols Co., Grating Pacific, or equal.

G. Concrete for Treads and Landings: Portland cement Type 1, 3000 pounds per square inch 28 day strength, 2 to 3 inch slump.

H. Bolts, Nuts, and Washers: ASTM A325 galvanized to ASTM A153 for galvanized components.

I. Provide Type 304 stainless-steel fasteners for exterior [and interior] use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

J. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design or stair structure.

K. Welding Materials: AWS D1.1; type required for materials being welded.

L. Touch-Up Primer for Galvanized Surfaces: Zinc rich type.

M. Stair Nosings: Refer to Section 05 50 00, Metal Fabrications.

2.02 FABRICATION - GENERAL

A. Refer to Drawings.

B. Treads shall be 11" deep minimum. Risers shall be 7" high maximum and 4" high minimum. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.

C. Fit and shop assemble in largest practical sections for delivery to site.

D. Ease exposed edges to small uniform radius.

E. Fabricate items with joints tightly fitted and secured.

F. Welded Joints. Seal joined members by continuous welds. Dress welded joints, leaving no burrs, or sharp or abrasive corners, edges or surfaces.
   1. Where exposed to view, dress welds in accordance with NOMMA Guidelines for Finish 1.
   2. Where concealed, dress welds in accordance with NOMMA Guidelines for Finish 3.

G. Exposed Mechanically Fastened Joints. Make exposed, butt joints hairline-tight and flush. Secure with flush-mount, countersunk, screws or bolts; unobtrusively located; consistent with design of component, except where specifically indicated otherwise.

H. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

I. Accurately form components required for anchorage of stairs and landings and railings to each other and to building structure.

J. Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads. At steel stringers for stairs, complete joint penetration welds.

2.03 FINISHES

A. Prepare surfaces to be primed in accordance with SSPC-SP 2 Hand Tool Cleaning.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Galvanized items to minimum 2.0 ounces per square feet zinc coating accordance with ASTM A123, Grade 85.

D. Prime paint items with one coat.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete including nosings or embedded in masonry with setting templates, to appropriate sections.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects, and per manufacturer's installation instructions.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.

E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain Architect approval prior to site cutting or making adjustments not scheduled.

H. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.05 FINISH

A. Paint Finish: High Performance coating as specified in Section 09 90 00.

3.06 SCHEDULE

A. Items as scheduled or shown in drawings.

B. Steel pan stairs with reinforced concrete fill and cast-in-place nosings.

END OF SECTION

SECTION 05 52 00

HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Stainless Steel pipe railings, handrails, balusters and posts.
   2. Brackets and fittings.

B. Related Sections:
   1. Division 32 Section(s) for concrete used in post footings.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990 as amended
   1. Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design

C. ASTM International
   1. A 276 - Stainless Steel Bars and Shapes
   2. A 312/A 312M - Austenitic Stainless Steel Pipes
   3. A 666 - Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
   4. A 743/A 743M - Castings, Iron-Chromium, Iron-Chromium-Nickel
   5. C 1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

D. AWS - American Welding Society
   1. D1.6 - Structural Welding Code - Stainless Steel

E. CBC - 2019 California Building Code, 24 CCR Part 2
   1. Chapter 10 - Means of Egress
   2. Chapter 11B - Accessibility to Public Buildings

F. NOMMA - National Ornamental & Miscellaneous Metals Association
   1. Guideline 1 - Joint Finishes

G. AWS - American Welding Society
   1. AWS A2.4 - Standard Symbols for Welding, Brazing and Non Destructive Examination
   2. AWS A5.1 - Carbon Steel Electrodes for Shielded Metal Arc-Welding
   3. AWS A5.5 - Low Alloy Steel Electrodes for Shielded Metal Arc-Welding
   4. AWS B2.1 - Welding Procedure and Performance Qualification
   5. AWS D1.6 - Structural Welding Code, Stainless Steel
   6. AWS D1.8 - Structural Welding Code, Seismic Supplement

1.03 DESIGN REQUIREMENTS

A. Handrails
1. The mounting of handrails shall be such that the completed handrail and support structure shall be capable of withstanding vertical and lateral single concentrate load of 200 pounds applied in any direction at any point on the rail, or 50 pounds per linear foot per applied in any direction at the top, Section 1607A.8 of CBC.

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners and accessories.

B. Samples: Submit three samples of handrail and each component.

C. Welder's Certificates: Welders shall be Project certified in accordance with AWS D1. 1-02.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, Structural Welding Code-Steel. Certified Welders required.
2. AWS D1.6, Structural Welding Code-Stainless Steel.

B. Mock-ups
1. Provide 4' x 4' mock-up, including frames, in-fill panels, supports, and anchorage.
2. Mock-up shall include finishes specified.
3. Do not proceed with fabrication without approval by Architect.
4. Mock-up shall not be incorporated into the Work, and shall be removed from site upon completion of the Work.

1.06 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Top of gripping surfaces of handrails shall be 34" minimum and 38" maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.

B. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2" minimum. Handrail may be located in a recess if the recess is 3" maximum deep and 18" minimum clear above the top of the handrail.

C. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20% of their length. Where provided, horizontal projections shall occur 1-1/2" minimum below the bottom of the handrail gripping surfaces.

D. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4" minimum and 2" maximum.

E. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4" minimum and 6-1/4" maximum, and a cross-sectional dimension of 2-1/4" maximum.

F. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.

G. Handrails shall not rotate within their fittings.

H. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.

I. The orientation of at least one handrail shall be in the direction of the stair run, perpendicular to the direction of the stair nosing, and shall not reduce the minimum required width of the stair. CBC Section 11B-505.2.1.

J. At 2" minimum high curb or barrier shall be provided to prevent the passage of a 4" diameter sphere rolling off the edges on a ramp or landing surface. Such a curb or barrier shall be continuous and uninterrupted along the length of a ramp. CBC Section 11B-405.9.2.

2.02 MATERIALS

A. Manufacturers:
   1. Craneveyor Corp., South El Monte, CA.
   2. R & B Wagner Inc./McNichols Co. South Gate, CA.
   3. Julius Blum & Co. Inc.
   4. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

B. Railings, Handrails, Guardrails, Balusters, and Posts: Stainless steel pipe, ASTM A 312/A 312M, Grade TP304, 1-1/4 inch NPS, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads (for posts spaced more than 48 inches on centers, use Schedule 80 Extra Heavy), 1.660 inch outside diameter, welded joints. Refer to details for other sizes of posts, guardrails and spacing of balusters.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

E. Stainless Steel Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

F. Fittings: Elbows, T shapes, wall brackets, escutcheons, caps: Steel or Stainless steel, finish to match rails.
   1. Wall Rail Brackets: Weld mounted, 1/4" thick material, formed or cast, round top to accept tube rail, size to allow 1-1/2 inch clearance from rail to wall.

G. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

H. Sleeve: Pipe ASTM A53, Grade B, Type E or S, Schedule 40, galvanized. Contractor's option: "EZ Sleeve" Model EZ 4012 by R & W Wagner, 12" H, 7/16" thick plastic tapered tube.

I. Nonshrink Grout:
   1. Cement Based Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 4,000 psi in 24 hours and 8,000 psi in 7 days; of consistency for application and a 30 minute working time. 1107 Advantage Grout by Dayton Superior, Miamisburg, OH; Sonogrout 10K by BASF; Super Por-Rok Anchoring Cement by Novex Systems International, Clifton, NJ; or equal.

2.03 FABRICATION

A. Fabricate handrails of specified pipe or tubing only in conformance with requirements of CBC 13 and 11B, Section 11B-505.
   1. Handrails: Weld bracket to bottom of handrail.
   2. Handrail clearance: weld handrail to bracket to allow clearance of 1-1/2" between the wall and the handrail, Section 11B-505.5.
   3. The handgrip portion of handrails for stairs and ramps shall not be less than 1-1/4" nor more than 1-1/2" in cross-sectional nominal dimension or a shape providing an equivalent gripping surface, CBC Section 11B-505.6.

B. Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads. At steel stingers for stairs, complete joint penetration welds.
   1. Assemble handrails and railings in shop to greatest extent possible to minimize field splicing and assembly.
   2. Corners: Standard flush weld pipe ells, welded and ground smooth.
   3. All surfaces and welded joints of the grip portion of handrails shall be ground smooth with no sharp corners. Gripping surfaces (top or sides) shall be uninterrupted by newel posts, other construction elements or obstructions. Edges shall have a minimum radius of 1/8".
   4. Any wall or other surface adjacent to handrail shall be free of sharp or abrasive elements.
   5. Wheel guide rails or guide curbs shall provide continuous and uninterrupted barrier along the length of a ramp.

C. Fabricate components with joints tightly fitted and secured.

D. Welded Joints. Seal joined members by continuous welds. Dress welded joints, ground smooth, leaving no burrs, or sharp or abrasive corners, edges or surfaces CBC 11B-505.8.
   1. Where exposed to view, dress welds in accordance with NOMMA Guidelines for Finish 1.
   2. Where concealed, dress welds in accordance with NOMMA Guidelines for Finish 3.

E. Exposed Mechanically Fastened Joints. Make exposed, mechanically fastened joints hairline-tight, flush, butt joints. Secure with flush-mount, countersunk, screws or bolts; unobtrusively located; consistent with design of component, except where specifically indicated otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

G. Accurately form components to each other and to building structure.

H. Finish
   1. Stainless steel: Brushed stainless steel finish.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive Work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Provide concrete footings 6" diameter, 12" deep under each post. Set vertical supports in galvanized steel sleeves with specified non-shrink grout. Option for EZ Sleeve, set before or immediately after concrete is poured. Install in precise location where railings will occur. Fill with non-shrink grout. Slope grout to drain at each post.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Provide anchors, plates or angles required for connecting railings to structure. Anchor railing to structure. Mount railings 1-1/2 inches clearance from side walls or columns. Top of handrail grasping surface shall be mounted between 34" to 38" above the nosing of the treads or the ramp surface.
   1. Field welds shall be dressed and ground smooth, to match shop welds, leaving no sharp or abrasive corner edges or surfaces.

2. Gripping surfaces (top or sides) shall be uninterrupted by newel posts, other construction elements or obstructions. Edges shall have minimum radius of 1/8".
3. Field weld anchors as indicated on shop drawings.
4. Ends shall return smoothly to floor, wall, or post as indicated on Drawings.
5. Any wall or other surface adjacent to handrail shall be free of sharp or abrasive elements, CBC Sections 11B-505.8.

D. Conceal bolts and screws. Where not concealed, use flush countersunk fastenings.

E. Wheel guide rails or guide curbs shall provide a continuous and uninterrupted barrier along the length of ramp, CBC Section 11B-405.9.2 and Figure 11B-405.8.2.

3.04 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/16 inch in 3 feet.

3.05 SCHEDULE

A. As detailed and located in drawings.

END OF SECTION

SECTION 05 73 16

WIRE ROPE METAL RAILINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Stainless steel handrails, balusters, and posts.

B. Cable system and components for railing infill.

C. Lighting Sway Bracing

1.02 REFERENCES

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990 as amended
   1. Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design

C. ASTM International
   1. A 36 - Carbon Structural Steel
   2. A 47 - Ferritic Malleable Iron Castings
   3. A 48 - Gray Iron Castings
   4. A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
   5. A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   6. A 240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip
   7. A 276 - Stainless Steel Bars and Shapes
   8. A 312 - Austenitic Stainless Steel Pipes
   9. A 492 - Stainless Steel Rope Wire
   10. A 666 - Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
   11. A 743 - Castings, Iron-Chromium, Iron-Chromium-Nickel
   12. A 780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
   13. C 1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

D. AWS - American Welding Society
   1. D1.1 - Structural Welding Code - Steel
   2. D1.6 - Structural Welding Code - Stainless Steel

E. CBC - 2019 California Building Code, 24 CCR Part 2
   1. Chapter 10 - Means of Egress
   2. Chapter 11B - Accessibility to Public Buildings

F. MIL - Military Specifications, United States Department of Defense
   1. P-21035 - Paint, High Zinc Dust Content, Galvanizing Repair

G. MPI - Master Painters Institute Approved Products List

1. 18 - Primer, Zinc Rich, Organic.
2. 19 - Primer, Zinc Rich, Inorganic

H. NOMMA - National Ornamental & Miscellaneous Metals Association
1. Guideline 1 - Joint Finishes

I. SSPC - The Society for Protective Coatings
1. Paint 20 - Zinc-Rich Coating (Type 1 Inorganic and Type II Organic)

1.03 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners and accessories.

B. Samples: Of each exposed finish, each component, and a partial fabrication including at least one bend and one welded "T" joint.

C. Mill Certificates: Signed by steel manufacturers, certifying that products furnished comply with requirements.

D. Welding certificates.

PART 2 - PRODUCTS

2.01 PERFORMANCE CRITERIA

A. Railing assembly, wall rails and attachments to resist a load of 50 lbs. per lineal foot and 200 lbs. applied in any direction at any point on the rail, without damage or permanent set, in accordance with CBC.

B. Railing system shall support tensioning of cable system.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 and AWS D1.6.

D. Where used for guards, the height of guardrail shall be min. 42" high and shall not permit passage of a 4" sphere per CBC 1015.

2.02 MATERIALS

A. Stainless Steel Sheet, Strip, and Plate: ASTM A 240M or ASTM A 666, Type 316L.

B. Stainless Steel Bars and Shapes: ASTM A 276, Type 304.

C. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47, unless otherwise indicated.

D. Stainless Steel Castings: ASTM A 743, Grade CF 8 or CF 20.

E. Wire Rope and Fittings:
1. Manufacturers

a. Products of the following manufacturer form the basis of design and quality intended for the Project:
   1) Feeney Inc., Oakland, CA
b. Or equal, as approved in accordance with Division 01 requirements for Substitutions.

2. Wire Rope: 7 x 7 semi-flexible wire rope made from wire complying with ASTM A 492, Type 302 or 304 , 3/16 inch.
3. Wire-Rope Fittings: Connectors as required, fabricated from Type 316 stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
   a. Swage and swage turnbuckles:
      1) Thread - 5/16" œ 24
      2) Wire Size - 3/16"
      3) Body L - 4-3/4"
      4) Open L - 8-3/4"
   b. Termination stud turnbuckle and termination stud:
      1) Cap Size - 9/16", surface mount
      2) Fixed Jaw End - 15/16" throat and 5/16" cord.
      3) Thread - 5/16" œ 24
      4) Wire Size - 3/16"
      5) Body - 4-3/4"
      6) Open L - 10-3/4"
      7) Closed L - 8"
      8) Shaft - 2-1/4"

F. Sleeve: ASTM A 53 pipe, Grade B, Type E or S, Schedule 40, galvanized. Contractor's option: "EZ Sleeve" Model EZ 4012 by R & W Wagner, 12" H, 7/16" thick plastic tapered tube.

G. Nonshrink Grout: ASTM C 1107, premixed compound consisting of non metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 4,000 psi in 24 hours and 8,000 psi in 7 days; of consistency for application and a 30 minute working time. 1107 Advantage Grout by Dayton Superior, Miamisburg, OH; Sonogrout 10K by BASF; Super Por-Rok Anchoring Cement by Novex Systems International, Clifton, NJ; or equal.

2.03 LIGHTING SWAY BRACING

A. Products / Basis-of-Design: parts below from Unicorn Stainless:
   1. Set Screw Turnbuckle: item no. S0791-0004
   2. Cross Wire Clamp: item no. S0721-0004
   3. Cable, 1 x 19 construction: item no. S0702-0004-1, size: 5/32 inch diameter
   4. Attach to pendant lighting and structure as indicated.

2.04 FABRICATION

A. Fabricate handrails of specified shapes only in conformance with requirements of CBC Chapters 10 and 11B.

B. Fit, shop assemble, and weld components in largest practical sizes for delivery to site; minimize field welding.

C. Fabricate components with joints tightly fitted and secured.

D. Accurately form components to each other and to building structure.

E. Drill 3/16" dia. holes for cable railing system at line posts 4" dia. o.c. size holes for end supports, corners, for shafts at termination stud turnbuckles.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Seal joined pieces by continuous welds in accordance with AWS D1.1.

I. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush and hairline. Ease exposed edges to small uniform radius.
   1. Dress welded joints, ground smooth, leaving no burrs, or sharp or abrasive corners, edges or surfaces CBC 11B-505.6 and 11B-405.8
      a. Where exposed to view in finished, habitable spaces, dress welds in accordance with NOMMA Guideline 1 for Finish 1.
      b. Where exposed to view in utility spaces and exit stairs, dress welds in accordance with NOMMA Guideline 1 for Finish 2.
      c. Where concealed, dress welds in accordance with NOMMA Guideline 1 for Finish 3.

2.05 FINISHES

A. Stainless steel finish: ASTM A 480, No. 4, General Purpose Polished.

B. Refer to Finish Schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Provide anchors, welding plates or angles required for connecting railings to structure. Anchor railing to structure.
   1. Surface Mount with base plate.

2. As indicated on drawings.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Set vertical supports in sleeves with the specified non-shrink grout. Slope to drain at each post. Spacing of supports 48 o.c. max.

D. Field weld anchors as indicated on shop drawings. Grind welds smooth.

E. Conceal bolts and screws. Where not concealed, use flush countersunk fastenings.

F. Repair surfaces scheduled for painted finish in conformance with ASTM A 780, Annex 2, touch up welds and chipped surfaces with specified galvanizing compound prior to painting, minimum thickness 5 mils.

G. Install cable railing system.
1. Tension and Termination: Cables must be terminated and tensioned properly by experienced riggers. Use adjustment turnbuckles in the middle or at the end of the cable run. Terminate cables with threaded swage studs on one or both ends. Provide one turnbuckle for cable run up to 50 feet. Multiple turnbuckles at specific designed locations only.
2. Cable Tensioning: Tension cables to approximately 200 lbs. Verify post installation prior to tensioning. Follow manufacturer's recommendations for tensioning sequence.
3. Swaging: Swaging shall be performed by experience riggers. Use rotary roll type swaging only to produce smooth swaging, no flash marks.

H. Erection Tolerances
1. Maximum Variation From Plumb: 1/4 inch in 10 feet.

3.04 FINISHING

A. Protect stainless steel wire rope and fittings from overspray.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY - INSTALLATION OF DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Installation of wood and hollow metal doors.

B. Installation of door hardware and attachment accessories.

C. Wood blocking backing and nailers.

D. Related Sections:
1. Section 01 35 42, CALGreen Requirements.
2. Section 08 12 13, Hollow Metal Frames - Welded.
3. Section 08 13 13, Hollow Metal Doors.
4. Section 08 14 16, Flush Wood Doors.
5. Section 08 71 00, Door Hardware.
6. Section 09 90 00, Painting.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990
1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

C. APA - The Engineered Wood Association.
1. APA Guide – APA Design and Construction Guide

D. BHMA - Builders Hardware Manufacturers Association
1. BHMA A156.1 through 24 - Standards

E. CBC 2019 California Building Code.

F. California Green Building Standards Code, CALGreen - 2019.

G. CBC - 2019 California Building Code
1. CBC-10 - CBC Chapter 10, Means of Egress
2. CBC - 2019 - CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing

H. CRSC - California Referenced Standards Code (CCR Title 24, Part 12)
1. CRSC-7A.2 - Standard 12-7A-2, Exterior Windows
2. CRSC-7A.4 - Standard 12-7-4 Fire Resistive Standards, Fire Door Assemble Tests

3. CRSC-10.2 - Standard 12-10-2 Single Point Latching or Locking Devices
4. CRSC-10.3 - Standard 12-10-3 Emergency Exit and Panic Hardware

I. ITS-WH - Intertek Testing Services-Warnock-Hersey

J. NFPA - National Fire Protection Association
1. NFPA 80 - Fire Doors and Windows
2. NFPA 105 - Smoke Door and Window Assemblies
3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies

K. PS - U.S. Department of Commerce, Product Standard
1. PS-1 - Construction and Industrial Plywood
2. PS-2 - American Softwood Lumber Grading Standards

L. SDI - Steel Door Institute
1. SDI-107 - Hardware on Steel Doors.
2. SDI-109 - Hardware for Standard Steel Doors and Frames.
3. SDI-122 - Installation for Standard Steel Doors and Frames.>>>

M. UL - Underwriters Laboratories, Inc.
1. UL-10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Fire Tests of Door Assemblies
3. UL 1784 - Air Leakage Test for Door Assemblies

1.03 SUBMITTALS

A. CALGreen Submittals:
1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.B.

1.04 QUALITY ASSURANCE

A. Acceptable Lumber Grading Associations
1. PLIB - Pacific Lumber Inspection Bureau
2. RIS - Redwood Inspection Service, a division of the California Redwood Association
3. WCLIB - West Coast Lumber Inspection Bureau

B. WWPA - Western Wood Products Association

C. All Plywood shall be free of urea-formaldehyde binders and adhesives.

D. California Green Building Standards Code, CALGreen - 2019.
1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3
3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store materials in ventilated, interior locations.

PART 2 - PRODUCTS

2.01 DOOR MATERIALS

A. Hollow Metal Doors: As specified in Section 08 13 13.

B. Flush Wood Doors: As specified in Section 08 14 16.

C. Door Hardware: As specified in Section 08 71 00, Door Hardware.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive Work and field measurements are as indicated on shop drawings.

B. Verify mechanical, electrical and building items affecting Work of this Section are placed and ready to receive this Work.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION OF FLUSH WOOD DOORS

A. Door shall have clearance of 1/8 inch at the sides and top and shall have bottom clearance of 1/4 inch over thresholds and 1/2 inch at other locations unless otherwise indicated. The lock edge or both edges of door shall be beveled at the rate of 1/8 inch in 2 inches. Cuts made on the job shall be sealed immediately after cutting, using clear varnish or sealer.

B. Installation of Fire Rated Doors: Installation, hardware and operational characteristics shall conform to Fire-Resistive Standard 12-7-4 and NFPA 80, and shall be in conformance with the manufacturer's printed instructions. Properly sized pilot holes shall be drilled for screws in door edges. Factory applied permanent metal labels shall remain intact where installed. Labeled edge of door shall not be trimmed.

C. Machine cut relief for hinges.

D. Pilot drill screw and bolt holes.

E. Prepare doors to receive finish hardware in accordance with applicable BHMA Standards requirements. Seal tops, bottoms and cutouts for hardware and accessories per Section 08 71 00, Door Hardware.

F. Conform to applicable BHMA requirements for fit tolerances.

3.03 INSTALLATION OF HOLLOW METAL DOORS

A. Install doors in accordance with SDI ANSI A250.11/105 and SDI 122 recommendations.

B. Coordinate installation of glass or louvers where indicated.

3.04 INSTALLATION OF HARDWARE

A. Install hardware in accordance with Section 08 71 00, Door Hardware.

B. Exit Devices shall comply with in accordance with CBC 2019 Sections 1010.1.9 and 11B-404.2.7, mounted bewteen 36 inches and 44 inches above finish floor, comply with Standard 12-10-3. The unlatching force shall be by Authority having Jurisdiction and may increase the maximum effort to operate doors required to be fire rated to achieve positive latching, but in no case shall the pressure exceed 15 pounds per CBC Section 11B-404.2.9 when applied in the direction of exit travel.

C. Rated Wood Doors: Cutouts for hardware in wood doors having a fire rating of 20 minutes or more shall be accomplished at the factory before labels are affixed. Preparation shall be performed in accordance with manufacturer™s inspection service procedure and under label service.

D. Conform to SDI-107 and SDI-109 for hardware on steel doors.

E. Fire doors and frames assembly shall be installed in accordance with their listing per NFPA No. 80 and testing per CRSC California Referenced Standards Code, Standard 12-7-4, and the manufacturer’s instructions.
   1. Glazing in door assemblies: Test in accordance with Section 716.1.2.1, 2019 CBC, and NFPA 257.

3.05 INSTALLATION TOLERANCES

A. Conform to standard of flatness and squareness as required by SDI-117. Maximum Diagonal Distortion: 1/16 inch measured with straight edge corner to corner, or as required to meet door warranty.

3.06 FIELD QUALITY CONTROL

A. Provide testing certification of fire-rated door assemblies in accordance with CBC Section 716.2.1 and Fire-Resistive Standard 12-7-4.

B. Provide manufacturer's installation instructions for each listed assemblies for review by the Inspection Authority.

3.07 ADJUSTING AND CLEANING

A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 06 41 13

WOOD CASEWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cabinet Units.

B. Countertops

C. Cabinet hardware

D. Pre-finished surfaces

E. Preparation for installing utilities

F. Related Sections:
1. Section 01 35 42, CALGreen Requirements.
2. Section 06 61 16, Solid Polymer Fabrications.
3. Section 06 61 19, Quartz Surfacing Fabrications.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. WI - Woodwork Institute, Latest Edition.

C. National Electric Manufacturers Association (NEMA) LD3 - High Pressure Decorative Laminates.

D. ADA - Americans with Disabilities Act of 1990, as amended
1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

E. CBC - 2019 California Building Code
1. CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing
2. CBC Chapter 16A, Structural Requirements (for DSA)

F. California Green Building Standards Code, CALGreen - 2019.

G. HPVA HP-1 - Hardwood and Decorative Plywood.

H. DOC PS 1-07 - Construction and Industrial Plywood.

I. DOC PS 20-05 - American Softwood Lumber Standard.

J. DOC PS 58 - Basic Hardwood.

K. ANSI A208.1 - Wood Particle Board.

L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

M. AQMD - Local Air Quality Management District Regulations.

N. California Title 17 Division 3 Subchapter 7.5 Air Bourne Toxic Control Measures, Section 93120.1 through 93120.12.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Conference
1. Convene two weeks prior to commencing work of this section.

B. Field Measurements
1. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
2. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
3. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Coordination
1. Coordinate the work with electrical rough-in and floor finish sections.
2. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

1.04 SUBMITTALS

A. CALGreen Submittals:
1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.05.M.

B. Action Submittals:
1. Product Data: For particleboard, plywood, cabinet hardware and accessories, and finishing materials and processes.
2. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

3. Two samples, 36 x 36 inches, illustrating cabinet transparent finish and special surface materials. Approval by Architect is required prior to commencing finishing work.
4. Three samples of drawer pulls, hinges and all exposed cabinet hardware, illustrating finish and type.
5. Three Hardware Sample Boards each displaying complete set of hardware items; label board with the project name and cabinet maker's name and address.
6. Samples for Verification: For the following:
   a. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
   b. Wood-veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
   c. Plastic-laminate-clad panel products, 8 by 10 inches, for each type, color, pattern, and surface finish [with separate samples of unfaced panel product used for core].

C. Information Submittals:
   1. Statement of Qualifications from fabricator
   2. Statement of Qualifications from installer

D. Closeout Submittals:
   1. Record Documents

1.05 QUALITY ASSURANCE

A. Casework shall be manufactured in accordance with Section 10 of the latest edition of the WI for Custom Grade or to higher standards as specified herein.

B. Qualifications
   1. Fabricator: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
   2. An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork with sequence-matched wood veneers including wood doors where veneer matching includes door faces.

D. Before delivery to the jobsite, the casework supplier shall submit WI Certified Compliance Certificate (Certified Compliance Program) indicating the products he will furnish for this job, and certifying that they will fully meet all the requirements of the grade or grades specified.

E. First page of shop drawings shall bear the WI Certified Compliance Label. Shop drawings not conforming to this requirement will be rejected.

F. Each elevation of casework and countertop shall bear Certified Compliance Label.

G. One (1) copy of the latest issue of the WI shall be made available for reference at the jobsite throughout the installation period.

H. A statement shall appear prominently on the shop drawings certifying that all casework construction complies the structural requirements of Table 1607.1A, California Building Code Horizontal Force Factor for Anchorage of Non-Structural Components.

I. Inspections by Authorized WI inspectors shall be made in accordance with the following schedule:
   1. Shop inspection at place of manufacturer, prior to initial shipment of cabinet components to site.
   2. Site inspection immediately following installation of first cabinet components.
   3. Site inspection immediately following final installation of all cabinet Work.
   4. Additional site inspections may be required at the option of the Architect and at no cost to the Owner when certified WI inspection reports indicate unsatisfactory conformance with specified requirements.
   5. Provide full written reports to Architect.

J. Upon completion, a WI Certified Compliance Certificate shall be submitted for manufacture and installation.

K. WI Certification costs shall be included.

L. Mockups: Before fabricating and installing interior architectural woodwork, build mockups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be fabricated and installed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
   4. Obtain Architect's approval of mockups before starting interior architectural woodwork fabrication.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

M. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.2.
   2. Paints and coatings shall comply with VOC Limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.
   3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect units from moisture damage.

B. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and will maintaining temperature between 60 and 90 deg F and relative humidity between 17 and 50 percent during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Casework: Operable parts for all accessible casework shall comply with CBC Section 11B-309.

2.02 WOOD MATERIALS

A. General: Provide materials that conform to the requirements of WI's quality standard for each type of wood casework and quality grade specified, unless otherwise indicated.

B. Dimension Lumber Provide "No.1" and "No.2" grade Douglas Fir graded in conformance with WCLIB Grading Rules, S4S, seasoned to a moisture content of not more than 19 percent, and stamped "NS-Dry".

2.03 SHEET MATERIALS

A. Urea-Formaldehyde-Free MDF:
   1. 1. Manufacturer: Provide products manufactured by one of the following:
      a. Sierra Pine.
      b. Or equal.
   2. Basis of Design Products:
      a. At Countertops where Sinks Occur: Design is based on "Medex" sustainable moisture resistant MDF.
      b. Flame Resistant MDF: Design is based on "Medite FR" flame resistant MDF.
      c. Elsewhere: Design is based on "Medite II" sustainable MDF.
   3. Items must conform to the following:
      a. Minimum Density:
         1) Flame Resistant MDF: At least 50 pounds per cubic foot.
         2) Elsewhere: At least 45 pounds per cubic foot.
      b. Minimum Thickness:
         1) At least nominal 1/2-inch, unless otherwise indicated.

c. Minimum Grades:
   1) At Countertops where Sinks Occur: Provide at least Grade 155 MRSO.
   2) Flame Resistant MDF; Provide at least Grade 130.
   3) Elsewhere: Provide MDF having at least Grade 155-F11-MR30.
d. Fire Class:
   1) Flame Resistant MDF: Provide MDF having at least a Class A flame spread rating (Maximum FSI value of25 or less, when tested in compliance with ASTM E 84).
   2) Elsewhere: Provide MDF having at least a Class C flame spread rating (Maximum FSI value of 75 or less, when tested in compliance with ASTM E84).

4. Thermoset Decorative Panels (Melamine): Provide the specified minimum particleboard grades finished with thermally fused, melamine-impregnated decorative paper conforming to LMA SAT-1

B. Cabinet Liner: NEMA LD 3, CLS grade 0.020 inch thick, high pressure plastic laminate.

C. Laminate Backing Sheet: 0.020 inch Backing Sheet grade, undecorated high pressure plastic laminate.

2.04 MANUFACTURERS - PLASTIC LAMINATE

A. Plastic Laminate Facing
1. Manufacturers: Provide products manufactured by one of the following:
   a. Arborite.
   b. Lamin-Art, Inc.
   c. Formica Corp.
   d. Panolam Industries International, Inc.
   e. Wilsonart LLC.
2. Items must conform to the following:
   a. Exposed Surfaces: Provide general purpose type HPDL conforming to NEMA LD- 3, minimum Grade HGS, Toe bases are considered exposed surfaces, unless the toe base is indicated as receiving an applied base (e.g., a resllient base).
   b. Semi-Exposed Surfaces:
      1) Drawer Sides, Bottoms and Backs: Provide thermoset decorative panels (melamine) with specified edge banding on components with exposed or semi-exposed edges.
      2) Edges of Plastic-LaminateShelves: 3mm
      3) Door and Drawer Edges: Provide PVC edge banding
      4) Elsewhere: Cabinet liner type HPDL conforming to NBMA LD-3, minimum Grade CLS.
   c. Concealed Surfaces (Including the underside of countertop substrates) Backer type HPDL conforming to NEMA LD-3, minimum Grade BKV.
   d. Fire Class: Provide PLAM having at least a Class A flame spread rating (maximum FSI value of 25 or less, when tested in compliance with ASTM E 84).
3. Finishes:
   a. Exposed Surfaces:
      1) Colors, Patters, and Finish: Refer to Finish Schedule on Drawings.

b. Semi-Exposed Surfaces:
   1) Color: White, unless otherwise noted.

2.05 ACCESSORIES

A. Adhesive: Contact adhesive type recommended by WI to suit application in area where casework is installed.
   1. Adhesive shall comply with AQMD, Local Regulations.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins and Screws: Of size and type to suit application.

D. Concealed Joint Fasteners: Threaded steel.

E. Grommets for Cable Passage through Countertops: Doug Mockett 2-inch OD stainless steel.

2.06 CABINET HARDWARE

A. General
   1. Provide all components and accessories necessary or required for a complete cabinet hardware installation, as listed In WIs current edition of publication, Approved Cabinet Hardware Listings Applicable to the Manual of Millwork, unless otherwise indicated or specified.
   2. Unless otherwise indicated, cabinet hardware finishes must match adjacent door hardware finishes specified in Section 08 71 00 for the same room 01 space.

B. Pulls:
   1. Description: Back mounted pulls conforming to BHMAA156.9 Hardware Type No.A09021.
   2. Pulls, ADA Compliant: Provide "No. 562" drawer and cabinet pulls manufactured by Trimco, Rockford Process Control, LLC; verify with Architect.
   3. Items must conform to the following:
      a. Sizes: As indicated.
      b. Finish: As selected by Architect.

C. Concealed Hinges:
   1. Description: Frameless, self-closing concealed hinges (European cup style) conforming to BHMAA156,9, B01601
   2. Manufacturers: Provide products supplied by one of the following.
      a. Hafele America Co.
      b. Blum, Inc.
      c. Or Equal.
   3. Items must conform to the following:
      a. Opening Type:
         1) Provide hinges having between 95 and 100 degrees of opening for cabinets having retractable doors; and for cabinets next to walls or similar obstructions.

2) Provide hinges having between 165 and 175 degrees of opening for cabinets requiring the most cabinet access; and for installations where there are drawer pullouts in the cabinets.
3) Provide hinges having at least 120 degrees of opening for all other cabinets.

b. Quantity: Provide at least 3 hinges where doors are at least 24 inches wide or at least 36 inches high.
c. Mounting Style: Provide either Screw- or Rapido-mounted hinges.

D. Full Extension Drawer Slides with Self-Closing Feature:
1. Description: Full extension, telescopic, ball bearing slides conforming to BHMAA156.9 Hardware Type No. B0509.
2. Manufacturers: Provide products manufactured by one of the following:
a. Hafele America Co.
b. Accuride.
c. Blum.
d. Or Equal.
3. Items must conform to the following:
a. Grades: Drawer slides must be capable of supporting anticipated drawer loads when fully extended.
1) Light Duty Slides: Provide BHMA-certlfled Grade 1, rated to at least 75 pounds per pair for general purpose drawers.
2) Medium Duty Slides: Provide BHMA-certifled Grade lHD-100, rated to at least 100 pounds per pair.
3) Heavy Duty Slides: BHMA-certified Grade 1HD-200, rated to at least 200 pounds per pair.
b. Mounting Style: Provide bottom-mount slides.
c. Finish: Provide either a powder coated; or chrome- or zinc-plated steel finish.

E. Adjustable Shelf Hardware: Pin type, for use In holes drilled 32mm on center.
1. Manufacturers: Provide products manufactured by one of the following:
a. Hafele America Co.
b. Blum, Inc.
c. Or Equal.

F. Base Cabinet Levelers:
1. Description: Base cabinet levelers consisting of a 2-part adjuster and a separate black plastic panel with a steel spring clip screw-mounted to the toe kick panel.
2. Manufacturers: Provide products manufactured by one of the following:
a. Hafele America Co.
b. Blum, lnc.
c. Or Equal.
3. Basis of Design Products:
a. Adjuster: Design is based on "Item No. 637.19.228" manufactured by Hafele America Co, (4-3/4 to5-1/2-inch toe kick height).
b. Panel Clip: Design is based on "Item No, 637,19.906" manufactured by Hafele America Co.

G. Work Surface Supports: Provide one of the following, manufactured by Doug Mockett & Co., AS SELECTED BY THE ARCHITECT:

1. "SWS5" large arc shelf supports for 24-Inch-deep light-duty work surfaces.
   a. Size:12-13/16 inches long by 9-1/4, inches high.
   b. Weight Capacity: 35 pounds each.
   c. Finish: AS SELECTED BY THE ARCHITECT.
2. "SWS4" large basic work support surface for maximum 26-inch deep work surfaces:
   a. Size: 24 1/4 inches by 18 1/4 inches.
   b. Weight Capacity: 400 pounds per pair.
   c. Color: AS SELECTED BY THE ARCHITECT.

H. Table Legs: Provlde "TL27P-4" table legs with plate leveler manufactured by Doug Mockett &Co.
   1. Length: 27 inches.
   2. Diameter: 4 lnches.
   3. Plate Leveler: 1/2-inch thick.
   4. Finish, AS SELECTED BY THE ARCHITECT.

2.07 FABRICATION

A. Provide Custom Grade, Construction Type J (single-length sections), Style 1 (frameless) cabinets with Type A (flush overlay) cabinet doors and drawers, conforming to the requirements of the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated.

D. Edge Profile: Square edge with applied banding.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.
   2. Provide access panels where required to access plumbing and associated casework utilities.

G. Fit shelves, doors, and exposed edges with matching veneer edging. Use one piece for only full length.

H. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

I. Provide cutouts for inserts, appliances, outlet boxes fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

3.02 INSTALLATION

A. Set and secure casework in place; rigid, plumb and level and in strict accordance with WI Architectural Woodwork Standards. Secure casework to walls or floors or both to conform to ASCE 7, Section 13.5 Table 13.5-1 anchorage requirements.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
   1. Set shelves on specified clips, secure with wood screws each clip, front only. Confirm shelves spacing with Owner, do not proceed without Owner’s approval.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c.
   4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealers."

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

H. When adhesive is applied on the site, adhesive shall comply with AQMD, Local Regulations.

3.03 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings and fixtures.

END OF SECTION

SECTION 06 42 00

ARCHITECTURAL BAMBOO PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Unfinished bamboo panels and accessories for bench application.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. 2019 California Building Code.

C. ASTM E84 - Method of Test for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Submit the follow items in accordance with Division 01:
   1. Product Data
   2. Specification sheet.
   3. Shop Drawings
   4. Samples

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Minimum 15 years' experience continuously manufacturing bamboo panels
   2. Quality Standards:
      a. American National Standards Institute/Hardwood Plywood and Veneer Association
      b. Test reports including an electronic copy of certified laboratory reports submitted on Laboratory letterhead.

B. Pre-Installation Conference in accordance with Division 01.

C. Mock-up:
   1. Install not less than two panels of each pattern specified in an area designated by Architect.
   2. Test installation area shall be reviewed for conformance to manufacture's standard installation instructions recommended adhesive.

3. The approved test area shall remain as part of the finished installation work as standard of comparison for the installation throughout the project

1.05 DELIVERY, STORAGE AND HANDLING

A. Panels are to be delivery to project site in original packaging in advance of installation to allow sufficient acclimatization to site conditions.

B. Panels must be stored in original packaging in conditioned space where HVAC systems are operation and controlling storage site temperature and humidity.

1.06 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

A. Warranty for Plyboo bamboo panels: 5 years.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. Smith & Fong Company, San Francisco, CA.

B. CPS Garten, Lake Forrest, CA.

C. Or approved equal in accordance with Division 01, General Requirements for Substitutions.

2.02 MATERIALS

A. Plyboo™ Architectural Bamboo Plywood
   1. Species: Moso (Phyllostachys Pubescens) bamboo
   2. 100% bamboo
   3. Sanded to 180 grit
   4. Forest Stewardship Council (FWSC) certified
   5. Unfinished.
   6. Three-quarter inch (3/4”) (19.05 mm) thick 3-ply
      a. amber edge grain
      b. FSC-certified; 100 FSC
   7. Finished one side

B. Physical/Mechanical Properties
   1. ASTM E84: Surface Burning, Class C
   2. ASTM D1037
      a. Dimensional Stability (AR to 20% RH)
         1) Linear Expansion: 3-ply: Parallel -0.07%/Perpendicular -0.09%; 1-ply: Parallel -0.40%/ Perpendicular -0.10%
         2) Thickness Swell (AR to 20%RH): 3-ply -0.39%; 1-ply -0.13%
         3) Screw Hold (face/back/edge 1/edge 2): 3-ply 1009 lbs. / 681 lbs. /361 lbs. /670 lbs. (avg); 1-ply 261 lbs. / 233 lbs. / 513 lbs. / 636 lbs. (avg)
      b. ASTM D3043 Method D: Flexural Strength
         1) Density: 3-ply 40 lbs/ft^3; 1-ply 36 lbs/ft^3
         2) MOE/ MOR (parallel): 3-ply 148,000 psi/ 9,110 psi; 1-ply 179,000 psi/ 11,370 psi
      c. ASTM D3500 Tensile Strength (parallel), ASTM 1037 Tensile Strength (perpendicular): Load 3-ply 892 lbs. (avg)/ 1,536 lbs. (avg); 1-ply 1,700 lbs. (avg)/ 642 lbs. (avg); Strength: 3-ply 3,497 psi (avg)/ 1024 psi (avg); 1-ply 7,535 psi (avg)/ 428 psi (avg)
      d. ASTM D4442 Moisture Content: 3-ply 6% - 9% (avg); 1-ply 6% - 9% (avg)
      e. ASTM D6007: Standard Test Method for Determining Formaldehyde Concentrations in Air from Wood Products Using a Small-Scale Chamber: ¾-inch (19.05 mm) 1-ply edge grain = 0.004ppm; ¾-inch (19.05 mm) = 0.004ppm

C. Adhesive: Manufacturer's recommended adhesive and in full compliance with California VOC Regulations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates upon which panels will be installed and conditions are correct.
   1. Verify that substrate is clean, dry and free of contaminates.
   2. Verify that HVAC system is operating properly and maintaining proper occupancy-level temperature and humidity conditions.
   3. Coordinate with responsible party to correct unsatisfactory conditions.
   4. Fabricator or installer shall inspect products upon arrival, inspect for any freight damage, confirm condition and examine to determine it matches the work order.

B. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

A. If panels are to be stored prior to fabrication or installation:
   1. Leave in protective packaging and stack horizontally.
   2. If panels need to be acclimated, unbag, stack horizontally with pacers to allow circulation

3.03 INSTALLATION

A. Install bamboo panels in accordance with manufacturer's installation instructions.

3.04 CLEANING

A. Remove all debris left from installation; vacuum; leave space in clean condition.

3.05 PROTECTION

A. Cover with suitable covering. Do not use a non-breathable sheet or film. Maintain covering throughout remainder of construction.

END OF SECTION

SECTION 06 61 16

SOLID POLYMER FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cast acrylic polymer countertops.

B. Related Section(s):
   1. Section 01 35 42, CALGreen Requirements.
   2. Section 06 41 13, Wood Casework.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990 as amended
   1. ADA/Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

C. CBC - 2019 California Building Code
   1. CBC-11 - CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing
   2. CBC-16 - CBC Chapter 16A, Structural Requirements.

D. California Green Building Standards Code, CALGreen -2019.

E. ASTM E84 - Surface burning characteristics of building materials.

F. ASTM D638 - Tensile Properties of Plastics.

G. ASTM D785 - Rockwell Hardness of Plastics and Electrical Insulating Materials.

H. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.

1.03 SUBMITTALS

A. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.A.

B. Shop Drawings: Indicate dimensions, thickness, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, mounting methods, integration of [plumbing and electrical] components and anchorages.

C. Product Data: Provide data on specified component products.

D. Three samples illustrating color, textures and finishes, 6" x 6" each.

E. Manufacturer's Installation Instructions: Indicate preparation of opening required with rough-in sizes. Provide templates for cast-in or placed frames or anchors.

F. Maintenance Data: Indicate list of approved cleaning materials and procedures required and provide list of substances that are harmful to product. Include instructions for stain removal and surface.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing this product as specified with minimum three years experience.

1.05 FIRE RESISTANCE REQUIREMENTS

A. Flame Spread: Less that 25, smoke density less than 450, ASTM E84.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install components when site conditions may be detrimental to product or curing.

1.07 QUALITY ASSURANCE

A. Mockups: build mockup of each type of Solid Polymer Fabrication.

B. Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

C. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.

1.08 FIELD MEASUREMENTS

A. Verify field measurements as indicated on shop drawings.

1.09 WARRANTY

A. Warrants product for a period of 1 year to repair or replace for products that fail in material or workmanship.

1.10 SEQUENCING

A. Sequence work to permit installation of adjacent affected construction, plumbing and electrical rough-in.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Dupont Company, Wilmington, DE; Product: CORIAN.
   2. Avonite Inc., Belen, NM; Product: AVONITE.
   3. Formica Corporation, Cincinnati, OH; Product: Surell.
   4. LG Solid Source, LLC, Peoria, AZ; Product: Hi-Macs.
   5. Hanwha Hanex Solid Surfaces, Atlanta, GA.
   6. Wilsonart International, Temple, TX.

B. Or equal as approved in accordance with Division 01 for substitutions.

2.02 MATERIALS

A. Corian: Homogenous, mineral-filled acrylic polymer, solid, non-porous with full depth color pattern, conforming to following:
   1. Tensile Strength, ASTM D638: Minimum 4000 pounds per square foot.
   2. Elongation, ASTM D638: 0.3 percent Maximum
   3. Hardness, ASTM D785: 90 Rockwell M
   4. Weight per square foot, 3/4 inch thick: 7 lbs. (Approximate)

B. Adhesive: Neoprene-based panel adhesive or Type I solvent-based mastic type, approved for use by materials manufacturer. At joints, use manufacturers joint adhesive, color matched to material.

C. Sealant: Silicone type specified in Section 07 92 00 and approved by manufacturer.

D. Cleaner: type recommended by manufacturer.

E. Fasteners: use screws designed specifically for plastics. Self-threading screws acceptable for permanent installation. Provide threaded metal inserts for applications requiring frequent disassembly.

2.03 FABRICATION

A. Fabricate components by mold to achieve required shape and configuration. Comply with manufacturer written recommendations for fabrication.

B. Fabricate in shop to greatest completion possible.

C. Square edges, and square inside corners, eased.

D. Cure components before shipment, except sheet materials requiring site handling.

2.04 FINISH

A. Colors: Refer to Finish Schedule on Drawings.

B. Exposed to View Surface Texture: Semi-gloss .

C. Orientation: As indicated on Drawings

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are complete and ready to receive work of this Section.

B. Verify that joint preparation, substrates and affected dimensions are acceptable to manufacturer.

3.02 PREPARATION

A. Provide anchoring devices for installation and embedment.

B. Provide templates and rough-in measurements.

3.03 INSTALLATION

A. Install components, sinks according to shop drawings and manufacturers instructions.

B. Align Work plumb and level. Form joints using manufacturer’s recommended procedures. Panel seams should not align with substrate seams.

C. Rigidly anchor to substrate to prevent misalignment. Utilize fasteners, adhesives and bonding agents as recommended by the manufacturer. Materials damaged as a result of installation or fabrication methods will not be accepted.

3.04 TOLERANCES

A. Maximum Variation From True Dimension: 1/8 inch.

B. Maximum Offset From True Position: 1/8 inch.

3.05 CLEANING

A. Clean and polish fabrications according to manufacturer's instructions.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished work until Date of Substantial Completion.

B. Do not permit construction near unprotected surfaces.

END OF SECTION

SECTION 06 61 19

QUARTZ SURFACING FABRICATIONS

PART 1 - GENERAL

1.01 Summary

A. Section Includes
   1. Quartz surfacing fabrications, countertops.

B. Related Requirements:
   1. Section 06 41 13, Wood Casework.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ANSI - American National Standards Institute
   1. IAPMO/ANSI Z124.6 - Plastic Sinks

C. ASTM International
   1. C 97 - Absorption and Bulk Specific Gravity of Dimension Stone
   2. C 170 - Compressive Strength of Dimension Stone
   3. C 501 - Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
   4. C 880 - Flexural Strength of Dimension Stone
   5. D 790 - Flexural Properties of Unreinforced and Reinforced Plastics
   6. E 84 - Surface Burning Characteristics of Building Materials

D. NSF International
   1. Certified Products Directory
   2. NSF/ANSI 51 - Food Equipment Materials

E. SCAQMD - South Coast Air Quality Management District
   1. Rule 1168 - Adhesives and Sealants

1.03 SUBMITTALS

A. Product Data: For each type of product indicated

B. Shop Drawings: Show location of each item, dimensioned plans, elevations, and sections, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in countertops.

C. Samples
   1. Material: Manufacturer’s standard sample size, but not less than 6 inches square
   2. A minimum 1 foot wide by 6 inch deep, full size sample for each type of counter top indicated, including the edge profile and backsplash.

D. Test and Evaluation Reports: For specified performance criteria, by an independent testing agency

E. Qualification Statements
   1. Fabricator

1.04 QUALITY ASSURANCE

A. Qualifications
   1. Fabricator: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of not less than 5 years of successful in-service performance, with at least one project in the past 5 years where the value of the quartz surfacing fabrications was within 20 percent of the cost of quartz surfacing fabrications for this Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery of surfacing fabrications shall be made only when the area of operation is enclosed, all plaster, concrete work, painting, and similar operations that could damage casework are dry, and the area broom clean.

1.06 FIELD CONDITIONS

A. Do not deliver or install surfacing fabrications until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. CaesarStone USA Inc, Van Nuys, CA
   2. Cambria, Eden Prairie, MN
   3. Cosentino USA Inc Stafford, TX. Product: Silestone
   4. E. I. du Pont de Nemours and Company Wilmington, DE. Product: Zodiaq
   5. Hanwha L & C Corp Atlanta, GA. Product: HanStone
   6. Seieffe Corp ("Okite"), Houston, TX
   7. Samsung Chemical USA Inc, La Mirada, CA; Product: Staron/Radianz
   8. Ice Stone
   9. Daltile

B. Or equal, as approved in accordance with Division 01 requirements for Substitutions

2.02 PERFORMANCE CRITERIA

A. Surface Burning Characteristics, ASTM E 84
   1. Flame Spread Index: 25 or less
   2. Smoke Developed Index: 450 or less

B. Water Absorption: 0.05% or less, ASTM C 97

C. Compressive Strength: Not less than 20,000 psi, ASTM C 170

D. Flexural Strength: Not less than 5,000 psi, ASTM C 880 or D 790

E. Abrasion Resistance: Material loss not greater than 225, ASTM C 501

F. Comply with IAPMO/ANSI Z124.6

G. NSF/ANSI 51 Certified

H. Adhesives and sealants shall comply with VOC limits of SCAQMD Rule 1168.

2.03 MATERIALS

A. Material Dimensions: As indicated on Drawings.

B. Proprietary blend of natural quartz aggregate and pigments in a polymer matrix.

2.04 FABRICATION

A. Fabricate components by mold to achieve required shape and configuration. Comply with manufacturer's written recommendations for fabrication.
   1. Fabricate in shop to greatest completion possible; minimize cutting and fitting in the field.
   2. Square edges, and square inside corners, eased, unless indicated otherwise.
   3. Cure components before shipment, except sheet materials requiring site fabrication.

B. Edge Detail: As indicated in Drawings.

2.05 FINISH

A. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

B. Exposed finished surfaces and edges per Finish Schedule on Drawings.

C. Colors: Refer to Finish Schedule on Drawings.

2.06 ACCESSORIES

A. Accessory products, as specified below, shall be manufactured by the quartz surface fabrication manufacturer or shall be products approved by the quartz surface fabrication manufacturer for use with the solid polymer materials being specified.

1. Seam Adhesive: Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between quartz surface fabrication materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the quartz surface fabrication manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned materials are being bonded together.
2. Panel Adhesive: Panel adhesive shall be neoprene based panel adhesive meeting TCA Hdbk, Underwriters Laboratories (UL) listed. Use this adhesive to bond solid polymer components to adjacent and underlying substrates.
3. Silicone Sealant: As specified in Section 07 92 00 and approved for use by the quartz surface fabrication manufacturer; use sealant to seal all expansion joints between components and all joints between components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.
4. Conductive Tape: Manufacturer's standard foil tape, 0.1 mm 4 mils thick, applied around the edges of cut outs containing hot or cold appliances.
5. Insulating Felt Tape: Manufacturer's standard product for use with drop-in food wells used in commercial food service applications to insulate solid polymer surfaces from hot or cold appliances.
6. Heat Reflective Tape: As recommended by the solid polymer manufacturer for use with cutouts for heat sources.
7. Mounting Hardware: Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks where specified, and lavatories.

2.07 FABRICATION

A. Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Provide factory cutouts for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth.
   1. Joints and Seams: Form joints and seams between components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.
   2. Edge Finishing: Rout and finish component edges to a smooth, uniform appearance and finish. Rout all cutouts, then sand all edges smooth.

B. Countertops: Fabricate counter top components from 1/2 inch thick material unless indicated otherwise. Counter tops shall be complete with 4 inch high backsplash, permanently attached with coved transition, and loose endsplashes unless indicated otherwise. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam.
   1. Permanently attached backsplashes shall be attached with seam adhesive and to form a radiused coved transition from countertop to backsplash.
   2. End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are complete and ready to receive work of this Section.
   1. Verify that joint preparation, substrates and affected dimensions are acceptable to manufacturer.

3.02 PREPARATION

A. Provide anchoring devices for installation and embedment.
   1. Provide templates and rough-in measurements.

3.03 INSTALLATION

A. Install components, sinks according to shop drawings and manufacturers instructions.
   1. Align Work plumb and level. Form joints using manufacturer's recommended procedures. Panel seams should not align with substrate seams.
   2. Rigidly anchor to substrate to prevent misalignment. Utilize fasteners, adhesives and bonding agents as recommended by the manufacturer. Materials that is damaged as a result of installation or fabrication methods will not be accepted.

3.04 TOLERANCES

A. Maximum Variation From True Dimension: 1/8 inch.
   1. Maximum Offset From True Position: 1/8 inch.

3.05 CLEANING

A. Clean and polish fabrications according to manufacturer's instructions.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished work until Date of Substantial Completion.
   1. Do not permit construction near unprotected surfaces.

END OF SECTION

SECTION 07 13 26

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Self-Adhering applied elastomeric sheet membrane waterproofing.

B. Protection Board

C. Application to vertical and horizontal surfaces occupied spaces and where indicated.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM D412 - Rubber Properties in Tension.

C. ASTM E154 - Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover.

D. ASTM D570 - Water Absorption of Plastics.

E. AQMD - Local Air Quality Management District Regulations.

1.03 SUBMITTALS

A. Product data for sealing openings, projections, holes, slots, sleeves and corners.

B. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Qualifications
1. Membrane Manufacturer: Company specializing in waterproofing sheet membranes with five years' experience.
2. Applicator: Company specializing in application of specified waterproofing with five years experience.

B. Mock-Up
1. Provide mock-up of installed membrane.
2. Mock-up to represent conditions of finished work including internal and external corners, seam jointing, attachment method, sealing and counterflashing cover, control and expansion joints.
3. Approved sample may be incorporated as part of the work.

C. Pre-construction Conference

1. Convene two weeks before installation.
2. Who Should Attend:
   a. Contractor's Representative
   b. Architect's Representative
   c. Owner's Representative
   d. Manufacturer's Representative
   e. Sub-Contractor/Installer.
3. Inspection before backfilling.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not apply waterproofing during inclement weather or when air temperature is below 50 degrees F.

B. Do not store materials where temperature exceeds 90 degrees F.

C. Do not store or apply liquid material in unventilated spaces.

D. Do not employ products that do not comply with AQMD, Local Regulations. Chlorinated primer, solvent-based primers or asphalt emulsion not permitted.

1.06 WARRANTY

A. Special Warranty (Extended Warranty): Manufacturer agrees to repair or replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16” in width.
   2. Include coverage of materials and installation and resultant damage from failure of installation to resist penetration of moisture.
   3. Warranty Period: 5 years from date of Certified Completion.

B. Special Installer’s Warranty (Extended Warranty): Specified form, signed by installer, covering Work of this Section, for Warranty period of 2 years.
   1. Warranty includes removing and reinstalling protection board, drainage panels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. W.R. Grace and Co., Cambridge, MA. Product: Bituthene 4000 with Surface Conditioner
   2. W.R. Meadows, Inc., Hampshire, IL. Product: Mel-Rol.
   3. Carlisle Coatings and Waterproofing Inc., South Sapulpa, OK. Product: CC-705 CCW/ MiraDRI 860 and MiraDRAIN 6000/6200.
   4. Polyguard Products, Inc., Ennis, TX. Product: Polyguard 650.
   5. SOPREMA Inc., Wadsworth, OH; Product: Colphene 3000
   6. IKO, Wilmington, DE; Product: Aquabarrier FP.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MEMBRANE MATERIALS

A. Membrane: Heavy Duty Composite Sheet, minimum of 60 mils thick, consisting of one layer of rubberized asphalt or polymeric 56 mils thick and one layer of woven polypropylene film , covered with release paper, self adhesive, conforming to the following properties:

1. Properties	Test	Results
a. Tensile Strength	ASTM D412	325 psi min.
b. Elongation	ASTM D412	300 percent min.
c. Puncture Resistance	ASTM E154	50 pounds. min.
d. Hydrostatic Head Resistance		231 feet water min.
e. Water Absorption	ASTM D570	0.1 percent max.

B. Seaming: Self-adhering.

2.03 ADHESIVE MATERIALS

A. Surface Conditioner: Water based, VOC compliant as recommended by manufacturer.

B. Mastic: Rubberized asphaltic type, Grace LM2 or manufacturer's approved product.

C. Liquid Membrane Patch: Two component elastomeric.

D. Adhesive tape: Bitustik tape.

E. Stripping (flashing) Materials: manufacturer's products for corner and edge details.

F. Primer: as recommended by manufacturer for product specified.

2.04 ACCESSORIES

A. Protection Board for Vertical Walls: One inch thick, lightweight expanded polystyrene, 1 lb/cu ft density, or 3/16 inch thick extruded polystyrene, 2 lb/cu ft density.

1. Protection Board Attachment for Vertical Walls: Insulation stick pins, double-sided self adhesive tape or water-based contact cement, as approved by the manufacturer.

B. Sealant and backing material: One component polyurethane and closed-cell polyethylene foam rod per Section 07 92 00.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify items that penetrate surfaces to receive waterproofing are rigidly installed.

B. Verify surfaces are smooth free of cracks, depressions, waves, or projections that may be detrimental to successful installation.

C. Do not apply waterproofing to damp, frozen, dirty or dusty surfaces.

D. Beginning of installation means acceptance of existing surfaces.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

3.03 INSTALLATION

A. Install membrane waterproofing in accordance with manufacturer's instructions.

B. Roll out membrane. Minimize wrinkles and bubbles.

C. Apply surface conditioner at rate recommended by manufacturer, and with spray or roller equipment as required.

D. Remove release paper layer. Roll out on to surface with mechanical roller to encourage full contact bond. Start at bottom, minimize bubbles.

E. Overlap edges and ends minimum 2-1/2 inches. Stagger end laps. Roll on membrane firmly. Patch mis-aligned seams with multiple layers. Seal patched edges with the specified mastic.

F. Shingle joints in direction of drainage. Apply liquid membrane at minimum 90 mil thickness at inside corners and double layers at outside corners.

G. Seal to adjoining surfaces.

H. Continue membrane up vertical surfaces minimum 6 inches above finish grade unless otherwise noted.

I. Seal items penetrating membrane with double layers of membrane material, or apply the specified liquid membrane patch, overlapping the sheet membrane minimum 2 inches.

J. Install flashings where indicated. Seal watertight to membrane. Apply trowelled bead of specified mastic to all vertical and horizontal terminations.

K. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or moving.

3.04 PROTECTION

A. Protect finished installation.

B. Vertical Surfaces:

1. Install protection board with butt joints and retain in place by applying double-sided tape or insulation stick pins to membrane or retain in place as recommended by manufacturer of membrane. Remove boards with broken corners or punctures. Provide solid, even barrier against backfill.

C. After installation, close off area to prevent unauthorized traffic.

D. Do not permit foot or vehicular traffic on unprotected membrane.

E. Protect waterproofing from damage and wear during remainder of construction period.

F. Protect installed protection board from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

G. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 17 16

BENTONITE COMPOSITE SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
   1. Provide a complete composite sheet membrane waterproofing system to be used at elevator pit as indicated on Drawings.
   2. Work includes all applicable sealants, waterstops and waterproofing flashings needed to ensure a complete waterproof system for buried concrete at locations indicated.

1.02 SUBMITTALS

A. Product data:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
   3. Shop Drawings or catalog illustrations in sufficient detail to show installation and interface of the work of this Section with the work of adjacent trades;
   4. Manufacturer's current recommended installation procedures which, when reviewed by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.
   5. Written documentation of applicator's qualifications, including reference projects of similar scope and complexity, with current phone contacts of architects and owners for verification.
   6. Where work of this Section may potentially contact groundwater, include manufacturer's report confirming laboratory testing of membrane system with project groundwater samples and confirming suitability for installation in Project conditions.

B. Mock-up: Prior to installation, prepare a sample panel of the work of this Section at a location on the job site where approved by the Architect.
   1. Make the sample panel in dimensions approved by the Architect and with one panel for each of the various types of installation.
   2. Show all aspects of the work of this Section to the quality specified.
   3. Make necessary adjustments in the sample panel(s) and secure the Architect's approval.
   4. The sample panel(s), when approved by the Architect, will be used as a datum point for comparison with the remainder of the work of this Section for the purpose of acceptance or rejection.
   5. Upon approval of the Architect, the sample panel(s) may become actual part of the installation required for this Work.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

B. Applicator qualifications:
   1. Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.
   2. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

C. Convene a pre-installation job-site conference three weeks prior to commencing work of this Section:
   1. Secure attendance by Architect, Contractor, applicator, and authorized representatives of the membrane system manufacturer and interfacing trades.
   2. Examine Drawings and Specifications affecting work of this Section, verify all conditions, review installation procedures, and coordinate scheduling with interfacing portions of the Work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.

B. Maintain the products in a dry condition during delivery, storage, handling, installation, and concealment.

1.05 SUBSTRATE CONDITIONS

A. Provide applicator with substrates that are free of standing water, dirt and debris, loose material, voids and protrusions or deformations which may inhibit application or performance of waterproofing.
   1. Where work of this Section will be installed on earth, provide subgrades that are stable, smoothed and compacted to minimum 85 percent modified proctor density.
   2. Where work of this Section will be installed on earth retaining system, fill gaps and voids in earth retaining system to conform with waterproofing manufacturer's requirements; fill voids and cavities exterior of wood-lagged shoring with sand or cement slurry; remove nails in wood lagging.
   3. Where work of this Section will be installed on concrete or masonry, provide substrates that are free of voids deeper than 3/8" and free of surface protrusions more than 1/4" above the surface.
   4. Where work of this Section will be installed on concrete footings, provide wood float or better finish to surfaces scheduled to receive the membrane.
   5. Where work of this Section will include bentonite waterstop strips, provide concrete surfaces as required for that installation.
   6. Rigidly install penetrations of membrane for detailing procedures.

B. Groundwater:

1. Where work of this Section will encounter groundwater, provide waterproofing manufacturer with sufficient groundwater samples taken from Project at logged locations for manufacturers laboratory analysis.
2. Manufacturer shall provide written report confirming laboratory testing with regard to suitability of waterproofing system for installation in Project conditions.

1.06 WARRANTY

A. Deliver to Architect signed copies of the following written warranties against defective materials and workmanship for a period of ten years following date of completion. Warrant that installed waterproofing system shall be free of defects including waterproofing failure resulting from substrate cracking up to 1/8 inch.
   1. Manufacturer's standard warranty covering materials.
   2. Applicator's standard warranty covering workmanship.

PART 2 - PRODUCTS

2.01 GENERAL

A. Where indicated on the Drawings, provide a complete dual-waterproofing, resealable, composite sheet membrane system composed of high-density polyethylene with a sodium-bentonite face designed for buried concrete or masonry construction having the following attributes.
   1. Acceptable products
      a. Paraseal Membranes
      b. or prior approved equal
   2. Obtain primary waterproofing materials of each type required from a single manufacturer to greatest extent possible. Provide accessory materials that are approved by membrane manufacturer.

B. Membrane properties: Equal to "Paraseal Membrane," for use on buried vertical and horizontal conditions such as backfilled foundation walls, between-slab plaza and parking decks, below slab with bentonite-side down, earth-covered roofs, retaining walls and ponds:

1.	Puncture resistance	169 lbs.	ASTM E154
2.	Tensile strength	4,000 psi	ASTM D 412
3.	Water vapor permeance	0.03 perms	ASTM E 96
4.	Percent elongation	700 percent	ASTM D 638, Type 4 Dumbbell
5.	Resistance to hydrostatic head	150 feet	ASTM D 751
6.	Warranted crack-bridging capability	1/8 inch	

C. For use in blindside conditions on retained earth, below slab with bentonite-side up, in elevator pits or where shotcrete/gunite is scheduled to be blown directly onto the membrane face, provide "Paraseal LG Membrane," which is the Paraseal Membrane with additional protective laminate layer of spun polypropylene.

D. For use in subgrade conditions designed to be impervious to both water and natural gas, provide " Paraseal GM Membrane," which is Paraseal Membrane with modified overlap area providing for nonreinforced seam tape in special taping procedure within laps.

E. For applications in areas where saline, alkaline, acid or otherwise contaminated groundwater conditions exist, provide "Saltwater Paraseal," which is Paraseal Membrane specially designed.

2.02 ACCESSORIES

A. For installation at horizontal-to-vertical junctures, provide "Paragranular" loose bentonite granules in weatherproof 50 lb. bags and capable of swelling to occupy a minimum volume of 17 ml when 2 grams are dispersed into deionized water.

B. For detailing vertical junctures and penetrations, provide "Paramastic" non-hydrated expandable mastic of trowelable consistency containing not less that 55 percent high swelling Wyoming sodium bentonite.

C. Provide the following fasteners as needed:
   1. Case-hardened steel nail with fluted shank having a minimum 1" length and a minimum 1" diameter cap for use on green concrete and masonry substrates.
   2. Powder shot steel pin having a minimum 3/4" diameter washer for use on hardened concrete and grouted masonry substrates.
   3. Steel staples approved by membrane manufacturer for use according to Project conditions.

D. Provide the following seam tapes as needed:
   1. "Temporary Tape" reinforced temporary joint closure tape 3" wide composed of acrylic adhesive bonded to polyvinyl chloride coated fabric used to protect seams against debris intrusion during backfill and for temporary terminations during periods of exposure to rain.
   2. "Permanent Seam Tape" reinforced, rubberized-asphaltic waterproofing seam tape 4" wide by 60 mils thick for sealing membrane overlaps wherever flood-testing is required and elsewhere as required by Project conditions or designs.
   3. "Para JT Tape" non-reinforced, adhesive tape of partially cross-linked polymeric elastomers 2" wide by 1/8" thick for molding form-fit seals around difficult contours and for taping seams within overlaps.

E. Provide "Paraterm Bar" extruded aluminum bar with upper flange to receive sealant for terminations at grade line and on parapet walls.

F. Provide "Vulkem 116 Sealant" one-part gun-grade polyurethane sealant for completing termination seals and other sealing recommended by manufacturer.

G. Provide "TREMproof 201/60 polyurethane, liquid-applied, elastomeric waterproofing flashing.

H. Provide "Parastick'N'Dry" pressure sensitive, double-sided tape laminate of bentonite sandwiched between a netting and non-woven fabric for wrapping through-concrete imbeds and other detailing.

I. Provide "Superstop" flexible, reinforced, bentonite-laminate waterstop strips 1/2" by 1" by 20' -0" with pressure-sensitive adhesive backing for sealing static cold joints in concrete.

J. Provide "Paraprimer" versatile adhesive bonding agent primer formulated for use with tapes and pressure-sensitive waterproofing accessories.

K. Provide an approved Tremco Inc. drainage mat from the TREMDrain series of products such as TREMDrain, TREMDrain 1000 or TREMDrain 2000 composed of a filter fabric laminated to free-draining high-density dimpled polystrene drainage core.

L. Provide TREMDrain Total-Drain: replaces perforated pipe and aggregate connect directly to the approved Tremco Inc. TREMDrain product.

M. Provide base sheet of minimum 6 mil polyethylene sheet for use as hydration barrier below slabs.

N. Provide protection course as recommended by the waterproof system manufacturer.

2.03 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the membrane system manufacturer as compatible, subject to review of the Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section and to prevent damage to installed waterproofing.

B. Applicator shall examine the areas and conditions under which work of this Section will be performed.
   1. Verify conformance with manufacturer's requirements;
   2. Report unsatisfactory conditions in writing to the Architect;
   3. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. General: Surface preparation and detailing procedures shall be in accord with this Specification and the Drawings. Comply with waterproofing system manufacturer's instructions except where more stringent requirements are indicated or specified.

B. Lay out project to determine and anticipate conditions prior to start of work.
   1. Note termination and penetration conditions to determine methods for creating a waterproof envelope. Verify that where below-grade waterproofing extends to grade, other waterproofing provides for substrate continuing above grade.

3.03 INSTALLATION

A. General: Install waterproofing system in accord with manufacturer's instructions, recommendations and specific project instructions as applies to the Work.

1. Coves: Form 2" coves with granular bentonite at horizontal-to-vertical junctures such as at footings and horizontal shelves; form 1" coves with sealant, elastomeric flashing or expandable mastic at vertical inside corners and under ledges.
2. Place membrane in manner that assures minimum handling; fit closely to and seal around inlets, outlets and other penetrations; press membrane tight to corner surfaces and securely fasten.
3. Priming: Prime concrete, masonry and metal surfaces with substrate primer immediately prior to application of tapes and pressure-sensitive waterproofing accessories.
4. Terminations: Terminate membrane system with termination bar finished off with bead of sealant or terminate to elastomeric flashing using reinforced waterproofing tape.
5. Construction joints: Protect static construction joints in concrete with flexible, reinforced, bentonite-laminate waterstop strips; install to suitable hardened concrete surface prior to subsequent concrete placement.

B. Below slab installation:
1. Bentonite-side up:
   a. Install membrane sheets bentonite-side up with edges overlapped 3" minimum over stable, smoothed and compacted subgrade or mud slab; position membrane to stagger end laps 12"; securely fasten seams with staples every 8"on center.
   b. Extend membrane upward 6" minimum within the formwork at bottom edges of mat slabs and wrapped footings to provide for proper tie-in to vertical membrane; install membrane in double layer continuous along bottom edges of slabs and wrapped footings extending 6" from edge in both directions.
   c. Install membrane to wrap footings where shown on Drawings; carry membrane across top surfaces of unwrapped footings or mud slab to interior vertical faces of walls and columns and terminate as manufacturer recommends.
   d. Waterproof penetrations in accord with manufacturers recommendations.
   e. Verify membrane is protected from damage caused by rebar and support chairs.
   f. Protect exposed bentonite from moisture with temporary plastic sheets; remove plastic sheets before final covering.
   g. Inspect and repair damaged material immediately before concrete placement.
2. Bentonite-side down:
   a. Install polyethylene base sheets with edges lapped 5" over stable, smoothed and compacted subgrade or mud slab; trim base sheet away from penetrations and terminations.
   b. Install membrane bentonite-side down over polyethylene base sheets with edges lapped 3" minimum; position membrane sheets to stagger end laps 12"; tape seams with reinforced seam tape closely following membrane placement and immediately secure by roll-pressing with hand-held metal seam roller.

c. Extend membrane upward 6" minimum within the formwork at bottom edges of mat slabs and wrapped footings; install a second layer of membrane, with the bentonite-side up, under the field membrane and extending upward within the formwork at bottom edges of mat slabs and wrapped footings to provide for proper tie-in to vertical membrane; membrane double layer continuous along bottom edges of slabs and wrapped footings shall extend 6" from edge in both directions.
d. Install membrane to wrap footings where shown on Drawings; carry membrane across top surfaces of unwrapped footings or mud slab to interior vertical faces of walls and columns and terminate as manufacturer recommends.
e. Waterproof penetrations in accord with manufacturer's recommendations.
f. Verify membrane is protected from damage caused by rebar and support chairs.
g. Inspect and repair damaged material immediately before concrete placement.

C. Backfilled wall installation:
1. Install membrane sheets in vertical or horizontal lifts with HDPE-side facing applicator to prepared surfaces conforming to manufacturer's requirements.
a. Vertical installation: Securely fasten membrane 12" on center along top edge with sheet extending out onto footing surfaces 6" minimum, overlapping below-slab membrane 6"; install subsequent membrane sheets to overlap previous sheets 1-1/2" minimum; securely fasten membrane 24" on center through both sheets at overlaps; securely fasten 18" on center to tops of footing surfaces and horizontal shelves; apply seam tape to seam overlaps.
b. Horizontal installation: Start membrane at lowest portion of wall; securely fasten membrane 24" on center along top edge with sheet extending out onto footing surfaces 6" minimum, overlapping under slab membrane 6"; install subsequent membrane sheets to overlap previous sheets minimum 1-1/2" in shingle fashion with staggered end laps; securely fasten membrane 24" on center through both sheets at overlaps; securely fasten 18" on center to tops of footing surfaces and horizontal shelves; apply seam tape to seam overlaps.
2. Waterproof penetrations in accord with manufacturer's recommendations.

D. Blindside wall installation:
1. Ensure that vertical surfaces to receive waterproofing system conform to manufacturer's requirements as applicable to the earth retaining system employed prior to commencing installation; contact manufacturer for requirements of project conditions not provided for in installation manuals.
2. Install waterproofing membrane starter-strip to vertical surfaces of earth retaining system with bentonite-side facing applicator prior to placement of concrete footings or foundation mat slab.
3. Prepare all vertical inside corners that occur along the earth retaining system by fastening a minimum 12" wide strip of membrane pressed tight into corner with bentonite-side facing applicator; securely fasten along vertical edges 24" on center.

4. Install membrane sheets oriented vertically with bentonite-side facing applicator; overlap membrane sheets 3" minimum for poured-in-place walls and 4" minimum for shotcrete/gunite walls; securely fasten membrane through both sheets at overlap areas with nails every 24" on center and staples every 3" on center.
5. Verify which penetrations must be accessed after concrete placement for completion of waterproofing detail treatment and ensure that sufficient access to membrane is provided within a formed boxout; verify which penetrations will not be accessed after concrete placement for completion of waterproofing detail treatment and ensure that final detailing procedures are completed prior to erection of concrete formwork or shotcreting/guniting; waterproof penetrations in accord with manufacturer's current procedures; contact manufacturer for procedures at project conditions not provided for in installation manuals.
6. Protect membrane system from excessive rain.
7. Inspect and repair damage to membrane system immediately prior to erection of concrete formwork or shotcreting/guniting; ensure that concrete directly contacts membrane.
8. Complete waterproofing details and terminations at gradeline coordinating with other trades.

E. Drainage mat installation: Install drainage mat units where shown on Drawings according to manufacturer's installation instructions as shown in installation manuals.

END OF SECTION

SECTION 07 21 00

INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Thermal insulation in all exterior wall construction.

B. Sound attenuation insulation in all interior partition construction.

C. Related Requirements:
1. Energy calculations or prescriptive compliance documents.
2. Section 01 35 42, CALGreen Requirements.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM - American Society for Testing and Materials
1. ASTM C 165 - Test Method for Measuring Compressive Properties of Thermal Insulations
2. ASTM C 356 - Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat
3. ASTM C 612 - Mineral Fiber Block and Board Thermal Insulation
4. ASTM C 665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
5. ASTM C 1104 - Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
6. ASTM C 1304 - Test Method for Assessing the Odor Emission of Thermal Insulation Materials
7. ASTM C 1338 - Test Method for Determining Fungi Resistance of Insulation Materials and Facings
8. ASTM D 816 - Rubber Cements
9. ASTM E 84 - Surface Burning Characteristics of Building Materials
10. ASTM E 96 - Test Methods for Water Vapor Transmission of Materials
11. ASTM E 136 - Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

C. CBC - 2019 California Building Code
1. CBC-7 - CBC Chapter 7, Fire and Smoke Protection Features.
2. Section 120, in conformance with ASTM E-84 or UL 723-Standard for Test for Surface Burning Characteristics of Building Materials.

D. 2019 California Energy Code, Title 24, Part 6, Subchapter 3, Section 140.3.

E. California Green Building Standards Code, CALGreen - 2019.

F. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.

1.03 PERFORMANCE REQUIREMENTS

A. Materials shall provide continuity of thermal barrier at building enclosure elements.

B. Materials shall provide continuity of sound barrier at designated room enclosure elements.

C. Materials shall conform to Section 720 Thermal and Sound Insulating Requirements, California Building Code and Section 110.8 California Energy Code.

D. Thermal Resistance: R values to achieve overall assembly U-Factor no greater than applicable value in Table 140.3-B California Energy Code unless noted otherwise in T-24 Energy Report.

1.04 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria and methods of installation.

B. Three samples of each material specified minimum 12 inches square. Provide fasteners, clips and other accessories.

C. Certification of Compliance with Section 110.8(a) California Energy Code, 2019 and Part 12, Title 24,CCR Standards for Insulating Materials Chapter 12-13, Section 12-13-1555.

D. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.05.B.

1.05 QUALITY ASSURANCE

A. Provide U-value limits in accordance with Section 140.3, Table 140.3-B of 2019 California Energy Code, Title 24 Part 6 California Code of Regulations.

B. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.
   3. Recycled Content: requirements per Section A5.405.4 CALGreen code.
   4. Adhesives shall comply with VOC content limits defined by SCAQMD Rule 1168.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Johns Manville Insulations, Commercial/Industrial Division, Denver, CO.
   2. Certainteed Corporation, Valley Forge, PA.
   3. Owens - Corning, Toledo, OH.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 MATERIALS - THERMAL

A. Batt Insulation: ASTM C665, Type III, Class A, Category 1. Preformed, foil faced, formaldehyde-free glass fiber batt insulation, with tabs, Johns Manville FSK-25, or equal. Conforming to following:
   1. Thermal Resistance: R values to achieve overall assembly U-Factor no greater than applicable value in Table 140.3-B CEC unless noted otherwise in T-24 Energy Report.
   2. Batt Size: As required to fully fill cavity width and height or length.
   3. Thickness: As required to meet specified R-value without compression.
   4. Facing: Faced on one side with flame resistant foil facing.
   5. Flame Spread: Less than 25, ASTM E 84.
   6. Smoke Developed Rating: Maximum 50, ASTM E 84.
   7. Permeance: 0.05 perms, ASTM E 96.

2.03 MATERIALS - SOUND

A. Sound Attenuation Insulation: ASTM C665, Type I; preformed glass fiber, formaldehyde-free, "Sound Control Batts", acoustical fiber glass insulation, by Johns Manville or equal. Conforming to the following:
   1. Size: As required to fully fill cavity width and height.
   2. Thickness: 3-5/8" for 4" walls and 6-1/2" for 6" walls, minimum. 10" thick between floors.
   3. Facing: Unfaced.
   4. Flame Spread: Less than 25, ASTM E84.
   5. Smoke Developed Rating: Maximum 50.
   6. Formaldehyde-free.

2.04 ACCESSORIES

A. Fasteners, type and size to suit application.

B. Tape: Acrylic with Polypropylene backing, Class A, flame spread less than 25, adhering type, 2-1/2 inch wide; No. 8087 Contractor's Seaming Tape, manufactured by 3m Company, St. Paul, MN, or equal as approved in accordance with Division 01, General Requirements for substitutions.

C. Insulation Fasteners: Steel impale spindle and clinch shield on flat metal base with applied adhesive, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place; INSUL-ANCHORS, manufactured by Gemco, Dansville, OH, or equal as approved in accordance with Division 01, General Requirements for substitutions. Self-adhesive base plates are prohibited.

D. Adhesive: Tuff Bond Hanger Adhesive manufactured by Gemco, Dansville, OH, or equal as approved in accordance with Division 01, General Requirements for Substitutions.

E. String wire: Minimum 16 gauge galvanized annealed steel wire spaced at 18" on center.

F. Do not use salvage cut-offs, materials less than space width, or in multiple short lengths to fill-in the gaps.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that substrate and adjacent materials are satisfactorily installed and in place and are ready to receive insulation.

3.02 INSTALLATION

A. Install insulation in accordance with insulation manufacturer's instructions.
   1. Clean tracks prior to installation.

B. Install in cavities designated to receive sound thermal insulation without gaps or voids. Extend material full height of cavity.

C. Cut insulation to fit tightly at cavities between studs not standard 16 inches on center spacing.

D. Trim insulation neatly to fit spaces.

E. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.

F. Extend thermal materials full height of cavity to structure above and as otherwise required to produce a completely insulated building envelope.

G. Extend sound materials full height of cavity to structure above and as otherwise required to produce a completely sound insulated enclosure.

H. Tape and seal [butt ends, lapped flanges, and] tears or cuts in foil in thermal batts.

I. Friction fit semi-rigid sound insulation batts in cavities, no gaps voids permitted.

J. Metal Framing: Place foil side of thermal batts toward inside of building. Place insulation fasteners at 36 inches on centers, vertically in two rows at each stud cavity. Tape and seal tears or cuts in foil.

K. Install material to preclude slipping from place by use of nails, screws, wires or other approved fastening devices.

L. Where tight, congested, difficult or otherwise unforeseen conditions are encountered, employ alternate application methods or materials to effect the intended insulation system. Alternate methods or materials shall be submitted to Architect for review and approval..

3.03 INSPECTION

A. Notify Project Inspector before Work is covered. Approval by Project Inspector shall be received before any Work is concealed. Work that has been covered prior to inspection and approval shall be uncovered for inspection and recovered.

END OF SECTION

SECTION 07 21 13

RIGID THERMAL INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rigid thermal insulation board behind cement plaster installation.

B. Rigid thermal insulation board for roofs.

C. Related Section:
1. Section 01 35 42, CALGreen Requirements.
2. Section 07 21 00, Insulation.
3. Section 07 21 15, Tapered Insulation

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

C. ASTM D1621 - Compression Properties of Rigid Cellular Products.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. California Building Code, 2019.

F. California Green Building Standards Code, CALGreen - 2019.

G. California Energy Code, 2019.

H. Local AQMD - Local Air Quality Management District.

I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.03 PERFORMANCE REQUIREMENTS

A. Materials shall provide continuity of thermal barrier at walls and roofs.

1.04 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria and methods of installation.

B. Product Test Reports: Submit evaluation reports published by independent authority indicated compliance with specified criteria and showing compliance specified assembly meets ASTM E84 Class and NFPA 285.

C. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.05.C.

D. Three samples of insulation material specified, minimum 12 inches square. Provide fasteners and other accessories.

E. Certification of Compliance with Section 110.8-Mandatory Requirements for Insulation, Roofing Products and Radiant Barriers, California Energy Code, 2019 and Part 12 CCR Standards for Insulating Materials Chapter 12-13, Section 12-13-1555.

1.05 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.

B. Roofing Insulation: Insulation shall meet the requirements of Section 110.8 and roofs shall have an overall assembly U-factor no greater than applicable value in Table 140.3-B, C, or D, California Energy Code.

PART 2 - PRODUCTS

2.01 MANUFACTURERS - INSULATION MATERIALS

A. Products of following manufacturers form basis for design and quality intended.
   1. Rmax, Inc, Dallas. TX.
   2. Atlas Wall CI (Atlas Roofing Corporation).
   3. Johns Manville, Denver, CO.
   4. Hunter Panels, LLC.
   5. Dow Chemical Company, Midland, MI.

B. Or equal as approved in accordance with Division 01 General Requirements for substitutions.

2.02 MATERIALS - THERMAL

A. Roof Rigid Insulation: ASTM C1289, Type II, Class I, Grade 2, rigid polyisocyanurate conforming to the following:
   1. Thermal Resistance: As indicated on Drawings.
   2. Size: 48 x 48 inches or 48 x 96 inches.
   3. Thickness: As indicated on Drawings.
   4. Facings: Coated polymer bonded glass fiber mat.
   5. Flame Spread: Less than 25, ASTM E84.
   6. Smoke-developed rating of not more than 450 as tested per CBC 719.5.

7. Compression Resistance: 10 percent consolidation, 20 pounds per square inch, ASTM D1621.
8. Recycled Content: Minimum 25 percent.
9. Roof Tapered Rigid Insulation: Refer to Section 07 21 15.

B. Wall Exterior Polyisocyanurate Board Insulation, rigid thermal insulation, ASTM C1289, Type I, Class 1 or Class 2, with a glass fiber reinforced aluminum foil facers on each side of a polyisocyanurate foam core, conforming to the following physical properties:
1. Basis-of-Design Products: Rmax ECOMAXci FR, or approved equal.
2. Thermal Resistance: As indicated on Drawings.
3. Size: 4 feet x 8 feet
4. Thickness: As indicated on Drawings.
5. Foil Face: Glass fiber reinforced aluminum foil facers on both sides; exterior side to have 12 mil facer with aluminum reflective surface and printing to identify exterior side.
6. Compressive Strength, ASTM D1261: Minimum 25 psi.
7. Flame Spread, ASTM E84: 25 or less
8. Smoke Developed, ASTM E84: 450 or less
9. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved.

2.03 ACCESSORIES

A. Fasteners: Manufacturer's recommended fasteners for insulation type and specific substrate upon which the rigid thermal insulation is installed.
1. Washers for Rigid Thermal Insulation at Walls: RodenHouse Thermal-Grip Ci Prong Washer, or equal, and as approved by rigid thermal insulation manufacturer.

B. Self-Adhered Flashing: Manufacturer's recommended 20 mils nominal thickness, polypropylene film with butyl rubber adhesive.

C. Insulation Adhesive: Per manufacturer's Recommendation.

D. Fasteners - Roof Insulation: Solid stainless steel with drill points, Factory Mutual approved for rating Class 1-90 uplift, with sufficient lengths to penetrate deck minimum of 3/4 inch with 3 inch diameter plastic stress plate. Refer to roofing section in Division 07.

E. Insulation Caulk: Provide insulation manufacturer's recommended caulk for sealing small penetrations and anchors.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that substrate and adjacent materials are satisfactorily installed and in place and are ready to receive insulation.

3.02 INSTALLATION

A. Thoroughly clean existing substrate. Remove paint, dust, dirt, loose scale or other foreign materials from areas where fasteners will occur.

B. Install rigid thermal insulation in accordance with manufacturer's installation instructions for specific substrates to which the insulation is to be installed.
   1. Position and install fasteners and washers in accordance with the manufacturer's instructions.
   2. Fasteners are to be installed consistently in accordance with fastener manufacturer’s recommendations.

C. Install flashing at all openings and penetrations, unless noted otherwise, in accordance with the manufacturer's installation instructions.

D. Where obstructions preclude firm attachment of insulation to substrate, install 14 gauge galvanized wires attached to spindles to contain insulation boards.

3.03 INSULATION OVER ROOF DECK INSTALLATION

A. Install according to insulation manufacturer's recommended procedures.
   1. Security roof insulation with specified fasteners in pattern to achieve Class FM 1-90.

B. Neatly cut to fit around penetrations and projections.

C. Do not install more insulation board than can be covered with roof membrane by the end of the day or the onset of inclement weather.

D. Mechanical Attachment:
   1. Insulation board shall be mechanically fastened to the deck with approved fasteners and plates at rate according to the insulation manufacturer's, FM's and manufacturers recommendations for fastening rates and patterns. The quantity and locations of the fasteners and plates shall also cause the boards to rest evenly on the roof deck so that there are no significant and avoidable air spaces between the boards and the substrate. Each insulation board shall be installed tightly against the adjacent boards on all sides.
   2. Fasteners are to have minimum penetration into structural deck recommended by the fastener manufacturer and roofing manufacturer.
   3. Use fastener tools with a depth locator and torque-limiting attachment as recommended or supplied by fastener manufacturer to ensure proper installation.
   4. Install fasteners per manufacturer's installation instructions.

3.04 INSPECTION

A. Notify Project Inspector before work is covered. Approval of Project Inspector shall be received before any work is concealed in manner that will make inspection difficult. Work that has been covered prior to inspection and approval shall be uncovered for inspection and recovered.

END OF SECTION

SECTION 07 21 15

TAPERED INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Tapered insulation over bare and composite steel deck.

B. Accessories.

C. Related Sections
   1. Section 01 35 42, CALGreen Requirements.
   2. Division 07 requirements for roofing installation.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

C. ASTM E84 - Surface Burning Characteristics of Building Materials.

D. California Green Building Standards Code, CALGreen - 2019.

1.03 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, limitations, and thermal properties.

B. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.A.

C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation, installation techniques and limitations.

D. Shop drawings indicating layout of units, slopes, thicknesses and profiles to produce minimum required slope to drain.

1.04 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Johns Manville, Denver, CO.
   2. GAF Corporation, Wayne, NJ.
   3. Hunter Panels, LLC.
   4. Dow Chemical Company, Midland, MI.
   5. Rmax, Inc, Dallas. TX.
   6. Atlas Roofing Corporation

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 INSULATION MATERIALS

A. Taperd Isocyanurate Roof Insulation - core of rigid, closed-cell polyisocyanurate foam, faced with universal black fiberglass reinforced mat. ASTM C 1289 Type II, Class 1, Grade 2. Provide tapered units for minimum slope of 1/4 inch per foot for roofs, crickets, drains and valley slopes to drains, total thickness to achieve average R-value of 30 minimum. Roof insulation materials in conformance with:

1.	Thermal Resistance	ASTM C177; R of 6 per inch.
2.	Flame Spread	ASTM E84; Less than 25.
3.	Smoke Density	Less than 50
4.	Thickness	Varies, 1 inch minimum, slope 1/4 inch per foot
5.	Board Size	48 by 48 inches.
6.	Compressive Strength	Minimum 20 pounds per square foot.
7.	Water Absorption	< 1 percent by volume maximum
8.	Edges	Square

9. California Building Code Sections 2603.3.
10. Maximum Flame Spread 25, Class II and smoke-developed rating of not more and 450 as tested per ASTM E84.

2.03 ACCESSORIES

A. Tape: Polyethylene self-adhering type, mesh reinforced, 2 inch wide.

B. Fasteners: Solid stainless steel with drill points, Factory Mutual approved for rating Class 1-90 uplift, with lengths sufficient to penetrate deck minimum of 3/4 inch with 3 inch diameter plastic stress plate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that substrate and adjacent materials are dry and ready to receive insulation.

C. Verify substrate surface is flat, free of irregularities.

D. Maintain adequate fire protection during installation.

3.02 INSTALLATION OVER METAL DECK

A. Install insulation per shop drawings, NRCA Specification and manufacturer's installation instructions. Provide tapered units as required to obtain a minimum roof slope of 1/4 inch per foot.

B. Maximum Gap Permitted: 1/8 inch.

C. Maximum elevation variation between boards at joints: 1/8 inch.

D. Cut and fit tightly to all vertical surfaces.

E. Multiple layers of polyisocyanurate insulation required to achieve R-value required. Mechanically fasten bottom layer of insulation to deck with specified fasteners in pattern conforming to approved UL Directory fastening pattern, penetrate deck minimum 1 inch. Seat discs with heads flush or below disc's top surface, do not over-tighten. Adhere top insulation layer in staggered joint pattern with hot asphalt to bottom layer at 24 lbs per square.

F. Minimum Thickness of Insulation Boards Over Entire roof Deck: As required to obtain specified R-value. Minimum 2 layers plus cover board.

3.03 PROTECTION OF FINISHED WORK

A. Protect finished

B. Do not permit Work to be damaged prior to covering insulation.

C. Do not exposed loose-laid insulation to wind conditions.

END OF SECTION

SECTION 07 26 16

VAPOR BARRIER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Installation of Vapor Barrier under concrete slabs.

B. Related Sections:
   1. Section 03 30 00, Cast-In-Place Concrete.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. SCAQMD - South Coast Air Quality Management District - Rule 1113.

C. ASTM D 882 - Tensile Properties of Thin Plastic Sheeting.

D. ASTM D 1709 - Impact Resistance of Plastic Film by the Free-Falling Dart Method.

E. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

F. ASTM E 96 - Water Vapor Transmission of Materials.

G. ASTM E 154 - Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover.

H. ASTM F 1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

I. ASTM E 1643 - Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

J. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.03 SUBMITTALS

A. Product Data: For membrane materials and accessories.

B. Third party documentation that all testing was performed on a single production roll per ASTM E 1745 Section 8.1.

C. Manufacturer's Installation Instructions.

1.04 QUALITY ASSURANCE

A. Membrane Manufacturer: Company specializing in high strength density polyethylene use as vapor barrier with five years minimum experience.

B. Applicator: Company specializing in application of specified vapor barrier with three years minimum experience and approved by manufacturer.

C. Regulatory Requirements
   1. Conform to AQMD, Local Regulation. Copies of document are available at Architect's office.

D. Field Sample
   1. Approved sample may be incorporated as part of Work.

E. Manufacturer Review
   1. Contact vapor barrier manufacturer for pre-construction meeting and/or to coordinate a review of the vapor barrier installation either by digital review or in person.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not apply vapor barrier membrane when air temperature is below 50 degrees F.

1.06 WARRANTY

A. Provide manufacturer's limited 1 year warranty.

B. Warranty: Include coverage of materials and installation and resultant damage from failure of installation to resist penetration of moisture.

C. Warranty: Include coverage of waterproofing failure to resist penetration of water except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered as structural failure.

D. Be responsible for removal and replacement of materials concealing waterproofing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Stego Industries LLC, San Juan Capistrano, CA; Product: 15 Mil Stego Wrap.
   2. W.R. Meadows, Pomona, CA.; Product: Perminator 15 Mil
   3. Reef Industries, Inc. Houston, TX. Product: Vaporguard.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIAL

A. Physical Properties:
   1. Puncture Resistant Results, ASTM D1709: 2266 grams, min. Water Vapor
   2. Transmission Rate, ASTM F 124: 0.0036 WVTR
   3. Permeance (New Material), ASTM F 1249: 0.0086 perms
   4. Permeance (After Conditioning Tests Per Section 7.1), ASTM E1745: Less than 0.010 perms.
   5. Tensile Strength, ASTM E 1745: 70.6 pounds force per inch.
   6. Performance Class, ASTM E 1745: Class A

2.03 ACCESSORIES

A. Seam Tape
   1. Tape must have the following qualities:
      a. Water Vapor Transmission Rate, ASTM E 96: 0.03 perms or lower
      b. As approved by the vapor barrier manufacturer.

B. Proofing Mastic
   1. Mastic must have the following qualities:
      a. Water Vapor Transmission Rate, ASTM E 96: 0.17 perms or lower
      b. As approved by the vapor barrier manufacturer.

C. Perimeter/Terminating Edge Seal (Choose one of the following)
   1. Seal edge of vapor barrier to existing foundation wall or grade beam using double-sided adhesive strip with the following qualities:
      a. Water Vapor Transmission Rate, ASTM E 96: 0.03 perms or lower
      b. As approved by the vapor barrier manufacturer
   2. Seal edge of vapor barrier to fresh concrete of slab using a tape with a textured surface that creates a mechanical seal to freshly-placed concrete with the following qualities:
      a. Water Vapor Transmission Rate, ASTM E 96: 0.03 perms or lower
      b. 180° Adhesion Peel Strength, ASTM D 903: 17.6 lbf/in
      c. As approved by the vapor barrier manufacturer

D. Pipe Boots
   1. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 - EXECUTION

3.01 INSPECTION

A. For application under concrete slabs verify with Section 03 30 00 that substrate conditions are ready to receive membrane

B. Verify items that penetrate surfaces to receive waterproofing are securely installed and cleaned.

C. Beginning of installation means acceptance of substrate.

3.02 APPLICATION

A. Install vapor barrier over 4-inches of clean sand (sand equivelent or greater than 30).

B. Apply and seal vapor barrier under concrete slab in accordance with manufacturer's recommended procedures, ASTM E 1643 and per the following:
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
      a. Install vapor retarders in largest practical widths.
   2. Place sheets contnuous between footngs or foundaton walls, without voids.
   3. Lap vapor barrier over footings and/or seal to foundation walls.
   4. Lap all joints 6 inches minimum. Seal seams as noted below.
   5. Turn down sheeting 12 inches minimum along inside face of perimeter grade beams and/or contnuous perimeter footngs.
   6. Fit sheeting tightly around column, pipe and conduit penetrations. Install standard pipe boot where possible, following manufacturer's instructions.
   7. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utlities.
   8. Seam and Lap Sealing: With adhesive mastic and adhesive sealing tape, seal all seams, edges and penetrations of vapor retarder/barrier.
   9. For adhesive mastic seal, apply adhesive to both surfaces, allow approximately 10 minutes to set up and then press together smoothly and evenly, without gaps or fishmouths, for full contact bond.
   10. For adhesive tape seal, comply with manufacturer's instructions and recommendatons.
   11. Seal all penetratons with both adhesive sealing tape and adhesive mastc.
   12. Seal sheets to concrete footing faces and penetrating components with adhesive mastic or double sided tape as recommended by membrane manufacturer.
   13. Ensure there is no moisture entrapment by vapor retarder due to rainfall or ground water intrusion.
   14. Immediately repair holes in vapor retarder with self-adhesive repair tape.

C. For interior forming and screeding applications, do not use non-permanent stakes driven through the vapor barrier. Install forming and screeding devices per manufacturer’s standard.

3.03 PROTECTION

A. Close off area to prevent unauthorized traffic or work over membrane.

END OF SECTION

SECTION 07 27 26

FLUID APPLIED MEMBRANE WEATHER BARRIERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Vapor-permeable, fluid applied weather barriers over exterior sheathing.

C. Application of materials to provide bridge and seal air leakage pathways in
   1. Wall and roof connections and penetrations.
   2. Connections to foundation walls.
   3. Walls, windows, curtain walls, storefronts, louvers or doors
   4. Expansion and control joints.
   5. All other penetrations through the wall assembly.

D. Related Sections:
   1. Section 07 21 13, Rigid Thermal Insulation.
   2. Section 07 92 00, Joint Sealants.
   3. Section 09 29 00, Gypsum Board.

1.02 REFERENCES

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

C. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

D. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

E. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.

F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.

G. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

I. 2019 California Building Code.

1.03 SUBMITTALS

A. Product Data: for each type of product specified.

B. Include product data sheets for each accessory used to prevent contact between non-compatible materials.

C. Manufacturer's Installation Instructions.
   1. Include manufacturer's instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

D. Shop Drawings: Show locations and extent of weather-barrier materials, accessories, and assemblies specific to Project Conditions. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction. Include details of interfaces with other materials that form part of weather barrier.

E. Product Certificates: From weather-barrier manufacturer, certifying compatibility of weather barriers and accessory materials with Project materials that connect to or that come in contact with the weather barrier.

F. Product Test Reports: For each weather barrier assembly, for tests performed by a qualified testing agency.

G. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Weather Barrier Installer shall be currently accredited under the Air Barrier Association of America (ABAA) and ensure applicators are certified in accordance with the ABAA Quality Assurance Program.
   2. Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the weather barrier.
      a. Weather Barrier Installer performing Work shall be approved by weather barrier membrane manufacturer.

B. Obtain weather barrier materials from a single manufacturer regularly engaged in manufacturing the product.

C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

1.05 PRECONSTRUCTION MEETING

A. Preconstruction Meeting: Convene one week prior to commencing Work of this section, in accordance with Division 01, General Requirements.

1.06 MOCK-UPS

A. Prior to installation of weather barrier, apply weather barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution.

B. Apply weather barrier in field-constructed mock-ups of assemblies specified.

C. Apply weather barrier in field-constructed mock-ups of assemblies specified in Division 01, General Requirements.

D. Construct typical exterior wall panel, 8 feet long by 8 feet wide, incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing, [building corner condition,] [junction with roof system] [foundation wall] [and] [typical penetrations and gaps]; illustrating materials interface and seals.

E. Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed weather barrier membrane unless it has been inspected, tested and approved.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mock-ups.

B. Mock-up testing: weather barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mock-up testing by a qualified testing agency.
   1. Adhesion Testing: Test in accordance with ASTM D4541.

C. Notify Architect Seven days in advance of the dates and times when mock-ups will be tested.

D. Do not cover any installed weather barrier membrane unless it has been inspected, tested and approved.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean dry area in accordance with manufacturer's instructions.

C. Store at temperatures above 32oF (0oC), free from contact with cold or frozen surfaces.

D. Protect materials during handling and application to prevent damage or contamination.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Apply weather barrier within the range of ambient and substrate temperatures recommended in writing by the air-barrier manufacturer.
   1. Protect substrates from environmental conditions that affect weather barrier performance.

B. Do not apply weather barrier to damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Products of the following manufacturers form basis for design and quality intended.
   1. Prosoco, Inc., Lawrence, KS. Product: R-Guard Cat 5 air and waterproof barrier.
   2. W. R. MEADOWS, INC. Product: Airshield LMP
   3. Grace Construction Products. Product: Perm-A-Barrier VPL 50 Membrane

B. Or equal in accordance with Division 01 for Substitutions.

2.02 MATERIALS

A. Liquid Vapor Permeable Membrane System: Fluid-applied membrane with an installed dry film minimum thickness not less than the manufacturer's standard thickness.
   1. Performance Based Specification: weather barrier membrane shall conform to the following characteristics:
      a. Air Permeance, ASTM E2178: Maximum 0.004 cfm / sq. ft. of surface area at 1.57-lbf / sq. ft. pressure difference.
      b. Vapor Permeance, ASTM E96: Minimum 10 perms, Desiccant Method, Procedure A.
      c. Ultimate Elongation, ASTM D412, Die C: Minimum 200
      d. Adhesion to Substrate, ASTM D4541: Minimum 16 lbf / sq. in.
      e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
      f. UV Resistance: Can be exposed to sunlight for minimum 90 days according to manufacturer's written instructions.

B. Shall conform to ICC-ES AC 212, Acceptance Criteria for Water-Resistive Coating used as Water-Resistive Barriers over Exterior Sheathing.

C. Fluid applied weather barrier and accessories shall be a part of an NFPA 285 compliant tested assembly.

2.03 ACCESSORIES

A. General: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended by the weather barrier manufacturer. Accessories must be compatible with weather barrier and adjacent materials.

B. Primer: Liquid primer recommended for substrate by the weather barrier manufacturer.

C. Flashing and Transition Membrane: Self-adhesive polymeric air/vapor barrier membrane having a thickness of 40 mils, as recommended by manufacturer.

D. Liquid Flashing and Joint Sealant for exterior sheathing panels: Fluid applied, single component, flashing membrane for rough openings and detailing.

E. Membrane Adhesive:
   1. Pointing Mastic: mastic for sealing penetrations and terminations of membrane.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that substrates have cured and aged for minimum time recommended in writing by weather barrier manufacturer.
   3. Verify that substrates are visibly dry and free of moisture.
   4. Verify that masonry joints are flush and completely filled with mortar.

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

3.02 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by weather barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge [isolation joints] [expansion joints] [and] discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.03 ACCESSORIES INSTALLATION

A. Install accessory materials according to weather barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of weather barrier.
   1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
   2. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by weather barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall weather barrier material continuously to exterior glazing and window systems, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of weather barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition membrane so that a minimum of 3-inches of coverage is achieved over each substrate. Maintain 3-inches of full contact over firm bearing to perimeter frames, with not less than 1-inch of full contact.
   1. Transition Strip: Roll firmly to enhance adhesion.
   2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of weather barrier material with foam sealant.

G. Seal top of through-wall flashings to weather barrier with an additional 6-inch wide, transition strip.

H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.04 PRIMARY WEATHER BARRIER MATERIAL INSTALLATION

A. Apply weather barrier material to form a seal with strips and transition strips and to achieve a continuous weather barrier according to weather barrier manufacturer's written instructions and details. Apply weather barrier material within manufacturer's recommended application temperature ranges.
   1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
   2. Limit priming to areas that will be covered by weather barrier material on same day. Reprime areas exposed for more than 24 hours.
   3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. Weather Barriers: Apply continuous unbroken weather barrier material to substrates according to the following thickness. Apply weather barrier material in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable, Weather Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in number of coats as recommended in writing by manufacturer.

C. Do not cover weather barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove weather barrier that does not comply with requirements; repair substrates and reapply weather barrier components.

3.05 CLEANING AND PROTECTION

A. Protect weather barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect weather barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace weather barrier or install additional, full-thickness, weather barrier application after repairing and preparing the overexposed materials according to weather barrier manufacturer's written instructions.
   2. Protect weather barrier from contact with incompatible materials and sealants not approved by weather barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

SECTION 07 42 14

INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preformed metal wall panel system with related flashings and accessory components.

B. Related Sections
1. Section 05 40 00 - Cold-Formed Metal Framing.
2. Section 07 27 26 - Fluid Applied Membrane Weather Barriers.
3. Section 07 62 00 - Sheet Metal Flashing and Trim.
4. Section 07 92 00 - Joint Sealants.
5. Section 09 29 00 - Gypsum Board.

1.02 REFERENCES

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A 653/A 653M: Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

D. ASTM A 924 - general requirements for Steel Sheet, Zinc-coated (galvanized) by the Hot-Dip Process.

E. ASTM E 283 - Test for Rate of Air Leakage through Exterior Windows, Curtain Wall, and Doors.

F. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

G. Chapter 22A, 2019, California Building Code.

1.03 SYSTEM DESCRIPTION

A. System: Preformed, pre-finished and field assembled metal wall panel system of vertical and horizontal profile including a sealed vapor barrier LINER PANEL, insulation, subgirts and concealed fastener exterior profile; field assembled panel system.

B. Design Requirements
1. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with Chapter 22A, California Building Code.

2. Deflection Limits: Engineer steel panel assemblies to withstand test pressures with deflection no greater than 1/180 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.
3. Air infiltration: Maximum of 0.06 cubic per minute per square foot at positive pressure differential of 1.57 pounds square foot when tested according to ASTM E 283.
4. Water Leakage: None, when measured in accordance with ASTM E331 at positive pressure differential of 6.24 pounds per square foot or 20 percent of design wind pressure whichever is greater. The test pressure need not exceed 12 pounds per square foot.
5. Accommodate positive drainage for moisture entering or condensation occurring within panel system, to exterior.
6. Products of this section shall provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Section 07 21 00.

C. Performance Requirements
1. Air Infiltration - ASTM E283: test span minimum 5'-0"; maximum leakage 0.06 CFM/SQ. FT at a positive pressure differential of 1.57 psf.
2. Water Penetration Ó Zero to the room side; ASTM E331, at a positive pressure differential of 6.24 psf. Test span minimum 5'-0".

1.04 SUBMITTALS

A. Independent laboratory tests reports, design and performance data.

B. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage.

C. Three samples of each panel type illustrating finish color, sheen and texture. Size: full width by 12 inches, closures and fasteners.

1.05 QUALITY ASSURANCE

A. Qualifications
1. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years experience.
2. Installer: Company specializing in performing the Work of this section with minimum five years experience.

B. Mock-up
1. Provide under provisions of Division 01, General Requirements.
2. Provide mock-up of wall system Assembly to illustrate component assembly including panel materials, weep drainage system, attachments, anchors and perimeter sealant.
3. Mock-up may remain as part of the Work.

C. Pre-Installation Conference
1. Convene two weeks prior to commencing Work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Stack pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

D. Prevent contact with materials that may cause discoloration or staining.

1.07 FIELD MEASUREMENTS

A. Verify field measurements.

1.08 COORDINATION

A. Coordinate the work of Section 05 40 00 for installation of substrate.

1.09 WARRANTY

A. Provide under provisions of Division 01.

B. Material Warranty: warrants materials and accessories free from defects for a period of 2 years from Date of Substantial Completion.

C. Provide 20 year warranty including coverage for degradation of panel finish including color fading caused by exposure to weather.

D. Provide two year warranty for water-tight system for panels, flashing, sealants fasteners and accessories.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Kingspan Benchmark; a division of Kingspan Insulated Panels,Inc. (www.kingspanpanels.us)

B. Basis of Design: Designwall 1000, 2000 Flat Panel and DW2000S Shadowline.

C. Or equal as approved in accordance with Division 01 for substitutions.

2.02 WALL PANELS

A. Panel Assembly:
   1. Panel thickness: Refer to Finish Schedule on Drawings.
   2. Panel width (Flat Panels) varies, refer to exterior elevations for dimensions.

3. Panel joint shall consist of fasteners and attachment clip completely concealed within the joint. Panel joint shall have two distinct lines of defense against water infiltration using continuous finned rubber gasketseal on both face and liner sheet. Horizontal panels shall have a nominal gutter height of 2-7/8 inches.
4. Exterior Face of Panel:
   a. Material:
      1) Coil material shall be in accordance with ASTM A755 Grade 33, G90 galvanized steel in accordance with ASTM A653 and A924.
      2) Gauge: 20 (steel)
   b. Profile: Refer to Finish Schedule on Drawings.
      1) Flat profile to have no flutes, planking, or mild profiling of any type. Reveal width shall be as indicated on the Drawings.
   c. Texture: Refer to Finish Schedule on Drawings.
   d. Exterior Paint Finish Color:
      1) Color: Refer to Finish Schedule on Drawings.
      2) Finish System:
         a) 2.4 mil. Fluropolymer (PVDF) Three Coat system: 0.8 mil primer with 0.8 mil Kynar 500 (70 percent) SOLID color coat and 0.8 mil clear coat.
5. Interior Face of Panel:
   a. Material:
      1) Coil material shall be Grade 33, G90 galvanized steel in accordance with ASTM A653 and A924.
      2) Gauge: 24 gauge for Designwall 1000; 20 gauge (steel) for 2000 Flat Panel and DW2000S Shadowline.
   b. Profile: Standard flat, non-profiled
   c. Texture: Smooth
   d. Interior Finish: Modified polyester finish with a total minimum dry film thickness of 0.9 to 1.1 mil including primer.
      1) Color: Refer to Finish Schedule on Drawings.
6. Insulating Core: Precured, profiled, sanded flat, and fully inspected prior to lamination. Core material shall be polyisocyanurate (ISO).
7. Structural Adhesive: Type II Class 2 Structural Urethane Adhesive, 100 percent solids and 100 percent solvent free, evaluated and listed for sandwich panel construction by ICC Evaluation Service or other recognized agency.

2.03 ACCESSORIES

A. Fasteners: Fasteners as recommended by manufacturer.

B. Clips: Shall be zinc-plated C1050 annealed spring steel, heat-treated to nominal 150 ksi yield strength.

C. Perimeter Trim:
   1. Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating color as exterior face of insulated metal wall panel.
      a. Extruded perimeter trim: Shall be extruded aluminum 6063-T5 alloy with spray applied PVF coating in same color as exterior face of insulated metal wall panel.

D. Butyl Weather Barrier Sealant: Non-skinning butyl tube sealant per panel manufacturer's recommendations compliant with AAMA 809.2.

E. Sealants at exposed joints: Neutral cure silicone sealant compliant with ASTM C920.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Provide field measurements to manufacturer as required to achieve proper fit of the preformed wall panel envelope. Measurements shall be provided in a timely manner so that there is no impact to construction or manufacturing schedule.

B. Supporting Steel: All structural supports required for installation of panels shall be by others. Support members shall be installed within the following tolerances:
   1. Plus or minus 1/8 inch in 5 feet in any direction along plane of framing.
   2. Plus or minus 1/4 inch cumulative in 20 feet in any direction along plane of framing.
   3. Plus or minus 1/2 inch from framing plane on any elevation.
   4. Plumb or level within 1/8 inch at all changes of transverse for performed corner panel applications.
   5. Verify that bearing support has been provided behind vertical joints of horizontal panel systems and horizontal joints of vertical panel systems. Width of support shall be as recommended by manufacturer.

C. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.02 PANEL INSTALLATION

A. Installation shall be in accordance with manufacturer¢s installation guidelines and recommendations.

B. Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.

C. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer¢s instructions. Ventilate area where polyurethane dust is generated. Personnel should wear respiratory and eye protection devices.

D. Butyl Weather Barrier Sealant:

1. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
2. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
3. Do not use non-skinning butyl tube sealant to bridge gaps.

E. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the approved shop drawings.

3.03 TRIM INSTALLATION

A. Place trim and trim fasteners only as indicated per details on the approved shop drawings.

B. Field drill weep holes where appropriate in horizontal trim; minimum 1/4 inch diameter at 24 inches on center.

C. Place a continuous strip of butyl tape or butyl tube sealant on closure trims for the length of the panel to be covered by trim.

3.04 SEALANT INSTALLATION FOR EXPOSED JOINTS

A. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.

B. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

C. Direct contact between butyl and silicone sealants shall not be permitted.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: engage an independent testing and inspection agency acceptable to the architect to perform field tests and inspections and to prepare reports of findings.

B. Field Water Test: After completing portion of metal wall panel assembly including accessories and trim, test a 2-bay area selected by the architect for water penetration in accordance with AAMA 501.2 or ASTM E1105.

C. Insulated metal wall panel system will be considered defective if they do not pass tests and/or inspections.

3.06 CLEANING AND PROTECTION

A. Remove protective film immediately after installation.

B. Touch-up, repair or replace metal panels and trim that have been damaged.

C. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07 46 21

EQUIPMENT SCREENS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preformed metal panel system to screen roof-mounted equipment and gate.

B. Installation of steel support members.

C. Related Section:
   1. Section 05 50 00 Metal Fabrications.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

C. 2019 California Building Code.

1.03 SUBMITTALS

A. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage. Indicate all loads imposed on the roof structure.

B. Provide structural calculations, signed and stamped by the manufacturer's licensed structural engineer licensed in California for the entire manufactured screen product.

C. Three samples of siding illustrating finish color, sheen and texture.

1.04 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years experience.
   2. Installer: Company specializing in performing the Work of this section with minimum three years experience.

B. Mock-up
   1. Provide under provisions of Division 01, General Requirements.
   2. Provide mock-up of equipment screen system to illustrate component assembly including panel materials, and attachments.
   3. Mock-up may remain as part of the Work.

C. Pre-installation Conference
   1. Convene two weeks prior to commencing Work of this section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Stack pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

D. Prevent contact with materials that may cause discoloration or staining.

1.06 FIELD MEASUREMENTS

A. Verify field measurements.

1.07 COORDINATION

A. Coordinate Work of Section 05 50 00 for installation of substrate and support members.

1.08 WARRANTY

A. Provide under provisions of Division 01, General Requirements.

B. Provide 20-year warranty including coverage for degradation of panel finish including color fading caused by exposure to weather.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Morin, a Kingspan Co. Fontana, CA.
   2. Centria, Moon Twp, PA.
   3. Copper Sales Inc, Anoka, MN.
   4. BHP Steel Building Products USA Inc., West Sacramento, CA.
   5. ATAS International Inc., San Diego, CA.
   6. AEP Span, Fontana, CA 92337

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 METAL PANEL

A. Materials:
   1. Aluminum:
      a. Coil stock meeting ASTM B209; Alloy and temper as required for forming operations.
      b. Thickness: 0.040 inches.

B. Panel:
   1. Panel Width: 12 inches.
   2. Profile: Morin Matrix MX 1.0
   3. Panel Thickness: 1-1/2 inch thick.
   4. Panel Joint: Tongue and Groove Interlock Joint.
   5. Texture: Smooth.
   6. Perforations: Refer to Finish Schedule on Drawings.

C. Support Framing
   1. Shop fabricated ferrous metal items, galvanized G-90 and painted, members as detailed in drawings and specified in Section 05 50 00.
   2. Carbon Structural Steel: ASTM A36.
   3. Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless: ASTM A53.
   4. Zinc (Hot-Dip Galvanized) on Coatings on Iron and Steel Products: ASTM A123.
   5. Aluminum rail system.

D. Accessories
   1. Fasteners: 400 series stainless steel, hex washer head with dished stainless steel and bonded EPDM washers. Heads are to be painted to match color of panel.
   2. Trims, framing components, panels, flashing: Manufacturer’s prefabricated units.
   3. Base Support: Complete assembly includes Base Supports, welded steel base caps, stainless steel Flashing Boots, Rubber gaskets.

E. Fabrication
   1. Form sections true to shape, accurate in size, square, and free from distortion or defects.
   2. Form pieces in longest practical lengths.
   3. Form panels for interlocking seams.

F. Finish
   1. 1.0 mil. Fluropolymer (PVDF) Two Coat system: 0.2 mil primer with 0.8 mil Kynar 500 (70 percent) SOLID color coat.
   2. Color: Refer to Finish Schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify substrate framing.

B. Verify that building framing members are ready to receive panel system.

3.02 INSTALLATION

A. Install metal siding system on framing members in accordance with manufacturer's instructions.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

C. Fasten siding to structural supports; aligned, level, and plumb.

3.03 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.04 CLEANING

A. Remove site cuttings from finish surfaces.

END OF SECTION

SECTION 07 55 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cold Applied 2-Ply Asphalt Roofing

B. Accessories

C. Edge Treatment and Roof Penetration Flashings

D. Related Sections:
   1. Section 07 21 13, Rigid Thermal Insulation.
   2. Section 07 21 15, Tapered Insulation.
   3. Section 07 62 00, Sheet Metal Flashing and Trim.
   4. Section 09 29 00, Gypsum Board.

1.02 REFERENCES

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings

C. Factory Mutual Research (FM): Roof Assembly Classifications.

D. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

F. Underwriters Laboratories, Inc. (UL): Fire Hazard Classifications.

G. Warnock Hersey (WH): Fire Hazard Classifications.

H. ANSI-SPRI ES-1 Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.

I. ASCE 7, Minimum Design Loads for Buildings and Other Structures

J. UL - Fire Resistance Directory.

K. California Title 24 Energy Efficient Standards.

1.03 DESIGN / PERFORMANCE REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Exterior Fire Test Exposure: Roof system shall achieve a WH Class rating for roof slopes indicated on the Drawings as follows:
   1. Warnock Hersey Class A Rating.

1.04 DESIGN REQUIREMENTS:

A. Uniform Wind Uplift Load Capacity
   1. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
      a. Design Code: ASCE 7, Method 2 for Components and Cladding.
      b. Wind Speed: 110 mph, unless noted otherwise on Drawings

B. Roof system shall have been tested in compliance with the following codes and test requirements:
   1. International Code Council Evaluation Service (ICC-ES):
      a. Membrane Systems
         1) ESR

1.05 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions.

B. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE 7 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before Work begins.

C. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

D. Manufacturer's Certificates: Provide to certify products meet or exceed specified requirements.

E. Applicator Qualifications: Submit manufacturer’s written acceptance of applicator stating contractor is qualified to install system and receive specified warranty.

F. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.

G. Manufactures Inspections: Provide letter from corporate officer of manufacture stating intent to provide inspections (5) per week, during project as outlined in section 3.8 “Field Quality Control”.

H. Manufacturer's Fire Compliance Certificate: Certify that the roof system furnished is approved by Warnock Hersey (WH) or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.

I. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.

C. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.

D. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.

E. Product Certification: Provide manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

F. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.07 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:

1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging with labels intact until ready for installation.

B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with "breathable" tarpaulins.

C. Stored in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface. No wet or damaged materials will be used in the application.

D. Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50 degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.

F. Adhesive storage shall be between the range of above 50 degree F (10 degree C) and below 80 degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.09 COORDINATION

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

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.11 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed Edge-To-Edge NDL System Warranty, warranting that, if a leak develops in the roof during the

term of this warranty, due either to defective material or defective workmanship by the installer, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition including Garland Metal Components.

B. Warranty Period:
   1. 30 years from date of acceptance.
   2. Installer is to guarantee all work against defects in materials and workmanship for a period indicated following final acceptance of the Work.
      a. Warranty Period:
         1) 2 years from date of acceptance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Garland Company, Inc. Cleveland, OH.

B. Or approved equal in accordance with Division 01, General Requirements for Substitutions.

2.02 COLD APPLIED 2-PLY ROOF

A. Nailable Base Sheet: One ply fastened to the deck per wind uplift calculations.
   1. HPR Glasbase

B. Base (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressBase 80:

C. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressPly Plus FR Mineral:

D. Interply Adhesive: (1 and 2)
   1. Weatherking Plus WC:

E. Flashing Base Ply: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressBase 80:

F. Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressPly E FR Mineral:

G. Flashing Ply Adhesive:
   1. Weatherking Flashing Adhesive:

H. Surfacing: Requires 30 day wait before applying.

I. Surface Coatings:
   1. Pyramic:
   2. LiquiTec: In water ways and around drains only.

2.03 ACCESSORIES

A. Roof Cover Board: Refer to Section 09 29 00, Gypsum Board.

B. Insulation: Refer to Section 07 21 13 and Section 07 21 15.

C. Roof Mats: Manufacturer's standard roof walkway mats for specified roofing system.

2.04 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

A. Vents and Breathers: Heavy gauge aluminum and fully insulated vent that allows moisture and air to escape but not enter the roof system as recommended and furnished by the membrane manufacturer.

B. Pitch pans, Rain Collar 24 gauge stainless or 20oz (567gram) copper. All joints should be welded/soldered watertight. See details for design.

C. Drain Flashings should be 4lb (1.8kg) sheet lead formed and rolled.

D. Plumbing stacks should be 4lb (1.8kg) sheet lead formed and rolled.

E. Liquid Flashing - Tuff-Flash: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.
   1. Tensile Strength, ASTM D 412: 400 psi
   2. Elongation, ASTM D 412: 300%
   3. Density @77 deg. F 8.5 lb/gal typical

F. Fabricated Flashings: Fabricated flashings and trim are specified in Section 07620.
   1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.

G. Manufactured Roof Specialties: Shop fabricated copings, fascia, gravel stops, control joints, expansion joints, joint covers and related flashings and trim are specified in Section 07 62 00.
   1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.

D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Verify roof insulation and cover board have been installed per manufacturer's installation instructions.

F. Beginning installation means acceptance of substrate.

3.02 PREPARATION

A. General: Clean surfaces thoroughly prior to installation.
   1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.
   3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
   4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.
   5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
   6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pull-out capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with cap nails require a minimum pullout capacity of 40 lb. per nail.
   7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

B. Metal Deck: Metal deck shall be installed as specified in Section
   1. Fastening of the deck should comply with the anticipated live and dead loads pertaining to the building as well as applicable Code.
   2. Steel decks shall be minimum 22-gauge factory galvanized or zinc alloy coated for protection against corrosion.
   3. Suitable insulation shall be mechanically attached as recommended by the insulation manufacturer.

4. Decks shall comply with the gauge and span requirements in the current Factory Mutual FM Approval Guide and be installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
5. When re-roofing over steel decks, surface corrosion shall be removed, and repairs to severely corroded areas made. Loose or inadequately secured decking shall be fastened, and irreparable or otherwise defective decking shall be replaced.

C. Lightweight Insulating Concrete Deck
1. Lightweight insulating concrete decks are required to have a minimum thickness of 2 inches (51 mm), a minimum compressive strength of 125 psi (0.86 MPa) and a minimum density of 22 pcf (352 kg/sm).
2. Install roof system immediately following deck curing to prevent damage from exposure to precipitation. The deck manufacturer determines the minimum curing time and maximum exposure limitations.
3. LWIC shall not be poured during rainy periods. Deck areas that have frozen before they have cured shall be removed and replaced. Decks which receive precipitation prior to installation of the roof membrane shall be checked for moisture content and dryness.
4. Lightweight insulating concrete decks are acceptable only on slopes up to 1 inch per foot (83 mm/m).
5. Do not attach insulation directly to lightweight concrete decks. Over old, dry decks, additional board insulation may be solidly mopped to an approved mechanically attached anchor sheet (base sheet).

3.03 INSTALLATION - GENERAL

A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.

B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.

C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water

D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.04 INSTALLATION COLD APPLIED ROOF SYSTEM

A. Base Ply: Cut base ply sheets into 18 foot lengths and allow plies to relax before installing. Install base sheet in Interply Adhesive: applied at the rate required by the manufacturer. Shingle base sheets uniformly to achieve one ply throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.

B. Lap ply sheet ends 8 inches. Stagger end laps 12 inches minimum.
   1. Solidly bond to the substrate and adjacent ply with specified cold adhesive at the rate of 2 to 2-1/2 gallons per 100 square feet.
   2. Roll must push a puddle of adhesive in front of it with adhesive slightly visible at all side laps. Use care to eliminate air entrapment under the membrane.
   3. Install subsequent rolls of modified across the roof as above with a minimum of 4 inch side laps and 8 inch staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
   4. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
   5. Install base flashing ply to all perimeter and projection details.
   6. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.

C. Modified Cap Ply(s): Cut cap ply sheets into 18 foot lengths and allow plies to relax before installing. Install in interplay adhesive applied at the rate required by the manufacturer. Shingle sheets uniformly over the prepared substrate to achieve the number of plys specified. Shingle in proper direction to shed water on each large area of roofing.
   1. Lap ply sheet ends 8 inches. Stagger end laps 12 inches minimum.
   2. Solidly bond to the base layers with specified cold adhesive at the rate of 2 to 2-1/2 gallons per 100 square feet.
   3. Roll must push a puddle of adhesive in front of it with adhesive slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.
   4. Install subsequent rolls of modified across the roof as above with a minimum of 4 inch side laps and 8 inch staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
   5. Allow cold adhesive to set for 5 to 10 minutes before installing the top layer of modified membrane.

6. Extend membrane 2 inches beyond top edge of all cants in full moppings of the cold adhesive as shown on the Drawings.

D. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.

E. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.
   1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
   2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
   3. Nailer lengths should be spaced with a minimum 1/8 inch gap for expansion and contraction between each length or change of direction.
   4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.

F. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07 62 00. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.

G. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.

H. Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.
   1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
   2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
   3. Adhere to the underlying base ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
   4. Solidly adhere the entire flashing ply to the substrate. Secure the tops of all flashings that are not run up and over curb through termination bar fastened at 6 inches (152 mm) O.C. and sealed at top.
   5. Seal all vertical laps of flashing ply with a three-course application of trowel-grade mastic and fiberglass mesh.
   6. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
   7. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.

8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.

I. Flashing Cap Ply:
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
3. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
4. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
5. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.
6. All stripping shall be installed prior to flashing cap sheet installation.
7. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.
8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.

J. Surface Coatings: Apply roof coatings in strict conformance with the manufacturer's recommended procedures. Coating can only be applied after a 30-daywaiting period following installation of all membrane.

K. Install roof mats per manufacturer's installation instructions.

3.05 INSTALLATION EDGE TREATMENT AND ROOF PENETRATION FLASHING

A. Metal Edge:
1. Inspect the nailers to assure proper attachment and configuration.
2. Run one ply over the edge. Assure coverage of all wood nailers. Fasten plies with ring shank nails at 8 inches (203 mm) o.c.
3. Install continuous cleat and fasten at 6 inches (152 mm) o.c.
4. Install new metal edge hooked to continuous cleat and set in bed of roof cement. Fasten flange to wood nailers every 3 inches (76 mm) o.c. staggered.
5. Prime metal edge at a rate of 100 square feet per gallon and allow to dry. Do not prime for Green-Lock System lightly sand metal to improve bond.
6. Strip in flange with base flashing ply covering entire flange in bitumen with 6 inches (152 mm) on to the field of roof. Assure ply laps do not coincide with metal laps.
7. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Seal outside edge with rubberized cement.

B. Roof Edge With Gutter:

1. Inspect the nailer to assure proper attachment and configuration. Increase slope at metal edge by additional degree of slope in first board.
2. Run one ply over the edge. Assure coverage of all wood nailers. Fasten plies with ring shank nails at 8 inches (203 mm) o.c.
3. Install gutter and strapping.
4. Install continuous cleat and fasten at 6 inches (152 mm) o.c.
5. Install new metal edge hooked to continuous cleat and set in bed of roof cement. Fasten flange to wood nailer every 3 inches (76 mm) o.c. staggered.
6. Prime metal edge at a rate of 100 square feet per gallon and allow to dry. Do not prime for Green-Lock System lightly sand metal to improve bond.
7. Strip in flange with base flashing ply covering entire flange in bitumen with 6 inches (152 mm) onto the field of the roof. Assure ply laps do not coincide with metal laps.
8. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof.

C. Scupper Through Wall:
1. Inspect the nailer to assure proper attachment and configuration.
2. Run one ply over nailer, into scupper hole and up flashing as in typical wall flashing detail. Assure coverage of all wood nailers.
3. Install a scupper box in a 1/4 inch (6 mm) bed of mastic. Assure all box seams are soldered and have a minimum 4 inch (101 mm) flange. Make sure all corners are closed and soldered. Prime scupper at a rate of 100 square feet per gallon and allow to dry.
4. Fasten flange of scupper box every 3 inches (76 mm) o.c. staggered.
5. Strip in flange of scupper box with base flashing ply covering entire area with 6 inch (152 mm) overlap on to the field of the roof and wall flashing.
6. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all seams.

D. Coping Cap:
1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Maximum flashing height is 24 inches (609 mm). Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Attach tapered board to top of wall.
4. Install base flashing ply covering entire wall and wrapped over top of wall and down face with 6 inches (152 mm) on to field of roof and set in cold asphalt. Nail membrane at 8 inches (203 mm) o.c.
5. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all seams and allow to cure and aluminize.
6. Install continuous cleat and fasten at 6 inches (152 mm) o.c. to outside wall.
7. Install new metal coping cap hooked to continuous cleat.
8. Fasten inside cap 24 inches (609 mm) o.c. with approved fasteners and neoprene washers through slotted holes, which allow for expansion and contraction.

E. Surface Mounted Counterflashing/Coping Cap:
1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering wall set in bitumen with 6 inches (152 mm) on to field of roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all seams and allow to cure and aluminize.
5. Apply butyl tape to wall behind flashing. Secure termination bar through flashing, butyl tape and into wall. Alternatively use caulk to replace the butyl tape.
6. Secure counterflashing set on butyl tape above flashing. Fasten 8 inches (203 mm) o.c. and caulk top of counterflashing.
7. Attach tapered board to top of wall (minimum slope 1/4 -12). Do not use organic fiberboard or perlite.
8. Cover tapered board and all exposed wood with base flashing ply. Fasten inside and out at 8 inches (203 mm) o.c.
9. Install continuous cleat and fasten at 6 inches (152 mm) o.c. to outside wall.
10. Install new metal coping cap hooked to continuous cleat.
11. Fasten inside of cap 24 inch (609 mm) o.c. with approved fasteners and neoprene washers.

F. Surface Mounted Counterflashing:
1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Maximum flashing height is 24 inches (609 mm). Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering wall set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Apply butyl tape to wall behind flashing. Secure termination bar through flashing, butyl tape and into wall. Alternatively use caulk to replace the butyl tape.
6. Secure counterflashing set on butyl tape above flashing at 8 inches (203 mm) o.c. and caulk top of counterflashing.

G. Reglet Mounted Counterflashing:
1. Minimum flashing height is 8 inches (203 mm) above finished roof height. Maximum flashing height is 24 inches. Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering wall set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Apply butyl tape to wall behind flashing. Secure termination bar through flashing, butyl tape and into wall. Alternatively use caulk to replace the butyl tape.
6. Cut reglet in masonry one joint above flashing.
7. Secure reglet counterflashing with expansion fasteners and caulk reglet opening.

H. Expansion Joint:

1. Minimum curb height is 8 inches (203 mm) above finished roof height. Chamfer top of curb. Prime vertical curb at a rate of 100 square feet per gallon and allow to dry.
2. Mechanically attach wood cant to expansion joint nailers. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install compressible insulation in neoprene cradle.
4. Install base flashing ply covering curb set in bitumen with 6 inches (152 mm) on to field of the roof.
5. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Attach top of membrane to top of curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
6. Install pre-manufactured expansion joint cover. Fasten sides at 12 inches (609 mm) o.c. with fasteners and neoprene washers. Furnish all joint cover laps with butyl tape between metal covers.

I. Equipment Support:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Attach top of membrane to top of curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install pre-manufactured cover. Fasten sides at 24 inches (609 mm) o.c. with fasteners and neoprene washers. Furnish all joint cover laps with butyl tape between metal covers.
6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

J. Curb Detail/Air Handling Station:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install pre-manufactured counterflashing with fasteners and neoprene washers or per manufacturer's recommendations.
6. Set equipment on neoprene pad and fasten as required by equipment manufacturer.

K. Skylight:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field plies over cant a minimum of 2 inches (50 mm).

3. Install base flashing ply covering curb set in bitumen with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply in bitumen over the base flashing ply, 9 inches (228 mm) on to the field of the roof. Attach top of membrane to top of wood nailer and apply a three-course application of mastic and mesh. Allow to cure and aluminize.
5. Install pre-manufactured lens and fasten flashing sides at 8 inches (203 mm) o.c. with fasteners and neoprene washers.

L. Exhaust Fan:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb with 6 inches (152 mm) on to field of the roof.
4. Install a second ply of modified flashing ply installed over the base flashing ply, 9 inches (228 mm) on to field of the roof. Attach top of membrane to top of wood curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install metal exhaust fan over the wood nailers and flashing to act as counterflashing. Fasten per manufacturer's recommendation.

M. Passive Vent/Air Intake:
1. Minimum curb height is 8 inches (203 mm) above finished roof height. Prime vertical at a rate of 100 square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all plies over cant a minimum of 2 inches (50 mm).
3. Install base flashing ply covering curb with 6 inches (152mm) on to the field of the roof.
4. Install a second ply of modified flashing ply installed over the base flashing ply, 9 inches (228 mm) on to field of the roof. Attach top of membrane to top of wood curb and nail at 8 inches (203 mm) o.c. Apply a three-course application of mastic and mesh at all vertical seams and allow to cure and aluminize.
5. Install passive vent/air intake over the wood nailers and flashing to act as counterflashing. Fasten per manufacturer's recommendations.

N. Roof Drain:
1. Plug drain to prevent debris from entering plumbing.
2. Taper insulation to drain minimum of 24 inches (609 mm) from center of drain.
3. Run roof system plies over drain. Cut out plies inside drain bowl.
4. Set lead/copper flashing (30 inch square minimum) in 1/4 inch bed of mastic. Run lead/copper into drain a minimum of 2 inches (50 mm). Prime lead/copper at a rate of 100 square feet per gallon and allow to dry.
5. Install base flashing ply (40 inch square minimum) in bitumen.
6. Install modified membrane (48 inch square minimum) in bitumen.
7. Install clamping ring and assure that all plies are under the clamping ring.
8. Remove drain plug and install strainer.
9. Install LiquidTec Coating around all drains in 6’x6’ area at 5 gallons per square according to manufactures requirements.

O. Plumbing Stack:

1. Minimum stack height is 12 inches (609 mm).
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of 1 inch (25 mm) down inside of stack.

P. Heat Stack:
1. Minimum stack height is 12 inches (609 mm).
2. Run roof system over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new sleeve. Install properly sized sleeves set in 1/4 inch (6 mm) bed of roof cement.
4. Install base flashing ply in bitumen.
5. Install modified membrane in bitumen.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Install new collar over cape. Weld collar or install stainless steel draw brand.

3.06 CLEANING

A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.

B. Remove asphalt markings from finished surfaces.

C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.07 PROTECTION

A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.

B. Protect exposed surfaces of finished walls with tarps to prevent damage.

C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch (16 mm) thick.

D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.

E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.08 FIELD QUALITY CONTROL

A. Inspection: Provide manufacturer's field observations at least (5) days per week. Provide a final inspection upon completion of the Work.
   1. Warranty shall be issued upon manufacturer's acceptance of the installation.
   2. Field observations shall be performed by a Sales Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
   3. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
   4. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

3.09 SCHEDULES

A. Base (Ply) Sheet:
   1. StressBase 80: 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a fiberglass scrim, performance requirements according to ASTM D 5147.
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 0 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
         2) 50mm/min. @ -17.78 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 110 lbf XD 100 lbf
         2) 50mm/min. @ 23 +/- 2 deg. C MD 489 N XD 444 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 0 +/- 3.6 deg. F MD 4 % XD 4 %
         2) 50mm/min@ -17.78 +/- 2 deg. C MD 4 % XD 4 %
      d. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)

B. Modified Cap (Ply) Sheet:
   1. StressPly Plus FR Mineral: 155 mil SBS (Styrene-Butadiene-Styrene) mineral surfaced, rubber modified roofing membrane reinforced with a fiberglass and polyester composite scrim. ASTM D 6162, Type III Grade G
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 310 lbf/in XD 310 lbf/in
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 54.25 kN/m XD 54.25 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf XD 500 lbf
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 2224 N XD 2224 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 8% XD 8%
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 8% XD 8%
      d. Low Temperature Flexibility, ASTM D 5147, Passes -30 deg. F (-34 deg. C)

C. Interply Adhesive:
   1. Weatherking Plus WC: Rubberized, polymer modified cold process asphalt roofing bitumen V.O.C. compliant ASTM D 3019. Performance Requirements:

a. Non-Volatile Content ASTM D 4479 78%
b. Density ASTM D1475 9.0 lbs./gal.
c. Viscosity Stormer ASTM D562 900-1100 grams
d. Flash Point ASTM D 93 100 deg. F min. (37 deg. C)
e. Slope: up to 2:12
f. V.O.C. ASTM D 3960 Less than 250 g/l
g. Flash Point ASTM D 93 105 deg. F
h. Slope maximum 1:12

D. Flashing Base Ply:
1. StressBase 80: 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a fiberglass scrim, performance requirements according to ASTM D 5147.
a. Tensile Strength, ASTM D 5147
1) 2 in/min. @ 0 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
2) 50 mm/min. @ -17.78 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
b. Tear Strength, ASTM D 5147
1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 110 lbf XD 100 lbf
2) 50 mm/min. @ 23 +/- 2 deg. C MD 489 N XD 444 N
c. Elongation at Maximum Tensile, ASTM D 5147
1) 2 in/min. @ 0 +/- 3.6 deg. F MD 4 % XD 4 %
2) 50 mm/min. @ -17.78 +/- 2 deg. C MD 4 % XD 4 %
d. Low Temperature Flexibility, ASTM D 5147
1) Passes -40 deg. F (-40 deg. C)

E. Flashing Ply Adhesive:
1. Weatherking Flashing Adhesive: Brush grade flashing adhesive.
a. Non-Volatile Content ASTM D 4479 70 min.
b. Density ASTM D 1475 8.6 lbs./gal. (1kg/l)
c. Flash Point ASTM D 93 100 deg. F (37 deg. C)

F. Surfacing:
1. Flashing Cap (Ply) Sheet:
a. StressPly E FR Mineral (Environmental): 160 mil SBS and SIS (Styrene-Butadiene-Styrene and Styrene-Isoprene-Styrene) mineral surfaced rubber modified roofing membrane with fire retardant characteristics and reinforced with a dual fiberglass scrim and polyester scrim. ASTM D 6162, Type III Grade G
1) Tensile Strength, ASTM D 5147
a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf/in XD 550 lbf/in
b) 50 mm/min. @ 23 +/- 2 deg. C MD 87.5 kN/m XD 96.25 kN/m
2) Tear Strength, ASTM D 5147
a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 900 lbf XD 950 lbf
b) 50 mm/min. @ 23 +/- 2 deg. C MD 4003 N XD 4226 N
3) Elongation at Maximum Tensile, ASTM D 5147
a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 6.0% XD 6.0%
b) 50 mm/min. @ 23 +/- 2 deg. C MD 6.0% XD 6.0%
4) Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F(-40 deg.)
2. Surface Coatings:

a. Surfacing:
   1) Pyramic: White elastomeric roof coating, Energy Star approved acrylic roof coating:
      a) Weight/Gallon 12 lbs./gal. (1.44 g/cm3)
      b) Non-Volatile % (ASTM D 1644) 66 min
      c) Reflectance 81%
   2) LiquiTec: Highly reflective multi-purpose, zero VOC, dual-component polyuera, liquid waterproofing membrane. VOC compliant and meets South Coast AQMD standards.
      a) Tensile Strength: ASTM D 412, 2100 psi
      b) Tear Resistance: ASTM D 624, 449 lbs./in
      c) Elongation: ASTM D 412, 210%
      d) Density @ 77 degrees F (25 degrees C, ASTM D 2939) 10.4 lb./gal (1.2 g/m3)
      e) Flash Point: ASTM D 93, 110 degrees F min. (43 degrees C)
      f) Non-Volatile: ASTM D 75, Typical 83%
      g) Viscosity @ 77 degrees F (25 degrees C); Brookfield RVT, #4 Spindle 10 rpm9200 cP
      h) Wet Film Thickness@ 2 gal./100 sq. ft. (0.82 l/m2)
      i) VOC: 0 g/l
      j) Reflectance: 0.84
      k) Emittance: 0.88
      l) SRI: 105

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Wall Flashing.
2. Parapet Copings and Flashings.
3. Fascias and scuppers.
4. Roof flashings.
5. Reglets and counterflashing.
6. Roof joint cover flashings.
7. Downspouts and Strainers.
8. Conductor Heads.
9. Gravel Stops.
10. Counterflashings for roof hatches and skylights.
11. Interior Roof Drains.
12. Flashings for electrical conduits, mechanical lines and plumbing water lines roof [and wall] penetrations.
13. Door drips.
14. Equipment Roof Curbs and Flashing.
15. Equipment support stand penetrations.
16. Closures
17. Sill Pan Flashings.
18. Termination Bars.

B. Related Section:
1. Section 01 35 42, CALGreen Requirements.
2. Section 09 90 00, Painting.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. California Building Code 2019 Chapters 14 and 15.

C. California Green Building Standards Code, CALGreen - 2019.

D. American Society for Testing and Materials (ASTM)
1. ASTM A480/A480M- General Requirements for Flat-Rolled Stainless Steel and Heat Resisting Steel Plate, Sheet, and Strip.
2. ASTM A653/A653M-11 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc - Iron Alloy Coated by the Hot-Dip Process
3. ASTM B32 - Solder Metal
4. ASTM D4601 - Asphalt-Coated Glass Fiber Base Sheet Used in Roofing

E. National Roofing Contractors Association (NRCA)
   1. NRCA Manual - Fifth Edition.

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
   1. SMACNA Manual - Architectural Sheet Metal Manual, Current Edition

1.03 SUBMITTALS

A. Shop drawings showing material profile, jointing pattern, jointing details, fastening methods and installation details.

B. Product data.

C. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.A.

D. Manufacturer's installation instructions.

E. Samples for each type of sheet metal flashing and trim indicated with field-applied color finishes.

1.04 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.

1.05 STORAGE AND HANDLING

A. Stack preformed and pre-finished material to prevent twisting, bending, or abrasion and to provide ventilation.

B. Prevent contact with materials during storage that may cause discoloration, staining or damage.

PART 2 - PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M-11, G90.

2.02 ACCESSORIES

A. Fasteners: round head, galvanized steel with soft neoprene washers at exposed fasteners. Finish exposed fasteners same as flashing metal.

B. Ice Dam Underlayment: ASTM D 1970, Rubberized asphalt coated polyethylene film, 40 mils thick, Grace Ice & Water Shield HT, High Temperature, by W.R. Grace & Co., Cambridge, MA, or equal as approved in accordance with Division 01 for substitutions.

C. Metal Primer: For repair of Galvanized sheet metal, Zinc type, Galvilite by ZRC or equal.

D. Protective Backing Paint: Bituminous.

E. Sealant: Two-component, polyurethane-type specified in Section 07 92 00, Joint Sealants.

F. Solder: ASTM B32; Grade Sn50, flux type and alloy composition as required for use with metals to be soldered. Raw muriatic acid for galvanized steel.

G. Rosin-Sized sheathing paper: Sealtight Red Rosin Paper by W.R. Meadows.

H. Termination Bar: Mill finished Extruded aluminum (6063 alloy) with radius corners.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square and free from distortion or defects. Fabricate all components per SMACNA standards unless more stringent conditions are imposed by the Roofing Contractor, in that case the more stringent conditions shall prevail.

B. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet.

C. Form pieces in longest practical lengths.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

E. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

F. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

G. Solder lap seams of all non-moving metal joints and seal other metal joints, rivet to strengthen seam. After soldering, remove flux. Wipe and wash solder joints clean.

H. Fabricate corners from one piece with minimum 18 inch long legs; solder seam for rigidity.

I. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

J. Fabricate flashings to allow toe to extend 2 inches over roofing. Return and break edges.

K. Provide expansion joints for gutters at every 30 feet. Fabricate per SMACNA details.

2.04 FINISH

A. Galvanized finish: ASTM A653/A653M-11, G90.

B. Shop prepare and prime exposed ferrous metal surfaces.

C. Back paint concealed metal surfaces with protective backing paint when in contact with copper, redwood or red cedar.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place and nailing strips located.

B. Verify membrane termination and base flashings are in place, sealed and secure.

C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Field measure site conditions prior to fabricating Work.

B. Install starter and edge strips and cleats before starting installation.

C. Install reglets true to lines and levels. For surface-mounted seal top of reglets with sealant.

D. Insert counterflashings into reglets to form tight fit. Seal flashings into reglets with sealant.

E. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Architect.

F. Lock and seal all joints.

G. Apply plastic-cement compound between metal flashings and felt flashings.

H. Install separate layer(s) of metal strips, counter flashings, and aluminum tapes prior to Ice Dam Underlayment installation where adjoining EPDM, TPO, or PVC membranes.

I. Fit flashings tight in place. Make corners square, surfaces true and straight in planes and lines accurate to profiles.

J. Seal metal joints watertight.

3.03 INSTALLATION

A. Wall Flashing: Flashing shall be installed in such a manner so as to prevent moisture from entering the wall or to redirect it to the exterior. Flashing shall be installed at the perimeters of exterior door and window assemblies, penetrations and terminations of exterior wall assemblies, exterior wall intersections with roofs, decks, balconies and similar projections and at built-in gutters and similar locations where moisture could enter the wall. Flashings with projecting flanges shall be installed on both sides and the ends of copings, under sills and continuously above projecting trim, Section 1405.3 CBC.
   1. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
   2. Openings Flashing in Frame Stud Construction: Install continuous head, sill, jamb, and similar opening flashings to extend 4 inches beyond wall openings. Install over self-adhesive flashings.
   3. Sealants for penetrations: specified in section 07 92 00 Joint Sealers.
   4. Submit shop drawings showing details for approval and use minimum of 24 gauge galvanized steel, UNO.

B. Parapet Copings and Flashings: Fabricate in minimum 96-inch long, but not exceeding 10-foot long sections. Use minimum 20 gauge galvanized steel. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg Provide all copings and caps of the types and shapes indicated on the Drawings. Install Self-Adhesive Flashing (Ice dam, high temperature) under copings. Build in integral expansion joints allowing for movement of the metal without resulting in distortion of coping or leaks of any kind. Miter corners, seal, and solder watertight. All Work shall be watertight.

C. Copings at top of wall:
   1. Copings: Manufactured coping system consisting of formed metal coping cap in section lengths not exceeding 12 feet, concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units.
      a. Manufacturers:
         1) Metal-Era, Inc. Product: Perma-Tite Continuous Cleat Coping.
         2) Or equal in accordance with Division 01, Substitutions
      b. Coping Caps: fabricated from the following exposed metal.
         1) Aluminum: 0.050 inch thick.
      c. Coping Cap Color: As selected by Architect from manufacturer's full range.
      d. Corners: Continuously welded.
      e. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches wide, 0.028 inch thick, with integral cleats.

D. Fascias and Scuppers: Fabricate to detail of 20 gauge galvanized sheet. Apply sealant in all crevices. Fabricate scuppers with 6 inch flanges.

E. Roof Flashings: Provide roof flashings as indicated in drawings and required to complete entire project. Submit shop drawings showing details for approval, use minimum of 24 gauge galvanized steel.

F. Reglets and Counterflashings: Minimum 24 gauge galvanized steel as detailed in drawings, submit shop drawings.
   1. Reglets: For Surface-mounted and imbed applications.
   2. Counterflashings: Over bituminous base flashings.
   3. Counterflashings: Roof mounted mechanical equipment and vent stacks.
   4. Counterflashings: Roof Hatches and Skylights.

G. Roof Joint Cover Flashings: Provide roof joint covers as indicated in drawings. Submit shop drawings showing details for approval and use minimum of 24 gauge galvanized steel. Fabricate tops slope to drain.

H. Refrigerant Plumbing Lines Wall Flashing: Titan Outlet by Airex Manufacturing, Thousand Palms, CA or equal. Size as required to enclose pipes.

I. Downspouts and Strainers: Downspouts shall be 24 gauge, galvanized steel, rectangular unless noted otherwise. Strainers shall be 10 gauge galvanized steel wire basket type. Provide all anchor clips and straps as required for installation. Install a wire basket strainer in all downspouts at gutter level. Rivet and solder flange of downspout to gutters per SMACNA details. Locate downspouts every 30 feet unless otherwise noted on drawing. Provide splash pans. Concrete splash block, Section 03 48 00.
   1. At steel pipe overflow-drain and interior drain pipe leaders install Downspout Nozzle #1770 by JR Smith, Montgomery, Alabama. Nickel bronze with bird screen cast bronze body and flange. Refer to Drawings for pipe sizes and locations of drains and leaders. Minimum pipe size Schedule 40, 4 [6] inches, galvanized.
   2. Downspout Filter: FlowGard by KriStar Enterprises, Inc., Santa Rosa, CA. Model FG-DS4, 4" diameter, box size 14 x 29 x 7.5 inches, dual-wall geotextile fabric liner encapsulating absorbent, surfaced mounted unit. Locate at each pipe drain.

J. Conductor Heads: Provide conductor heads per SMACNA Figure 1-25, Design 1-25F unless Design Number noted otherwise; 24 gauge Galvanized sheet metal.

K. Gravel Stops: Fabricate of 24 gauge galvanized steel. Form true-to-line and detail as indicated. Provide formed corners locked and soldered full, with flashing flanges at least 4 inches under overlapping roofing materials and with aprons formed to straight lines. Install gravel stops in full bed of plastic cement and nail at 6 inch centers. All joints in gravel stops shall be butt type with back-up plates 12 inches long, of same gauge and profile as the gravel stop. Wipe all exposed surfaces clean. Protect adjacent, exposed surfaces from plastic cement smears and stains.

L. Counterflashings for roof hatches and skylights: 24 gauge sheet metal flashing, removable, per NRCA BUR/MB-14.

M. Interior Roof Drains: Provide 16 oz. Copper 30" x 30" [0.024" Stainless steel] flashing at single roof drains and 30" x 48" at drain and overflow drain unit.
   1. Refer to drawings.

N. Roof Pipe Penetrations Flashings: Provide pre-manufactured flashings and counterflashings for pipe penetrations for electrical conduits, mechanical and plumbing lines. Flashing: galvanized steel., with 6" flange. Field seal top of cast-iron counterflashing with silicone sealant per Section 07 92 00, secure to pipe with set screw.
   1. Model 1100-4 Series by Elmdor/Stoneman, City of Industry, CA: For single pipe penetrations and 1100-5 Series for vents.
   2. Model 910 Future Flash and 915 Multi-Flash Adaptors by Elmdor/Stoneman, City of Industry, CA: Multiple-pipe penetrations, within single pre-manufactured flashing unit: Counterflashing: PVC cap, adapter base and compression nut. Compression rings and gasket. Install per manufacturer's instructions.

O. Window drips at heads of all doors and windows in exterior walls where no roof or overhead protection occurs :
   1. At non-recessed or flush conditions: Provide drips of aluminum metal, extend drips 2-inches beyond jambs. Product: Superior Metal Trim SWD Superior Window Drip for 7/8" thick plaster, 2" leg, No. SWD 078-200A, or equal.
   2. At recessed or soffit conditions: Provide drips of aluminum, alloy 6063 T5, clear anodized. Product: Fry Reglet Drip Screed, non-vented, No. DS-875-875 or equal.

P. Equipment Roof Curbs and Flashing: Fabricate equipment roof curbs with 20 gauge galvanized steel, not less than 8" high, with 6" flanges, full welded construction. Provide curb flashings and counterflashings, 24 gauge galvanized sheet metal fully soldered and mitered corners. Lengths, sizes, quantities, and location to completely flash roof equipment curbs.

Q. Roof Penetrations: Equipment support stand penetrations; 8" high Flashing Collar flanged 6", overlapped 4" by Rain Collar, 24 gauge [26 gauge stainless steel] components, secured with stainless steel drawband sealed top with polyurethane sealant. Stripping and roofing cement products per Roofing Section. Pitch pockets not permitted.

R. Miscellaneous: Provide miscellaneous flashings as indicated in drawings and required to complete entire project, except for items provided under other Sections. Submit shop drawings showing details for approval and use minimum of 24 gauge galvanized steel.
   1. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

S. Galvanized sheet metal plaster reveals: 24 gauge sheet metal reveal moldings as detailed and as specified herein. Form molding flanges with screed to slope and drain moisture away from plaster. Paint Finish: Per Section 09 90 00, Special Coatings. Color as selected by Architect.

T. Sill Pans and Window Flashings: Window, door and storefront sill/jamb pans per SMACNA, ASTM E2112 or manufacturer's recommendations. Sill pans: Fabricate from 24 galvanized sheet metal fully soldered seams , minimum 4" high returns at window openings, 1/2" turnup at back.

3.04 FINISH

A. Paint exposed metal flashings with High Performance paints in accordance with Section 09 90 00, for Special Coatings. Colors to be selected by Architect.
   1. Parapet Coping to match metal panel color where adjacent.
   2. Parapet Coping to match curtain wall color (clear anodized) where adjacent.
   3. Parapet Coping to match plaster color where adjacent.

END OF SECTION

SECTION 07 72 00

ROOF ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Prefabricated roof hatches, with integral support curbs with cap counterflashing, and operable hardware.

B. Related Sections:
   1. Section 05 50 00 Metal Fabrications, for ladder and accessories.
   2. Section 09 90 00, Painting.

1.02 REFERENCE standards

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. OSHA - Standards 29 CFR, 1910.23, 1910.27 - For Railing system

C. California Code of Regulations, Title 8, Division 1, Chapter 4 Division of Industrial Safety, Subchapter 7, Group 1 - For Railing system.
   1. Section 3212 Floor Openings, Floor Holes, Skylights and Roofs.

D. American Society for Testing and Materials (ASTM): ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.03 SUBMITTALS

A. Shop drawings showing general construction, configurations, jointing methods and locations when applicable, and fastening methods.

B. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Manufacturer:
   1. Design, fabricate, and furnish roof curbs and equipment supports to accurate dimensions, configuration, and structural rigidity to meet requirements for systems.
   2. Accommodate loading capacity and connections of roof equipment, configuration of and watertight connections to roofing system, and configuration and spanning capacity between structural members at openings in roof deck.

1.05 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the dated of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. The Bilco Company, New Haven, CN.
   2. Milcor Incorporated, Lima, OH.
   3. Babcock-Davis Hatchways, Inc., Arlington, MA.
   4. Nystrom Products Co., Minnesota, MN.
   5. Lane - Aire Manufacturing Corporation, Carson, CA.
   6. Prescision Ladders, Morristown TN.
   7. JL Industries, Bloomington, MN.
   8. Miro Industries, Inc. Salt Lake City, Utah.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 ROOF HATCHES FOR LADDER ACCESS

A. Units: size as indicated on drawings, single leaf type, for vertical ladder access.
   1. Bilco Model Type S: - S-20 - galvanized steel, primer coat.
   2. When roof hatch opening dimension, perpendicular to ladder, is less than 37-inches, provide a minimum16-gage, galvanized steel deflector plate in accordance with 29 CFR 1910.27, Figure D.5.

B. Curb: 14 gauge galvanized prime painted steel, with fire-retardant plywood, exterior grade; integral cap flashing to receive roof flashing system; extended flange for mounting.

C. Cover and frame: 14 gauge galvanized prime painted steel with one inch glass fiber insulation retained by 22 gauge steel inner liner. Continuous neoprene gasket to provide weatherproof seal.

D. Hardware: Manufacturer's standard manually operated type with compression spring operators, positive snap latch with turn handles inside and out and padlock hasp inside; automatic hold-open arm with vinyl covered grip handle for easy release; cadmium plated finish.

E. Hinges: Heavy duty pintle type with 3/8" type 316 stainless steel hinge pins.

F. Safety Post: Refer to Section 05 50 00, Metal Fabrications.

2.03 FABRICATION

A. Fabricate free of visual distortions and defects. Weld corners and joints.

B. Provide for removal of condensation.

C. Provide weathertight assembly.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions. Coordinate with installation of roofing system and related flashings. Provide weathertight installation.

B. Apply bituminous paint on metal surfaces of units in contact with cementitious materials and dissimilar metals.

C. Paint hatches with High Performance coatings per Section 09 90 00 Painting.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems, products, materials and accessories.

B. Through-penetration firestopping systems.

C. Firestopping at intersections of fire-rated partitions and horizontal assemblies.

D. Perimeter Fire Containment System - Safing insulation.

E. Related Section:
   1. Section 01 35 42, CALGreen Requirements.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. ASTM E814 - Fire Tests of Through-Penetration Firestops.

D. ASTM E119 - Fire Tests of Building Construction and Materials.

E. ANSI/UL 2079-98 - Tests for Fire Resistance of Building Joint Systems.

F. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

G. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier System Using Intermediate-Scale, Multi-story Test Apparatus.

H. UL Fire Resistance Directory, Latest Edition.

I. UL Fire Resistance Directory for Perimeter Fire Containment System per UL XHDG and UL XHGU.

J. UL 1479 - Fire Tests of Through-Penetration Firestops.

K. UL 2079 Tests for Fire Resistance of Building Joint Systems.

L. Chapter 7, 2019 California Building Code.

M. California Green Building Standards Code, CALGreen 2019.

1.03 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance and limitation criteria.

B. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.B.

C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
   1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

D. UL approval numbers for firestopping materials, devices and systems.

E. State approvals for firestopping materials and devices and systems.

1.04 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Company specializing in manufacture of products specified in this Section, with minimum five years' experience.
   2. Installer Qualifications: A firm that has been approved by either FMG or UL.
      a. FMG 4991, "Approval of Firestop Contractors."
      b. UL, "Qualified Firestop Contractor" program.
      c. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. California Green Building Standards Code, CALGreen 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3

C. Regulatory Requirements
   1. Conform to Sections 703, 714, 715 and 720.1, 2019 CBC for fire resistance standards and requirements for penetrations and joint systems in walls, partitions, floor-ceilings and roof-ceilings.
   2. Firestop Systems installation shall meet requirements of ASTM E814, UL 1479, or UL 2079 tested assemblies that provide fire rating equal to that of construction being penetrated.
   3. Maintain one copy of current UL Fire Resistance Directory Listings, on jobsite at all times.

4. Firestopping systems shall meet temperature limitations as described in ASTM E119 and hose stream exposure as described in ASTM E814.
5. Firestopping system components shall consist of materials exhibiting limited combustibility, and shall have an oxygen index greater than 40 when tested in accordance with ASTM D2863. The flame spread rating shall be a maximum of 20 when tested in accordance with ASTM E84.
6. Firestopping system components shall have low smoke producing characteristics (less than 200) when tested in accordance with ASTM E84.
7. Electrical Boxes shall meet the requirements of UL 514.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when temperature of substrate material and ambient air is below manufacturer's minimum recommendations.

B. Maintain ambient air temperature above this minimum temperature before, during and for 3 days after installation of materials.

C. Provide ventilation in areas to receive solvent cured materials.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

1.07 SEQUENCING

A. Sequence Work to permit firestopping materials to be installed during or after adjacent and surrounding Work is complete.

PART 2 - PRODUCTS

2.01 GENERAL

A. Manufacturers, products and systems as listed in UL Fire Resistance Directory, are approved for use under this Section:
1. Through-Penetration Firestop Systems, (XHEZ) Field-Erected Type.
2. Fill, Void or Cavity Materials (XHHW), Installed at Jobsite.
3. Firestop Devices (XHJI), Factory Built Systems.
4. Forming Materials (XHKU) Jobsite Applied.

5. Through-Penetrating Products (XHLY) Cable, Conduit, Pipe and Tubing.
6. Joint Systems (XHBN) showing Class II and Class III movement capabilities.
7. Perimeter Fire Containment Systems per XHDG and XHGU.

B. Manufacturers, products and systems as listed in the WHI Certification Listings, are approved for use under this Section:
   1. Through-Penetration Firestop Systems: Listed in "Firestop Systems" Section.

C. Materials and devices utilized in the above referenced systems shall be used only in those systems in which they were tested. Substitutions are not permitted.

D. Or approved equal systems in compliance and listed in the UL Directory.

2.02 APPROVED FIRESTOPPING SYSTEMS

A. Head-of-Wall Track: CEMCO Slotted Track (CST) 16 gauge, ICC ESR-2012 or equal as approved in accordance with Division 01, General Requirements for substitutions.
   1. Insulation Backer: mineral wool or cementitious fire proofing, per system UL Directory.
   2. Sealant: per system UL Directory.
   3. Install in accordance with manufacturer's approvals.
   4. Approval: Bearing UL Fire Resistance Classification and approve assembly.

B. Head-of-Wall Track: FIRE TRAK CORP., KIMBALL, MN. or equal as approved in accordance with Division 01, General Requirements for substitutions.
   1. Deflection Track: FIRETRAK SHADOWLINE deflection track shall be attached to bottom flute of decking as recommended by manufacturer.
   2. Insulation Backer: mineral wool or cementitious fire proofing, per system UL Directory.
   3. Sealant: FS-90 National Gypsum or any of approved system under UL.
   4. Install one or two 5/8 inch thick sections of fire-rated gypsum board, 9 inches wide at deck flutes, both sides, custom fitted to within 1/8 to 3/8 inch of decking profile. Fill space with sealant, full depth, both sides.
   5. Approval: Bearing UL Fire Resistance Classification No. R15133 and approve assembly.
   6. UL System: HW-D-0060, HW-D-0061, HW-D-0117 HW-D-0118 HW-D-1011 HW-D-1012, HW-D-1019 HW-D-1020 HW-D-0012 HW-D-0013 HW-D-0014 HW-D-0015

C. 3M Inc., St Paul, MN www.3m.com/firestop
   1. Sealants, caulking, or spray materials used for openings between structurally separate sections of wall and floors, and top of wall conditions. Following products are acceptable:
      a. 3M IC 15WB+ intumescent sealant.
      b. 3M CP25WB+ intumescent sealant.
      c. 3M FireDam 150+ acrylic latex sealant.
      d. 3M Fire Barrier Mortar. Firestop Mortar.
      e. 3M Fire Barrier 3000WT Water Tight Silicone Sealant
      f. 3M FireDam Spray 200
      g. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

2. Sealants, caulking or spray materials for use with fire-rated construction joints, edge of slab perimeter joints, and other gaps. Following products are acceptable:
   a. 3M FireDam Spray 200
   b. 3M FireDam 150+ acrylic latex sealant.
   c. 3M Fire Barrier 1000 NS Silicone Sealant
   d. 3M Fire Barrier 1003 SL Silicone Sealant
   e. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2A, 2B.
3. Cast-in place firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and cables bundles penetrating concrete floors, following products are acceptable:
   a. 3M Fire Barrier Cast-in place MCID firestop device for use with Metallic penetrants
      1) Add Aerator adaptor when in used in conjunction with aerator (solvent) system.
   b. 3M Tub Box Kit for use with tub installations.
   c. 3M Fire Barrier Cast-in place PCID firestop device for use with noncombustible penetrants.

D. Hilti Inc., Plano, TX.
1. Sealants, caulking, or spray materials used for openings between structurally separate sections of wall and floors, and top of wall conditions. Following products are acceptable:
   a. Hilti CFS-SP WB Firestop Joint Spray
   b. Hilti CFS-SP SIL Firestop Silicone Joint Spray
   c. Hilti CFS-S SIL GG Firestop Silicone Sealant Gun Grade
   d. Hilti CFS-S SIL SL Firestop Silicone Sealant Self Leveling
   e. Hilti CP 606 Flexible Firestop Sealant
   f. Hilti CP 637 Firestop Mortar
   g. Equivalent products listed in the U.L. Fire Resistance Directory - Volume 2
2. Sealants, caulking, spray, or pre-formed materials for use with fire-rated construction joints, edge of slab perimeter joints, and other gaps. Following products are acceptable:
   a. Hilti CFS-TTS Firestop Top Track Seal
   b. Hilti CFS-TTS MD Firestop Top Track Seal Metal Deck
   c. Hilti CFS-EOS QS Edge of Slab QuickSeal
   d. Hilti CFS-SP WB Firestop Joint Spray
   e. Hilti CFS-S SIL GG Firestop Silicone Sealant Gun Grade
   f. Hilti CFS-S SIL SL Firestop Silicone Sealant Self Leveling
   g. Hilti CP 606 Flexible Firestop Sealant
   h. Hilti CP 605 Bottom-of-Wall Sealant
   i. Equivalent products listed in the U.L. Fire Resistance Directory - Volume 2A, 2B.
3. Pre-formed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors, following products are acceptable:
   a. Hilti CP 680-P Cast-In Place Firestop Device
      1) Add Aerator Adaptor when in used in conjunction with aerator (solvent) system.

b. Hilti CP 680-M Cast-In Place Firestop Device for use with noncombustible penetrants.
c. Hilti CP 681 Tub Box Kit for use with tub installations.
d. Hilti CFS-CID CS Closet Stub

4. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item, the following products are acceptable:
   a. Hilti CP 643N Firestop Collar
   b. Hilti CP 644 Firestop Collar
5. Fire Rated Cable Pathways: Hilti Speed Sleeve Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
   a. Hilti CP 653 Firestop Speed Sleeve
6. Firestop Drop-In-Device: Hilti Drop-In-Device Brand devices used with noncombustible and combustible pipes (closed and open systems), penetrating concrete floors, the following products are acceptable:
   a. Hilti CFS-DID Firestop Drop-In Device
7. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24", the following products are acceptable:
   a. Hilti CFS-P PA Firestop Putty Pad
   b. Hilti CP 617 Firestop Putty Pad
   c. Hilti Firestop Box Inserts
8. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
   a. Hilti CP 618 Firestop Putty Stick
9. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film, the following products are acceptable:
   a. Hilti CP 648S Firestop Wrap Strip
   b. Hilti CP 648E Firestop Wrap Strip
10. Firestop Block: Re-enterable, non-curing, intumescent flexible 2 component polyurethane foam block, the following products are acceptable:
    a. Hilti CFS-BL Firestop Block
11. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar, the following products are acceptable:
    a. Hilti CP 637 Firestop Mortar
12. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam, the following products are acceptable:
    a. Hilti CP 620 Fire Foam
13. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil, the following products are acceptable:
    a. Hilti CP 675T Firestop Board
14. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves, the following products are acceptable:
    a. Hilti CFS-PL Firestop Plug

E. Rectorseal Corp., Houston, TX.
   1. Insulation Backer: Fiberglass.
   2. Sealant: METACAULK 1100, sprayed, 1/8 inch thick, from metal deck to gypsum board, both sides.
   3. Sealant: Flamesafe FS 900 + Sealant.
   4. Approval: WHI TRC/PV 60-04, T & F rating 60 minutes, WHI TRC/PV 120-14, T & F rating 120 minutes.

F. Specified Technologies, Inc., Somerville, NJ.
   1. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
      a. SpecSeal Series SSS Intumescent Sealant
      b. SpecSeal Series LCI Intumescent Sealant
      c. SpecSeal Series LC Endothermic Sealant
      d. SpecSeal Series AS Elastomeric Spray
      e. SpecSeal Series ES Elastomeric Sealant
   2. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item, the following products are acceptable:
      a. SpecSeal Series SSC Firestop Collars
      b. SpecSeal Series LCC Firestop Collars
   3. Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
      a. EZ-PATH™ Fire Rated Pathway
   4. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24", the following products are acceptable:
      a. SpecSeal Series SSP Firestop Putty Pads
      b. SpecSeal Series EP PowerShield Insert Pads
   5. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
      a. SpecSeal Series SSP Firestop Putty
   6. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film, the following products are acceptable:
      a. SpecSeal Series RED2 Wrap Strip
      b. SpecSeal Series BLU2 Wrap Strip
   7. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
      a. SpecSeal Series SSB Firestop Pillows
   8. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar, the following products are acceptable:
      a. SpecSeal Series SSM Firestop Mortar
   9. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag), the following products are acceptable:
      a. SpecSeal SIL300 Silicone Firestop Sealant

b. SpecSeal SIL300 SL Self-Leveling Silicone Firestop Sealant

10. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam, the following products are acceptable:
    a. Pensil 200 Silicone Foam
11. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil, the following products are acceptable:
    a. SpecSeal CS Composite Sheet
12. Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket, the following products are acceptable:
    a. SpecSeal CD Cast-In Firestop Device
13. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use on steel HVAC ducts, the following products are acceptable:
    a. SpecSeal FyreFlange Firestop Angles
14. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves, the following products are acceptable:
    a. SpecSeal Series FP Firestop Plug
15. Fire-Rated T Rating Collar Device: Louvered steel collar system with synthetic aluminized polymer coolant wrap installed on metallic pipes where T Ratings are required by applicable building code requirements, the following products are acceptable:
    a. SpecSeal T-Collar Device
16. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing individual cable penetrations up to 0.27 in. diameter, the following products are acceptable:
    a. Ready Firestop Grommet

G. Smoke and Acoustical sealants: Specified in Section 07 92 00.

H. Color: White color where exposed to public.

I. Or equal in accordance with Division 01, General Requirements.

2.03 FIRESTOPPING AT ELECTRICAL BOXES AND UTILITY OUTLETS

A. Steel electrical outlet boxes on opposite sides of walls requiring protected openings shall be separated by horizontal distance of 24 inches.

B. Steel electrical outlet boxes that occur in combination with outlet boxes of size such that aggregate area of unprotected outlet boxes exceeds 100 square inches in any 100 square feet of wall area shall be protected by approved material or detail to decrease aggregate area of unprotected utility boxes to less than 100 square inches in any 100 square feet of wall.

C. Steel electrical outlet boxes that do not exceed 16 square inches in area shall be protected by an approved firestop material: at each side of wall:

1. CP 617 and CP 617L MOLDABLE FIRESTOP PUTTY PADS, by Hilti Inc. Tulsa, OK
2. MPP-4S MOLDABLE PUTTY PADS, by 3M Contractor Products, Minneapolis, MN.
3. FSP FIRESTOP PUTTY PADS, by Hevi-Duty Nelson Products, Tulsa, OK.
4. SPECSEAL PUTTY PADS, By Specified Technologies, Inc., Somerville NJ.
5. Johns Manville, Denver CO. Firetemp Puddy Pad.
6. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

D. Utility and electrical outlets or boxes shall be securely fastened to the stud or framing of the wall, or ceiling assembly. The opening in the gypsum board facing shall be cut so that the clearance between the box and the gypsum board does not exceed 1/8 inch.
   1. In smoke walls the 1/8 inch clearance shall be filled with an approved fire-rated sealant.

2.04 SAFING INSULATION - PERIMETER FIRE CONTAINMENT SYSTEMS

A. Mineral Wool / Fire Safing Insulation: 4-inch thick, 4 pcf, noncombustible, moisture-resistant, noncorrosive, non-deteriorating, synthetic vitreous fiber bound in a matrix.
   1. Fiber: rock- or slag-wool fiber, or man-made vitreous fiber
   2. ASTM E 136, Combustibility: NFPA Standard 220, non-combustible
      a. ASTM E 84, Flame Spread Index: 0
      b. ASTM E 84, Smoke Developed Index: 0
   3. Recycled Content: 70-percent, minimum
   4. Acceptable Products: Thermafiber, Safing Insulation, Johns Manville MinWool Safing.

B. Fill, Void or Cavity Material: Static; USG Types FC (1" Firecode Compound), RFC (Ready Mixed Firecode Compound). UL Listed, R11822.

C. Locations: as indicated in drawings, and at all gaps, crevices and openings between multistory floors and walls requiring Fire Rated protection.

D. Insulation shall be as approved in accordance with Division 01, General Requirements for substitutions and shall be UL listed.
   1. Curtain Wall Insulation; Mineral wool, Foil-Faced Thermafiber CW Firespan 90, 2 inches thick panel insulation and 1 inch thick by 8 wide at aluminum mullions, or 4 inches thick at stud walls. Opposite side faced with black mat. Secure with impaling pins and clinch shields at 12 inches on center, attach impaling pins to perimeter steel angles, 2" x 2" x2", screw attached to mullion. Install a steel angle horizontally behind insulation at safing line. ICC-ES Legacy Report No. VAR-1025 and ER-2331.

2. Safing: Mineral wool, Thermafiber LLC, Thermafiber Safing Insulation Type SAF, 4 inches thick min. at all floors between aluminum curtain wall or framed stud walls and concrete floors or concrete/metal deck floors. Compression fit and support with safing Z-clips at 12 inches o.c. Install 1 inch thick USG Firecode Compound, Types FC, RFC, tight over entire safing. Fire Hazard Classification, Flame Spread 15, Smoke Developed 0, shall meet Federal Specifications HH-1-521E, Type I, Class A/HH-1-521E, Form A, Classes 1 and 2, THERMAFIBER SAFING INSULATION, ICC-ES Legacy Report No. VAR-1025 and ER-2331.
3. THERMAFIBER LLC, Wabash, Indiana. Firespan Insulation, UL R4643.
   a. UL System Number: CW-S-1001, 5/8" thick Exterior Fire Code Gypsum Board or Cement Board spandrel sheathing substrate over steel stud framed wall and exterior finish.
   b. UL System Number: CW-S-2001, 1/4" Spandrel Glass.
   c. UL System Number: CW-S-2002, 1/8" thick aluminum spandrel panel with 1/4" thick edges.
4. Any Perimeter Fire Containment System per UL XHDG and UL XHGU.

E. Spandrel panel assembly shall meet requirements for two-hour fire rating.

2.05 ACCESSORIES

A. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that openings are ready to receive Work of this Section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material or other matter that may affect bond of firestopping material.

B. Remove incompatible materials that affect bond.

C. Install backing materials to arrest liquid material leakage.

3.03 APPLICATION

A. Install fluted through penetration firestopping system per Section 09 22 16.

B. Apply primer, firestop sealant or other firestop materials in accordance with manufacturer's recommendations and as approved by regulatory agencies. Apply at voids between fire-rated assemblies and adjoining fire-rated materials or assemblies.

C. Apply firestopping materials with sufficient thickness or configuration to achieve designated fire rating.

D. Install firestopping material in locations where designated fire rating must be maintained, including, but not limited to following:
   1. Voids or annular openings around sleeves, piping, ductwork or electrical/communications conduits that penetrate fire rated walls, partitions, floors, ceilings or assemblies.
   2. Intersections of fire-rated vertical and horizontal assemblies, including but not limited to door and window frames.

E. Remove dam material after firestopping material has cured.

F. Safing Insulation: Install compression fit and with support accessories specified where required.

3.04 IDENTIFICATION

A. Wall Identification per CBC 703.7: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
   1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.07 INSPECTION

A. Notify Inspector before Work is covered. Approval of Inspector shall be received before any Work is concealed in manner that will make inspection difficult. Work that has been covered prior to inspection and approval shall be uncovered, inspected and recovered.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparing substrate surfaces.

B. Sealant and joint backing.

C. Related Section:
   1. Section 01 35 42, CALGreen Requirements
   2. Section 07 84 00, Firestopping. For fire-rated assemblies.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM C834 - Latex Sealing Compounds.

C. ASTM C881 - Epoxy-Resin Base Bonding Systems for Concrete.

D. ASTM C919 - Use of Sealants in Acoustical Applications.

E. ASTM C920 - Elastomeric Joint Sealants.

F. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

G. ASTM C1184 - Structural Silicone Sealant.

H. ASTM C1193 - Standard Guide for Use of Joint Sealants.

I. ASTM C1311 - Solvent Release Sealants. Butyl and acrylic base polymer.

J. ASTM C1330 - Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

K. ASTM C1635 Standard Test Method to Evaluate Adhesion/Cohesion Properties of a Sealant at Fixed Extensions

L. SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification (www.SWRIONLINE.org).

M. GANA: Glass Association of North America Sealant Manual, 2008.

N. California Green Building Standards Code, CALGreen - 2019.

O. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications

1.03 SUBMITTALS

A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

B. CALGreen Submittals:
1. Product Data Sheets and Declaration Statements showing compliance with CALGreen code per 1.04.E.

C. Manufacturer's installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

D. Pre-Construction Laboratory Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Pre-Construction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion-Test Reports: For each sealant application tested.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform acoustical sealant application work in accordance with ASTM C919.

C. Prepare sample joints in the construction to demonstrate to the Architect the quality of the Work to be performed. Accepted sample joints will be used to judge the quality of the Work.

D. Qualifications
1. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum three years' experience.
2. Applicator:
   a. Pre-qualified applicator specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.
   b. This applicator shall be licensed joint sealing specialty Contractor.
   c. Submit list of completed local projects of similar sealant applications.

E. Product Testing: Test Joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

F. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.

G. Comply with Air Quality regulations, California Regulations:
   1. SCAQMD Rule 1168 compliant VOC limit of 250.

1.05 PRE-CONSTRUCTION TESTING

A. Pre-Construction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
   1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
   2. Conduct field tests for each kind of sealant and joint substrate.
   3. Notify Architect seven days in advance of dates and times when test joints will be erected.
   4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
      a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C1521.
         1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
   6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07 COORDINATION

A. Coordinate the Work with all Sections referencing this Section.

1.08 WARRANTY

A. Provide five-year product warranty, submit under provisions of Division 01, General Requirements.

B. Provide two-year installer's warranty, submit under provisions of Division 01, General Requirements.

C. Warranty: Include coverage for installed sealants and accessories which fail to achieve air tight seal, water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

D. Upon written notification of failure due to defective materials or application, repair or replace failure to the approval of the Architect and at no cost to Owner.

PART 2 - PRODUCTS

2.01 SEALANT AND MATERIAL MANUFACTURERS

A. Following is list of acceptable manufacturers of sealants and sealant materials. Inclusion in this list is not intended to imply that all manufacturers make all products. Products made by listed manufacturers must comply with all specified requirements.
1. Bostik Construction Products.
2. Dow Chemical Corporation (www.dowcorning.com/construction)
3. Sika Corporation.
4. General Electric Company.
5. W.R. Meadows, Inc.
6. Pecora Corporation.
7. Mameco International.
8. Tremco/Vulkem.
9. Sonneborn, ChemRex Inc.
10. Hilti
11. 3M Company

B. Substitutions: Under provisions of Division 01, General Requirements.

2.02 SEALANT TYPES

A. Single-Component Urethane: ASTM C 920, Type S, Grade NS, Class 35, Use NT, A, M, and O; USDA and FDA status.

B. Single-Component Urethane (Self-Leveling): ASTM C 920, Type S, Grade P, Class 35, Use T, A, M.

C. Multi-Component Urethane (Gun-Grade): ASTM C 920, Type M, Grade NS, Class 35, Use NT, A, M, and O.

D. Multi-Component Polyurethane (Gun-Grade): ASTM C 920, Type M, Grade NS, Class 35, Use T, A, M, and O.

E. Multi-Component Urethane (Self-Leveling): ASTM C 920, Type M, Grade P, Class 25, Use T, A, M, and O.

F. Single-component sealant, Silicone (Neutral-curing): ASTM C 920, Type S, Grade NS, Class 35, Use NT, G, A, M, and O; USDA, NSF and FDA 21 CFR 177.2600 approved.

G. Single-component sealant, Silicone (Neutral-curing,): ASTM C 920, Type S, Class 100/50, Grade P, Use T, and O.

H. Single-component, modified silicone polymer (silyl-terminated polyether resin - STPe), elastomeric sealant with plus-100-percent to minus-50-percent movement and complying with ASTM C-920, Type S, Grade NS, Uses NT, G, M, A, and O.
   1. Acceptable Product: BASF, Sonolastic 150 Tint Base, or equal. Color shall be as selected by the Architect from the manufacturer's full range of available colors.

I. Acrylic-Latex Caulk: ASTM C 834, Type OP or C, Grade 18 deg. C.

J. Bedding Compound: For installation of thresholds and similar items indicated to be bedded in sealant, use a preformed butyl-polyisobutylene sealant tape. Size of tape as required for the specific application.

K. Structural Silicone Sealant: ASTM C1184, compatible with system components with which it comes in contact, specifically formulated and tested for use as a structural sealant.
   1. Color: As selected by Architect from manufacturer's full range of colors.
   2. Tensile Strength: 100 psi minimum.
   3. Provide sealant with high performance structural silicone, high modulus of elasticity that will not allow movement of more than 50 percent. Dow Corning 995 Silicone Structural Glazing Sealant for gray, black, white, or 795 Silicone Building Sealant for clear.

L. Adhesives: Type that complies with Mil. Spec. MIL-A-46146
   1. Product: Dow Corning 3145 Silicone Adhesive
   2. Color: Clear or Translucent.
   3. Peel Strength: 75

M. Acoustical Sealant: gunnable type, non-drying, non-hardening permanently flexible, ASTM C919, ASTM C834, ASTM C920.
   1. Manufacturers: Tremco Acoustical Sealant, U.S. Gypsum Sheetrock Acoustical Sealant, Pecora Corp. BA-98 or equal.

N. Fire-Rated Sealants: Per Section 07 84 00 Firestopping.

O. Butyl Sealants: Butyl rubber sealant, BC-158 by Pecora or equal in compliance with VOC regulations of local Air Quality Districts.

2.03 JOINT AND SURFACE TYPES

A. Pedestrian and Vehicle Traffic Joints - Provide one of the following for each joint type:
   1. Multi-component urethane (self-leveling)
   2. Single-component urethane (self-leveling)
   3. Single-component sealant, silicone (neutral curing)

B. Non-Traffic Deck Joints - Provide one of the following for each joint type:
   1. Multi-component urethane (gun-grade)
   2. Single-component urethane
   3. Single-component sealant, silicone

C. Concrete Surfaces exceeding 20 square feet.

1. Single-Component Silicone (Neutral-curing,): ASTM C 920 Class 25, Type S, Grade P, Use T, and O (self-leveling).

D. Vertical Joints - Provide one of the following for each joint type:
   1. Multi-component urethane (gun-grade)
   2. Single-component sealant, silicone (neutral cure)

E. Expansion, Control, and Perimeter Joints - Provide one of the following for each joint type:
   1. Multi-component urethane (self-leveling)
   2. Single-component urethane; use only where dynamic movement will not exceed 50 percent of joint width - above or below grade
   3. Single-component urethane (self-leveling)
   4. Single-component sealant, silicone.

F. Curtainwalls, storefronts, entrances, and Related Assemblies - Provide one of the following for each joint type or installation at perimeter of aluminum-framed systems:
   1. Single-component silicone (neutral-curing)
   2. Non-Moving Joints, Interior and Exterior: Single-component sealant, silicone (neutral cure), ASTM C920.

G. Water-Immersion Areas - Provide one of the following for each joint type, ASTM C920, Class 25, Use I, T, NT, M, and O.:
   1. Multi-component urethane (self-leveling)
   2. Single-component urethane (self-leveling)
   3. Multi-component polysulfide (self-leveling)
   4. Multi-component polysulfide (non-sag)

H. Glazing - Provide one of the following for each joint type:
   1. Single-component sealant, silicone (neutral-curing).
   2. Structural silicone sealant for Structural Glazing.

I. Acoustical Sealant - gunnable, provide the following:
   1. Non-drying, non-hardening, non-skinning sealant type, ASTM C919.
   2. Acrylic-latex caulk, Type OP opaque or Type C clear at visual locations, ASTM C834.
   3. Chemically curing Sealant, for interior sound reduction application, ASTM C920.

J. Smoke and Acoustical Sealant: ASTM C834, Hilti CP 506 (openings), CP 572 (joints), STI SpecSeal "Smoke 'N' Sound Acoustical Spray".

K. Food Service Areas: Sealant complying with FDA requirements for use in food areas - Provide one of the following for each joint type:
   1. Single-component urethane
   2. Single-component silicone (neutral-curing)
   3. Single-component silicone (acid cure)

L. Toilet and Bath Areas: Sealant containing a fungicide for mildew resistance - Provide one of the following for each joint type:
   1. Single-component silicone (neutral-curing)
   2. Single-component silicone (acid cure)

M. Exterior Doors and Windows: Sealant used for exterior joints or butyl rubber.
   1. Fire-rated sealant at fire-rated assemblies per Section 07 84 00.

N. Interior Doors and Windows - Provide one of the following for each joint type:
   1. Single-component sealant, silicone (neutral cure)
   2. Fire-rated sealant at fire-rated assemblies per Section 07 84 00.

O. Built-In Cabinet Work: In kitchen, toilet, and bath areas, as specified for those areas. In other areas, single-component silicone (neutral-curing) or acrylic-latex caulk.

P. Rated Walls: Fire-rated Sealant, per UL Systems classification and in accordance with Section 07 84 00.
   1. Fire-rated sealant between rated walls or ceilings and their adjoining rated materials and construction, including but limited to door and window frames.

Q. Miscellaneous locations: Butyl rubber at all gaps, holes, openings, under wood sills, penetrations or channel metal track in exterior envelope of building not identified herein. Install as directed by the Architect.

R. Seal all cutouts and penetrations: For electrical, mechanical, plumbing and structural framing cutouts and penetration at interior surfaces with acoustical sealant and fire-rated sealant for rated walls per section 07 84 00, or butyl rubber for exterior surfaces including walls.

2.04 SEALANT COLORS

A. Provide materials matching colors indicated or if no color is indicated, matching the color samples selected from those submitted to the Architect.
   1. Sealant between walls and door, window, and louver frames to match adjacent wall color.

2.05 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing Rod: ASTM C1330 Class C, closed cell polyethylene cylindrical backer rod; oversized 30 to 50 percent larger than joint width, Green Rod by Nomaco Inc., Zebulon, NC, Backer Rod Mfg. Denver, CO or equal.

D. Elastomeric Tubing Sealant Backing: ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

F. Filler: Mineral fiber board; ASTM C612, Class1, thickness same as joint, depth to fill void completely behind backer-up rod.

G. Tape Sealants: pressure sensitive, 100% solid, sealing tape with a release paper backing. Provide permanent elastic, non-sagging, non-toxic, non-staining tape sealant. Schnee-Morehead Inc. "Tacky Tape" SM5227, 3/32" or 1/2" wide x 3/8" thick x 45' long, or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces and joint openings are ready to receive Work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter which might impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions.

D. Protect elements surrounding the Work of this Section from damage or disfiguration.

E. At deep joints install filler material to fill space behind the back-up rod and position the rod at proper depth.

3.03 INSTALLATION

A. Do not proceed with sealant Work until the sample joints specified in Part 1 of this Section have been prepared and accepted by the Architect.

B. Install sealant in accordance with manufacturer's instructions and ASTM C1193.

C. Apply sealant per ASTM C919 at gypsum board framed sound walls, side of runners in metal framing and miscellaneous openings and cutouts.

D. Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.

E. Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.

F. Install bond breaker where joint backing is not used.

G. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

H. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

I. Tool joints concave unless detailed otherwise.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joint as follows:
      a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
      b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per evaluation.
   2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.
      c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
   4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
   5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

A. Clean adjacent soiled surfaces.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished installation under provisions of Division 01, General Requirements.

B. Protect sealants until cured.

END OF SECTION

SECTION 07 95 13

EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies for roofs, walls, ceilings and floor surfaces.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM - American Society for Testing and Materials
   1. ASTM E119 - Methods for Fire Tests of Building Construction and Materials.
   2. ASTM E1399 - Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.

C. ADA - Americans with Disabilities Act of 1990, as amended.
   1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

D. 2019 California Referenced Standard Code (CCR Title 24, Part 12), Chapter 12-7-1 Fire Resistive Standards.

1.03 SUBMITTALS

A. Product Data: Provide joint assembly profiles, dimensions, locations in Work, affected adjacent construction, anchorage devices, available colors and finish and locations of splices.

B. Shop Drawings: Provide the following for each joint system specified:
   1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirement, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
   2. Detailing of anchorage devices.

C. Three samples illustrating profile, dimension, color and finish and flexible seal selected.

D. Manufacturer's Installation Instructions, Indicate rough-in sizes. Provide templates for cast-in or placed frames or anchors and indicate tolerances for item placement.

E. UL or California State Fire Marshal approval numbers on assemblies submitted.

F. Certification that products meet ASTM E119 fire classification tests and ASTM E1399 joint movement capability.

1.04 FIELD MEASUREMENTS

A. Verify that field measurements are as instructed by manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. C/S Group, Conspec Systems, Muncy, PA.
   2. MM System Corp., Pendergrass, GA.
   3. Watson-Bowman-Acme Corp., Amherst, NY.
   4. JointMaster/InPro Corporation, Muskego, WI.
   5. Thermal Structures Inc., Corona, CA.
   6. Balco Inc.
   7. Emseal Joint Systems, Westborough, MA.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Refer to drawings for type of assemblies required in specific locations.

B. Types:
   1. Series ASM-200, aluminum exterior wall joint covers, extruded aluminum with "Duroflex" gasket (polyethylene vapor barrier).
   2. Emseal Seismic Colorseal expansion joint. Colors as selected by Architect.
   3. Refer to drawings for widths.

2.03 FABRICATION

A. Back paint components in contact with cementitious materials.

B. Galvanize embedded ferrous metal anchors and fastening devices.

C. Shop assemble components and package with anchors and fittings.

D. Provide joint components in single length wherever practical. Minimize site splicing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that joint preparation and affected dimensions are acceptable.

3.02 PREPARATION

A. Provide anchoring devices for installation and embedment.

B. Provide templates and rough-in measurements.

3.03 FABRICATION

A. Furnish units in longest practicable lengths.

B. Provide hairline joints, miter corners.

C. Provide closure materials, transition pieces, T-joints, corner, curbs, cross-connections and accessories required to provide continuous joint cover assemblies. Provide a silicone bead at all transitions in addition to items listed above to provide a water tight connection between all joints.

3.04 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor components to substrate to prevent misalignment.

3.05 PROTECTION OF FINISHED WORK

A. Do not permit traffic over unprotected floor joint surfaces.

B. Provide removable strippable coating or reinforced cloth tape protect finish surface.

END OF SECTION

SECTION 08 12 13

HOLLOW METAL FRAMES - WELDED

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Non-rated and Fire-rated Welded steel frames for doors ,transoms , and borrowed lights.

B. Related Sections
   1. Section 06 20 00, Finish Carpentry - Installation of Doors.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. SDI - Steel Door Institute.
   1. SDI 100 - Recommended Specifications for Standard Steel Doors and Frames, Latest Edition.
   2. SDI 111 - Recommended Standard Details Steel Doors and Frames.
   3. SDI 117 - Manufacturing Tolerances Standard Steel Doors and Frames.
   4. SDI 118 - Basic Fire Door Requirements.
   5. SDI 134 - Glossary of Terms for Hollow Metal Doors and Frames.

C. ANSI - American National Standards Institute
   1. ANSI A250.4 and A450.5 - Test Procedure / Acceptance Criteria for Physical Conformance.
   2. ANSI A250.6- Hardware on Steel Doors (Reinforcement Applications).
   3. ANSI A250.8/SDI-100 - Recommended Specifications for Standard Steel Doors and Frames, Latest Edition.
   4. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Steel Surfaces for Steel Doors and Frames.
   5. ANSI A250.11/SDI-105 - Recommended Erection Instructions for Steel Frames.

D. ASTM - American Society for Testing and Materials
   1. ASTM A653 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc - Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A924 – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   3. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   4. ASTM D6386 – Preparation of Hot-Dipped Galvanized Coated Iron and Steel and Hardware Surfaces for Painting.

E. ADA - Americans with Disabilities Act of 1990, as amended.
   1. ADA Standards – ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

F. CBC - 2019 California Building Code.

G. CRSC - California Referenced Standards Code (CCR Title 24, Part 12)
   1. CRSC-7A.2 - Standard 12-7A-2, Exterior Windows
   2. CRSC-7A.4 - Standard 12-7A-4 Fire Resistive Standards, Fire Door Assemble Tests
   3. CRSC-10.2 - Standard 12-10-2 Single Point Latching or Locking Devices
   4. CRSC-10.3 - Standard 12-10-3 Emergency Exit and Panic Hardware

H. NFPA - National Fire Protection Association
   1. NFPA 80 - Fire Doors and Windows

I. UL - Underwriters Laboratories, Inc.
   1. UL-10B - Fire Test of Door Assemblies
   2. UL 10C - Positive Pressure Fire Tests of Door Assemblies

J. Standard 12-7-4 Fire Resistive Standards, Fire Door Test Assembly Tests - California Referenced Standards Code, CCR Title 24, Part 12.

K. AWS - American Welding Society
   1. AWS A2.4 - Standard Symbols for Welding, Brazing and Non Destructive Examination
   2. AWS A5.1 - Carbon Steel Electrodes for Shielded Metal Arc-Welding
   3. AWS A5.5 - Low Alloy Steel Electrodes for Shielded Metal Arc-Welding
   4. AWS B2.1 - Welding Procedure and Performance Qualification
   5. AWS D1.1 - Structural Welding Code, Steel
   6. AWS D1.3 - Structural Welding Code, Sheet Steel

1.03 SUBMITTALS

A. Shop drawings indicating frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement and finish.

B. Product data.

C. Manufacturer's installation instructions.

D. Job Closeout: provide one complete manufacturer's catalog to Owner's lock shop or Authorized Representative.

1.04 QUALITY ASSURANCE

A. Manufacture frames to conform to SDI standards except where exceeded by this Specification.

B. Comply with ANSI/SDI A250.4 Level A, one million cycle swing test performance for 3070 door frames.

C. Manufacturer: Company specializing in manufacturing products specified in this Section having minimum five (5) years experience.

D. Installer: Firm with minimum five (5) years experience in installation of metal doors and frames.

1.05 DELIVERY, STORAGE AND PROTECTION

A. Deliver and protect frames with manufacturer's shipping safeguards.

B. Attach spreader bars on welded frames to preclude warping or bending during delivery and storage.

C. Storage: Store in dry secure location. Place units on minimum 4 inch high wood blocking. Avoid non-vented plastic or canvas shelters. Provide 1/4 inch wide spaces between stacked units.

1.06 WARRANTY

A. One-year warranty against defects in materials and workmanship. Warranty to commence at Date of Certified Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
1. Ceco Door, Milan, TN.
2. Curries Company, Mason City, IA.
3. Door Components, Inc., Fontana, CA.
4. Mesker Doors, Huntsville, AL.
5. Republic Doors and Frames, McKenzie, TN.
6. SteelCraft, an Allegion Brand, Dublin, Ireland.

B. Or equal in accordance with Division 01, General Requirements for Substitutions.

2.02 WELDED FRAMES

A. Type: ANSI A250.8/SDI-100, Level 1 Standard Duty frames, Transom frames with integral stop and flat trim, double rabbet, profiles as indicated on Drawings, cold rolled steel, Commercial Steel, ASTM A1008, galvanized steel ASTM A653 and ASTMA924 for exterior applications. Minimum: 16 gauge.
1. Drywall: Provide backbend returns.
2. Plaster: Keyed-in-frame backbends.

B. Anchors: Provide two anchors at head for openings up to 48 inches, three if wider, maximum 30 inches on centers. Provide three at jamb for doors up to 84 inches in height, additional anchors at maximum 30 inches on centers for higher doors.
1. Provide appropriate type of anchors consistent with type of wall construction for each installation and in conformance with SDI 111 and ANSI 250.11.

C. Floor Attachment: Provide adjustable base anchor with extension for expansion anchor attachment to concrete floor. Extension factory welded. Minimum thickness: 14 gauge.

1. Wedge Type: KWIK Bolt TZ, 3/8 to 3/4 inch diameter, ICC ESR-1917, by Hilti Inc., Tulsa, OK.
2. Monolithic Concrete Slabs: Clip-type anchors, with holes to receive fasteners.

D. Hardware Attachment: Mortise, reinforce, drill and tap at factory to receive specified hardware. Install minimum 10 gauge reinforcing welded to frame for surface mounted hardware, except install 7 gauge reinforcing for hinges. Tap to templates.
1. Install reinforcing for closers, both sides of frames, on all frames, single and pairs, labeled and non-labeled.
2. Use 10 Gauge reinforcing for locks, panics, closers, and hold-open arms.

E. Silencers: Make provision for minimum three rubber silencers at strike jamb of all doors except fire-rated doors, and one at head of each leaf of double doors, except fire-rated doors.

F. Fire-Rated Frames:
1. Construct as tested and rated in accordance with SDI 118.
2. Conform to Standard 12-7-4 Fire Resistive Standards, Fire Door Test Assembly Tests - California Referenced Standards Code, CCR Title 24, Part 12 and NFPA 80.
3. Attach UL or WH label to frame.
4. Solid grout frames abutting against masonry and concrete walls.
5. Refer to drawings for rating requirements.

2.03 PROTECTIVE COATINGS

A. Interior Frames:
1. Metallic coating protection not required.
2. Pretreat and shop prime, air-dried, conforming to ANSI A250.10.
3. Approved Primer: Series 115 Uni-Bond DF @ 2-4 mils DFT Gray, by Tnemec or equal.
4. Finish paint frames under Section 09 90 00 Painting, colors per Finish Schedule on Drawings.

B. Exterior Frames:
1. Metallic coating protection required: ASTM A653, zinc type G60 Grade designation.
2. Pretreat and shop prime, air-dried, conforming to ANSI A250.10.
3. Finish paint frames under Section 09 90 00, colors per Finish Schedule on Drawings.
4. Wipe coat galvanized steel is not permitted.

C. On surfaces where metallic coating has been damaged or removed during fabrication, frames shall be touched-up with factory-applied primer.

2.04 FABRICATION

A. Fabricate exterior welded steel door frames machine-mitered and full welded (Continuously Welded) unit type. Weld and grind smooth. No intermittent welds or plate splices permitted at intersections.

B. Fabricate interior welded steel door, borrowed lights , and transom frames as machine-mitered face-welded unit type. Weld and grind smooth.
   1. Where cross mullions or T intersections occur, frames shall be fabricated as butted and face-welded assembly joints. At mullion-to-base intersections extend mullion to floor and face weld. Where butted joints are exposed to weather, seal intersection as specified in Section 07 92 00.

C. At borrowed lights , transom frames apply minimum 5/8-inch-high, 16 gauge channel stops. Attach with flat head machine screws, countersunk, tamper-proof type on outside of exterior frames.
   1. Channel stops to be located on outside of exterior frames and on secure side of interior frames.

D. Machine mitered faces and butt-joined integral stops permitted with continuous welds.

E. Fabricate frames with hardware reinforcement plates welded in place.

F. Fabricate frames to accept anchors as described in SDI-111 for type of wall construction.

G. Reinforce frames for door closers on both sides of frames.

H. Apply primer to all surfaces of frames, in accordance with requirements of ANSI A250.10. Metallic-coated protected surfaces shall be pretreated prior to application of primer.

I. Attach fire-rated label to each fire-rated door frame.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install frames in accordance with ANSI A250.11/SDI-105.
   1. Installation of jamb anchors to steel framing: Per SDI-105.
   2. Install Floor anchors, 1 clip angle per jamb with expansion wedge type anchor.
   3. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

B. Fire doors frames shall be installed in accordance with their listing, Standard 12-7-4 Fire Resistive Standards, Fire Door Assembly Tests California Referenced Standards Code, CCR Title 24, Part 12, and NFPA No. 80, and the manufacturer's instructions.

C. Install insulation behind frames, unless noted otherwise.

D. Coordinate anchor placement with type of wall construction.

E. Paint frames under Section 09 90 00, Painting.

3.02 TOLERANCES

A. Conform to standard of tolerances as required in SDI-117.

END OF SECTION

SECTION 08 13 13

HOLLOW METAL DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire-rated rolled-steel doors.

B. Related Sections:
   1. Section 06 20 00, Finish Carpentry - Installation of Doors.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990, as amended.
   1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

C. SDI - Steel Door Institute.
   1. SDI 100 - Recommended Specifications for Standard Steel Doors and Frames, Latest Edition.
   2. SDI 118 - Basic Fire Door Requirements.
   3. SDI 111 - Standard Details Steel Doors and Frames .
   4. SDI 117 - Manufacturing Tolerances Standard Steel Doors and Frames.

D. ANSI - American National Standards Institute
   1. ANSI A250.4 - Test Procedures and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings.
   2. ANSI A250.5 - Accelerated Physical Endurance Test Procedure for Steel Doors, Frames, and Frame Anchors.
   3. ANSI A250.8/SDI 100 - Recommended Specifications for Standard Steel Doors and Frames.
   4. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
   5. ANSI A250.11/105 - Recommended Erection Instructions for Steel Frames.

E. ASTM - American Society for Testing and Materials
   1. ASTM A653 - Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A924 - General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   3. ASTM A1008 - Standard Specifications for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   4. ASTM A568 - General Requirements for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

F. CBC - 2019 California Building Code
   1. CBC-10 - CBC Chapter 10, Means of Egress
   2. CBC-11 - CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing

G. CRSC - California Referenced Standards Code (CCR Title 24, Part 12)
   1. CRSC-7A.4 - Standard 12-7-4 Fire Resistive Standards, Fire Door Assemble Tests
   2. CRSC-10.2 - Standard 12-10-2 Single Point Latching or Locking Devices
   3. CRSC-10.3 - Standard 12-10-3 Emergency Exit and Panic Hardware

H. NFPA - National Fire Protection Association
   1. NFPA 80 - Fire Doors and Windows
   2. NFPA 105 - Installation of Smoke Door Assemblies
   3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies

I. UL - Underwriters Laboratories, Inc.
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies
   2. UL 1784 - Air Leakage Test for Door Assemblies

J. ITS-WH - Intertek Testing Services-Warnock-Hersey.

1.03 SUBMITTALS

A. Shop drawings indicating core material, location of cutouts for hardware, reinforcement and finish.

B. Product data.

C. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Manufacture doors to conform to SDI standards except where exceeded by this Specification.

B. Comply with ANSI/SDI A250.4 Test Procedure and Acceptance Criteria for - Physical Endurance for Steel Doors and Hardware Reinforcings. Level A, one million cycle swing test performance.

C. ADA-The Americans with Disabilities Act - Title II-Uniform Federal Accessibility Standards.

1.05 DELIVERY, STORAGE AND PROTECTION

A. Deliver and protect doors with manufacturer's shipping safeguards.

B. Storage: Store in dry secure location. Place units on minimum 4-inch high wood blocking. Avoid non-vented plastic or canvas shelters. Provide 1/4-inch wide spaces between stacked doors.

1.06 WARRANTY

A. One-year warranty against defects in materials and workmanship. Warranty to commence at Date of Certified Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form the basis for design and quality intended.
   1. Ceco Door, Milan, TN.
   2. Curries Company, Mason City, IA.
   3. Door Components, Inc., Fontana, CA.
   4. Mesker Doors, Huntsville, AL.
   5. Republic Doors and Frames, McKenzie, TN.
   6. SteelCraft, an Allegion Brand, Dublin, Ireland.

B. Or equal in accordance with Division 01, General Requirements for Substitutions.

2.02 DOORS

A. Interior Doors: ANSI A250.8/SDI-100, Level 2, Heavy-Duty, Physical Performance Level B, 1-3/4 inches thick, Model 2 Seamless, 18 gauge cold-rolled face sheets, ASTM A1008, seamless continuously welded seam dressed smooth, hollow-steel construction, Close top and bottom with flush end closure, beveled edge profile, sizes as scheduled on drawings, prime coated only.

B. End Closures: Minimum 18 gauge.

C. Fire Rated Doors Assembly: Test in accordance with NFPA 252. CRSC California Referenced Standards Code, Standard 12-7-4, Fire Door Assembly Tests.

D. Fire Rated Doors: Label "S" for smoke assembly requirements, NFPA 80, NFPA 105.

2.03 DOOR CORE

A. Performance Test Procedures Requirements: Conform to ANSI A250.4

B. Core for Fire-Rated Doors: mineral core 16-20 lb. density (incombustible). Conform to Door Schedule for fire rating required.

C. Frames for Fire-Rated Doors: Conform to CRSC California Referenced Standards Code, Standard 12-7-4, fire door tests, Label "S" for smoke assembly requirements NFPA 105 and Section 08 12 13.

2.04 PROTECTIVE COATINGS

A. Interior Doors:
   1. Metallic-coating protection not required.
   2. Pre-treat and shop prime with modified alkyd, air-dried, conforming to ANSI A250.10.

B. On surfaces where zinc has been damaged or removed during fabrication, doors shall be touched-up with factory-applied primer.

2.05 FABRICATION

A. Fabricate doors from cold-rolled steel conforming to ASTM A1008/A1008M or ASTM A924. Stretcher-leveled standard of flatness for face sheets.

B. Manufacturing tolerances per SDI 117 - Manufacturing Tolerances Standard Steel Doors and Frames.

C. Fabricate doors with cutouts sized for hardware and openings as indicated. Non-handed doors using hinge fillers are not permitted.

D. Reinforce, drill and tap doors to receive mortise hinges, locks, latches, flush bolts and closer. Use reinforcing gauges as listed in Table 4 of ANSI A250.8/SDI-100. Channel or plate reinforcing only.

E. Locate hardware according to Table 5, ANSI A250.8/SDI-100, CBC 11B-404.2.7.

F. Apply primer to all surfaces of doors in accordance with requirements of ANSI A250.10. Metallic-coated surfaces shall be pre-treated prior to application of primer.

G. Attach fire-rated label to hinge-stile of each fire-rated door unit and frames.

H. Hardware Enclosures: Provide enclosures and junction boxes within doors for electrically operated door hardware, interconnected with UL-approved, 1/2-inch-diameter conduit and connectors. Where indicated for installation of wiring, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least 4 security fasteners spaced not more than 6 inches on centers.

PART 3 - EXECUTION

3.01 INSTALLATION OF HOLLOW METAL DOORS

A. Install doors in accordance with SDI ANSI A250.11/105 and SDI 122 recommendations.

B. Install doors under Section 06 20 00 Finish Carpentry - Installation of Doors.

C. Coordinate installation of glass or louvers where indicated.

3.02 ADJUSTING AND CLEANING

A. Adjust for smooth and balanced door movement.

B. Paint doors under Section 09 90 00, colors per Finish Schedule on Drawings.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wood doors, fire-rated and non-rated.

B. Glass stops.

C. Related Sections:
   1. Section 01 35 42, CALGreen Requirements.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ANSI A208.1 - American National Standard -Particleboard.

C. WDMA I.S.1A - (Latest Edition) - Window and Door Manufacturers Association.

D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

E. Chapter 7 and 10, 2019 California Building Code.

F. ADA - Americans with Disabilities Act of 1990, as amended.
   1. ADA Standards ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

G. WI - Manual of Millwork, Architectural Woodwork Standards (AWS), Latest Edition.

H. CBC - 2019 California Building Code
   1. CBC-10 - CBC Chapter 10, Means of Egress
   2. CBC-11 - CBC Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing

I. California Green Building Standards Code, CALGreen - 2019.

J. CRSC - California Referenced Standards Code (CCR Title 24, Part 12)
   1. CRSC-7A.4 - Standard 12-7A-4 Fire Resistive Standards, Fire Door Assemble Tests
   2. CRSC-10.2 - Standard 12-10-2 Single Point Latching or Locking Devices
   3. CRSC-10.3 - Standard 12-10-3 Emergency Exit and Panic Hardware

K. NFPA - National Fire Protection Association
   1. NFPA 80 - Fire Doors and Windows
   2. NFPA 105 - Installation of Smoke Door Assemblies

3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies

L. UL - Underwriters Laboratories, Inc.
1. UL-10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Fire Tests of Door Assemblies

M. WH - Warnock-Hersey Laboratory

N. ITS-WH - Intertek Testing Services-Warnock-Hersey.

1.03 SUBMITTALS

A. Shop drawings indicating door elevations, types, hand, thickness, stile and rail reinforcement, internal blocking for hardware attachment and cutouts.

B. Product data.

C. CALGreen Submittals:
1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.I.

D. Three samples for transparent finish doors provide two 36 x 36 inches samples, of each door type specified, illustrating each face veneer specified. Samples shall illustrate core material and finish choice.

E. Manufacturer's installation instructions.

F. Certificate of Compliance for fire-rated doors.

1.04 QUALITY ASSURANCE

A. Conform to Standard 12-7-4 Fire Resistive Standards, Fire Door Assemble Tests - California Referenced Standards Code, CCR Title 24, Part 12 and NFPA 80.

B. Provide doors from one manufacturer only.

C. Doors shall be manufactured in accordance with Section 12 of the Latest edition of the Architectural Woodwork Standards (AWS) of the Woodwork Institute for Premium Grade, Hot Press 5-Ply construction, bonded construction, or to higher standards as specified herein.

D. Before delivery to jobsite, door supplier shall submit WI Certified Compliance Certificate, countersigned by manufacturer, indicating products he will furnish for this job and certifying that they will fully meet requirements of grade or grades specified.

E. First page of shop drawings shall bear WI Certified Compliance Label. Shop drawings not conforming to this requirement will be rejected.

F. One (1) copy of latest issue of WI Architectural Woodworks Standards (AWS) shall be made available for reference at jobsite throughout installation period.

G. Upon completion, WI Certified Compliance Certificate, countersigned by manufacturer, shall be submitted.

H. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3
   3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.

1.05 DELIVERY, STORAGE AND PROTECTION

A. Protect doors with resilient packaging, sealed with heat shrunk plastic or other manufacturer's shipping safeguards.

B. Package, deliver and store doors in accordance with WI requirements.
   1. Store in dry, broom-clean area.
   2. Protect materials from damage.
   3. Replace units damaged, warped or otherwise not usable.

C. Exposed wood at tops, bottoms and cutouts for hardware and accessories: Seal prior to shipment.

1.06 WARRANTY

A. Provide documentation under provisions of Division 01, General Requirements.

B. Provide Life-of-Original-Installation Warranty for solid core interior doors.
   1. Warranty shall state that doors will not warp, twist, bend, shrink, the veneers buckle or delaminate, or the joints open for the warranty period. Any door of 25 square feet or larger may have a warp or twist of not more than 1/4 inch in eight feet. Any door that develops defects within the scope of the warranty shall be replaced with a new door without expense to the Owner.
   2. During the first year of warranty, replacement doors shall be delivered to the Contractor for installation.
   3. During the succeeding years of the warranty, replacement doors shall be delivered to the building in which defective door is located. Bill of lading shall indicate the name of the building and room or location where door is to be replaced. Warranty shall include cost of removal of defective unit, installation of replacement and finishing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Marshfield Door Systems Inc., Marshfield, WI.
   2. Eggers Industries, Two Rivers, WI.
   3. VTI Industries, Holstein, IA.

4. Algoma Architectural Doors, Algoma, WI.
5. Oshkosh Door Company, Oshkosh, WI.
6. Haley Bros., Inc., Buena Park, CA.
7. Graham Wood Doors, Mason City, IA.
8. ABS Manufacturing, Stockton, CA.
9. Western Oregon Door, Winston, OR.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 DOOR CONSTRUCTION TYPES

A. Particle Board Core PC-5 (Non-Fire-Rated)
1. Thickness: 1-3/4 inch.
2. Face:
a. Transparent Finish:
1) Grade: Premium, Grade "AA" faces .
2) Face: wood veneer, species; Select Select White Maple hardwood veneer, sapwood.
3) Cut: plain sliced.
4) Matching: balance slip match for leaf matching.
5) Pair Match: Balance Match for doors in pairs.
6) Set Match: Balance Match for doors in sets.
3. Crossband: Hardwood veneer or engineered high-density fiberboard, 1/16 inch thick.
4. Stiles: Stiles same species at transparent finish.
5. Top and Bottom rails: 1-1/8 inch hardwood or softwood mill option, bonded to core.
6. Face Assembly Adhesive: Type I, waterproof.
7. Core Assembly Adhesive: Type II, water-resistant.
8. Core: Particleboard, 28 lb. low density, ANSI A208.1, Table A, Grade LD-2.
9. Moisture Stripping: Sealed edges.
10. Acoustical rating: 31 STC
11. Blocking for Hardware: Flame resistant, 6 inch top edge for closers, 5.5 inches for bottom hardware or automatic closers where applicable, 5 x 18 inch lock blocks, 5.5 inch cross blocking for panic hardware, 5 x 12 inch for floor closers or pivot hinges where applicable.
12. Performance Rating: Extra Heavy Duty.

B. Particle Board Core - PC-5 20PP (20 minute fire rated, Positive Pressure), S-Label, smoke and draft rated.
1. Thickness: 1-3/4 inch.
2. Face:
a. Transparent Finish:
1) Grade: Premium, Grade "AA" faces .
2) Face: wood veneer, species; Select Select White Maple hardwood veneer, sapwood.
3) Cut: plain sliced.
4) Matching: balance slip match for leaf matching.
5) Pair Match: Balance Match for doors in pairs.
6) Set Match: Balance Match for doors in sets.

3. Crossband: Hardwood veneer or engineered high density fiberboard, 1/16 inch thick.
4. Stiles: Stiles same species at transparent finish. Factory install concealed intumescent seals per UL 10C, Category A.
5. Top and Bottom Rails: 1-1/8 inch hardwood or softwood mill option, bonded to core. Install intumescent seals per UL 10C at top rail.
6. Face Assembly Adhesive: Type I, waterproof.
7. Core Assembly Adhesive: Type II, water-resistant.
8. Core: Particleboard, 28 lb. low density, ANSI A208.1, Table A Grade LD-2
9. Moisture Stripping: Not applicable.
10. Acoustical rating: 29 STC
11. Blocking for Hardware: Flame resistant, 6 inch top edge for closers, 5.5 inches for bottom hardware or automatic closers where applicable, 5 x 18 inch for lock blocks, 5.5 inches cross blocking for panic hardware, 5 x 12 inch for floor closers or pivot hinges where applicable.
12. Performance Rating: Extra Heavy Duty.

C. Pair of doors in exits: Minimum width of doors, 32 inches, to allow a clear unobstructed opening of 32 inches in width when door is positioned at an angle of 90 degrees from its closed position.

2.03 ACCESSORIES

A. Glass Stop: Unit frame, Model FGS 75 manufactured by Anemostat Products Division, Carson, CA, or equal as approved in accordance with Division 01, General Requirements for Substitutions, for fire-rated and non-fire-rated doors.
1. Frame: 18 gauge.
2. Finish: Beige baked enamel primer, paint per Section 09 90 00 [shop finish, baked enamel color], color as selected by Architect.
3. Glass: Refer to Section 08 80 00.
4. Mounting: Countersink, one-way vandal resistant heads, through bolts.

B. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

C. Ratings: For doors specified.

2.04 FABRICATION

A. Fabricate non-rated doors in accordance with WI Quality Standards and WDMA I.S.1-A.

B. Fabricate fire-rated doors in accordance with WI Quality Standards and WDMA I.S.1-A-Latest Edition and to UL or WH requirements. Attach permanent metal fire-rating label to door edge, either on hinge stile or top edge.

C. Intumescent Seals: Fabricate fire-rated doors with intumescent seals in accordance with UL 10C, Category A, for positive pressure compliance. Furnish flush with door edge type intumescent seals, exposed at top rail and veneer-covered at stiles. Frame Surface-applied adhesive seals, Category B, not permitted.

D. Pre-machine doors at factory for finish hardware. Cutouts for hardware in doors having a fire rating of 20 minutes or more shall be accomplished at the factory before labels are affixed. Preparation shall be performed in accordance with manufacturer's inspection service procedure and under label service.

E. Medium density overlay shall be readily sandable. Hardboard surface material not permitted.

F. Only five-ply hot-press construction is permitted.

G. Veneer: Face veneer grain shall run vertically; crossband veneer run horizontally.

H. Transom Panels: Same construction as doors. For transparent finish: continuous match.

2.05 FACTORY FINISH

A. Factory Finish: Premium finish, meet or exceed performance standards of WI System 4 Conversion Varnish, clear and opaque. Factory-finished doors shall be installed just prior to Substantial Completion.
   1. Stained and sealed finish: Refer to Finish Schedule on Drawings and as selected by Architect.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Section 06 20 00.

3.02 INSTALLATION TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge corner to corner, or as required to meet door warranty.

B. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire-rated and non-rated access doors and frames in walls and ceilings and Stainless Steel access panels in tile walls as indicated.

B. Fire Rated Access Panel Enclosure for elevator rated shafts.

C. Related Sections:
1. Section 09 90 00, Painting: Field paint finish.
2. Division 21- Fire Suppression.
3. Division 22 - Plumbing.
4. Division 23 - HVAC: Locations and requirements for access doors.
5. Division 26 - Electrical: Locations and requirements for access doors.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. UL - Underwriter's Laboratories.

C. WH - Warnock Hersey.

D. NAAMM - National Association of Architectural Metal Manufacturers

1.03 SUBMITTALS

A. Shop Drawings: Indicate exact positions of all access units.

B. Product data including sizes, types, finishes, scheduled locations and details of adjoining Work.

C. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Manufacture fire-rated access doors and frames to conform to UL or WH requirements.

B. Provide labels indicating rating.

1.05 COORDINATION

A. Locations: Coordinate Work and locations with plumbing, mechanical, electrical and fire sprinkler systems work requiring access units.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Milcor Incorporated; Holland, OH.
   2. The Bilco Company, New Haven, CT.
   3. Karp Associates, Inc.; Maspeth, NY.
   4. JL Industries Incorporated; Bloomington, MN.
   5. Larsen's Manufacturing Company; Minneapolis, MN.
   6. Nystrom Building Products; Minneapolis, MN.
   7. Williams Brothers Corporation of America; Reno, NV.
   8. Elmdor Access Doors, City of Industry, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 REGULATORY DESCRIPTION

A. Attic Spaces: an opening not less than 20" x 30" shall be provided to any attic area having a clear height over 30". Clear headroom of not less than 30" shall be provided in the attic space at or above the access opening.

2.03 FABRICATION

A. Fabricate components so as to be straight, square, flat and in same plane where required. Slightly round exposed edges and provide access without burrs, snags and sharp edges. Size: Minimum of 24 inches by 30 inches, unless otherwise specified in this Section or shown/noted on mechanical or electrical Drawings.

B. Weld continuous, fill and grind joints smooth to assure flush and square unit.

C. Hardware: 175 degree steel hinges with removable pin.

D. Number of locks and non-continuous hinges shall be as required to maintain alignment of panel with frame.

E. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors as required to secure access door in opening.

2.04 ACCESS DOORS, FIRE RATED

A. Universal FIRE-RATED DOOR, style Milcor UFR prime painted with concealed hinges, size 24 inch x 30 inch, with 1-1/2 hour label fire rating, automatic closing device.

B. FIRE RATED ACCESS PANEL ENCLOSURES - ELEVATORS SHAFTS: Model WB-FR, B.L. Wilcox/JJM Construction Access Enclosure, with concealed hinges, sizes: 10" x 10" and 12" x 12" , with 1-1/2 hour Label B fire rating, automatic closing device with lock. Vertical or horizontal application.
   1. Enclosure: Welded expanded steel metal cage with shelf.
   2. Door Panel: 18 gauge steel
   3. Frame and trim: 16 gauge steel
   4. Door Core: 1-7/8" mineral wool insulation
   5. Hinge: fully concealed, pivot type, opening to 140 degrees.
   6. Latches: self-latching direct action latch, opposite hinge. For Knurled knob or key.
   7. Automatic Panel Closer and inside panel release: standard
   8. Finish: baked enamel, grey

C. Door Panel: Form of minimum 20 gauge thick steel sheet, insulated sandwich type construction.

D. Frame: Form of minimum 16 gauge steel sheet of depth and configuration to suit material and type of construction where installed. Provide frame flange at perimeter where installed in concrete, masonry, or existing openings. Weld exposed joints in flange and grind smooth. Provide expanded galvanized metal lath perimeter wings when installed in plastered partitions.

E. Automatic Closing Device: Provide automatic closing device for each door.

F. Hinge: Continuous steel hinge with stainless steel pin.

G. Lock: Self-latching, flush-mounted paddle latch with key-operated cylinder lock with two keys. Interior latch release device operable from inside of door.

2.05 ACCESS DOORS, FLUSH PANEL

A. In Gypsum Board framed for walls and ceilings:
   1. Milcor Model DW prime painted or stainless steel with concealed hinges, size 24 inch x 30 inch, unless noted otherwise, Acudor Specialty

B. In plaster walls and ceilings: Milcor Model K, size 24" x 30".

C. In cement plaster, masonry concrete: Milcor Model M, prime painted, 14 gauge frame and door panel, size 24 x 30 inches, unless noted otherwise..

D. Door Panel: Form of 14 gauge, for DW and K, thick steel or 16 gauge thick stainless steel sheet. Reinforce as required to maintain flat surface.

E. Frame: Form of 16 gauge thick steel or stainless steel sheet of depth and configuration to suit material and type of construction where installed. Provide surface mounted units having frame flange at perimeter where installed in concrete, masonry, or existing construction. Weld exposed joints in flange and grind smooth. Provide expanded galvanized metal lath perimeter wings when installed in plastered partitions.

F. Hinge: Concealed spring hinge to allow panel to open 175 degrees. Provide removable hinge pin to allow removal of panel from frame.

G. Lock: Flush, with key operated steel cam latch.

2.06 FINISH

A. Provide in accordance with NAAMM Metal Finishes Manual on exposed surfaces.

B. Steel Surfaces: Chemically bonded prime coat of baked-on electrostatic powder. Paint finish under Section 09 90 00.

C. Stainless Steel: Type 304, No. 4 finish, for exposed surfaces.

PART 3 - EXECUTION

3.01 LOCATION

A. Provide wall, ceiling access doors wherever valves, traps, dampers, cleanouts or other control items of mechanical or electrical work are concealed in walls, partitions, or gypsum board or plaster ceiling construction and as indicated on drawings.

B. Use fire-rated doors in fire-rated partitions and ceilings.

C. Use flush panel doors in partitions and ceilings, except lay-in acoustical panel ceilings or upward access acoustical tile ceilings.

3.02 INSPECTION

A. Verify rough openings for door and frame are correctly sized and located.

B. Beginning of installation means acceptance of existing conditions.

3.03 INSTALLATION

A. Install frame plumb and level in ceiling openings.

B. Position to provide convenient access to concealed Work requiring access.

C. Secure rigidly in place in accordance with manufacturer's instructions.

D. Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling grid or side walls when installed in ceiling. Set frames so that edges of frames without flanges will finish flush with surrounding finish surfaces. Set frames with flanges to overlap opening and so that face will be uniformly spaced from finish surface. Set access doors recessed so that face of surrounding materials will finish on same plane when door is installed.

E. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through frame members. Type, size and number of anchoring devices shall be suitable for material surrounding opening, and as required to maintain alignment and resist displacement during normal use of access door and building. Anchors for fire-rated access doors shall be as required by related fire test.

F. Adjust hardware so that door panel will open freely, and when closed door panel will be centered within frame.

G. Paint per Section 09 90 00, Painting . Color and gloss to match adjacent wall.

END OF SECTION

SECTION 08 41 13

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aluminum doors, frames, glazing components and glazed lights.

B. Shadow Boxes.

C. Anchors, brackets and attachments.

D. Door hardware.

E. Perimeter sealant.

F. Partition Closures.

G. Related Sections:
1. Section 08 71 00, Door Hardware.
2. Section 08 71 05, Acoustical Door Gaskets.
3. Section 08 80 00, Glazing.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM - American Society for Testing and Materials
1. ASTM A36 - Structural Steel.
2. ASTM A123 - Zinc (Hot-Dip Galvanized) coatings on Iron and Steel Products.
3. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.
4. ASTM E90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
5. ASTM E283 - Rate of Air Leakage through External Windows, Curtain Walls and Doors.
6. ASTM E330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
7. ASTM E331 - Water Penetration of Exterior Windows, Curtain Walls and Doors.
8. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation.
9. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
10. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylights, and Glazed Wall Systems.

C. AAMA - American Architectural Manufactures Association: AAMA 501 - Methods of Test for Exterior Walls. (Mfg's mock up tested in lab).

D. Test per AAMA 503-12 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.

E. AAMA TIR-A11-04 - Maximum Allowable deflection of Framing Systems for Building Cladding Components at Design Wind Loads.

F. AAMA 1801 - Voluntary Specification for the Acoustical Rating of Exterior Windows, Doors, Skylights, and Glazed Window Sections.

G. ADA - Americans with Disabilities Act of 1990, as amended.
   1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

H. CBC - 2019 California Building Code.

I. DSA - The Division of the State Architect.

J. ICC - International Code Council.

K. CPSC 16 CFR 1201- U.S. Consumer Products Safety Commission, Safety Standard for Architectural Glazing Material, Consumer Protection Safety Commission, Code of Federal Regulations. All glazing shall be tested in accordance with CPSC 16 CFR 1201. Glazing shall comply with the test criteria for Category II as indicated in Table 2406.2(1), 2019 CBC.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements
   1. System to provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F without causing detrimental effects to system or components.
   2. Design and size members to withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with requirements of Chapter 24, and Chapter 16A Section 1609A of CBC and ASCE 7 Chapter 6.
   3. Uniform Load: A static air design load of 20 psf shall be applied in the positive and negative direction in accordance with ASTM E330. No deflection in excess of L/175 of the span of any framing member up to 13'-6" and L/240 13'-6" plus 1/4" and above. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
   4. Limit water infiltration to zero at 12 pounds-force per square foot, ASTM E331.
   5. Air Infiltration: ASTM E283; maximum .06 cfm per square foot of fixed area when tested at 6.24 pounds per square foot (50 wind speed) static air pressure difference
   6. System to accommodate, without damage to system or components, or deterioration of perimeter seal: Movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; and deflection of structural support framing.

7. When a pair of doors is used, one of the doors to provide clear, unobstructed opening 32 inches in width with the door positioned at an angle 90 degrees from its closed position.
8. Noise Reduction: Test according to ASTM E90, with ratings determined by ASTM E1332.:

1.04 SUBMITTALS

A. Shop Drawings: including system and component dimensions; components with in assembly; framed opening requirements and tolerances; anchorage and fasteners; glass and infills; door hardware requirements; and affected related work.

B. Product data

C. Manufacturer's installation instructions.

D. Samples: Three samples, illustrating pre-finished aluminum surface and specified glass.

E. Deferred Approval
1. Installation of Aluminum Storefronts and Entrances shall not be started until detailed plans and specifications are approved by Division of the State Architect, (DSA).
2. DSA Approval: Manufacturer shall furnish Architect complete shop drawings and calculations as specified above, certified and stamped by Structural Engineer currently licensed in California. Manufacturer shall employ and pay Engineer for Certification of Drawings and Calculations.
   a. Architect will submit drawings and calculations to DSA for approval before fabrication.
   b. Show details of Aluminum Storefront fasteners and anchorage to structural members at head and jambs. Size of anchors and embedment lengths, use 80 percent of ICC Reports capacities for anchors. Key details to elevation section.
   c. Headers and king studs connections to structural beams and columns. Provide details keyed to elevations section.
   d. Provide calculations for worst case D+L+Seismic or wind loads, justify connections. Consider areas of discontinuity as required by CBC.
   e. Calculations required: analyze and design jamb and head elements (king studs, header beams).
   f. The aluminum mullions and cross pieces shall be designed by a Registered Engineer (with calculations) show sectional properties. Show connections between storefront and various elements.
3. Refer to Division 01, General Requirements for Deferred Approvals.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide wrapping or strippable coating to protect pre-finished aluminum surfaces.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.
2. Manufacturer Qualifications: Manufacturer capable of providing structural calculations, applicable independent product test reports, installation instructions, a review of the application method, customer approval and periodic field service representation during construction.
3. On access control installations, all wiring to be coordinated with a licensed electrical installer.

B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.07 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.09 WARRANTY

A. Provide under Provisions of Division 01 General Requirements.

B. Warranty: Include coverage for complete System installation for failure to meet specified requirements.
1. Failures include, but are not limited to the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Air and Water leakage through fixed glazing and framing areas.
   d. Failure of operating components to function properly.

C. Special Finish Warranty: Contractor agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 10 years

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Arcadia Inc., Vernon, CA.
   2. Kawneer Company, Inc., Visalia, CA.
   3. EFCO Corporation, Monett, MO.
   4. Oldcastle Glass/Vistawall Architectural Products, Terrell, TX.
   5. Wausau Window and Wall Systems, Wausau, WI.
   6. Graham Architectural Products

B. Or equal as approved in accordance with Division 01 General Requirements for Substitutions.

2.02 MATERIALS

A. Extruded Aluminum: ASTM B221; 6063-T6 alloy and temper.

B. Glazing Gaskets:
   1. EPDM elastomeric extrusions

C. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements

D. Steel Reinforcement Sections: ASTM, A36; shapes to suit mullion sections, ASTM A611 for cold-rolled sheets.

E. Touch-Up Primer for Galvanized Surfaces: Zinc-rich Type.

F. Fasteners: Stainless steel.

G. Sealant: per Section 07 92 00 Joint Sealers.

2.03 FABRICATED COMPONENTS

A. Frames: 2-1/4" x 6", profile with offset glazed. Minimum wall thickness of 0.08 inches. Framing Section Properties in confirmance with Wind Load and height requirements.
   1. Model:
      a. SF1: Arcadia TC670 Series: Thermally broken, captured, offset glazed, 1" glazing, 2-1/4" x 6".
      b. Screw Spline System.
      c. Or equal in accordance with Division 01, General Requirements

B. Entrances - Swing doors:
   1. Arcadia WS 512 HD, Heavy Duty
      a. Wide stile, size 2 inches x 5 inches, 5-1/8 inch top rail, offset pivot hinges. 10 inch bottom rail. Square glass stops. Thermally Broken.
      b. For 1" insulating glazing.
      c. Acoustical door gaskets as indicated in Schedule on Drawings.

C. Shadow Boxes: Comply requirements with Section 08 80 00.

D. Partition Closures - Aluminum: Sound Barrier Mullion Trip Cap Systems by Mull-it-Over or approved equal.
   1. Profile: 55 Classic Mullion Trim Cap
   2. Components:
      a. Aluminum Extrusions:
      b. Thickness: 0.125 inches.
      c. Profile: As selected and approved by Architect to allow solid attachment and fastening to the partition wall framing.
   3. Sound Absorbing Foam:
      a. Resistant to smoke, flame, and microbial growth.
      b. Fire Rating: ASTM E 84 Class 1.
      c. Fungi Resistance: Zero rating per ASTM G 21.
   4. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.
      a. Thickness: Standard 1/2 inch (12.7 mm), 3/4" (19.1 mm), 1 inch (25.4 mm) or 1-1/2" (38.1 mm) as required to accommodate mullion deflection.
      b. Color: Light gray
   5. Fasteners:
      a. Self Tapping or appropriate threaded fastener.
      b. Compatible with all materials fasteners will contact with and not causing galvanic corrosion.
   6. Snap Cover: Snap-on fastener cover.
   7. Acoustical Sound Sealant: Acrylic latex based.
   8. Accessories:
      a. Provide necessary and related parts and tools to complete installation.
   9. Finish: As selected by Architect.

E. Corner Mullions: 90 degree inside and outside corners, refer to drawings.

2.04 GLASS AND GLAZING MATERIALS

A. Tempered glass: All glazing shall be tested in accordance with CPSC 16 CFR 1201, and comply with the test criteria for Category II as indicated in Table 2406.2(1), 2019 CBC.

B. Glass in Exterior Lights and Doors: 1" thick insulating, tempered, tinted Low-E glass for TRIFAB VG 451T Thermal , as specified in Section 08 80 00.

C. Glazing: All units shall be "dry" glazed with EPDM gasket on both exterior and interior.

2.05 HARDWARE - DOORS

A. Applied Stop with weathering: Manufacturer's standard.

B. Sill Sweep Strips: Resilient seal type, Manufacturer's standard.

C. Threshold: Extruded aluminum, one piece per door opening 4 inches wide, 1/2 inch high, Manufacturer's standard.

D. Hinges: Refer to Section 08 71 00, Door Hardware.

E. Cross Rail: 3-1/2 inch high, Manufacturer's standard.

F. Pull Bars (non-panic locations): As specified in Section 08 71 00.

G. Panic Devices: As specified in Section 08 71 00.

H. Closer: As specified in Section 08 71 00.

I. Cylinder Lock: As specified in Section 08 71 00.

J. Weatherstripping:
   1. Meeting stiles on pairs of doors: adjustable astragal utilizing wool pile with polymeric fin.
   2. Single acting door and frame: thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.

K. Provide EPDM or vinyl-blade gasket weather-stripping in bottom of door rail, adjustable for contact with threshold.

2.06 FABRICATION

A. Fabricate doors and frames allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation. Door corner construction shall consist of mechanical clip fastening, Shielded Inert Gas Metal Arc deep penetration plug welds and 1-1/8" long fillet welds inside and outside of all four corners.

B. Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline and weatherproof.

C. Develop drainage holes with moisture pattern to exterior.

D. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Prepare components to receive anchor devices. Fabricate anchorage items.

F. Arrange fasteners, attachments and jointing to ensure concealment from view.

G. Prepare components with internal reinforcement for door hardware and door operator hinge hardware.

H. Provide acoustic door gasket where indicated.

2.07 FINISHES

A. Extruded Aluminum Surfaces: Clear Anodized AA-M10C22A41, Class I, 0.7 mil, AAMA 611.

B. Apply two coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

2.08 SOURCE QUALITY CONTROL

A. Source Quality: Provide aluminum entrances specified herein from a single source.

B. Fabrication Tolerances: Fabricate aluminum entrances in accordance with entrance manufacturer’s prescribed tolerances.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install doors, frames, glazing and hardware in accordance with manufacturer's instructions. .
   1. Install doors and hardware in accordance with manufacturer’s printed instructions.
   2. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weather-tight construction.

B. Use anchorage devices to securely attach frame assembly to structure.

C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work.

D. Coordinate attachment and seal of air and vapor barrier materials.

E. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.

G. Install glass and infill panels in accordance with Section 08 80 00, using exterior manufacturer's standard extruded glazing gaskets.

H. Install perimeter two component polyurethane type sealant, backing materials, and installation requirements in accordance with Section 07 92 00. Color shall match adjacent aluminum finish.

I. Adjust operating hardware.

J. Install Partition Closures at voids between glazing system and abutting walls, per manufacturer's recommendations.

3.03 TOLERANCES

A. Variation from Plane: 0.03 inches per foot maximum or 0.25 inches per 30 feet, whichever is less.

B. Misalignment of Two Adjoining Members Abutting in Plane: 0.015 inches.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following tests on representative areas of aluminum-framed entrances and storefronts.
   1. Test per AAMA 503-12 and ASTM E1105 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems. During construction prior to issuance of the building occupancy permit, but no later than six months after issuance of the occupancy permit.
      a. Air Infiltration Tests: Conduct tests in accordance with AAMA 503 and ASTM E783. Allowable air infiltration (air leakage) shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.
      b. Water Infiltration Tests: Conduct tests in accordance with AAMA 503 and ASTM E1105. No uncontrolled water leakage is permitted when tested at a static pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).

C. Manufacturer's Field Service: Upon Owner's written request, provide periodic site visit by manufacturer's field service representatives.

D. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and/or inspections.

E. Prepare test and inspection reports.

3.05 ADUSTING

A. Test door operating functions. Adjust closing and latching speeds and other hardware in accordance with manufacturer's instructions to ensure smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION

SECTION 08 44 14

GLAZED ALUMINUM CURTAIN WALL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aluminum tube framing system and entrances.

B. Vision glass and glass infill panels.

C. Perimeter sealant.

D. Related Sections:
   1. Section 07 84 00 Firestopping, Firestop Insulation, safing.

1.02 REFERENCES

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990
   1. ADA/Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessibility Standards.

C. AAMA - American Architectural Manufacturers Association
   1. AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
   2. AAMA - Aluminum Curtain Wall Design Guide Manual.
   3. AAMA - Curtain Wall Manual #10 - Care and Handling of Architectural Aluminum From Shop to Site
   4. AAMA TIR-A11-04 (Technical Information Report) - Maximum Allowable Deflection of Framing Systems for Building Cladding Components at Design Wind Loads.
   5. AAMA 501 - Methods of Test for Exterior Walls. (mfg's unit tested in lab)
   6. AAMA 501.2 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems. (Field Test)
   7. AAMA 503-12 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems (field test).

D. ASTM - American Society for Testing and Materials
   1. ASTM A36 - Specification for Structural Steel.
   2. ASTM A153 - Specification for Zinc-Coating (Hot-Dip on Iron and Steel Hardware.
   3. ASTM A653/A 653M Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   4. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   5. ASTM B221 - Specification for Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.

6. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
7. ASTM E90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
8. ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
9. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
10. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
11. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
12. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation.
13. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylights, and Glazed Wall Systems.

E. CBC - California Building Code, 2019

F. CBC Section 1609A - Wind Loads

G. CBC Section 1613A - Earthquake Loads.

H. FGMA - Flat Glass Marketing Association Manual - 1990 edition.

I. FGMA - Sealant Manual - Current Edition.

1.03 SYSTEM DESCRIPTION

A. Glazed aluminum curtain wall system includes a tubular aluminum sections with self supporting framing, shop fabricated, factory prefinished, vision glass, glass spandrel infill, related flashings, anchorage and attachment devices.

1.04 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand dead and wind loads Section 1615A, and pressure and suction of wind acting normal to plane of wall as calculated in accordance with Section 1609A CBC

B. Design and size components to withstand seismic loads and sway displacement as calculated in accordance with Section 1613A CBC.
   1. When tested to AAMA 504.4 System must meet design displacement of 0.010 x the story height and ultimate displacement of 1.5 x the design displacement.
   2. Seismic inter-story drifts of 2".

C. Wind Loads: provide Curtain wall system; include anchorage, capable of withstanding wind load design pressure as indicated on Structural Drawings.

D. Uniform Load Deflection: Limit mullion deflection to L/175 of the span up to 13'-6" or to L/240 + 1/4" above 13'-6", with full recovery of glazing materials and allowable stress with a safety factor of 1.65, per ASTM E330.

E. Uniform Load Structural Test: Test in accordance with ASTM E 330 at a pressure 1.5 times the design wind pressure. At conclusion of the test there shall be no glass breakage, permanent damage to fasteners, curtain wall parts, or any other damage which would cause the curtain wall to be defective.

F. System to accommodate, without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; deflection of structural support framing.

G. Condensation Resistance Test (CRF)
   1. Test unit in accordance with AAMA 1503.1.
   2. Condensation Resistance Factor (CRF) shall not be less than 66 Frame, 60 glass (clear).

H. Thermal Resistance of Wall System (Excluding Vision Areas): R of 9.17.

I. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, shall not be more than: 0.66 (clear) BTU/hr/ft2 /°F per AAMA 507.

J. Noise Reduction: Test according to ASTM E90, with ratings determined by ASTM E1332.

K. Air Infiltration: ASTM E283; not to exceed 0.06 cfm/ sq. ft. of wall area measured at a reference differential pressure across assembly of 6.24 lbf/sq. ft.

L. Water Penetration under Dynamic Pressure: Test according to AAMA 501 as follows: No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 psf.

M. System to provide for expansion and contraction within system components caused by a cycling temperature range of 180 degrees F over a 12 hour period without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance or other detrimental effect to system components.

N. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

O. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air and vapor barrier.

P. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

Q. System Performance
   1. Aluminum Entrances and storefronts assembly installed to maintain specified thermal performance.

1.05 SUBMITTALS

A. Submit under provisions of Division 01 General Requirements.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details and field welding required.

C. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
   1. Provide framing member structural and physical characteristics, dimensional limitations, special installation requirements.

D. Three samples illustrating prefinished aluminum surface, specified glass units, glazing materials illustrating edge and corner.

E. Test Reports: Include substantiating engineering data, test results of previous tests by independent laboratory that purport to meet performance criteria, and other supportive data.

F. Manufacturer's Installation Instructions: Indicate special installation procedures.

G. Test results for field testing.

H. Deferred Submittals and Approval for:
   1. Glazed Aluminum Curtain Wall:
      a. Installation of Glazed Aluminum Curtain Wall shall not be started until detailed plans and specifications are approved by Division of the State Architect, (DSA).
      b. DSA Approval: Manufacturer shall furnish Architect complete shop drawings and calculations as specified above, certified and stamped by Structural Engineer currently licensed in California. Manufacturer shall employ and pay Engineer for Certification of Drawings and Calculations.
         1) Architect will submit drawings and calculations to DSA for approval before fabrication.
         2) Show details of fasteners and anchorage to structural members at head and jambs. Size of anchors and embedment lengths, use 80 percent of ICC Reports capacities for anchors. Key details to elevation section.
         3) Curtain wall framing connections to structural beams and columns. Provide details keyed to elevations section.
         4) Provide calculations for worst case D+L+Seismic or wind loads, justify connections. Consider areas of discontinuity as required by CBC.
         5) Calculations required: analyze and design jamb and curtain wall framing.

6) The aluminum mullions and cross pieces shall be designed by a Registered Engineer (with calculations) show sectional properties.

c. Refer to Division 01, General Requirements for Deferred Approvals.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AAMA - Aluminum Curtain Wall Design Guide Manual.

B. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

A. Manufacturer and Installer: Company specializing in manufacturing aluminum curtain wall systems with minimum 10 years experience.

B. Installer for Total System: Company authorized by system manufacturer.

C. Design structural support framing components under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of California.

1.08 MOCKUP

A. Provide mockup of system components under provisions of Division 01.

B. Provide mockup including structural sealant joint, head and sill sections, vision glass light, and infill glass. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors and perimeter sealant.

C. Mockup may remain as part of the Work.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene two weeks prior to commencing work of this Section.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01, General Requirements.

B. Handle work of this Section in accordance with AAMA - Curtain Wall Manual #10.

C. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and after installation of sealants.

1.12 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.13 COORDINATION

A. Coordinate the Work with installation of firestopping air and vapor barrier insulation, components and related trades.

1.14 WARRANTY

A. Manufacturer's Product Warranty: Provide two-year warranty under provisions of Division 01. Special Warranty: Provide 5-year Warranty under provisions of Division 01.

C. Warranty: Include coverage for complete Curtain Wall System installation for failure to meet specified requirements.
   1. Failures include, but are not limited to the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Adhesive or cohesive sealant failures. Including perimeter sealant installation.
      d. Air and Water leakage through fixed glazing and framing areas.
      e. Failure of operating components to function properly.

D. Special Finish Warranty: Contractor agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturer or supplier form basis for design and quality intended.
   1. Arcadia Inc., Vernon, CA.
   2. The Kawneer Company, Inc. Visalia, CA.
   3. EFCO Corporation, Monett, Missouri.
   4. Oldcastle Glass/Vistawall Architectural Products, Los Angeles, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 MATERIALS

A. Extruded Aluminum: ASTM B221, 6063-T6 alloy and temper, 0.125 inches thick

B. Sheet Aluminum: ASTM B209.

C. Sheet Steel: ASTM A653, galvanized in accordance with ASTM A153, 2.0 oz.

D. Steel Sections: ASTM A36 shaped to suit mullion sections.

E. Fasteners: Stainless steel.

F. Touch-Up Primer for Galvanized Steel Surfaces: Zinc rich type, as specified in Section 09 90 00, Painting.

G. Thermal Barrier: EPDM applied thermal isolator, minimum 1/4".

2.03 COMPONENTS

A. Mullion Profile, Arcadia:
   1. CW1: T500 OPG-1900 Series
      a. size 2-1/4" x 7", pressure plate, of sufficient size and strength to provide 1/2-inch bite on glass and infill panels
   2. CW2: T500 OPG-17-1800 Series
      a. size 2-1/4" x 7", pressure plate, of sufficient size and strength to provide 1-1/2-inch bite on glass and infill panels.

B. Cap Extensions: OPG-PRO Series cap extensions as per the Drawings, including end caps and cover caps.

C. Firestopping: Specified in Section 07 84 00.

D. Corner Mullions: 90 degree inside and outside corners, refer to drawings.

E. Partition Closures - Aluminum: Sound Barrier Mullion Trip Cap Systems by Mull-it-Over or approved equal.
   1. Profile: 55 Classic Mullion Trim Cap
   2. Components:
      a. Aluminum Extrusions:
      b. Thickness: 0.125 inches.
      c. Profile: As selected and approved by Architect to allow solid attachment and fastening to the partition wall framing.
   3. Sound Absorbing Foam:
      a. Resistant to smoke, flame, and microbial growth.
      b. Fire Rating: ASTM E 84 Class 1.
      c. Fungi Resistance: Zero rating per ASTM G 21.
   4. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.
      a. Thickness: Standard 1/2 inch (12.7 mm), 3/4" (19.1 mm), 1 inch (25.4 mm) or 1-1/2" (38.1 mm) as required to accommodate mullion deflection.
      b. Color: Light gray
   5. Fasteners:
      a. Self Tapping or appropriate threaded fastener.
      b. Compatible with all materials fasteners will contact with and not causing galvanic corrosion.
   6. Snap Cover: Snap-on fastener cover.
   7. Acoustical Sound Sealant: Acrylic latex based.
   8. Accessories:
      a. Provide necessary and related parts and tools to complete installation.

9. Finish: As selected by Architect.

2.04 GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials: As specified in Section 08 80 00 of Types described below:
   1. Glass in Exterior Lights: Insulated glass.
   2. Glass in Entrance Lights: Clear tempered.
   3. Glass Infill Panels: shadow box.

B. Dry Glazed Preset EPDM type gaskets per curtain wall manufactures.

2.05 SEALANT MATERIALS

A. Sealant and Backing Materials: As specified in Section 07 92 00 of Types described below.

B. Structural Sealant: Type I, High Performance structural silicone, high modulus.

C. Perimeter Sealant (Not Used for Glazing): Type I, silicone.

2.06 FABRICATION

A. Fabricate curtain wall components with minimum clearances and shim spacing at head and sill of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Arrange fasteners and attachments to ensure concealment from view.

F. Reinforce framing members for external imposed loads where indicated.

2.07 FINISHES

A. Exterior and Interior Exposed Aluminum Surfaces:
   1. Clear Anodized AA-M10C22A41, Class I, AAMA 611, Anodized Class I, 0.7 mil thick min.

B. Finishes: Refer to Finish Schedule on Drawings.

C. Concealed Steel Items: Primed with iron oxide paint.

D. Apply two coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify structural supports and related work and materials are ready to receive work of this Section.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions and AAMA - Aluminum Curtain Wall Design Guide Manual.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install head and sill flashings.

G. Coordinate installation of firestop insulation at each floor slab edge and install in accordance with Section 07 84 00.

H. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Install Light Shelves in accordance with manufacturer's instructions.

K. Install glass and infill glass in accordance with Section 08 80 00, to glazing method required to achieve performance criteria.

L. Install perimeter sealant to method required to achieve performance criteria. Type of backing materials and installation criteria in accordance with Section 07 92 00.

M. Install Partition Closures at voids between glazing system and abutting walls, per manufacturer's recommendations.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Division 01 General Requirements.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspection will monitor quality of installation and glazing.

D. Perform the following field test on representative areas of curtain wall [or mockups]:
   1. Test per AAMA 503-08 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems. During construction prior to issuance of the building occupancy permit, but no later than six months after issuance of the occupancy permit.
      a. Air Infiltration Tests: Conduct tests in accordance with AAMA 503 and ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.
      b. Water Infiltration Tests: Conduct tests in accordance with AAMA 503 and ASTM E1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration but not less than 8 psf (383 PA).
   2. Test per AAMA 501.2-09 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems. Conduct test at water pressure 30 to 35 psi with calibrated gauge.
      a. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 shall not indicate evidence of water penetration or water leakage.
      b. Perform a minimum of two tests in areas as directed by Architect.
      c. Perform tests in each test area as directed by Architect. Perform tests, prior to 50%, and 90% project Completion.
         1) Water leakage is defined as any uncontrolled water that appears on any normally exposed interior surfaces, that is not contained or drained back to the exterior, or that can cause damage to adjacent material finishes.

E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and/or inspections.

F. Prepare and submit test and inspection reports.

3.05 MANUFACTURER'S FIELD SERVICES

A. Curtain wall product manufacturers to provide field surveillance of the installation of their products under provisions of Division 01.

B. Monitor and report installation procedures, unacceptable conditions and report inconsistencies to the Architect.

3.06 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.07 PROTECTION OF FINISHED WORK

A. Protect finished Work from damage.

END OF SECTION

SECTION 08 62 70

TUBULAR DAYLIGHTING DEVICE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Tubular daylighting device system and accessories; configuration as indicated on the drawings.

1.02 RELATED SECTIONS

A. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings.

B. Division 26 - Electrical, Equipment Wiring, Electrical connections.

1.03 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008a.

D. ASTM A 463/A 463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process; 2006.

E. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process; 2007.

F. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.

G. ASTM E 308 - Standard Practice for Computing the Colors of Objects by Using the CIE System; 2006.

H. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors; 2002.

I. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference; 2000.

J. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

K. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane.

L. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position; 2006.

M. ASTM D-1929 - Test Method for Ignition Properties of Plastics; 1996 (2001).

N. UL 181 - Factory Made Air Ducts and Air Connectors

O. ICC AC-16 - Acceptance Criteria for Plastic Skylights; 2008.

1.04 PERFORMANCE REQUIREMENTS

A. Completed tubular daylighting device assemblies shall be capable of meeting the following performance requirements:
   1. SOLAMASTER 750 DS-C (CLOSED CEILING)
      a. AAMA/WDMA/CSA 101/IS2/A440, Class CW-PG70, size tested 21 inch (530 mm) diameter, Type TDDOC and Type TDDCC.
         1) Air Infiltration Test:
            a) Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
         2) Water Resistance Test:
            a) Passes water resistance; no uncontrolled water leakage with a pressure differential of 10.7 psf (512 Pa) or 15 percent of the design load (whichever is greater) and a water spray rate of 5 gallons/hour/sf for 24 minutes when tested in accordance with ASTM E 547 and ASTM E 331.
         3) Uniform Load Test: All units tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
            a) No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 70 psf (3.35 kPa).
      b. Fire Testing:
         1) Fire Rated Roof Assemblies:
            a) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the California Building Code for Class A, B, and C roof assemblies.
         2) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the California Building Code.
         3) Self-Ignition Temperature - Greater than 650 degrees F per ASTM D-1929.
         4) Smoke Density: Rating no greater than 450 per ASTM E 84 in way intended for use. Classification C.
         5) Rate of Burn and/or Extent: Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2 per ASTM D 635.

6) Rate of Burn and/or Extent: Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D 635.

c. Fall Protection Performance:

1) Passes fall protection test: No penetration of dome or curb cap when subject to 400 lb (160 Kg)/42 inch (1066 mm) impact drop test when tested in accordance with OSHA 29 CFR 1926.506(c) Safety Net Systems.

2) Passes fall protection test: California State OSHA Fall Protection Code of Regulations, Title 8, Section 3212 (e)(1) Skylight Screens.

1.05 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.

C. Verification Samples: As requested by Architect.

D. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engaged in manufacture of tubular daylighting devices for minimum 20 years.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. Daylighting Device: Manufacturer's standard warranty for 10 years.

B. Electrical Parts: Manufacturer’s standard warranty for 5 years, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Solatube International, Inc., Vista, CA. Web: www.solatube.com

B. Or equal in accordance with Division 01 for substitutions.

2.02 TUBULAR DAYLIGHTING DEVICES

A. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.

B. SolaMaster Series: Solatube Model 750 DS, 21 inch (530 mm) Daylighting System:
   1. Model:
      a. Solatube Model 750 DS-C Closed (Penetrating) Ceiling. AAMA Type TDDCC.
   2. Capture Zone:
      a. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
         1) Outer Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
            a) Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
      b. Tube Ring: 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC. Prevents thermal bridging between base flashing and tubing and channel condensed moisture. Attached to base of dome ring with butyl glazing rope 0.24 inch (6 mm) diameter; to minimize air infiltration.
      c. Dome Seal: Adhesive backed weatherstrip, 0.63 inch (16 mm) tall by 0.28 inch (7 mm) wide.
   3. Flashings:
      a. Roof Flashing Base:
         1) One Piece: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A792/A 792M, 0.028 inch (0.7 mm) plus or minus .006 inch (.015 mm) thick.
            a) Base Style: Type FC, Curb cap, with inside dimensions of 27 inches by 27 inches (685 mm by 685 mm) to cover curb as specified in Section 07 60 00.
      b. Curbs: Metal Insulated Roof Curb: Corrosion resistant 18 Gauge hot-dipped galvanized steel conforming to ASTM A 653 G90 with continuous welded seams, integrated base plate for water tightness and extra strength, lined with 1-1/2 inch fiberglass fireproof sound attenuating thermal insulation, factory installed 2 by 2 treated wood nailer secured to top ledge of curb. Curb designed for single-ply roofing, lightweight fill or tapered insulation low slope roof types.

1) C12 12 inch (305 mm) high Metal insulated curb
2) Curbs provided by manufacturer.

c. Flashing Options:
1) Curb Cap Insulation: Type CCI, Nominal 1 inch thick thermal insulation pad to reduce thermal conduction between curb-cap and tubing and thermal convection between room air and curb-cap. Rated R-6 (OFxft2xhr/Btu) Insulation is Polyisocyanurate foam utilizing CFC, HCFC, & HFC free blowing agent. Type-1 Class-1 per ASTM C 1289; Passes UL 1715 (15-minute thermal barrier per IBC 2603.4); Attic ventilation may be required per IBC 1203.2(OFxft2xhr/Btu). For use with Flashing Type FC.

4. Transfer Zone:
a. Extension Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm) conforming to ASTM B 209.
1) Reflective Tubes:
a) Reflective extension tube, Type EXX and Type EL with total length of run as indicated on the Drawings.
b) Interior Finish: Spectralight Infinity with INFRAREDuction Technology combining ultra-high Visible Light reflectance with Ultra-low Infrared (IR) reflectance.
2) Tube Options
a) Extension Tube Angle Adapter: Provide manufacturer's standard adapters for applications requiring:
b) Type A1 one 0 to 90 degree extension tube angle adapter.
c) Type A2 two 0 to 90 degree extension tube angle adapters.
d) Top Tube Angle Adapter and Bottom Tube Angle Adapter Kit: Type AK, Reflective 45 degree adjustable top and bottom angle adapters (one each), 16 inches (406 mm) long

5. Delivery Zone:
a. Diffuser Assemblies for Tubes Penetrating Ceilings: Solatube Model 750 DS-C. Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches (605 mm by 605 mm) square frame to fit standard suspended ceiling grids or hard ceilings.
1) Metal Transition Box: Type TM, Metal Round to Square transition box comprised of Spectralight Infinity SoftLight material with structured finish on exposed reflective surface, .015 in (0.4 mm) thick. Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
b. Lens: Type L1, OptiView Fresnel lens design to maximize light output and diffusion with extruded aluminum frame and EPDM foam seal to minimize condensation and bug, dirt and air infiltration per ASTM E 283. Visible Light Transmission shall be greater than 90 percent at 0.022 inch (0.6 mm) thick. Classified as CC2.
c. Delivery Zone Options:
1) Daylight Dimmer - 0 to 10 V Dimmer Control: Provide an electrical actuator controller, auxiliary switch(s), and cable as specified in Section 25 50 00; Common Work Results Electrical Section 26 05 00; and Lighting Equipment and Controls Section 26 50 00.

a) Low Voltage Daylight Dimmer: Type D1, is an Electro-mechanically actuated daylight valve; 0-10 V Control, Class-2, UL Listed. Low voltage Daylight Dimmer electrical actuator provides for programmable (0 to 10VDC) scene-based dimming control for daylight output between 2 and 100 percent, auxiliary 12VDC dimming control for daylight output between 2 and 100 percent, or auxiliary ON/OFF control. Input voltage: 24VAC at 50 or 60 Hz.
b) Programmable (0 to 10VDC) Control: requires an electrical actuator controller or building automation controller capable of producing a signal between 0 and +10 VDC (Min 50mA) to incrementally modulate up to 50 daisy chained Daylight Dimmers (Current Sinking) between fully closed at 0 to 1 volts to fully open at 9 to 10 volts.
c) Auxiliary 12VDC Dimming Control: requires 12VDC Dimming Switch (Current Sourcing; 12VDC power supply not required).
d) Requires CL-2 (Min), 18AWG, stranded copper, two conductor, twisted cable from lighting controller to first dimmer and interconnecting between subsequent dimmers
e) Auxiliary ON/OFF Control: requires commercial or residential single pole electric light switch.
f) ON/OFF control requires CL-2 (Min), 22 AWG, stranded, three conductor, twisted cable from switch to first dimmer and CL-2 (Min), 18 AWG, stranded copper, two conductor twisted cable; interconnecting subsequent dimmers.

d. Power can be transformed from line voltage through use of a UL Listed Class-2, 24VAC Transformer.

6. Accessories
   a. Optional Low-voltage Transformer: Solatube Remote Transformer, Type TR20, is a 20VA, 24VAC, 50/60HZ, UL Listed, UL Category XOKV7, CE Marked, Class-2 Transformer with cover plate mounting system configured for easy field assembly onto standard 4.06 inch by 4.06 inch (103 mm by 103 mm) square junction box: Inherently Limited, Primary: 120VAC, 208VAC, 240VAC, and 277VAC. For use with Daylight Dimmer Type D1 only.
7. Catalog Number: S750DS-C-FC-CCI-AK-EXX-A1-A2-TM -L1-D1-TR20-C12

2.03 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.

B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Coordinate requirements for power supply, conduit and wiring.

3.03 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 63 00

TRANSLUCENT ROOF ASSEMBLY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Insulated translucent roof panel assemblies.

B. Flashed and weather sealed.

C. Related Sections:
1. Section 05 12 00, Structural Steel.
2. Section 07 62 00, Sheet Metal Flashing and Trim.
3. Section 07 92 00, Joint Sealants.
4. Section 08 80 00, Glazing.

1.02 WORK INCLUDED:

A. Design, engineer, manufacture and installation of two panels insulated translucent skylights panel system. An assembly of two independent insulated single glazing polycarbonate panels in one integrated daylighting panel assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. The exterior single panel can be removed at any time, independently of the interior single panel and without exposing the building's interior. The interior single insulated panel remains intact for the life of the building envelope.

B. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weatherability and water-tightness performance requirements. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.

C. Trained and factory authorized labor with supervision to complete the entire panel installation.

1.03 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bar, Rod, Wire, Shape and Tube.

C. ASTM D2244 - Calculation of Color Differences from Instrumentally Measured Color Coordinates.

D. UL 723 (ASTM E84) - Surface Burning Characteristics of Building Materials.

E. ASTM E283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.

F. ASTM E331 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

G. Chapter 24 and 26, California Building Code, 2019.

1.04 QUALITY ASSURANCE

A. The glazing panels must be evaluated and listed by recognized building code evaluation organization: International Council Evaluation Service Inc (ICC-ES)

B. Materials and Products shall be manufactured by a company continuously and regularly employed in the manufacturing, engineering, and designing, stocking and building of skylights using the specified material and system for a period of at least ten (10) years. Manufacturers shall provide a list of at least ten (10) projects having been in place a minimum of ten (10) years, with similar size, scope, climate and type.

C. Erection shall be by a factory-approved installer who has been in the business of erecting similar material for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

D. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system, in accordance with the requirements of this specification.

1.05 SUBMITTALS

A. Submit shop drawings and color samples in accordance with Division 01.

B. Manufacturer shall submit written guarantee accompanied by substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.

C. The manufacturer shall submit certified test reports made by an independent organization. Reports shall verify that the material will meet all performance requirements of this specification. Previously completed test reports will be acceptable if they are indicative of products used on this project. Test reports required are:
   1. Self Ignition Temperature (ASTM 1929-3)
   2. Smoke Density (ASTM D-2843)
   3. Burning Extent (ASTM D-635)
   4. Interior Flame Spread (ASTM E-84)

5. Class A roof construction per ASTM E108, FM 4470, NFPA 256, UBC 32-7, ULC-S107, UL 790
6. Color Difference (ASTM D-2244-85)
7. Weathering Evaluation before and after exposure to 300°F, 25 minutes include Light Transmission and Color Change, per ASTM E-1175, and ASTM D-2244 respectively.
8. OSHA Life Safety Fall and Walk Through Protection for 300 lb. point load per STD 29 CFR 1910.23 (e)(8)
9. OSHA Life Safety STD 29 CFR - Impact loading by blunt object of 500 ft. lbs. per ASTM E-695-03
10. CalOSHA 600 lb load - California Code or Regulations, Title 8, Section 1623(b)(3) & Section 3212(b)
11. Insulation's 'U' value - Center of Glazing per NFRC100.
12. Insulation's 'U' value for skylight system, glazing and aluminum framing, per NFRC 100 & NFRC 700 certification.
13. Visible light Transmission (VT) per ASTM E972 & ASTM E1084
14. Solar Heat Gain Coefficient (SHGC) based on tests or calculations which are based on tests per methodology and procedure given in the NFRC/Calorimeter Standard.
15. Maximum air infiltration rate for fenestration assemblies, per NFRC 400 or ASTM E283.
16. Water Penetration (ASTM E-331)
17. Load Bearing Capability (ASTM E-330-97)
18. Performance of exterior windows, curtain walls when impacted by wind-borne debris per ASTM E 1996-02, Level D
19. Haze per ASTM D 1003 for glare measurement.
20. ICC evaluation service report.

1.06 MAINTENANCE DATA

A. The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.

B. Submit Installer Certificate signed by installer, certifying compliance with project qualification requirements.

1.07 WARRANTY:

A. Provide a single source skylight system manufacturer warranty against defective materials and fabrication. Submit manufacturer's written warranty agreeing to repair skylight system work, which fails in materials within one year from date of delivery.

B. Provide single source skylight's manufacturer 10 year glazing panel warranty. Third party warranty for glazing panels shall not be acceptable. Glazing warranty to include:
   1. Change in light transmission of no more than 6% per ASTM D-1003
   2. No delamination of panel affecting appearance, performance or structural integrity of the panel or the system

3. Thermal aging - the light transmission and the color shall not change after exposure to heat of 300°F for 25 minutes (when measured per ASTM D-1003 and ASTM D-2244 respectively).

C. In addition submit installer's written warranty agreeing to repair installation workmanship, defects and leaks within one year from date of delivery.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. The design and performance criteria of this job are based on the Quadwall - 2 panel skylight systems as manufactured by CPI Daylighting, Inc.
   1. The system noted herein and the products have been submitted to DSA and the DSA approval is specific to these products indicated herein. If the contractor request a substitution of any of these products, systems or related items indicated he shall be responsible for the following:
      a. Approved equal shall meet or exceed performance items specified herein as a basis of design.
      b. Contractor shall secure DSA approval with assistance of the architect. All time spent with the architect in securing this approval shall be reimbursed by the Contractor at office billing rates.
      c. Any time spent by the Architect in coordinating the material substitution, reviewing items, trips to DSA, DSA communications, securing approvals and related items shall be reimbursed as aforementioned.

B. APPROVED MANUFACTURERS
   1. Other manufacturers may bid this project provided they comply with all requirements of the specification and submit evidence of compliance with all performance criteria specified herein. This evidence must include proof of conformance and test reports as per Article 1.05. Any exceptions taken from this specification must be noted on the approval request. If no exceptions are noted and approval is given, product performance will be as specified. Should non-compliance be subsequently discovered, the previously given approval will be invalidated and use of the product on the project will be disallowed. All manufacturers acceptable for use on this project under this section must be approved prior to bid. Requests for approval, with all appropriate submittal data and samples must be received no less than 10 days prior to bid date. A list of all approved manufacturers and products will be issued by addendum. No other manufacturers will be acceptable. No verbal approval will be given. Listing manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein. Fiberglass skins are unacceptable**.** Single panel system in lieu of 2 panel system is unacceptable.

2.02 TRANSLUCENT PANEL PERFORMANCE AND APPEARANCE

A. Panel construction for Longevity and Resistant to Buckling and Pressure:
   1. Translucent panels must be constructed of tight cell sizes not exceeding 0.18”. Wide cell l size exceeding 0.18”shall not be acceptable.
   2. The translucent panel shall include an integral extruded tight-cell structural core. The panel’s exterior skins shall be connected with supporting continuous ribs, perpendicular to the skins, at a spacing not to exceed 0.18” (truss-like construction). In addition, the space between the two exterior skins shall be divided by multiple parallel horizontal surfaces, at a spacing not to exceed 0.18”.

B. Translucent Skylight Panel - Two Panel Assembly:
   1. Design, engineer, manufacture and installation of two panel insulated translucent skylight system. An assembly of TWO independent insulated single panels of extruded polycarbonate into one glazing assembly, incorporated into a complete aluminum framed system that has been tested and warranted by the manufacturer as a single source system. The exterior insulated single panel can be removed at any time, independently of the interior insulated single panel and without exposing the building’s interior. The interior insulated single panel remains intact for the life of the building envelope.
   2. Panel glazing assembly thickness shall be 4” two panel system with concealed interlocking H battens, grid and FR insert. Minimum thickness of the exterior and the interior single panels shall be 0.315” thick each.
   3. Panel Width: Shall not exceed 2’ to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels over 2’ wide will not be approved.

C. Thermal and Solar Performance:
   1. Insulation “U” Value performance per NFRC100 & 700, is required by the California Energy Code. Such performance values must be certified and labeled by NFRC. Labels shall be displayed on the product. NFRC certified and labeled products shall be published in the Certified Products Directory (CPD) on the NFRC official web site.
   2. U value for standard panel assembly with no bat or aerogel insulation, Center of Glazing per NFRC 100**:** 0.20
   3. U value for panel system assembly with no bat or aerogel insulation and including skylight aluminum framing per NFRC100 & NFRC700: 0.31 (for mill finish frame)
   4. Optional - Custom U value with variety of added insulation inserts.
      a. Custom U value center of glazing only per NFRC100, U factor: .18
      b. Custom U value for a complete aluminum frame per NFRC100 & 700 U factor: [ ]
   5. Visible Light Transmission Center of Glass (V.T. %) 22 per ASTM E972 ASTM & E1084.
   6. Solar Heat Gain Coefficient (SHGC) 18 independently tested or calculated based on testing per methods and procedures given in the NFRC Calorimeter
   7. Standard Color: Exterior - Clear; Interior - White Matte

D. Translucent Panel Joint System:

1. Panel shall be extruded in one single formable length. Transverse connections are not acceptable.
2. The panels should be manufactured with grip-lock double tooth upstands that are integral to the unit. The upstands shall be 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of upstands or standing seam is not acceptable.
3. The H battens shall have a grip-lock double tooth locking mechanism to ensure maximum uplift capability.
4. The metal retention clip shall be configured with a 0.4” wide top flange that extends continuously across the web from end to end and from side to side. To allow safety factor, the clip must be tested to meet a wind uplift standard of 90 PSF per ASTM E330. .
5. Water Penetration: No water penetration of the panel H joint connection length at test pressure of 6.24 PSF per ASTM E-331
6. Free movement of the panels shall be allowed to occur without damage to the weather tightness of the completed system.

E. Flammability:
1. The exterior and interior panels shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D-635. Flame spread no greater than 25 per ASTM E-84. Smoke density no greater than 75 per ASTM D2843 and a minimum self-ignition temperature of 1000°F per ASTM 1929.
2. Interior flame spread classification of Class A per ASTM E84.
3. The translucent panel must be listed by an independent recognized listing laboratory after successful evaluation for fire from exterior exposure per ASTM E108, FM 4470, NFPA 256, UBC 32-7, ULC-S107, UL 790 to meet a Class A rating.

F. CalOSHA /OSHA Life Safety Standards 29 CFR 1926.502 (i) (2) and 29 CFR 1910.23 (e) (8):
1. Panel assembly shall withstand a 300 lb. point load at 5’ span per OSHA standard 29CFR 1910 23e8.
2. Panel assembly shall withstand a 600lb point load over 12 square inches per CalOSHA California Code or Regulations, Title 8, Section 1623(b)(3) & Section 3212(b).

G. Cyclic Wind Load:
1. Translucent Panels shall be tested for cyclic wind loads and impact resistance per ASTM E 1886-97 and ASTM E 1996-02 at test load to verify the positive and negative design loads and level D impact.

H. Weatherability:
The light transmission shall not decrease more than 6% as measured by ASTM D-1003 over 10 years, or after exposure to temperature of 300°F for 25 minutes (thermal aging performance standard).
1. The weathering performance should be justified by successful testing of the glazing panel’s performance after exposure to actual Florida weather conditions for approximately 10 years in comparison to a new panel assembly. This

performance must be demonstrated by providing independent lab test reports for the exposed and a new panel assembly of 6' wide x 12' long for:
   a. ASTM 330 - Uniform static air pressure per at negative load of -105psf and positive load of 130psf.
   b. ASTM E695 - Impact loading per of 500 ft. lbs.
   c. ASTM 1886 & ASTM E1996 - Cyclic static air pressure at 65psf and impact level D
2. Test results must show that there is no deterioration in performance for the 10 year's exposed panels versus a new panel.
3. Panels shall be manufactured from polycarbonate resin with a permanent, co-extruded ultra-violet protective layer. Post-applied coatings or films of dissimilar materials are unacceptable.
4. The faces shall not become readily detached when exposed to temperatures of 300°F and 0°F for 25 minutes.
5. The panel shall not change color more than 4.0 units DELTA-E per ASTM D2244 after 60 months outdoor weathering in Arizona as determined by an average of at least two samples.
6. Thermal aging - the interior and exterior panel shall not change color in excess of 0.75 Delta E per ASTM D2244 and shall not darken more than 0.3 units Delta L per ASTM D2244 and shall show no cracking or crazing when exposed to 300°F for 25 minutes.
7. Panel shall be factory sealed at the sill to restrict dirt ingress.

I. Glare and Diffused Light Transmission: to avoid glare per IECC requirements, the panels shall have a matte finish with a minimum Haze measurement of 90% per ASTM D1003.

2.03 METAL FRAME STRUCTURE

A. Design criteria shall be:
   1. Negative design wind Load: See general notes on Structural Drawings.
   2. Positive design wind load: See general notes on Structural Drawings.

B. The skylight framing is designed to be self-supporting between the support constructions. The deflection of the structural framing members in a direction normal to the plane of the glazing, when subjected to a uniform load deflection, shall not exceed L/60 for the unsupported span. The skylight will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the skylight. Design or structural engineering services for the supporting structure or building components is not included in the skylight scope of this section.

C. Water Penetration: The metal framed skylight panels shall allow no water penetration at a minimum differential static pressure of 6.24 lbs. per sqf per AAMA 501 pressure difference recommendations and as demonstrated by prior testing of typical framing sample per ASTM E-331

D. Water test of metal frame structure shall be conducted according to procedures in AAMA 501.2.

E. Maximum air infiltration rate for fenestration of the two panel assemblies of skylight shall be per NFRC 400.

2.04 METAL MATERIALS

A. Extruded Aluminum shall be ANSI/ASTM B221; 6063-T6: 6063-T5 or 6005-T5.

B. Flashing:
   1. 5005 H34 aluminum
   2. Sheet metal flashings/closures/claddings are to be furnished shop formed to profile - when lengths exceed 10 ft. in nominal 10-ft lengths. Field trimming of the flashing and field forming the ends is necessary to suit as-built conditions. Sheet metal ends are to overlap at least 6-inc. to 8-inc. set in a full bed of sealant and riveted if required.

C. All Fasteners for aluminum framing to be stainless steel or cadmium plated steel, excluding the final fasteners to the building.

D. Exposed Aluminum Finish:
   1. CPICRF™- PREMIUM polymer resin powder coat per AAMA 2604 with 10 years warranty.

PART 3 - EXECUTIONS

3.01 EXAMINATION

A. Verify when structural support is ready to receive all work in this section and to convene a Pre-Installation Conference at least one week prior to commencing work of this Section. Attendance required of General Contractor, skylight installer and all parties directly affecting and effected by the work of this section.

B. All submitted opening sizes, dimensions and tolerances are to be field verified by general contractor unless otherwise stipulated.

C. Installer shall examine area of installation to verify readiness of site conditions. Notify general contractor about any defects requiring correction. Do not work until conditions are satisfactory.

D. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install components in strict accordance with manufacturer's instructions and approved shop drawings. Use proper fasteners, caulking and hardware for material attachments as specified.

B. Use methods of attachment to structure allowing sufficient adjustment to accommodate tolerances.

C. Remove all protective coverings on panels immediately after installation.

D. Align assembly free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Install flashings.

F. Install perimeter type sealant, backing materials and installation requirements in accordance with Section 07 92 00.

3.03 CLEANING

A. Follow manufacturer's instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, clean wiping cloths. Always test a small area before applying to the entire area.

B. Follow strict panel manufacturer guidelines when removing foreign substances from panel surfaces requiring mineral spirits or any solvents that are acceptable for use. Always test a small sample to validate compliance before applying to the entire glazing panels

C. Installers shall leave panel system clean at completion of installation. Final cleaning is By others upon completion of project, following manufacturer's cleaning instructions.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware, including electric hardware.
2. Gate Hardware.
3. Power supplies for electric hardware.
4. Low energy door operators plus sensors and actuators.
5. Cylinders for doors fabricated with locking hardware.

B. Related Divisions:

1. Division 06 – door hardware installation
2. Division 07 – sealant at exterior thresholds
3. Division 08 – metal doors and frames, interior aluminum frames, wood doors, integrated security systems, specialty doors, storefront and glazed curtainwall systems.
4. Division 10 – operable partitions
5. Division 21 – fire and life safety systems
6. Division 28 – security access systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

1. Windows.
2. Cabinets, including open wall shelving and locks.
3. Signs, except where scheduled.
4. Toilet accessories, including grab bars.
5. Installation.
6. Rough hardware.
7. Conduit, junction boxes & wiring.
8. Folding partitions, except cylinders where detailed.
9. Sliding aluminum doors, except cylinders where detailed.
10. Access doors and panels, except cylinders where detailed.
11. Corner Guards.
12. Welded steel gates and supports.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute

a) ANSI 156.18 – Materials and Finishes.

2. BHMA – Builders Hardware Manufacturers Association
3. 2019 California Building Code
   a) Chapter 11B – Accessibility To Public Buildings, Public Accommodations, Commercial Buildings and Public Housing
4. DHI – Door and Hardware Institute
5. NFPA – National Fire Protection Association
   a) NFPA 80 2016 Edition – Standard for Fire Doors and Other Opening Protectives.
   b) NFPA 105 – Smoke and Draft Control Door Assemblies
   c) NFPA 252 – Fire Tests of Door Assemblies
6. UL – Underwriters Laboratories
   a) UL10C – Positive Pressure Fire Tests of Door Assemblies.
   b) UL 305 – Panic Hardware
7. WHI – Warnock Hersey Incorporated State of California Building Code
8. Local applicable codes
9. SDI – Steel Door Institute
10. WI – Woodwork Institute
11. AWI – Architectural Woodwork Institute
12. NAAMM – National Association of Architectural Metal Manufacturers

B. Abbreviations

1. Manufacturers**:** see table at 2.1.A of this section
2. Finishes**:** see 2.7 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

A. SUBMITTALS**:** Submit six copies of schedule per D. Only submittals printed one sided will be accepted and reviewed. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt font size. Include following information**:**

1. Type, style, function, size, quantity and finish of hardware items.
2. Use BHMA Finish codes per ANSI A156.18.
3. Name, part number and manufacturer of each item.
4. Fastenings and other pertinent information.
5. Location of hardware set coordinated with floor plans and door schedule.
6. Explanation of abbreviations, symbols, and codes contained in schedule.
7. Mounting locations for hardware.
8. Door and frame sizes, materials and degrees of swing.
9. List of manufacturers used and their nearest representative with address and phone number.
10. Catalog cuts.
11. Point-to-point wiring diagrams.

12. Manufacturer's technical data and installation instructions for electronic hardware.

B. Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.

C. Deviations**:** Highlight, encircle or otherwise identify deviations from "Schedule of Finish Hardware" on submittal with notations clearly designating those portions as deviating from this section.

D. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.

E. Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

F. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE**:**

A. Qualifications**:**

1. Hardware supplier**:** direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.

a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

B. Hardware**:** Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

C. Exit Doors**:** Operable from inside with single motion without the use of a key or special knowledge or effort.

D. Fire-Rated Openings**:** NFPA 80 compliant. Hardware UL10C (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.

E. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions and code requirements.

F. Pre-Installation Meetings**:** Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Include manufacturers' representatives of locks, panic hardware and door closers in the meetings. Convene prior to commencement of related work.

1.5 DELIVERY, STORAGE AND HANDLING**:**

A. Delivery**:** coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores**:** secured delivery direct to Owner's representative.

B. Acceptance at Site**:** Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage**:** Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION**:**

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.

B. Coordination**:** Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information**:**

1. Location of embedded and attached items to concrete.
2. Location of wall-mounted hardware, including wall stops.
3. Location of finish floor materials and floor-mounted hardware.
4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits.
5. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
6. Coordinate: low-voltage power supply locations.

7. Coordinate: back-up power for doors with automatic operators.
8. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
9. Manufacturers' templates to door and frame fabricators.

C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

D. Environmental considerations**:** segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

1.7 WARRANTY**:**

A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties.

B. Include factory order numbers with close-out documents to validate warranty information, required for Owner in making future warranty claims:

C. Minimum warranties:

1.	Locksets**:**	Three years
2.	Extra Heavy-Duty Cylindrical Lock:	Ten Years
3.	Exit Devices**:**	Three years mechanical One year electrical
4.	Closers**:**	Thirty years mechanical Two years electrical
5.	Hinges**:**	One year
6.	Other Hardware	Two years

1.8 COMMISSIONING**:**

A. Conduct these tests prior to request for certificate of substantial completion**:**

1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
2. With installer, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

1.9 REGULATORY REQUIREMENTS**:** (delete this article in entirety for projects not under DSA's *or OSHPD's* auspices)(code citations are CBC 2019)

A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2019 California Building Code, Section 11B-404.2.7.

1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.

B. Handles, pull, latches, locks, other operable parts**:**

1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2019 California Building Code Section 11B-309.4.
2. Force required to activate the operable parts: 5.0 pounds maximum, per 2019 California Building Code Section 11B-309.4.

C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.

1. Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.

D. Low-energy powered doors: comply with ANSI/BHMA A156.19. Reference: 2019 California Building Code Section 11B-404.2.9.

1. Where powered door serves an occupancy of 100 or more, provide back-up battery power or stand-by generator power, capable of supporting a minimum of 100 cycles.

2. Actuators, vertical bar type: minimum 2-inches wide, 30-inches high, bottom located minimum 5-inches above floor or ground, top located minimum 35-inches above floor or ground. Displays International Symbol of Accessibility, per 2019 California Building Code Section 11B-703.7.

3. Actuators, plate type: use two at each side of the opening. Minimum 4-inches diameter or 4-inches square. Displays International Symbol of Accessibility, per 2019 California Building Code Section 11B-703.7. Locate centerline of lower plate between 7- and 8-inches above floor or ground, and upper plate between 30- and 44-inches above floor or ground.

4. Actuator location: conspicuously located, clear and level floor/ground space for forward or parallel approach.

E. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2019 California Building Code Section 11B-404.2.8.

1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.

F. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2019 California Building Code Section 11B-404.2.10.

1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges.
2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.

G. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and below 80 inches, and the hardware projects no more than 4 inches. 2019 California Building Code Section 11B-404.2.3.

1. Exception: doors not requiring full passage through the opening, that is, to spaces less than 24 inches in depth, may have the clear opening width reduced to 20 inches. Example: shallow closets.
2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2019 California Building Code 11B-307.4.

H. Thresholds**:** floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2019 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches**:** beveled to slope no greater than 1**:**2 (50 percent slope). 2019 California Building Code Section 11B-303.2 & ~.3.

I. Floor stops**:** Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).

J. Pairs of doors with independently-activated hardware both leafs**:** limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2019 California Building Code Section 11B-703.4.2.

K. Door and door hardware encroachment**:** when door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into the required exit width, with the exception of door release hardware such as lockset levers or panic hardware. These hardware items must be located no less than 34-inches and no more than 48-inches above the floor/ground. 2019 California Building Code, Section 1005.7.1.

2. In I-2 occupancies, surface mounted latch release hardware, mounted to the side of the door facing away from the adjacent wall where the door I sin the open position, is not exempt from the inclusion in the 7-inch maximum encroachment, regardless of its mounting height, per 2019 California Building Code, Section 1005.7.1 at Exception 1.

L. New buildings that are included in public schools (kindergarten through 12th grade) state funded projects and receiving state funding pursuant to Leroy F. Green, School Facilities Act of 1998, California Education Code Sections 17070.10 through 17079, and that are submitted to the Division of the State Architect for plan review after July 1, 2011 in accordance with the Education Code 17075.50, shall include locks that allow doors to classrooms and any room with an occupancy of five or more persons to be locked from the inside. The locks shall conform to the specification and requirements found in Section 1010.1.9. 2019 California Building Code Section 1010.1.11

Exceptions:

1. Door that are locked from the outside at all times such as, but not limited to, janitor's closet, electrical room, storage room, boiler room, elevator equipment room and pupil restroom.
2. Reconstruction projects that utilize original plans in accordance with California Administrative Code, Section 4-314.
3. Existing relocatable buildings that are relocated within same site in accordance with California Administrative Code, Section 4-314.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers and their abbreviations used in this schedule:

ADA	Adams Rite
CRO	Crown Industrial
DDT	D&D Technologies
GLY	Glynn-Johnson Hardware
IVE	H. B. Ives
LCN	LCN Closers
SCE	Schlage Electronics
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International

2.2 HINGING METHODS:

A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

B. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.

C. Conventional Hinges: Steel or stainless steel pins and approved bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.

1. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins and security studs.
2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.

D. Continuous Hinges:

1. Geared-type aluminum.

a) Use wide-throw units where needed for maximum degree of swing, advise architect if commonly available hinges are insufficient.

b) If units are used at storefront openings, color-coordinate hinge finish with storefront color. Custom anodizing and custom powdercoat finishes subject to Architect approval.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Mortise Locksets and Latchsets: as scheduled.

1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
2. Universal lock case – 10 functions in one case.
3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.

   a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
   b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
   c) Levers rotate up or down for ease of use.
   d) Vandalgard locks: locked lever freely rotates down while remaining securely locked. This feature prevents damage to internal lock components when subjected to excessive force.

6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
7. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.
8. Deadbolts: stainless steel 1-inch throw.
9. Electric operation: Manufacturer-installed continuous duty solenoid.
10. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
11. Scheduled Lock Series and Design: Schlage L series, 06N design.
12. Certifications:

    a) ANSI A156.13, Grade 1 Operational, Grade 1 Security.
    b) ANSI/ASTM F476-84 Grade 31 UL Listed.

13. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC 2019 11B-404.2.7 and 11B-309.4.

2.4 EXIT DEVICES / PANIC HARDWARE

A. General features:

1. Independent lab-tested 1,000,000 cycles.
2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. Deadlocking latchbolts, 0.75 inch projection.
4. End caps: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.

5. No exposed screws to show through glass doors.
6. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
7. Releasable in normal operation with 15-pound maximum operating force per UBC Standard 10-4, and with 32-pound maximum pressure under 250-pound load to the door.
8. Exterior doors scheduled with XP-series devices**:** Static load force resistance of at least 2000 pounds.
9. Accessibility: Require not more than 5 lb to retract the latchbolt, per CBC 2019 11B-404.2.7 and 11B-309.4.
    a) Mechanical method: Von Duprin “AX-“ feature, where touchpad directly retracts the latchbolt with 5 lb or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb requirement.
    b) Electrical method: Von Duprin’s “RX-QEL-“, where lightly pressing the touchpad with 5 lb or less of force closes an electric switch, activating quiet electric latch retraction.

B. Specific features**:**

1. Non-Fire Rated Devices**:** cylinder dogging.
2. Lever Trim**:** breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Rod and latch guards with sloped full-width kickplates for doors fitted with surface vertical rod devices with bottom latches.
4. Fire-Labeled Devices**:** UL label indicating “Fire Exit Hardware”. Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
5. Electrically Operated Devices**:** Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.

2.5 CLOSERS

A. Surface Closers**:** [4040XP]

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.

6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2016 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
    a) Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers**:** tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors**:** seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.

B. LCN Senior Swing**:**

1. Comply with ANSI/BHMA 156.19 and 2019 California Building Code Section 11B-404.2.9, Exception 2**:** Electric power-open and close operation. Modular construction. Finished metal cover. Field-adjustable opening force, opening speed, time-open, closing and latching speeds. Door reopens and timing cycle restores if system reactuated during closing cycle. Breakaway clutch protection from forced closing. Door, frame, motor and drive train protected by attenuated initiation of opening cycle.
2. Self-contained low-voltage power supply, terminal strip and sequencing for incorporation of electric hardware with system operation.
3. Actuators: as scheduled
    a) Plate type: minimum 4 inches square or 4 inches diameter. At each side of the opening, center one plate 7 inches to 8 inches above the finish floor, and another at 30 inches to 44 inches above the finish floor.
    b) Vertical bar type: minimum 2 inches wide by 30 inches in height. Locate bar with bottom 5 inches maximum above finish floor, and top 35 inches minimum above finish floor.
    c) Actuators of either type: display International Symbol of Accessibility (ISA) pictogram.
4. Safety sensors**:** as scheduled.

2.6 OTHER HARDWARE

A. Automatic Flush Bolts**:** Low operating force design.

B. Overhead Stops**:** Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

C. Kick Plates**:** Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

D. Door Stops**:** Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.
2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum**:** 90deg stop / 95deg deadstop. Note degree of opening in submittal.

E. Seals**:** At head & jambs. Inelastic, rigid back, not subject to stretching. Self-compensating for warp, thermal bow, door settling, and out-of-plumb. Adhesive warranted for life of installation.

1. Proposed substitutions**:** submit for approval.
2. Three-fingered type at hinge jambs of doors fitted with continuous hinges where jamb leaf of hinge is fastened to the frame reveal.

F. Automatic door bottoms**:** low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.

1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.

G. Thresholds**:** As scheduled and per details. Comply with CBC 2019 11B-404.2.5. Substitute products**:** certify that the products equal or exceed specified material's thickness. Proposed substitutions**:** submit for approval.

2. Saddle thresholds**:** 0.125 inches minimum thickness.
3. Exteriors**:** Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Minimum 0.25 inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors. National Guard Products' "COMBO" or Pemko Manufacturing's "FHSL".
4. Fire-rated openings, 90-minutes or less duration**:** use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, include a 0.25in high 5in wide saddle in the bid, and request direction from Architect.

a) City of Los Angeles: regardless of critical radiant flux values of organic-material floor coverings, furnish metal, concrete, or stone thresholds at fire-rated openings.

5. Fire-rated openings, 3-hour duration: Thresholds, where scheduled, to extend full jamb depth.
6. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
7. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.
8. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

H. Through-bolts: Do not use. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.

1. Exception: surface-mounted overhead stops, holders, and friction stays.

I. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Leave no unfilled/uncovered pre-punched silencer holes. Intent: door bears against silencers, seals make minimal contact with minimal compression – only enough to effect a seal.

J. Key Control Software: Same manufacturer as key cylinders, supply to Owner.

2.7 FINISH:

A. Generally: BHMA 626 Satin Chromium.

1. Areas using BHMA 626: furnish push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise scheduled.

B. Door closers: factory powder coated to match other hardware, unless otherwise noted.

1. Provide satin-chrome plated arms, tracks and covers where scheduled bright metallic powder coat (MTLPC) not available.

2.8 KEYING REQUIREMENTS:

A. Key System: Existing Campus Schlage Primus full size interchangeable core key system. For estimate use factory GMK charge. Initiate and conduct meeting(s) with Owner to determine system structure and keybow styles, furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the Owner. Owner will order and supply permanent cylinders/cores. Owner will install permanent cylinders/cores.

B. Keys

1. Construction keying: furnish keyed-alike temporary cores plus 10 operating keys. Temporary cores and keys remain property of hardware supplier.

C. Interchangeable Cores: 7-pin solid brass construction.

D. Permanent cores: furnish factory-keyed.

1. Locksets and cylinders same manufacturer.

E. Permanent keys and cores: use secured shipment direct from point of origination to Owner.

1. For estimate: 3 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.
2. For estimate: VKC stamping plus "DO NOT DUPLICATE".

F. Bitting List: use secured shipment direct from point of origination to Owner upon completion.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

A. Can read and understand manufacturers' templates, suppliers' hardware schedule and printed installation instructions. Can readily distinguish drywall screws from manufacturers' furnished fasteners. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

3.2 PREPARATION:

A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.

B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.

1. Notify Architect of code conflicts before ordering material.

1. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1010.1.9.2 and 11B-404.2.7.
2. Locate panic hardware between 36 inches to 44 inches above the finished floor.
3. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

C. Overhead stops**:** before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

3.3 INSTALLATION

A. Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.

1. Gaskets**:** install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
4. Replace fasteners damaged by power-driven tools.

B. Locate floor stops no more that 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.

C. Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.

D. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.

E. Drill pilot holes for fasteners in wood doors and/or frames.

F. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4. ADJUSTING

A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.

1. Hardware damaged by improper installation or adjustment methods**:** repair or replace to Owner's satisfaction.
2. Adjust doors to fully latch with no more than 1 pound of pressure.
   a) Door closer valves: turn valves clockwise until at bottom – do not force. Turn valves back out one and one-half turns and begin adjustment process from that point. Do not force valves beyond three full turns counterclockwise.
3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
4. Adjust door closers per 1.9 this section.

B. Inspection of fire door assemblies and means-of-egress panic-hardware doors**:** Per 2016 NFPA-80 5.2.1: hire an independent third-party inspection service to prepare a report listing these doors, and include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware. Certification, Testing and Quality Control shall be in accordance with Division 01 45 23 Testing and Inspection services. All doors hardware and installation will be inspected by a third party selected by the architect/owner.

Div 01 45 23:

1. Per 2016 NFPA-80 5.2.1: Use a third party inspector not associated with the construction, supply or installation of this project to develop a field survey of the doors and hardware. Survey is to be done by a member certified as a FDAI (Fire Door Assembly Inspector), Certified AHC (Architectural Hardware Consultant) or a certified testing laboratory: UL or Intertek. Certified Inspectors may be found at DHI.org, Intertek, or CAFDI.org.

C. Fire-rated doors**:**

1. Wood doors**:** adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
2. Steel doors**:** adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) above threshold or finish floor material under door.

D. Final inspection**:** Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following**:**

1. Has re-adjusted hardware.
2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
3. Has identified items that have deteriorated or failed.
4. Has submitted written report identifying problems.

3.5 DEMONSTRATION:

A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING:

A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.

B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

A. See door schedule in drawings for hardware set assignments.

B. Do not order material until submittal has been reviewed, stamped, and signed by Architect's door hardware consultant.

Hardware Group No. 01
For use on Door #(s):
100-C 100-E

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-98-L-M996-06-FSE		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQ'D)		695	LCN
1	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	WIRE HARNESS	CON-12P			SCH
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
ALUM SEALS BY DR MANUF

Hardware Group No. 02
For use on Door #(s):
115-B

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-98-EO		626	VON
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQ'D)		695	LCN
1	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	WIRE HARNESS	CON-12P			SCH
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE

FUTURE CARD READER AND WIRING BY SECURITY VENDOR.
ALUM SEALS BY DR MANUF
VERIFY CARD READER WITH EXIT ONLY FUNCTION.

Hardware Group No. 03
For use on Door #(s):
105-A 300-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	L9080T 06N		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
VERIFY THRESHOLD CONDTION.

Hardware Group No. 03A
For use on Door #(s):
106-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	L9080T 06N		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 04
For use on Door #(s):
101B-A 107-A 112-A 207-A 212-A 213-A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 06N	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 04A
For use on Door #(s):
115C-A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 06N	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
2	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR BOTTOM	364AA	AA	ZER
1	EA	THRESHOLD	655A-223	A	ZER

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 04B
For use on Door #(s):
100A-A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 06N	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	FLOOR STOP	FS13	626	IVE

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 06
For use on Door #(s):
214M-B

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 06N 09-544		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FLOOR STOP	FS13		626	IVE
2	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 06A
For use on Door #(s):
115B-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 06N 09-544		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 07
For use on Door #(s):
214M-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 06N 09-544		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 08
For use on Door #(s):
108-A 109-A 111-A 208-A 209-A 210-A
211-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8		652	IVE
1	EA	EU MORTISE LOCK	L9092TEU 06N RX CON 12/24 VDC		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
2	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	WIRE HARNESS	CON-38P			SCH
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 09
For use on Door #(s):
214-B

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-98-L-M996-06-FSE		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	WIRE HARNESS	CON-12P			SCH
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 10
For use on Door #(s):
114-A 206-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080T 06N		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 11
For use on Door #(s):
102-A 202-A 214A-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK	L9040 06N L583-363 L283-722		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE

Hardware Group No. 11A
For use on Door #(s):
205-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK	L9040 06N L583-363 L283-722		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER

Hardware Group No. 12
For use on Door #(s):
103-A 104-A 203-A 204-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	DOOR PULL, 1" ROUND	8103EZHD 10" I			IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	SURF. AUTO OPERATOR	9531 HL/D MS AS REQ (120/240 VAC)		ANCLR	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-853T		630	LCN
2	EA	FLUSH MOUNT BOX	8310-867F		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE

WIRING BY OTHERS.

Hardware Group No. 13
For use on Door #(s):
100-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-PA-9827-EO 24 VDC		626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-PA-9827-L-06 24 VDC		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
1	EA	SURF. AUTO OPERATOR	9553 REG2 HL/D MS AS REQ (120/240 VAC)		ANCLR	LCN
2	EA	ACTUATOR/BOLLARD PKG	8310-3836T		AL	LCN
2	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	WIRE HARNESS	CON-12P			SCH
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
ALUM SEALS BY DR MANUF

Hardware Group No. 13A
For use on Door #(s):
115-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-PA-9827-EO 24 VDC		626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-PA-9827-L-06 24 VDC		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
1	EA	SURF. AUTO OPERATOR	9553 REG2 HL/D MS AS REQ (120/240 VAC)		ANCLR	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-853T		630	LCN
2	EA	FLUSH MOUNT BOX	8310-867F		689	LCN
2	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	WIRE HARNESS	CON-12P			SCH
1	EA	POWER SUPPLY	PS902 BBK 900-2RS 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
ALUM SEALS BY DR MANUF

Hardware Group No. 13B
For use on Door #(s):
100-D

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
7	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8		630	IVE
1	EA	MANUAL FLUSH BOLT	FB458		626	IVE
1	EA	MANUAL FLUSH BOLT	FB458 36"		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	EU MORTISE LOCK	L9092TEU 06N RX CON 12/24 VDC		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQ'D)		695	LCN
2	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	WIRE HARNESS	CON-192P			SCH
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
VERIFY LOCK WITH ALUM DOOR.
ALUM SEALS BY DR MANUF

Hardware Group No. 14
For use on Door #(s):
100-B 101-B 101-C

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-9827-EO		626	VON
1	EA	ELEC PANIC HARDWARE	RX-PA-9827-L-M996-06-FSE		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQ'D)		695	LCN
2	EA	FLOOR STOP	FS444		626	IVE
1	EA	THRESHOLD	655A-223		A	ZER
2	EA	WIRE HARNESS	CON-12P			SCH
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
ALUM SEALS BY DR MANUF

Hardware Group No. 15
For use on Door #(s):
101-A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	MANUAL FLUSH BOLT	FB458 36"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	ELEC DEADLATCH	4300 X 4591 PADDLE	628	ADA
1	EA	MORTISE CYLINDER	20-060	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	FSIC CORE	23-030 ICX	ORG	SCH
2	EA	90 DEG OFFSET PULL	PR 8190HD 10" N	630	IVE
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA (AS REQ'D)	695	LCN
2	EA	FLOOR STOP	FS444	626	IVE
2	EA	DOOR BOTTOM	365AA	AA	ZER
1	EA	WIRE HARNESS	CON-192P		SCH
1	EA	MOTION SENSOR	SCANII 12/24 VDC	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC	LGR	SCE

CARD READER AND WIRING BY SECURITY VENDOR.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
SCAN II USED FOR REX.
VERIFY SEALS WITH ALUM DR MANUF

Hardware Group No. 16
For use on Door #(s):
101A-A 113-A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 06N	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
2	EA	WALL STOP	WS406/407CCV	630	IVE

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.

Hardware Group No. 17
For use on Door #(s):
115D-A 115E-A 115G-A 115H-A 115K-A 115L-A
115N-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	OFFICE/ENTRY LOCK	L9050T 06N L583-363 L283-711		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FLOOR STOP	FS13		626	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	SET	HARDWARE	BALANCE OF HARDWARE BY DOOR MFGR			BYO

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
HINGES BY PARTITIONS MANUF.
VERIFY SEALS WITH DOOR/FRAME.

Hardware Group No. 18
For use on Door #(s):
214-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	ELEC PANIC HARDWARE	RX-PA-AX-98-L-M996-06-FSE		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
1	EA	FLOOR STOP	FS13		626	IVE
1	EA	POWER SUPPLY	PS902 BBK 120/240 VAC		LGR	SCE
1	SET	HARDWARE	BALANCE OF HARDWARE BY DOOR MFGR			BYO

CARD READER AND WIRING BY SECURITY VENDOR.
BALANCE OF HARDWARE, INCLUDING ELEC POWER TRANSFER AND HINGES BY DOOR MANUF.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
VERIFY CYLINDER.

Hardware Group No. 19
For use on Door #(s):
214N-A 214N-B

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PANIC HARDWARE	PA-AX-98-L-06		626	VON
1	EA	RIM HOUSING	20-079		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
1	EA	FLOOR STOP	FS13		626	IVE
2	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	SET	HARDWARE	BALANCE OF HARDWARE BY DOOR MFGR			BYO

KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
VERIFY SEALS WITH DOOR/FRAME.

Hardware Group No. 20
For use on Door #(s):
115Q-A 115R-A 214B-A 214C-A 214D-A 214E-A
214F-A 214G-A 214H-A 214J-A 214K-A 214L-A

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	26-094		626	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH
	SET	HARDWARE	BALANCE OF HARDWARE BY DOOR MFGR			BYO

VERIFY CYLINDER.
KEY TO EXISTING CAMPUS SCHLAGE PRIMUS SYSTEM.
BALANCE OF HARDWARE BY HAWORTH.

Hardware Group No. 21
For use on Door #(s):
G-001

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	STRAP HINGE	SHUT IT BADASS STRAP HINGE 6"		Z	DDT
2	EA	CANE BOLT KIT	524P23		630	CRO
1	EA	PADLOCK LESS CYL-KNK	KS43F2200		606	SCH
1	EA	PRIMUS CORE	20-740		626	SCH
1	EA	FSIC CORE	23-030 ICX		ORG	SCH

TRIM STRAP HINGES AS NEEDED.
PULLS BY OTHERS.

END OF SECTION

SECTION 08 71 05

ACOUSTICAL DOOR GASKETS

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. Furnish and install acoustical door gaskets on building standard doors.

B. Related Sections. The following work is specified elsewhere:
1. Metal and wood doors.
2. Door frames.
3. Glazing

1.03 SUBMITTALS

A. Compliance: Comply with pertinent provisions of Division 1 – General Requirements.

B. Specifications: Submit Manufacturer's specifications and other product data needed to prove compliance with all specified requirements. Product data shall include: installation instructions, details of construction, materials, dimensions, hardware preparation, acoustical door gaskets, profiles and finishes

C. Exceptions: Identify all proposed changes, differences, discrepancies and conflicts, including verbiage, terms, definitions between Contract Documents and submittals.

1.04 QUALITY ASSURANCE

A. Manufacturer's Experience: The Manufacturer shall have successful experience in fabrication, including no less than five years' experience in the fabrication of materials and products identical to those required in this project.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Division 1 – General Requirements.

B. Protect products during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the requirements of the manufacturer's instructions for storage and handling.

C. Identify each product with individual room number which corresponds with designation system used on shop drawings using temporary, removable or concealed markings.

PART 2 - PRODUCTS

2.01 LIGHT-DUTY ACOUSTICAL DOOR GASKET “Type ADG-1”

A. Fixed head and jamb gaskets shall consist of double row of self-adhesive compression bulb gaskets along the entire length of the head and jamb.
   1. Zero International Model #188S
   2. or approved equal.

B. Automatic door bottoms shall consist of an extruded aluminum housing with solid neoprene gasket, which is adjusted via adjusting screws. Solid neoprene shall be used to seal the openings between the aluminum housing and the inner solid neoprene gasket assembly. The solid neoprene gasket shall be adjusted to form a uniform compressed seal against a flat, solid floor surface, such as concrete or a flat metal plate. Do not seal automatic door bottom gasket to carpet.
   1. Zero International Model 365 (surface mounted to door).
   2. Zero International Model 355 (mortised in metal door).
   3. Zero International Model 364 (mortised in wood door).
   4. or approved equal.

C. Fixed meeting stile gaskets shall consist of an extruded aluminum housing or closed cell sponge neoprene held in place with a metal housing. Adjustable meeting stile gaskets shall consist of an extruded aluminum housing with solid neoprene and pile brush gaskets. Gasket shall be adjustable via adjusting screws.
   <u>Single Door Active</u>
   1. Zero International Model 139 or 44 (surface mounted to door).
   2. or approved equal

   <u>Both Doors Active</u>
   1. Zero International Model 55 and Model 155 (surface mounted to door).
   2. Zero International Model 56 and Model 156 (mortised to door).
   3. or approved equal.

D. Threshold shall consist of 0.5-inch tall by 4-inch wide aluminum threshold.
   1. Zero International Model 164 or 664.
   2. or approved equal

2.02 HEAVY DUTY ACOUSTICAL DOOR GASKETS “Type ADG-2”

A. Fixed head and jamb gaskets shall consist of double row of self-adhesive compression bulb gaskets along the entire length of the head and jamb.
   1. Zero International Model #188S
   2. or approved equal.

B. Adjustable head and jamb gaskets shall consist of an extruded aluminum housing with a solid neoprene gasket, which is adjusted via adjusting screws. Solid neoprene shall be used to seal the openings between the aluminum housing and the inner solid neoprene gasket assembly. The solid neoprene gasket shall be adjusted to form a uniform compressed seal against the door leaf.
   1. Zero International Model 870 (for use with a rabbetted door frame)
   2. Zero International Model 770 (for use with a flat door frame).
   3. or approved equal.

C. Automatic door bottoms shall consist of an extruded aluminum housing with solid neoprene gasket, which is adjusted via adjusting screws. Solid neoprene shall be used to seal the

openings between the aluminum housing and the inner solid neoprene gasket assembly. The solid neoprene gasket shall be adjusted to form a uniform compressed seal against a flat, solid floor surface, such as concrete or a flat metal plate. Do not seal automatic door bottom gasket to carpet.

1. Zero International Model 365 (surface mounted to door).
2. Zero International Model 355 (mortised in metal door).
3. Zero International Model 364 (mortised in wood door).
4. or approved equal.

D. Fixed meeting stile gaskets shall consist of an extruded aluminum housing or closed cell sponge neoprene held in place with a metal housing. Adjustable meeting stile gaskets shall consist of an extruded aluminum housing with solid neoprene and pile brush gaskets. Gasket shall be adjustable via adjusting screws.

Single Door Active

1. Zero International Model 140 (surface mounted to door).
2. or approved equal

Both Doors Active

1. Zero International Model 55 and Model 155 (surface mounted to door).
2. Zero International Model 56 and Model 156 (mortised to door).
3. or approved equal.

E. Threshold shall consist of 0.5-inch tall by 4-inch wide aluminum threshold.

1. Zero International Model 164 or 664.
2. or approved equal.

2.03 HEAVY DUTY ACOUSTICAL DOOR GASKETS “Type ADG-3”

A. Fixed head and jamb gaskets shall consist of double row of self-adhesive compression bulb gaskets along the entire length of the head and jamb.

1. Zero International Model 870 (for use with a rabbetted door frame)
2. or approved equal

a. Adjustable head and jamb gaskets shall consist of an extruded aluminum housing with a solid neoprene gasket, which is adjusted via adjusting screws. Solid neoprene shall be used to seal the openings between the aluminum housing and the inner solid neoprene gasket assembly. The solid neoprene gasket shall be adjusted to form a uniform compressed seal against the door leaf.

1. Zero International Model 870 (for use with a rabbetted door frame)
2. Zero International Model 770 (for use with a flat door frame).
3. or approved equal.

b. Automatic door bottoms shall consist of an extruded aluminum housing with solid neoprene gasket, which is adjusted via adjusting screws. Solid neoprene shall be used to seal the openings between the aluminum housing and the inner solid neoprene gasket assembly. The solid neoprene gasket shall be adjusted to form a uniform compressed seal against a flat, solid floor surface, such as concrete or a flat metal plate. Do not seal automatic door bottom gasket to carpet.

1. Zero International Model 365 (surface mounted to door).
2. or approved equal.

c. Fixed meeting stile gaskets shall consist of an extruded aluminum housing or closed cell sponge neoprene held in place with a metal housing. Adjustable meeting stile gaskets shall consist of an extruded aluminum housing with solid neoprene and pile brush gaskets. Gasket shall be adjustable via adjusting screws.

Single Door Active
1. Zero International Model 140 (surface mounted to door).
2. or approved equal

d. Threshold shall consist of 0.5-inch tall by 4-inch wide aluminum threshold with solid neoprene gasket that seals against the door bottom leaf.
   1. Zero International Model 564 or 566.
   2. or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install acoustical gaskets in full compliance with the manufacturers printed instructions and recommendations.

B. Acoustically gasketed doors with door frames (head and jamb) in gypsum board construction shall be fully packed with with 1.5-pcf density unfaced fiberglass or mineral wool insulation. Acoustically gasketed doors with door frames in masonry construction shall be fully grouted.

C. Inspect adjacent construction and make sure that conditions detrimental to the proper and timely execution of this work are corrected before proceeding with installation.

D. All seals should be continuous with no interference from door hardware such as closures, exit devices, panic bars, etc. Coordinate auto closer with head gasket, lockset with jamb or meeting stile gasket, knob or pull with jamb and meeting stile gasket, and latches with head and bottom gaskets. Do not cut head or jamb gaskets to accommodate auto closer or other hardware.

E. Adjust all gaskets to provide airtight seals with no visible gaps or spaces. No light leaks shall be visible at the gasket seals around the entire perimeter of the door. Once properly adjusted, the acoustical door gaskets shall provide a firm uniform compression seal around the perimeters of the doors such that it shall be difficult to slide a credit card between the gaskets and the door leafs. The gaskets shall be adjusted until it is difficult to slide a credit card between the gaskets and door leaf.

3.02 CLEANING

A. Clean all surfaces following installation.

B. Replace material having scratches, abrasions or other defects with unblemished acoustical surface finish assemblies at no cost to the owner.

3.03 PROTECTION

A. Protection of acoustical door gaskets and doors from damage by other trades after installation shall be provided by the General Contractor.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Glass and glazing for Sections referencing this Section for products and installation.

B. Related Section(s):
1. Section 08 41 13 Aluminum Entrances and Storefronts
2. Section 08 44 14 Glazed Aluminum Curtain Wall
3. Section 08 87 00 Solar Control Window Film
4. Energy calculations or prescriptive compliance documents

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. 2019 California Building Code, Chapter 24, Table 2403.2.1, Tables 2406.2(1) and 2406.2(2).

C. 2019 California Energy Code, Title 24, Part 6, Subchapter 2, Sections 110.6 and Subchapter 5, Section 140.3.

D. 2019 California Administrative Code, Chapter 10, Sections 10-111 and 10-112.

E. ASTM C1036 - Standard Specification for Flat Glass

F. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass

G. ASTM D792 - Density and Specific Gravity (Relative Density) and Density of Plastics by Displacement.

H. ASTM E 2190 - Insulating Glass Unit Performance and Evaluation

I. GANA - Glass Association of North America - Glazing Manual, Latest Edition

J. GANA - Glass Association of North America - Sealant Manual, Latest Edition

K. AAMA - 92, Voluntary Specification and Test Methods for Sealants

L. GTA - Glass Tempering Division of Glass Association of North America

M. LSGA - Laminators Safety Glass Association - Standards Manual

N. SIGMA - Sealed Insulated Glass Manufacturers Association - Glazing Manual

O. IGMA - Insulating Glass Manufacturers Alliance

P. Chapter 24 , 2019 California Building Code

Q. Section KCMZ, UL Fire Resistance Directory, Volume 3, Latest Edition.

R. California Code of Regulations, Title 24
   1. CBC California Building Code (CBC) 2019
   2. CRSC California Referenced Standards Code, Standard 12-7-4, fire door tests

S. NFPA-80 Fire Doors and Fire Windows

T. NFPA-257 Fire Test for Windows and Glass Block Assemblies

U. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Material, Consumer Protection Safety Commission, Code of Federal Regulations. All glazing shall pass the test requirements of CPSC 16 CFR 1201, listed in Chapter 35. Comply with the CPSC 16 CFR, Part 1201 criteria, for Category I or II as indicated in Table 2406.1, CBC. Required for fully tempered glass, laminated glass, and wire Glass.

V. ANSI Z-97.1-84 (R1994) - Performance Specifications and Methods of Test for Transparent Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Method of Test. Required for fully tempered glass, laminated glass.

1.03 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass sloped 15 degrees or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the wind load in Section 1609.6.4.4 and Table 1609.6.2(2). Glass in glazed curtain walls, glazed storefronts and glazed partitions shall meet the seismic requirements of ASCE 7, Section 13.5.9. Load resistance under uniform load per ASTM E1300.
   1. Sloped glass: CBC Section 2404.2 and Section 2405 Sloping Glass and Skylights.

C. Provide minimum frame lap in accordance with Table 2403.2.1, California Building Code and Note "*1*" for design wind and earthquake drift.

D. Glazing materials and assemblies shall be tested in accordance with California Referenced Standards Code, Standard 12-7-4 and NFPA 80 Fire Doors and Fire Windows and shall be labeled and installed in accordance with their listing.

E. Glazing in fire door and fire window assemblies subject to human impact loads and in hazardous locations shall comply with requirement of CBC Sections 2406.2 and 2406.4.

F. Air and Water Infiltration per ASTM E283 and ASTM E331.

G. Performance Rating: Glazing U-Factor, Relative Solar Heat Gain Coefficient and Visible Transmittance shall be rated in accordance with the T-24 Energy Report per maxima and minimum requirements in California Energy Code, Subchapter 5, Section 140.3(a)5 and Table 140.3-B.

H. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the CBC and ASCE 7/SEI 7.
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Basic Wind Speed (Ultimate design wind speed): 115 mph
      b. Seismic Importance Factor: 1.25 for schools, Category III
      c. Exposure Category: C
   2. Maximum Lateral Deflection: To be considered firmly supported, the framing members for each individual pane of glass shall be designed so the deflection of the edge of the glass perpendicular to the glass panel shall not exceed 1/175 of the glass edge length or 3/4-inch, whichever is less, when subjected to the larger of the positive or negative load where loads are combined as specified in CBC Section 1605A. CBC Section 2403.3.

1.04 SUBMITTALS

A. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

B. Three samples of each material specified illustrating coloration and design.

C. Submit certification of Manufacturer’s Certified Fabricators.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Glass Fabricators: Member of manufacturer’s Certified Fabricator Program (CFP)
   1. Program members participate in rigorous training program on processing of sophisticated glass products, including high-performance coated glasses.
   2. Subject to comprehensive, multiple-day audit addresses glass fabrication equipment as well as their documented processing procedures.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from single manufacturer for each product and installation method indicated.

D. Perform Work in accordance with:
   1. GANA Glazing Manual.
   2. GANA Sealant Manual.

3. LSGA Standards Manual.
4. IGMA/SIGMA Glazing Manual, Class CBA.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when ambient temperature is less than 50 degrees F.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.08 COORDINATION

A. Coordinate the Work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.

1.09 WARRANTY

A. Provide one-year manufacturer's warranty from Date of Substantial Completion for defective products including broken, cracked or otherwise damaged glass not caused by vandalism. Water intrusion through sealant/glass joint.

B. Manufacturer's Special Warranty: Include 10 years coverage for sealed glass units from seal failure, interpane dusting or misting and replacement of same.

C. Manufacturer's Special Warranty: Include 10 year silver spoilage coverage for reflective coating on mirrors and replacement of same.

1.10 IDENTIFICATION

A. Each pane shall bear the manufacturer's mark designating the type and thickness of glass and glazing material. Conform to Section 2403.1, California Building Code. Safety glass shall be identified in accordance with CBC Section 2406.3.

B. Each pane of safety glazing material installed in hazardous locations required per Section 2406.1 and as defined in Section 2406.3 Chapter 24, California Building Code. Safety glass shall be identified by a label which will specify the labeler, whether the manufacturer or installer, and state that safety glazing material has been utilized in such installation.
   1. Identification shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of that type once applied, cannot be removed without being destroyed, on glass and readable from inside of building after installation.
   2. Label text shall comply with Section 2406.3.

C. Each pane of tempered glass, except tempered spandrel glass, shall be permanently indentified by the manufacturer. The identification mark shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of the type that once applied cannot be removed without being destroyed. Tempered spandrel glass shall be provided with a removable paper marking by the manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS - FLAT GLASS MATERIALS

A. Products of following manufacturers form basis for design and quality intended.
   1. Vitro Architectural Glass, Pittsburgh, PA.
   2. Guardian Industries Corp. Kingsburg, CA, Corsicana TX.
   3. Pilkington Libbey-Owens-Ford Co, Toledo, OH.
   4. Saint-Gobain Corp.

B. Products of following fabricators form basis for design and quality intended.
   1. Solutia/Vanceva Laminated Glass/Oldcastle, St. Louis, MO.
   2. Envelope Corp.
   3. ASI Glass/SCHOTT Group, Elmsford, NY.
   4. Viracon Inc. Owatonna, MN.

C. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 GLASS MATERIALS

A. GL1: Insulating Glass Units, Low-E Coated: double pane with silicone sealant edge secondary seal and polyisobutylene primary seal with aluminum spacer, clear anodized. Outboard lite of tinted 1/4 inch heat-strengthened glass, ASTM C1048, Kind HS. Inboard lite of 1/4 inch clear tempered, Kind FT, glass, Category I, CPSC 16 CFR 1201. Category II for units less than 18" above floor, and top edge greater than 36". Low-E coating on surface 2, interpane space purged dry air; total unit thickness of one inch. Solarban 70.
   1. Vitro Solarban 70 - Low- E Tinted Insulating Glass, sputter-coated
      a. Solarban 70 (2) Clear + Clear
         1) Visible Light Transmittance of 79%, solar heat gain coefficients of 0.70

B. GL2: Insulating Glass Units, Low-E Coated with Solar Control Window Film: double pane with silicone sealant edge secondary seal and polyisobutylene primary seal with aluminum spacer, clear anodized. Outboard lite of tinted 1/4 inch heat-strengthened glass, ASTM C1048, Kind HS. Inboard lite of 1/4 inch clear tempered, Kind FT, glass, Category I, CPSC 16 CFR 1201. Category II for units less than 18" above floor, and top edge greater than 36". Low-E coating on surface 2, interpane space purged dry air; total unit thickness of one inch. Solarban 70.
   1. Vitro Solarban 70 - Low- E Tinted Insulating Glass, sputter-coated
      a. Solarban 70 (2) Clear + Clear
         1) Visible Light Transmittance of 79%, solar heat gain coefficients of 0.70
   2. Solar Control Window Film on Surface 4 per Section 08 87 00, Solar Control Window Film.

C. GL3: Insulating Glass Units, Low-E Coated with Shadow Box: double pane with silicone sealant edge secondary seal and polyisobutylene primary seal with aluminum spacer, clear anodized. Outboard lite of tinted 1/4 inch heat-strengthened glass, ASTM C1048, Kind HS. Inboard lite of 1/4 inch clear tempered, Kind FT, glass, Category I, CPSC 16 CFR 1201. Category II for units less than 18" above floor, and top edge greater than 36". Low-E coating on surface 2, interpane space purged dry air; total unit thickness of one inch. Solarban 70.
   1. Vitro Solarban 70 - Low- E Tinted Insulating Glass, sputter-coated
      a. Solarban 70 (2) Clear + Clear
         1) Visible Light Transmittance of 79%, solar heat gain coefficients of 0.70
   2. Shadow Box at Vision Glass: Screw attach formed sheet metal within mullion frame behind insulating glass, seal tight surrounding edges to prevent migration of warm moist air to inside shadow box. Paint metal per Architect's selected color. Drain cavity to exterior to prevent trapped condensation water. Provide rigid insulation behind sheet metal, insulation on interior side with foil faced surface.
      a. Mockup: provide mockup of shadow box for approval by Architect.

D. GL4: Insulating Glass Units, Low-E Coated with Solar Control Window Film and Shadow Box: double pane with silicone sealant edge secondary seal and polyisobutylene primary seal with aluminum spacer, clear anodized. Outboard lite of tinted 1/4 inch heat-strengthened glass, ASTM C1048, Kind HS. Inboard lite of 1/4 inch clear tempered, Kind FT, glass, Category I, CPSC 16 CFR 1201. Category II for units less than 18" above floor, and top edge greater than 36". Low-E coating on surface 2, interpane space purged dry air; total unit thickness of one inch. Solarban 70.
   1. Vitro Solarban 70 - Low- E Tinted Insulating Glass, sputter-coated
      a. Solarban 70 (2) Clear + Clear
         1) Visible Light Transmittance of 79%, solar heat gain coefficients of 0.70
   2. Shadow Box at Vision Glass: Screw attach formed sheet metal within mullion frame behind insulating glass, seal tight surrounding edges to prevent migration of warm moist air to inside shadow box. Paint metal per Architect's selected color. Drain cavity to exterior to prevent trapped condensation water. Provide rigid insulation behind sheet metal, insulation on interior side with foil faced surface.
         1) Mockup: provide mockup of shadow box for approval by Architect.
   3. Solar Control Window Film on Surface 4 per Section 08 87 00, Solar Control Window Film.

E. GL5: Safety Glass at all interior glazing, unless noted otherwise: ASTM C1048, Kind FT fully tempered, Condition A uncoated, Type I transparent glass, Class 1 Clear, Quality-Q3 Glazing select, 3/8 inch thick minimum. All safety glass shall pass the test requirements of CPSC 16 CFR 1201 criteria, for Category I or II as indicated in Table 2406.2(1), CBC and below, and for Hazardous locations per Section 2406.4:
   1. 9 sq. ft. or less: Category I
   2. More than 9 sq. ft.: Category II
   3. Refer to Section 10 22 19 for additional glazing information at Demountable Partitions.

F. GL6: Safety Glass with Shadow Box: ASTM C1048, Kind FT fully tempered, Condition A uncoated, Type I transparent glass, Class 1 Clear, Quality-Q3 Glazing select, 3/8 inch thick minimum. All safety glass shall pass the test requirements of CPSC 16 CFR 1201 criteria, for Category I or II as indicated in Table 2406.2(1), CBC and below, and for Hazardous locations per Section 2406.4:
   1. 9 sq. ft. or less: Category I
   2. More than 9 sq. ft.: Category II
   3. Shadow Box at Vision Glass: Screw attach formed sheet metal within mullion frame behind insulating glass, seal tight surrounding edges to prevent migration of warm moist air to inside shadow box. Paint metal per Architect's selected color. Drain cavity to exterior to prevent trapped condensation water. Provide rigid insulation behind sheet metal, insulation on interior side with foil faced surface.
      a. Mockup: provide mockup of shadow box for approval by Architect.

2.03 MIRROR GLASS

A. Mirror Glass: Vinyl-backed safety mirror glass , per CPSC 16 CFR 1201, Category II and ANSI Z-97.1, 1/4 inch thick minimum, sizes as noted on Drawings.
   1. Frame: Frame face 3/4 x 3/4 inch welded seamless stainless steel, No. 304 finish, 20 gauge galvanized steel backing, Series No. 290, by Bobrick Washroom Equipment Inc., North Hollywood, CA, or equal.
   2. Edges: Flat polished edges.
   3. Mounting: concealed mounting wall hangers with theft-resistant locking devices.
   4. For unframed mirrors: stainless steel edge channels at top and bottom and mastic bond to wall. Flat polish, ground arris (bevel) at exposed edges, UNO.
   5. Mirror Mastic: Adhesive setting compound and barrier coat, produced specifically for setting mirrors, compatible with glass coating and substrate on which mirrors will be installed, Gunther Mirror Mastics, Palmer Products Incorporated or equal.

2.04 GLAZING ACCESSORIES

A. Setting Blocks: 80-90 Shore A Durometer Hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: 40-50 Shore A Durometer Hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self-adhesive on one side.

C. Glazing Tape, minimum 1/8" thick, 1/2" wide, the following:
   1. Preformed butyl compound with integral resilient tube spacing device; 10 - 15 Shore A Durometer Hardness; coiled on release paper; black color.
   2. Expanded Cellular Glazing tape, closed-cell, PVC foam tapes, factory coated with adhesive of both surfaces, coiled with released liner, complying with AAMA 800. Type 1 for tape acting as primary sealant, Type 2 tape combination with full bead of sealant.

D. Glazing Splines: Resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot.

E. Sealants: for color sealants; DowSil 795 Silicone or as specified in Section 07 92 00. Use Pecora 895 Structural Glazing for translucent and structural glazing applications or Tremco Spectrem 2 clear or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify prepared openings.

B. Verify that openings for glazing are correctly sized and within tolerance.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions and ready to receive glazing.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

D. Mirror Glass: flat polish edge treatment. Edge Sealer: Seal edges for mirror glass after edge treatment to prevent chemical or atmospheric penetration of glass coating.

3.03 EXTERIOR - DRY METHOD (PREFORMED GLAZING)

A. Cut glazing spline to length; install on glazing pane. Seal corners by butting spline and sealing junctions with butyl sealant.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

D. Install removable stops without displacing glazing. Exert pressure for full continuous contact. Seal stop-screw holes and fill screw tips with silicone before installing.

3.04 EXTERIOR - DRY/WET METHOD (PREFORMED TAPE AND SEALANT)

A. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.

B. Apply toe bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

D. Rest glazing on setting blocks and push against tape and toe bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.

E. Install removable stops, with spacer shims inserted between glazing and applied stops 1/4 inch below sight line. Place glazing tape on glazing panel or unit with tape flush with sight line. Seal stop screw holes and fill screw tips with silicone before installing.

F. Fill gap between glazing and stop with silicone type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.

G. Apply cap bead of silicone type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.05 EXTERIOR - WET METHOD (SEALANT AND SEALANT)

A. Place setting blocks at 1/4 points and install glazing pane or glass unit.

B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line. Seal stop screw holes and fill screw tips with silicone before installing.

C. Fill gaps between glazing and stops with silicone type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line, to ensure full contact with glazing and continue the air and vapor seal.

D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.06 INTERIOR - DRY METHOD (TAPE AND TAPE)

A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

D. Place glazing tape on free perimeter of glazing in same manner described above.

E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact. Seal stop screw holes and fill screw tips with silicone before installing.

F. Knife trim protruding tape.

3.07 INTERIOR – DRY/WET METHOD (TAPE AND SEALANT)

A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or glass unit.

D. Install removable stops, with spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line. Seal stop-screw holes and fill screw tips with silicone before installing.

E. Fill gaps between pane and applied stop with silicone type sealant to depth equal to bite on glazing, to uniform and level line.

F. Trim protruding glazing tape edge.

3.08 MANUFACTURER'S FIELD SERVICES

A. Glass and glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures, unacceptable conditions and report deficiencies to the Architect.

3.09 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Clean and polish surfaces and frames.

3.10 PROTECTION OF FINISHED WORK

A. Protect finished Work.

B. After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing glass units.

END OF SECTION

SECTION 08 84 00

PLASTIC GLAZING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. High performance resin for vertical panels.

B. Accessories.

C. Related Sections:
1. Section 08 80 00, Glazing for glass and related glazing materials.

1.02 SYSTEM DESCRIPTION

A. Provide plastic glazing sheets and glazing materials capable of withstanding normal temperature changes, wind loading, and impact loading without failure, including loss or breakage of plastic sheets attributable to the following: failure of sealants or gaskets to remain watertight and airtight, deterioration of plastic sheet and glazing materials, or other defects in materials and installation.

B. UL 723/Surface Burning Characteristics, ASTM E84: Class A, Flame Spread: 0 vs. 25 maximum, Smoke Generation: 66 vs. 450 maximum.

1.03 SUBMITTALS

A. Product Data: For each type of plastic sheet and glazing material specified.

B. Shop Drawings: For each type of plastic glazing installation indicated. Show details of fabrication and installation.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of plastic sheets and exposed glazing materials showing the full range of colors and finishes available for each type of plastic sheet and exposed glazing material indicated.

D. Samples for Verification: Of each color and finish of plastic sheet specified, prepared on samples 12 inches square and of same thickness and material indicated for final Work.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain plastic glazing materials through one source from a single manufacturer for each type of plastic glazing and glazing product indicated.

B. Glazing Publication: Comply with published recommendations of GANA's "Glazing Manual", unless more stringent requirements are indicated. Refer to this publication for definitions of glazing terms not otherwise defined in this Section or other referenced standards.

C. Pre-Construction Compatibility and Adhesion Testing: Submit to glazing sealant manufacturer's samples of materials that will contact or affect glazing sealants for testing indicated below.
   1. Use manufacturer's standard test methods to determine whether priming or other specific glazing channel preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glazing channel substrates.
      a. Perform tests under normal environmental conditions that will exist during installation.
   2. Submit not fewer than 3 pieces of each type of material, including materials forming glazing channel substrates, each type and form of plastic sheet, gaskets, glazing tape, setting blocks, spacers, shims, glazing sealant backings, and miscellaneous materials.
   3. Schedule sufficient time of testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, obtain glazing sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primer.

D. Mockups: Construct mockups for each form of plastic sheet and glazing required to verify selections made under Sample submittals and to demonstrate aesthetic effects and quality of materials and execution.
   1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Obtain Architect's approval of mockups before proceeding with fabrication and installation of plastic glazing.
   3. Maintain mockups during construction in an undisturbed conditions as a standard for judging the completed Work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's written instructions for shipping, storing, and handling plastic glazing sheets and for removing protective coverings after installation.

B. Maintain protective coverings on sheets to avoid exposures to abrasive substances, excessive heat and other sources of possible deterioration.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing sealants if ambient and substrate temperature conditions are outside the limits permitted by glazing sealant manufacturers or when glazing channel substrates are wet because of rain, frost, condensation or other causes.
   1. Install liquid sealant at ambient and substrate temperature conditions above 40 deg F (4.4 deg C.).

1.07 WARRANTY

A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.

B. Warranty Period: 2 year after the date of substantial completion.

C. The warranty shall not deprive the owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. 3form Inc., Salt Lake City, Utah.
   2. Knoll Textiles
   3. Lumicor Inc./Schober Inc., Renton, WA
   4. Veritas Inc., Salt Lake City, Utah.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 MATERIALS

A. Product: Chroma by 3form Inc.
   1. Engineered polyester resin, glycol modified.
   2. Sheet Size: Maximum 4' x 8'
   3. Thickness: Minimum 1/2".
   4. Chroma: Monolithic solid surface, translucent or opaque.
   5. Chroma Colors: Refer to Finish Schedule on Drawings]
   6. Surface finish: Chroma; Renewable Matte finish, with etched/routed-in lines. Refer to Drawings.
   7. Accessories:
      a. 3form Point Support: Standoff system. Stainless steel barrels, caps, snap covers, connectors, flanges, spacer, and wall anchors.
   8. Colors: Refer to Finish Schedule on Drawings.

2.03 GLAZING POLYESTER PLASTICS, GENERAL

A. Sizes: Fabricate plastic glazing sheets to sizes required for glazing openings indicated. Allow for thermal expansion and contraction of plastic glazing without restraint and without withdrawal of edges from frames, with edge clearances and tolerances complying with written instructions of plastic glazing manufacturer.

2.04 FABRICATION

A. General: Fabricate Resin Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.

B. Comply with manufacturer's written recommendations for fabrication.

C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
   1. Sawing: Select equipment and blades suitable for type of cut required.
   2. Drilling: Drills specifically designed for use with Resin products.
   3. Milling: Climb cut where possible.
   4. Routing

D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
   1. Cold Bending
   2. Hot Bending
   3. Thermoforming
   4. Drape Forming
   5. Matched Mold Forming
   6. Mechanical Forming

E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.05 MISCELLANEOUS MATERIALS

A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaner: Mild soap and water or common acrylic cleaners such as Novus or Gel-Gloss.

C. Fasteners: Use screws designed specifically for Resins. Provide threaded metal or nylon inserts for applications requiring frequent disassembly such as light fixtures.

D. Bonding Cements: Solvent or adhesives, suitable for use with product and application.

E. Drilled Panel Wall Anchors: As provided by the manufacturer. Provide extensions to accommodate thicknesses scheduled or illustrated.

2.06 GLAZING SEALANTS

A. General: Provide manufacturer's standard products of type indicated and complying with the following requirements:

1. Compatibility: Provide glazing sealants that are compatible with other materials with which they will come into contact, including plastic glazing products and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
2. Colors: Provide color of exposed sealants as selected by Architect from manufacturer's full range of colors.

B. One-Part, Neutral-Curing, Silicone Sealant: ASTM C920; Type S; Grade NS; Class 25; Uses NT, M, G, A, and as applicable to joint substrates indicated, O; and with the additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719.

C. One Part, Neutral-Curing, Silicone Sealant:
1. DowSil 790; Dow Chemical Corporation.
2. DowSil 795; Dow Chemical Corporation.
3. Silpruf; GE Silicones.
4. 864; Pecora Corporation.

D. One-Part, Neutral-Curing, High Modulus Silicone Sealant:
1. Ultraglaze SSG 4000; GE Silicones.

E. Preformed Tape Sealant:
1. PTI 303; H.B. Fuller Company
2. PTI 606; H.B. Fuller Company
3. Extru-Seal; Pecora Corporation.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Provide materials with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine plastic glazing framing, with glazing installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Minimum required face or edge clearances.
3. Effective sealant between joints of plastic glazing faming members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members to receive plastic glazing immediately before glazing. Remove coatings not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.03 GENERAL

A. General: Comply with manufacturer's written instructions for the installation of Resin Fabrications.

B. Shop fabricates items to the greatest degree possible.

C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.

D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.04 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of plastic glazing materials, sealants, gaskets and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publication.

B. Remove burrs and other projects from glazing channel surfaces.

C. Protect plastic surfaces from abrasion and other damage during handling and installation.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by pre-construction sealant-substrate testing.

E. Install standoff components and anchors in patterns recommended by the glazing manufacturer engineered to address panel weight and deflection. Refer to drawings for architectural patterns.

3.05 TAPE GLAZING

A. Position tapes on fixed stops so that when compressed by plastic glazing, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not in one continuous length. Do not stretch tape to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sill.

D. Place joints in tapes at corner of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant recommended by tape manufacturer.

E. Do not remove release paper from tape until just before each lite is installed.

F. Apply heel bead of elastomeric sealant.

G. Center plastic glazing lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers between plastic glazing lites and glazing stops to maintain plastic glazing face clearances and to prevent sealant from extruding into glazing channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to plastic glazing and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial washaway from plastic glazing. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

3.07 PROTECTION AND CLEANING

A. Protect plastic glazing from contact with contaminating substances from construction operations. If, despite such protection, contaminating substances do come into contract with plastic glazing, remove immediately and wash by method recommended by plastic glazing manufacturer.

B. Remove and replace plastic glazing that is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

C. Wash plastic glazing on both faces before date scheduled for inspections to intended to establish date of Substantial Completion in each area of Project. Wash plastic glazing by method recommended by plastic glazing manufacturer.

END OF SECTION

SECTION 08 87 00

SOLAR CONTROL WINDOW FILM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Transitional Window Films.

B. Related Sections:
1. Section 08 41 13, Aluminum Entrances and Storefronts.
2. Section 08 44 14, Glazed Aluminum Curtain Wall.
3. Section 08 80 00, Glazing.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

C. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.
4. Mock-up may remain as a part of the Work.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.05 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard 10 year limited warranty. Will not blister, peel, change color, or bubble.
   1. Photochromic reactions are warranted for a minimum of five (5) years from date of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. CoolVu Transitional Window Films through Innovative Glass Corp, Plainview, NY.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 PERFORMANCE REQUIREMENTS

A. Energy Performance:
   1. Block Ultraviolet Radiation: 99%.
   2. Block Infrared Energy: 80%.
   3. Control Sun Glare: Up to 80%.

B. View Enhancement:
   1. Allow for clear vision through glass at all times and lighting conditions.
   2. Glare Control.

2.03 WINDOW FILM

A. Basis of Design: CoolVu Plus 2; as manufactured by CoolVu Transitional Window Films or approved equal.
   1. Performance under Normal Conditions:
      a. Solar Energy Transmitted: 61.0 percent.
      b. Solar Energy Reflected: 19.0 percent.
      c. Solar Energy Absorbed: 20.0 percent.
      d. Visible Light Transmitted: 72.0 percent.
      e. Visible Light Reflected to Exterior: 14.0 percent.
      f. Visible Light Reflected to Interior: 13.0 percent.
      g. Glare Reduction: 18.0 percent.
      h. Solar Heat Gain Coefficient (SHGC): 0.68.

i. Shading Coefficient: 0.77.
j. Total Solar Energy Rejection: 40.0 percent.
k. Infrared Rejection: 45.0 percent.
l. U-Factor: 0.9.
m. Emissivity: 0.9.
n. Ultraviolet Rejection: More than 99 percent.

2. Performance at Darkest:
   a. Solar Energy Transmitted: 50.0 percent.
   b. Solar Energy Reflected: 19.0 percent.
   c. Solar Energy Absorbed: 31.0 percent.
   d. Visible Light Transmitted: 35.0 percent.
   e. Visible Light Reflected to Exterior: 11.0 percent.
   f. Visible Light Reflected to Interior: 11.0 percent.
   g. Glare Reduction: 57 percent.
   h. Solar Heat Gain Coefficient (SHGC): 0.66.
   i. Shading Coefficient: 0.74.
   j. Total Solar Energy Rejection: 50.0 percent.
   k. Infrared Rejection: 45.0 percent.
   l. U-Factor: 0.9.
   m. Emissivity: 0.9.
   n. Ultraviolet Rejection: More than 99 percent.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the furnishing, testing, and application of systems for the reduction of moisture vapor transmission and alkalinity control for all interior concrete slabs scheduled to receive adhered floor coverings.

B. Related Sections: Coordinate work of this Section with work of other Sections to properly execute the work requirements and maintain satisfactory progress of work in other Sections.
   1. Section 03 30 00 - Cast-In Place Concrete.
   2. Division 09 Sections for adhered floor coverings.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM International
   1. E 96 - Standard Test Method for Water Vapor Transmission of Materials
   2. F 710 - Preparing Concrete Floors to Receive Resilient Flooring
   3. F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor
   4. F 2170 - Relative Humidity in Concrete Floor Slabs Using *in situ* Probes
   5. F 3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Covering

C. AQMD - Air Quality Management District
   1. SCAQMD - South Coast Air Quality Management District, Rule 1113 - Architectural Coatings

1.03 SCHEDULING

A. Coordinate scheduling of all pre-application testing, application, and post-application testing to allow adequate slab curing and acclimatization prior to testing, and adequate time for curing of the treatment before final testing and installation of floor coverings.

1.04 SUBMITTALS

A. Product Data: For each type of product and process proposed

B. Test and Evaluation Reports

C. Manufacturer's Instructions: For installation

D. VOC Submittals: Submit data substantiating that products comply with VOC limits.

E. Qualification Statements: For manufacturer and installer

F. Closeout Submittals
   1. Warranty Documentation

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall have no less than ten (10) years experience in manufacturing water vapor reduction systems. The water vapor reduction system must be specifically formulated and marketed for water vapor reduction and alkalinity control without change of system design for a minimum period of five (5) years.

B. Applicator's Qualifications: Currently approved by the manufacturer, experienced in surface preparation and application of the material and subject to inspection of the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the job site in their original unopened containers, clearly labeled with the manufacturer's name and brand designation.

B. Store products in an approved ventilated dry area; protect from dampness, freezing, and direct sun light. Product should not be stored in areas with temperatures in excess of 90° F or below 50° F.

C. Handle product in a manner that will prevent breakage of containers and damage products.

1.07 FIELD CONDITIONS

A. Environmental Conditions
   1. Do not apply moisture vapor reduction system to surfaces that may be exposed to excessive weather conditions (such as rain, wind, etc) until the material has fully cured, or when water is accumulated on the surface of the concrete. Protect freshly applied coating accordingly when material is applied outdoors.
   2. Do not apply water vapor reduction system when temperature is lower than 50°F or expected to fall below this temperature within 24 hours from time of application.

1.08 WARRANTY

A. Manufacturer shall warrant system to maintain moisture vapor emission rate, relative humidity, and pH within specified limits for not less than fifteen (15) years from the date of Certified Completion. Manufacturer shall not exclude ridgelines "mole lines" that develop in the finished flooring materials.

B. Manufacturer's warranty shall include all materials and labor to repair or replace damaged floor coverings, and any other construction or Owner's property damaged due to slab failure or resultant mold growth.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturer form the basis of design and quality intended for the Project:
   1. KÓSTER American Corporation, Virginia Beach, VA.

B. Subject to compliance with requirements, other acceptable manufacturers include, but are not limited to, the following:
   1. Ardex Engineered Cements, Aliquippa, PA.
   2. MAPEI Americas, Deerfield Beach, FL.
   3. Aquafin, Inc., Elkton, MD.
   4. Dex-O-Tex, Division of Crossfield Products Corp., Rancho Dominguez, CA.

C. Or equal, as approved in accordance with Division 01 requirements for Substitutions.

2.02 DESCRIPTION

A. Basis-of-Design: KÓSTER VAP I® 2000 System.

2.03 PERFORMANCE CRITERIA

A. Product shall comply with ASTM F3010.

B. ASTM E96: Water Vapor Reduction System cannot exceed 0.1 Net Perms (grains/hr/sq. ft. in Hg-1) and must be documented by an independent test report using the mil thickness required for Project.

C. Products shall comply with SCAQMD Rule 1168 VOC limit of 100 g/L.

2.04 MATERIALS

A. 100% solids epoxy coating, containing specifically formulated chemicals and resins to provide the specified criteria in a one coat system. No multi-coat, water-based, or silicate based systems are allowed. System must contain 100% solid epoxy system.

B. Primers, concrete repair materials, and other accessory products as recommended by moisture vapor reduction treatment manufacturer.
   1. Primer: Koster VAP I 06 Primer
   2. Cementitious Underlayment: Koster SL Standard or Level Strong (High Strength and Regular) as recommended by manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

A. All new and existing concrete slabs, including slabs-on-grade and suspended slabs, that are scheduled to receive adhered floor coverings: Install vapor emissions treatment systems per this Section regardless of test results. Pre-Treatment testing is for the manufacturer's and applicator's use in determining the necessary coverage rate.
   1. Slab areas not requiring testing or treatment include areas scheduled for the following flooring types:
      a. Sealed exposed concrete.
      b. Polished or dyed and polished concrete.
      c. Depressed slabs to receive mortar-bed tiling.

B. If pre-application test results indicate variations in the slab conditions among different areas, the coverage rate for the entire slab shall be determined based on the highest moisture area.

3.02 EXAMINATION OF SUBSTRATE BEFORE APPLICATION

A. Calcium Chloride and RH Probe test requirements:
   1. Provide anhydrous calcium chloride tests according ASTM F 1869 protocols.
      a. Only conduct calcium chloride tests at the same temperature and humidity expected during normal use. If this is not possible, then the test conditions should be 75°F +/-10°F and 50% (+/-10%) relative humidity. Maintain these conditions 48 hours prior to and during testing. Water vapor transmission levels are directly affected by ambient room temperature and readings conducted without a sustained ambient temperature are NOT acceptable.
   2. Provide RH Probe Tests according to ASTM F 2170 protocols.
   3. Provide test results with a marked-up floor finish plan showing test results. Provide a written clarification on status of the ambient air temperature and humidity before and during the testing procedures.

B. Test for concrete deficiencies and contaminates such as un-reacted water-soluble silicates, chlorides, A.S.R. (alkali-silica reaction), oil contamination, etc. This testing should be performed using standard coring methods. Also, the history of the slab installation should be reviewed. Concrete should conform to ACI Committee 201 Report "Guide to Durable Concrete."

3.03 PREPARATION

A. Inspect all surfaces with regard to their suitability to receive moisture vapor reduction system with manufacturer's representative.

B. Clean all surfaces to receive moisture vapor reduction system. Shot blast all floors to a Concrete Surface Profile (CSP) #3 or #4 and clean surfaces with an industrial vacuum cleaner and remove all residues from the substrate. Grinding is allowed only in areas not accessible by shot blasting. Remove ALL defective materials, and foreign matter such as dust, adhesives, leveling compounds, paint, dirt, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, shot blast beads, etc. Repair all cracks, expansion joints, control joints, and open surface honeycombs and fill in accordance with Manufacturer's recommendations. If concrete additives such as chlorides or any other water-soluble compounds that may contaminate surfaces have been used in the concrete mix do not use this product on that floor without written approval from moisture vapor reducing treatment manufacturer. Reinforcing fibers that are visible after shot blasting must be removed and vacuumed leaving no fibers left on the concrete surfaces. Provide an uncontaminated, sound surface. DO NOT ACID ETCH!

C. Repair concrete prior to moisture vapor reduction system installation with approved concrete repair materials. Comply with all requirements as listed in Manufacturer's technical data information. Consult with vapor reduction manufacturer.

D. Ensure surfaces to be treated with moisture vapor reduction system have NOT previously been treated with other materials such as underlayments, screeds, penetrating sealants, silicates, etc. If this is the case, consult with the Manufacturer's Representative prior to any application of moisture vapor reduction system.

E. Shot blast a small test area and review surface profile with the finished flooring applicator. As the moisture vapor reduction treatment is not a leveling material, make sure the flooring installer is aware that a feather finish or leveling material may be required to smoothen or level the surface of the treated concrete prior to the flooring installation.

3.04 MIXING

A. Use clean containers and mix thoroughly as per Manufacturer's requirements to obtain a homogeneous mixture. Use a low speed motor less than 400 rpm and a two bladed Jiffy-type mixing blade only. DO NOT AERATE. Mix ratios are measured by volume.

3.05 APPLICATION

A. Determine the necessary coverage rate based on the surface profile and porosity of the concrete substrate as well as the measured level of moisture, in accordance with manufacturer's requirements.

B. After mixing, pour material on the substrate in a ribbon. Empty can completely. Apply per manufacturer's written installation instructions and per ASTM F3010.

C. Spread material using a squeegee and back-roll with a 3/8 inch nap epoxy-rated roller leaving NO areas untreated.

D. Allow to cure a minimum of 12 hours before installing flooring system.

E. After shot blasting and installation of the vapor reduction system, a self-leveling cementitious underlayment system or patching compound shall be applied for the floor covering installer or floor covering manufacturer to smoothen or level surfaces, at no extra cost to the Owner. Never apply moisture vapor reduction treatment over any new or existing cementitious underlayment system unless approved in writing by the manufacturer.

F. When water based adhesives are used in the floor covering installation, use an approved underlayment system together with a non-porous substrate primer prior to the installation of the flooring system, at no extra cost to the Owner. Consult the adhesive manufacturer for their minimum recommended thickness of cementitious underlayment to absorb excess moisture in the adhesive, minimum 1/8" thickness.

3.06 FIELD QUALITY CONTROL

A. Post-installation testing shall be by IOR or Owner's Testing Laboratory.

B. Perform ASTM F 710 pH and ASTM F 1869, tests after curing of the vapor reduction treatment.

C. Verify proper adhesion of flooring adhesives, coatings, and leveling compounds to the final vapor reduction coating system for acceptability.

D. After curing, products shall be in compliance with AQMD VOC Regulations.

E. Contractor shall correct any deficiencies identified by Testing Laboratory prior to delivery and installation of flooring materials.

3.07 PROTECTION

A. Protect water vapor reduction system to prevent damage from active rain or topical water for a minimum period of 24 hours from time of application.

B. Protect each coat during specified cure period from any kind of traffic, topical water and contaminants.

END OF SECTION

SECTION 09 21 16

SHAFT WALLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Shaft Construction: Vertical, Elevator.

B. Wall construction accessible from one side.

1.02 REGULATORY REQUIREMENTS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. UL - Underwriters Laboratories, Inc., Fire Resistance Directory, Latest Edition.

C. ICC-ES NER - 258 National Evaluation Reports, Legacy Report.

D. Industrial Safety Orders, Title 8, CCR.

E. Conform to California Building Code Chapter 7 Section 713 for Shaft Enclosures requirements.

1.03 SUBMITTALS

A. Product Data: For each shaft-wall assembly indicated.

B. Fire-Test-Response Reports: From qualified independent testing and inspecting agency substantiating each shaft-wall assembly's required fire-resistance rating.

C. Include data substantiating that elevator entrances and other items that penetrate each shaft-wall assembly do not negate fire-resistance rating.

D. Research/Evaluation Reports: Evidence of compliance with building code in effect for Project, from model code organization acceptable to authorities having jurisdiction that substantiate required fire-resistance rating for each shaft-wall assembly.

E. Acoustical-Test-Response Reports: From qualified independent testing agency substantiating required STC rating for each shaft-wall assembly.

1.04 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by independent testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

B. STC-Rated Assemblies: Shaft-wall assemblies indicated to have STC ratings, provide assembly materials and construction complying with requirements of assemblies whose STC ratings were determined according to ASTM E90 and classified according to ASTM E413 by qualified independent testing agency.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.

D. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 01. Review methods and procedures for installing work related to shaft-wall assemblies including, but not limited to, following:
   1. Fasteners proposed for anchoring steel framing to building structure.
   2. Sprayed fire-resistive materials applied to structural framing.
   3. Elevator equipment, including hoistway doors, elevator call buttons, and elevator floor indicators.
   4. Wiring devices in shaft-wall assemblies.
   5. Doors and other items penetrating shaft-wall assemblies.
   6. Items supported by shaft-wall-assembly framing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to elements.

B. Damaged or deteriorated materials shall be removed from site.

C. Store materials flat, on solid supports in dry areas, with packages identified with manufacturer's name and brand.

D. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.06 COORDINATION

A. Coordinate other sections in placing, building-in or embedding into shaft walls construction, any fixtures, anchors, sleeves, inserts or miscellaneous items. Provide openings, or chases as necessary to permit installation of work of other sections.

B. Before closing in and finishing of shaft walls work, ascertain that piping, conduits, ductwork and fixtures that are to be concealed and which penetrate gypsum boards are in place, tested and approved.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form the basis for design and quality intended.
   1. United States Gypsum Company, Chicago, IL.

2. National Gypsum Company, Charlotte, NC.
3. Georgia-Pacific Corp. - Gypsum Products, Atlanta, GA.
4. Clark Dietrich Building Systems, West Chester, OH.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Liner Panels and Face Panels: ASTM C1396, 1 inch thick USG Sheetrock Brand Gypsum Liner panels and 1/2 inch or 5/8 inch thick USG FIRE CODE face panels, to produce fire rated assembly indicated on Drawings. Liner panels: 24 inches wide, beveled edges. Face Panels: 48 inches wide, square edges, in lengths as required. For solid applications: use V-shaped T & G edges.

B. Fasteners: Type S and Type S-12 ASTM C1002 and C954 lengths to permit minimum 1/4 inch penetration into steel.

C. Metal Studs: USG Steel, Type C-H, min. 25 gauge hot-dip galvanized, in lengths as required, 2-1/2 or 4 inches to conform to limiting heights as recommended by manufacturer. "E" shaped studs for end panels. Provide metal backing and 20 gauge C-H Studs at wall-hung cabinet locations or equipment.

D. Runners: Type J, 20 gauge, hot-dip galvanized.
1. Fasteners: As specified in Division 01, General Requirements.

E. Firestopping and Fire-Rated Sealants: In conformance with Section 07 84 00, Firestopping.

F. Sound Attenuation Fire Blankets: THERMAFIBER SAFB, Johns Manville Sound Control Batts, or equal, thickness as required to completely fill cavity, paperless, semi-rigid mineral fiber mat.
1. Install sound attenuation fire blankets at shaft walls surrounding elevator shafts and at shaft walls as indicated on Drawings.

G. Safing Insulation: In accordance with Section 07 84 00.

PART 3 - EXECUTION

3.01 PREPARATION

A. Scaffolding: Construct, erect and maintain in conformance with applicable laws and ordinances and in manner as not to interfere with work of other sections; Comply requirements of Industrial Safety Orders, Title 8, CCR.

B. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

3.02 INSTALLATION

A. Installation Standard: ASTM C 754

B. Unless noted otherwise, provide:
   1. Cavity Shaft Wall Systems, USG Corporation
      a. One-Hour Cavity Shaft Wall (Nonload Bearing).
   2. UL Design No. U 415 or U469 for one hour fire-rated partitions.

C. Position steel runners at floor and ceiling with short leg toward finish side of wall. Install runners over 4 full running beads of fire rated sealant. Securely attach runners to structural supports with powder driven fasteners or expansion bolts maximum 24 inches on centers.

D. Cut liner panels 1 inch less than floor to ceiling height and erect vertically between J Runners. Where shaft wall exceeds maximum available panel height, position liner panel end joints within upper and lower third points of wall.

E. Where the shaft walls exceed the maximum available panel height, liner panels must be butted together at factory cut ends. Position the liner panel end joints within the upper and lower third points of the wall. Stagger joints top and bottom in adjacent panels. Screw studs to runner on wall over 16'.

F. Screw attach studs to runner on walls over 16 feet high. Install full length steel E studs or J Runners vertically at intersections, corners, door jambs and columns. Install full length E Studs over gypsum liner panels both sides of closure panels. Frame openings cut within liner panel with J Runner around perimeter.

G. For openings, frame with vertical E Stud or J Runner at edges, horizontal J Runner at head and sill and reinforcing as required. Suitably frame openings to maintain structural support for wall.

H. Use only 16 gauge members at openings. Over openings install cut-to-length section of 16 gauge J Runner and attach to strut studs by minimum 1/8 inch weld full length of cross section.

I. For single layer finish, erect 5/8 inch faceboard on room side, using specified screws maximum 12 inches on centers. For double layer finish erect 1/2 inch faceboard vertically on one side of studs. Fasten base layer to studs with 1 inch screws maximum 24 inches on centers.

J. Apply second layer 1/2 inch faceboard vertically over base layer with joints staggered and attach with 1-5/8 inch screws staggered from those in base, spaced 12 inches maximum oc and driven into studs and runners.

3.03 ACCESSORY APPLICATION

A. Gypsum Base Joints: Apply manufacturer's recommended tape over full length of gypsum base joints.

B. Corner Bead: Reinforce vertical exterior corners with corner bead fastened with clinch-on-tool or staples 9 inches on centers on both flanges along entire length of bead.

C. Metal Trim: Where shaft walls terminates against masonry or other dissimilar material, apply metal trim over face layer edge and fasten with screws or staples spaced 9 inches on centers.

D. Fasteners: Power drive at least 3/8 inch from edges or ends of gypsum panels to provide uniform dimple 1/32 inch deep.

E. Control Joints: Break panels behind joint. Apply penetration sealant to fill gap and attach control joint to face layer with staples spaced 6 inches on centers on both flanges along entire length of joint. Apply control joints maximum 30 feet on centers both ways unless otherwise noted.

3.04 FINISHING

A. Joints, including internal corners shall be filled and taped. Thin uniform layer of cement, approximately 3 inches wide, shall be applied over joint. Tape shall be cemented over joint and seated into cement, leaving sufficient adhesive under tape to provide proper bond. Internal angles, [both horizontal and] vertical, shall be reinforced and with tape folded to form straight and true angle. Metal external corners shall be cemented in place and shall be cemented only, not taped. Joints shall be allowed to dry at least 24 hours between each application of cement.
   1. Exception: Taping not required over joints for that portion of fire rated wall located above suspended ceiling; UL fire resistance directory, fire resistance ratings, (BXUV), and following conditions are met:
      a. Vertical joints occur over framing members.
      b. Horizontal joints are staggered 24 inches on centers or are covered with strips of gypsum board 6 inches wide.
      c. System is two ply applications with joints staggered 16 inches or 24 inches.
      d. Partition is not part of smoke separation partition system or sound control system.

B. Sand each coat of cement after each application has dried. Final coat of cement and subsequent sanding shall leave gypsum wall board in uniformly smooth condition and ready for sealing.

3.05 PROTECTION, PATCHING AND CLEANING

A. Adjacent surfaces or other materials shall be protected from damage by gypsum board or spackle materials.

B. Shaft wall surfaces that have been cut out to install work of other sections shall be neatly patched. Damaged or defective gypsum board finish shall be made good.

C. During progress of Work, rubbish droppings and waste materials shall be removed promptly.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Formed metal stud framing at interior partitions.
   2. Framing accessories.

B. Related Sections:
   1. Section 05 40 00, Cold-Formed Metal Framing for structural applications.
   2. Section 09 29 00, Gypsum Board.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. AISI - American Iron and Steel Institute
   1. S100 - Design of Cold-Formed Steel Structural Members.
   2. S220 - Cold-Formed Steel Framing - Nonstructural Members.

C. ASTM International
   1. A 1003 - Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
   2. C 645 - Standard Specification for Nonstructural Steel Framing Members.
   3. A653/A653M - Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy -
   4. C 754 - Installation of Steel Framing Members to receive Screw-Attached Gypsum Panel Products.
   5. C 1513 - Steel Tapping Screws for Cold-Formed Steel Framing Connections.

D. CBC California Building Code 2019, Chapter 22A.

E. ICC-ES - ICC Evaluation Service, International Code Council
   1. AC46 - Acceptance Criteria for Cold-Formed Steel Framing Members.
   2. AC70 - Acceptance Criteria for Fasteners Power-Driven into Concrete, Steel and Masonry Elements
   3. AC86 - Acceptance Criteria for Cold-Formed Steel Framing Members-Interior Non-Load-Bearing Wall Assemblies.
   4. AC118 - Acceptance Criteria for Tapping Screw Fasteners.

1.03 SUBMITTALS

A. Product Data: Manufacturers' printed materials demonstrating compliance with specified requirements.

B. Test and Evaluation Reports: Current Evaluation Reports, from ICC-ES.

C. Qualification Statement: Provide 3rd party documentation that framing members' meet AISI S220 and CBC 2019 tolerance requirements.

1.04 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide Documentation that framing members are certified according to the product-certification program of the Stud Manufacturer's Association (SSMA) or the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides a verifiable code compliance program.

B. Manufacturer: Current member of SMMA or SFIA and regularly and continuously engaged in the manufacturing of non-structural metal framing members for not less than five (5) years.
   1. SSMA: Steel Stud Manufacturer's Association ICC ESR-3064
   2. SFIA: Steel Framing Industry Association ICC ESR-4205
   3. ClarkDietrich Building Systems, ICC ESR-1166P
   4. Cemco California Expanded Metal Products Company, ICC ESR-3016
   5. SCAFCO Steel Stud Company IAPMO ER-0313

C. Provide documentation that contractor has a minimum of 5 years' experience installing similar cold-form steel projects.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice."

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS AND PERFORMANCE CRITERIA

A. The deflection of steel members shall not exceed that allowed by the finish material manufacturers. Additionally, deflection shall not exceed L/240 for flexible finishes such as gypsum board and shall not exceed L/360 for brittle finishes such as plaster and tile.

B. Power actuated fasteners shall be qualified in accordance with ICC-ES AC70.

C. The design and installation of nonstructural members utilized in cold-formed steel light-frame construction shall be in accordance with AISI S220 and ASTM C754.

D. Headers, including box and back-to-back headers, and double and single L-headers shall be designed in accordance with AISI S100, or proprietary prefabricated headers qualified by current ICC-ES Evaluation Report under AC46.

E. Wall studs shall be designed in accordance with AISI S100 and AISI S220.

F. Steel studs, non-load bearing, used in gypsum board assemblies shall comply with ASTM C 645 and AISI S220.

G. Steel framing for gypsum boards shall be assembled and installed in compliance with ASTM C 754.

H. Non-structural metal framing shall be qualified by current ICC-ES Evaluation Reports under AC46 or AC86.

2.02 MATERIALS

A. Framing Members, General: Comply with ASTM C 645 and AISI S220 for conditions indicated.

B. Steel: ASTM A 1003, Class G60 hot dip galvanized, Grade ST33H, minimum base-steel thickness 0.0329 inch (33 mil) before galvanizing. Minimum material's yield strength, 33 ksi.
   1. Protective Coating: Comply with ASTM C645
      a. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to the authorities having jurisdiction.
      b. Galvanealed products are not acceptable.

2.03 FABRICATION

A. Fabricate assemblies to sizes and profiles required; with framing members fitted, reinforced and braced to suit design requirements.

B. Studs: Non-load bearing rolled steel, channel shaped, punched for utility access.
   1. Depths as indicated on Drawings.
   2. Flange Width: 1-5/8 inches unless indicated otherwise.

C. Bottom Track: Same material and finish as studs, channel shaped.

D. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Contractor to verify that slotted track can be utilized within specified fire and sound rated assemblies. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cemco Slotted Track (CST) Expansion Joint System and "Firestik". ICC ESR-2012.
   2. The Steel Network Inc; VertiTrack VTD Series.
   3. ClarkDietrich MaxTrak slotted deflection track.
   4. SCAFCO Slotted Leg Track (SLT).
   5. Or equal, as approved in accordance with Division 01 requirements for Substitutions.

E. Cold-Rolled Channel Bridging: Galvanized Steel, 0.053-inch (16 gauge) minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
   1. Depth: As indicated on Drawings.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.053-inch-thick (16 gauge), galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Depth: 7/8 inch.

G. Prefabricated Headers: ProX Headers, as manufactured by CEMCO IAPMO-UES ER 286, SCAFCO Priceless Header and Kwik-Jamb System IAPMO ER 0342 or equal, as approved in accordance with Division 01 requirements for Substitutions.

H. Slotted fire track at rated assemblies: As specified in Section 07 84 00.

2.04 ACCESSORIES

A. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
   2. Size: #8 by 3/8 inch unless indicated otherwise.
   3. Screws shall be qualified by current ICC-ES Evaluation Report under AC118.

B. Anchorage Devices, Drilled Expansion Anchors:
   1. Wedge Type: KWIK Bolt TZ Concrete Anchor, 3/8 to 3/4-inch diameter, ICC ESR-1917, by Hilti Inc., Tulsa, OK.
      a. Eyebolt HHDCA drill-in anchor for suspended ceilings. Provide minimum 1/4-inch size anchor, requires testing refer to Division 01.
   2. Adhesive Anchors System:
      a. For fully grouted CMU, lightweight concrete construction per ICC ES-1385, Hilti KWIK Bolt 3 (KB3).
      b. For Normal Weight concrete with min. compressive strength of 2500 ~~2000~~ psi or 4000 psi per ICC ESR-3814, Hilti HIT RE 500 V3 Adhesive Anchor System.

C. Anchorage Devices, Powder Actuated:
   1. Install to conform to the load requirements of this Section and Tables 1, 2, 3 and 4 of ESR 1663. Minimum diameter: 0.145" diameter.
      a. Utilize tools as recommended by the manufacture in compliance with ICC numbers.
      b. ICC ESR-1663 Hilti Inc; Fasteners - Manual, Pneumatic, or Powder-Driven Steel Studs and Nails.
   2. Allowable Loads: Values listed in Tables 1-5, ESR 1663.

D. Metal Backing: 20 gauge unless noted otherwise.

E. Mineral Wool: Specified in Section 07 84 00.

F. Fire-rated Sealant: Specified in Section 07 84 00.

G. Top and Bottom Track for Curved Walls: ASTM A1003, G40, 20 gauge, Flex-C Trac and Flex-C Angle, widths to match wall stud, provide "D-Flexion Post System" for deflection conditions. Manufacturers: Interior Contour Track by ClarkDietrich Building Systems Contour Track, FLEX-ABILITY CONCEPTS, Edmond, OK, SCAFCO Perfect Curve or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that conditions are ready to receive work.

B. Verify field measurements.

C. Verify that utility rough-ins are in proper location.

D. Beginning of installation means installer accepts existing conditions.

3.02 ERECTION

A. For partitions supporting wall-hung plumbing fixtures, casework, or wall-mounted equipment, all exterior walls, and framing of door and borrowed lite openings, refer to Section 05 40 00.

B. Perform work in accordance with AISI S220, AISI S240, ASTM C 754, and SFIA Product Technical Information or SSMA Product Technical Information.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

C. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate above ceilings. Continue framing around ducts penetrating partitions above ceiling.
   1. Do not install post-installed concrete anchors until all prestressing and reinforcing steel locations have been marked on the surface and approved by the Inspector of Record.
   2. Install floor track in bedding sealant as specified in Section 07 92 00.
   3. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   4. Attach top and bottom runner channels at ends and 24 inches on center maximum.

E. Opening Framing
   1. Frame openings wider than 32 inches as specified in Section 05 40 00.
   2. For through-wall openings of 32 inches or less:
      a. A stud shall be adjacent to all through-wall openings.
      b. Studs shall be securely anchored to opening frame anchor clips by bolt or screw attachment.
      c. A header shall be formed over opening, frames, and a sill below opening frames, with a cut-to-length section of runner placed horizontally with the flanges cut and web bent vertically at each end, and securely attached to the adjacent vertical studs.

d. Additional cut-to-length vertical ("cripple") studs shall be added above and below openings to comply with stud spacing requirements.

F. Install studs vertically at 16 inches on centers.
1. Studs where ceramic tile is applied on one or both sides higher than 36 inches: 12 inch spacing required.
2. At slip-type head joints, cut studs 1/2 inch shorter than required length and fit into top runner. Fasten studs to top runner in manner permitting runner movement.
3. Connect studs to tracks using one fastener at each flange.
4. Install studs so flanges within framing system point in same direction.
5. Align stud web openings.
6. Construct corners using minimum three studs.
7. Stud splicing not permissible.
8. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
9. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.

G. Fit runners under and above openings; secure intermediate studs at spacing of wall studs.

H. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
1. Where furring is installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between furring and exterior wall.

I. Install anchors and blocking for electrical and mechanical work to be placed in or behind stud framing.

J. In areas where a finish material occurs on one side of wall only, provide bridging or bracing. Two systems permitted:
1. For framing 2.5" or less install 3/4 inch x 16 gage continuous brace through stud punch-outs, fastened to studs with angle clips welded or screw fastened, spaced as scheduled below. For framing larger than 2.5" replace ¾" cold-rolled channel with 1 ½" cold-rolled channel.
2. Install 1-1/4 inch x 16 gage strap, 3/4 inch x 16 gage cold-rolled channel or 2-1/2 inch 20 gage stud continuous across unrestrained edges of studs, screw fastened or welded to each stud, and connected to one blocking member screw fastened or welded to adjacent studs.

K. Lateral Bracing Schedule: Install bridge U-Channel bracing, cold rolled channel CRC (16 gauge), attached to wall studs with steel clip angle, 1/2" less width of wall, using (4) S-12, #10, (2) each leg at per horizontal spacing below per Section D3 AISI. Refer to drawings for strap bracing method where required.

	Wall Stud Size	Bracing Spacing on center (horizontal), maximum
2.	2-1/2 inch	2'- 6"
3.	3-5/8 or 4 in	4'- 0"
4.	6 inch	6'- 0"

L. Refer to Drawings for indication of partitions extending to ceiling only and for partitions extending through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs.

M. Verify installation of insulation in multiple stud spaces made inaccessible after stud framing erection.

N. No flame (oxyacetylene) torch cutting is permitted, use Plasma Arc cutting to make penetrations for conduit or piping where required.

3.03 CLEANING

A. Clean substrate; remove dirt, oil, grease, construction markings, and foreign matter that could adversely affect final floor finish appearance or performance.

3.04 TOLERANCES

A. Level and plumb: not more than 1/8" in 10'-0".

B. Fastening Surfaces: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Portland cement plaster system with acrylic finish.

B. Metal furring and lathing over rigid insulation with Z-Furring members.

C. Related Section
1. Section 05 40 00, Cold-Formed Metal Framing.
2. Section 07 21 13, Rigid Thermal Insulation.
3. Section 07 27 26, Fluid Applied Membrane Weather Barriers.
4. Section 09 29 00, Gypsum Board.

1.02 SYSTEM DESCRIPTION

A. Portland Cement Plaster: 7/8-inch thick, 3 coat system with a texture and paint integral color finish.
1. Scratch coat: 3/8-inch thick
2. Brown coat: 3/8-inch thick
3. Finish texture coat: 1/8-inch thick, integral color plaster free of tool marks and patterns.
4. Finish color coat:
   a. Colors: as scheduled in Finish Schedule on Drawings.

1.03 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society for Testing and Materials (ASTM)
1. ASTM A653 - Galvanized Sheet Steel
2. ASTM C150 - Portland Cement
3. ASTM C206 - Finishing for Hydrated Lime
4. ASTM C847 - Standard Specification for Metal Lath
5. ASTM C897 - Aggregate for Job-Mixed Portland Cement - Based Plasters
6. ASTM C926 - Application of Portland Cement-Based Plaster
7. ASTM C932 - Bonding Compounds for Exterior Plastering
8. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033-inch to 0.112-inch in Thickness
9. ASTM C1063 - Installation of Lathing and Furring for Portland cement Based Plaster

C. AATCC - American Association of Textile Chemists and Colorists

1. AATCC 127 - Water Resistance: Hydrostatic Pressure Test

D. CCR Title 24, 2019 California Building Code
1. CBC-25 - Chapter 25, Gypsum Board and Plaster.
2. CBC-26 - Chapter 26, Plastics.

E. DSA IR 25-4 - Self-Furring Lath.

1.04 SUBMITTALS

A. Product Data: for each type of product indicated.

1.05 QUALITY ASSURANCE

A. Applicator: company with at least 5-years experience in cement plaster work for commercial projects similar in scale and complexity to those required for this Project.

B. Cement plaster work shall comply with 2019 California Building Code.
1. Two-Coat Plaster system (base and finish) not permitted.

C. Mockups: Prior to installing plaster work, construct panels for each type of finish and application required to verify selections and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with following requirements, using materials indicated for final unit of Work.
1. Locate mockups on-site in location and of size indicated or, if not indicated, as directed by Architect.
2. Erect mockups 48 by 48-inches by full thickness in presence of Architect using materials, including lath, support system, and control joints, indicated for final Work.
3. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
4. Demonstrate proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before start of plaster Work.
6. Retain and maintain mockups during construction in an undisturbed condition as standard for judging completed portland cement plaster Work.
a. When directed, remove mockups from Project site.

1.06 DELIVERY AND STORAGE

A. Deliver products in unbroken containers or bundles with manufacturer's labels intact and legible.

B. Store products in dry location.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with ASTM C 926 requirements.

B. Exterior Plasterwork

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Do not apply plaster during wet weather, or when wet weather conditions can be forecast reasonably or during periods of high winds.
3. Do not apply stucco when the ambient temperature is 40 degrees F or lower, or when a drop in temperature below 40 degrees F is expected within 48 hours after application, unless the work area is enclosed and heat is provided as follows:
   a. When artificial heat is required, heaters shall be located to prevent a concentration of heat on uncured plaster. Heaters shall be vented to the outside to prevent toxic fumes and other products of combustion from adhering to or penetrating plaster bases and plaster. Adequate ventilation shall be maintained in all areas, particularly in interior areas with little or no natural air movement.
4. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.01 PLASTER BASE COAT MATERIALS

A. Cement: Low alkali Portland Cement, ASTM C150, Normal, Type I or II. White color for finish coats.

B. Lime: ASTM C206 or ASTM C207, Type S

C. Aggregate: Natural or manufactured sand conforming to ASTM C897.
   1. For Scratch and Brown coats use sand graded as follows

Sieve Size	Percent Retained
No. 4	0
No. 8	0 to 10
No. 16	10 to 40
No. 30	30 to 65
No. 50	70 to 90 (60 to 80, Manuf. Sand)
No. 100	95 to 100 (75 to 90, Manuf. Sand)
No. 200	97 to 100 (90 to 100, Manuf. Sand)

D. Water: clear, fresh, from a potable source, and free of mineral or organic matter that would adversely affect plaster.

E. Plasticizers: Only approved plasticity agents and approved amounts thereof may be added to portland cement. Hydrated lime or equivalent amount of lime putty used as plasticizer may be added to portland cement plaster not to exceed limits set forth in ASTM C 926, 2019 California Building Code.

F. Glass Fibers: ASTM C1116, Alkaline-resistant glass Type II, or polypropylene, nylon Type III fibers, 1/2-inch long, free from contaminates, manufactured for use in Portland cement plaster.

2.02 PLASTER FINISH COAT MATERIALS

A. Factory-mixed Acrylic-based Finish Coatings: acrylic-emulsion coating system formulated with colorfast mineral pigments and fine aggregates: for use over Portland cement plaster base coats. Include manufacturer's primers and sealing topcoats for acrylic-based finishes. By STO, Sonneborn, Dryvit, Parex Inc. ParexLaHabra, Inc.; Acrylic Finish: Perma-Flex Stucco Grade or equal. For aggregates comparable to STO Stolit 0.75 apply finish in two coats. For aggregate comparable to STO Stolit 1.0, single coat application is acceptable. Include manufacturer's recommended primer.
   1. Finish Texture and Colors: Refer to Finish Schedule on Drawings.
   2. Primer: ParexUSA Primer or equal.

B. Water: clear, fresh, from a potable source, and free of mineral or organic matter that would adversely affect plaster.

2.03 FURRING AND LATHING

A. Z-Furring Members: Manufacturer's standard z-shaped furring members with slotted or nonslotted web, fabricated from steel sheet complying with ASTM A653; with minimum base metal (uncoated) thickness of 0.0179 face flange of 1-1/2 inches and wall attachment flange of 1-1/2 inches and depth required to fit insulation thickness indicated.
   1. Z-Furring shall be minimum 33 ksi steel per CBC Section 2603.12.2.

B. At Exterior Walls, Two Types Permitted:
   1. Welded Wire Paper-Backed Lath: STUCCO-RITE 60 Min., zinc coated galvanized, 16 by 16-gage, 2-inch mesh, weight 1.84 pounds per square yard, with Type 1, Style 1, Grade D, building paper, FS UU-B-790A. Manufactured by K-Lath, Fontana, CA, or equal as approved in accordance with Division 01, General Requirements for substitutions.
      a. Required: Heavy duty version with 11-gage stiffeners at 6-inches on centers.
      b. Screws required at rigid backing, including plywood exterior or gypsum sheathing.
   2. Expanded metal Lath, Paper-Backed Lath: ASTM C 847, Diamond mesh expanded metal lath, galvanized ASTM A653 G60, weighing 3.4 pounds per square yard, continuous "grooved" self-furred metal lath. Water-resistive barrier, FS UU-B-790a, Type 1, Style 1, Grade D, by ClarkDietrich Building Systems Riverside, CA. or equal.
   3. Woven wire fabric (netting) not permitted.

C. Manufacturers for Accessories
   1. ClarkDietrich Building Systems, Riverside, CA
   2. Fry Reglet Company, Alhambra, CA
   3. Flannery, Inc., San Fernando, CA.

4. Or equal, approved in accordance with Division 01, General Requirements, for substitutions.

D. Self-Adhered Flashing: Refer to Section 07 27 26, Fluid Applied Membrane Air Barriers.

E. Weather Resistive Barrier: Refer to Section 07 27 26, Fluid Applied Membrane Air Barriers.

F. Rigid Insulation: Refer to Section 07 21 13, Rigid Thermal Insulation.

G. Pre-Formed Penetration Flashings: Products of Quickflash Weatherproofing Products, Inc., Las Vegas, NV, or approved equal.

H. At soffits and horizontal surfaces; Diamond lath, 3.4 pounds per square yard expanded metal, cut from hot-dipped galvanized for 16" on center framing. For framing over than 16" on center use 3/8" rib expanded metal lath. Option: V-Truss Walls and Ceilings by Structa Wire Corp.

I. Corner Mesh, inside corner: Expanded steel mesh, shaped to permit complete embedding in plaster, minimum 3-inches wide, galvanized finish, 7/8" ground depth.

J. Corner Bead: Formed steel, minimum 26-gage thick, beaded edge, expanded steel mesh flanges, of longest possible length, sized and profiled to suit application, galvanized finish.

K. Strip Lath: Expanded steel mesh, 4-inches wide, galvanized finish.

L. Corner Expansion Joint: 26-gage galvanized, double V expansion joint formed to 90 degree for inside corners, 7/8" ground depth.

M. Foundation Weep Screed: Formed steel, minimum 26-gage thick, galvanized finish, holes to relieve trapped moisture. 4-inches flange height. Install minimum 4-inches above earth or 2-inches above paved areas.

N. Parting Screed: 26-gage galvanized steel, separation type, single point screed. Between floor levels and as indicated.

O. Casing Bead: Formed steel; minimum 26-gage thick, thickness governed by plaster thickness, maximum possible lengths, expanded or short flange with square edges to suit plaster applications, galvanized finish.

P. Expansion Joint: Formed steel, minimum 26-gage thick, Adjustable Expansion Joint ClarkWestern, Riverside, CA, #40 or equal, 2-inch metal flanges each side, galvanized finish, 1/4 to 5/8-inch adjustment, thickness of cement plaster.

Q. Stress Relief Control Joint: Formed steel, minimum 26-gage thick, galvanized, with clean-up tape, ClarkDietrich Building Systems, Riverside, CA, XJ15-3, 7/8" ground depth, or equal.

R. Anchorages:
   1. Approved self-tapping, self-drilling wafer head or pan-washer head galvanized metal screws, ASTM C1063, to rigidly secure lath and associated metal accessories in place, minimum penetration into steel framing supports per CBC Section 2603.12.2. Lath shall be held back from vertical supports a minimum of 1/4-inch, per reference standard listed in Table 2507.2, CBC. For horizontal application fit screws with 1-inch OD by 1/4-inch ID by 16 gage cut washers. Fastener type and minimum size per CBC Section 2603.12.2.
   2. Tie Wire: 18-gage annealed, galvanized.

S. Soffit Vents: Extruded aluminum material, 4-inch soffit vent unless otherwise noted on drawings. By Belmont, CA, Flannery, Inc., San Fernando, CA, Fry Reglet Company, Alhambra, CA, or equal.

T. Drip Screed: At soffits, preformed 24 gauge galvanized, 4" flange, ½" holes to key plaster to molding.

U. Door and window drips at heads of doors and windows in exterior walls where no roof or overhead protection occurs :
   1. At non-recessed or flush conditions: Provide drips of anodized aluminum, 6063 alloy T5, extend drip edge minimum 1-1/2". Product: Flannery Inc., Door Drip for 7/8" thick plaster, Minimum 2" attachment flange, or equal.
   2. At recessed or soffit conditions: Provide drips of anodized aluminum, 6063 alloy T5. Product: Fry Reglet Drip Screed, non-vented, No. DS-875-875 or equal.

V. Exterior Gypsum Sheathing Board: Refer to Section 09 29 00, Gypsum Board.

2.04 CEMENT PLASTER MIXES

A. Mix and proportion Portland cement plaster in accordance with California Building Code Section 2512.1 Table 2507.2 and ASTM C926.

B. Scratch Coat: One-part Portland cement and maximum 4 parts sand, to 0 - 3/4 parts lime.

C. Brown Coat: One-part Portland cement and maximum 5 parts sand to 0 - 3/4 parts lime.

D. Acrylic Finish Coat: Pre-mixed to manufacturer's recommendations.

E. Mix materials dry to uniform color and consistency before adding water.

F. Protect mixtures from frost, contamination and evaporation.

G. Do not re-temper mixes after initial set has occurred.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that surfaces and site conditions are ready to receive Work.

B. Grounds and Blocking: Verify items within walls for other Sections of Work have been installed.

C. Mechanical and Electrical: Verify services within walls have been tested and approved, otherwise uncover at no extra cost to Owner.

D. Beginning installation means acceptance of existing conditions.

3.02 PREPARATION

A. Protect floors, walls, trim and other surfaces near Work of this Section from damage or disfiguration.

B. Scaffolding: Construct and maintain in conformance with applicable laws and ordinances.

C. Verify exterior sheathing board have been installed at walls per Section 09 29 00, Gypsum Board.

D. Verify weather resistive barrier and flashings have been installed per Section 07 27 26, Fluid Applied Membrane Air Barriers.

E. Verify continuous insulation has been installed per Section 07 21 13, Rigid Thermal Insulation.

F. Install pre-formed penetration flashings.

3.03 INSTALLATION - LATHING MATERIALS

A. Fasten Z-furring members by screwing to each stud 16-inches on center vertically, unless noted otherwise. Screws shall penetrate into each stud minimum the steel thickness plus three threads.
   1. Z-furring member spacing, screw spacing and screw depth shall be in conformance to CBC 2603.12.2.

B. Metal Lath shall be installed per ASTM C1063 and as specified below. Metal Lath attachment shall conform to CBC 2603.12.1.

C. Diamond Lath at horizontal Surfaces - Furred Ceilings and soffits: secure diamond metal lath to each support with minimum 18 gage tie wires spaced not more than 6 inches on center, per Sections 2507.2 and 2510 or an agency-approved equivalent attachment. Apply with long dimension of sheets perpendicular to supports lapped not less than 1/2-inch at sides and 1-inch at ends.

D. Welded wire lath at vertical supports, apply self-furring paper-backed lath shingle style with self-furring rib perpendicular to supports. Attach lath to supports using approved screws at 6-inch centers, stagger vertical laps, lapped not less than one mesh at sides and ends but not less than 1 inch. Install screws at lath wire "high" location away from the designated fastener location. At rigid backing, secure lath with specified screws to maintain 1/4-inches from sheathing for proper keying of plaster.

E. Expanded metal lath at vertical supports, apply self-furring "grooved" metal lath with self-furring rib perpendicular to supports. Attach metal lath to supports using approved screws at 6-inch center. Stagger vertical laps. Lap not less than 1/2" at sides and 1 inch at ends. At rigid backing, secure lath with specified screws to maintain 1/4-inches from sheathing for proper keying of plaster.

F. Hold lath 1/4-inch away from vertical supports majority of the wall area in accordance with DSA Circular 25-4.

G. Continuously reinforce internal angles with corner mesh, except where metal lath returns 3-inches from corner to form angle reinforcement. Fasten at perimeter edges only.

H. Place beaded external angle with mesh at corners. Fasten at outer edges only.

I. Place strip lath diagonally at corners of lathed openings. Secure rigidly in place.

J. Place strip lath centered over junctions of dissimilar backing materials on same plane. Secure rigidly in place.

K. Place casing beads at terminations of plaster finish. Butt and align ends, cope or miter at corners. Secure rigidly in place, maximum 12 inches on center.

L. Install accessories to lines and levels.

3.04 CRACK CONTROL AND EXPANSION JOINTS

A. Control Joints: Install control joints at locations indicated on Drawings, and as follows:
   1. As required to delineate plasterwork into areas (panels) of the following maximum sizes
      a. Vertical Surfaces: 144 sq. ft.
      b. Horizontal and other Non-vertical Surfaces: 100 sq. ft.
   2. At distances between control joints of not greater than 18 feet o.c.
   3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
   4. Where control joints occur in surface of construction directly behind plaster.
   5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

B. Locate Expansion Joints at building expansion joints and as indicated on Drawings. At Expansion Joints, provide independent (double-stud) framing behind each side of joint. Apply 2 layers of Self-Adhesive Flashing centered behind joint; first layer 18-inches

wide and second layer 12-inches wide, entire length of joint. Install expansion joint over flashing. Cut (discontinue) lath and install over joint flanges on each side of joint; do not span expansion joint with lath.

C. Make control- and expansion-joints with specified joint devices.

D. Obtain Architect's approval of joint placement before plastering.

E. Apply one-component polyurethane sealant at splices, intersections and terminations in accordance with Section 07 92 00.

F. Paint per Section 09 90 00, Painting. Colors as selected by Architect.

3.05 PLASTERING

A. Two-Coat Plaster system (base and finish) not permitted.

B. Apply plaster in accordance with Section 2512 Exterior Plaster California Building Code and ASTM C926.
   1. Measuring Ingredients: Proportion and measure ingredients by means of calibrated boxes or containers of such nature that quantities measured can be readily and accurately checked at any time. Proportioning by shovel measure is not acceptable.
   2. Mixing Plaster: Mix plaster by machine for minimum of 2 minutes. Mix no more plaster than can be properly placed within 1/2 hour after mixing. Allow no material to remain overnight in mixers or mixing boxes. Thoroughly clean tools and implements used in mixing and transporting plaster.

C. Apply scratch coat to nominal thickness of 3/8-inch, brown coat to nominal thickness of 3/8-inch, and a finish coat to nominal thickness of 1/8-inch over metal lathed surfaces.

D. Moist cure scratch and brown coat minimum 48 hours each coat. Refer to Section 2512.6 California Building Code for alternate methods of application.

E. After curing, dampen base coat prior to applying finish coat.

F. Acrylic Finish: Apply acrylic system including primers, finish coats and sealing topcoats, per manufacturer's recommendations. Finish per Finish Schedule on Drawings and as defined in "Plaster Textures" publication of WWCCA / Technical Services & Information Bureau, Fullerton, CA.
   1. Scaffold Lines: Not permitted (Avoid scaffold lines by not placing scaffolding to close to the face of plaster where nozzle leaves horizontal and vertical lines.

3.06 TOLERANCES

A. Maximum Variation from True Flatness (discounting texture): 1/8-inch in 10 feet, non-accumulating.

B. Finished work shall be uniform in color and texture. Any areas of integrally colored plaster finish considered unacceptable to the Architect for reasons of color shade variations shall be fog coated at no expense to the Owner.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Gypsum Board Panels.

B. Vertical wall gypsum board application.

C. Metal channel ceiling framing and horizontal ceiling gypsum board application.

D. Taped and sanded joint treatment.

E. Exterior gypsum sheathing board.

F. Cementitious backer units for tile application.

G. Cementitious backer units for toilet room ceilings.

H. Roof Cover Board.

I. Related Sections:
1. Section 01 35 42, CALGreen Requirements.
2. Section 05 40 00, Cold-Formed Metal Framing.
3. Section 09 22 16, Non-Structural Metal Framing.
4. Section 09 24 00, Portland Cement Plastering.
5. Section 09 30 13, Ceramic Tile.
6. Section 09 53 23, Acoustical Suspension Systems.
7. Section 09 90 00, Painting

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society for Testing and Materials (ASTM)
1. ASTM C475 - Joint Compound and Joint Tape for Finishing Gypsum Board.
2. ASTM C645 - Specification for Nonstructural Steel Framing Members.
3. ASTM C754 - Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
4. ASTM C840 - Application and Finishing of Gypsum Board.
5. ASTM C954 - Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. to 0.112 in. in thickness.
6. ASTM C1002 - Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
7. ASTM C1177 - Glass Mat Gypsum Substrate for Use as Sheathing.

8. ASTM C1396 - Specification for Gypsum Board.

C. Underwriters Laboratories, Inc. (UL)
1. UL Directory - Fire Resistance Directory, Volume 1, Latest Edition.

D. Gypsum Association (GA)
1. GA-201 - Gypsum Board for Walls and Ceilings
2. GA-214 - Levels of Gypsum Board Finish
3. GA-216 - Application and Finishing of Gypsum Board
4. GA-600 - Fire Resistance Design Manual
5. GA-226 - Gypsum Board installation on Curved Walls.

E. 2019 California Building Code (CBC)
1. CBC-7 - Chapter 7, Fire Resistant Materials and Construction
2. CBC-19A - Chapter 19A, Concrete (for DSA)
3. CBC-25 - Chapter 25, Gypsum Board and Plaster.

F. California Green Building Standards Code, CALGreen - 2019.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

C. Samples: For following products:
1. Trim Accessories: Full-size sample in 12-inch-long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

D. CALGreen Submittals:
1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code, per paragraph 1.04.B this Section.

1.04 QUALITY ASSURANCE

A. Applicator: Company specializing in gypsum board systems work with three years' experience.

B. California Green Building Standards Code, CALGreen - 2019.
1. Adhesives, sealants, primers and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3
3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.
4. Recycled Content per CALGreen Section A5.405.4.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

C. Steel Framing and related accessories shall be stored and handled in accordance with AISI Code of Standard Practice.

1.06 WARRANTY

A. Provide manufacturer's warranty, 3 years against manufacturing defects.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturer form basis for design and quality intended:
   1. United States Gypsum Corporation (USG), Chicago, IL.

B. Subject to compliance with requirements, other acceptable manufacturers include the following:
   1. Georgia-Pacific, Atlanta, GA.
   2. National Gypsum Co./Gold Bond Building Products, Charlotte, NC.
   3. Pabco Gypsum, Rancho Cordova, CA.
   4. CertainTeed Corporation, Valley Forge, PA.
   5. Temple-Inland Forest Products, Diboll, TX.

C. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 BOARD MATERIALS

A. Fire-rated Gypsum Board, 1HR: ASTM C1396; Type X, fire resistive type, 5/8 inch thick, maximum permissible length; ends square cut, tapered round edges, USG SHEETROCK BRAND FIRECODE, or equal.

B. Exterior Gypsum Sheathing Board System: ASTM C1177; moisture resistant, and fire resistant, Type X, 5/8 inch thick, maximum permissible length, ends square cut, inorganic glass fiber mat faced, 48 inch width, DensGlass Exterior Sheathing by Georgia Pacific, USG Securock Glass-Mat, Gold Bond e²XP by National Gypsum, GlasRoc Brand Sheathing by BPB America or equal.

1. Install Water Resistive Barrier at exterior wall over sheathing substrate. Refer to Section 07 27 26.
2. For parapet wall in fire-resistive construction: Parapet Wall Paneling, Fire-Resistive Buildings: Exterior fire-resistive gypsum board 5/8 inches Dens Deck Prime Fireguard Roof Boards by Georgia-Pacific, ASTM C1177.

C. Cementitious Backer Units: Standard type; 5/8 inch thick; Solid tapered edges, ends square cut, maximum permissible length, USG DUROCK Cement Board or equal.

D. Roof Cover Boards: Exterior gypsum board 1/2 inch thick, UNO, DensDeck Prime Roof Boards by Georgia-Pacific, ASTM C1177, Class A (UL 790).

2.03 MATERIALS

A. Furring Channels: 25 gauge galvanized steel, 7/8 inch deep by 2-9/16 inch wide hat channels, 275 pounds per 1,000 feet weight, FHC-25 and CEMCO METAL FURRING CHANNEL CLIPS. Z Type, where required: CEMCO Z-FURRING CHANNEL, 1", 1-1/2", 2" and 3" depths.
1. Dietrich UltraSteel Framing, 25 gauge or equal.

B. Taping, Bedding and Finishing Compound: ASTM C475; compatible with tape and substrate.
1. USG SHEETROCK Brand Taping Joint Compound Ready-Mixed, drying-type, non-asbestos, vinyl base.
2. USG SHEETROCK Brand Topping Joint Compound Ready-Mixed, drying-type non-asbestos, vinyl base.
3. USG SHEETROCK Powder Joint Compound, drying-type, non-asbestos vinyl base, conventionally drying. For Taping and Topping.
4. USG SHEETROCK Powder Setting-type Joint Compound, chemical hardening.
5. Contractor's Option: USG SHEETROCK Lightweight All Purpose Joint Compound (Plus 3) with Dust Control.
6. USG SHEETROCK Brand All Purpose Joint Compound Ready-Mixed for laminating gypsum panels in multilayer partitions.
7. USG SHEETROCK Brand Joint Tape-Heavy, ASTM C475, high strength cross-fibered paper tape.
8. Drywall Primers: USG First Coat.
9. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

C. Accessories: Corrosive Protective-Coated steel.
1. U-Trims: USG, Dietrich No. 200-A for joint compound or equal.
2. J-Trim Casings, reveal type: USG, Dietrich No. 401 for 1/2" panels, 402 for 5/8" panels, no finishing compound.
3. Control Joint: Dietrich 093, USG Control Joint No. 093, Zinc metal.
4. Corner Bead: USG, Dietrich No. 103 for joint compounds or equal.

D. Fasteners: Self-drilling tapping screws shall comply ASTM C 954; Self piercing screws shall comply ASTM C 1002;
1. ASTM C1002, No. 2 Phillips recessed, bugle head, power-driven. Nails not permitted.
2. Type S-12, ASTM C954, 16 gage steel studs, minimum penetration 3/8 inch.

3. Type S, ASTM C 1002, 20 gage steel studs, minimum penetration 3/8 inch.
4. Type G, gypsum board to gypsum board, minimum penetration 1/2 inch.

E. Reveal Moldings: Extruded aluminum moldings as detailed and as manufactured by Fry Reglet Co., Alhambra, CA, or equal as approved in accordance with Division 01, General Requirements for substitutions. All intersections shall be factory fabricated with joints heliarc welded and backs sealed with permanent waterproof tape. Furnish with 6 inch legs to join with straight sections. Provide connector clips at butt joints of straight sections and end caps at terminations. Color as selected by Architect.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Fry Reglet Corp.
   b. Gordon, Inc.
   c. MM Systems Corporation.
   d. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, alloy 6063-T5.
3. Finish: Anodized finish, Class II medium etch 0.40 mils, AA-M12C22A31, clear anodized AA-M32C10A21 clear (natural) color

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that site conditions are ready to receive Work.

B. Beginning installation means acceptance of substrate.

3.02 PREPARATION

A. Delivery and Storage: Arrange for an adequate supply of materials on the jobsite so that progress of Work will be uninterrupted. Materials and accessories shall be delivered in original containers and bundles, and identified with the manufacturer's name and brand. Store gypsum board on flat, solid supports in dry areas, well protected from the elements.

B. Provide fixtures, anchors, sleeves, inserts and miscellaneous items, and provide openings and chases as necessary. Prior to closing in and finishing of dry wall Work, ascertain that piping, conduit, ductwork and fixtures which are to be concealed and which penetrate gypsum boards are in place, tested and approved.

C. Scaffolding: Construct, erect and maintain in conformance with applicable laws and ordinances.

D. Protection, Patching and Cleaning: Adjacent surfaces of other materials shall be protected from damage. Dry wall surfaces that have been cut out shall be neatly patched. Damaged or defective gypsum board finish shall be replaced. During progress of Work, rubbish droppings and water materials shall be removed.

E. Fire Protection: Where required, the Work shall comply with the requirements for the protection rating indicated in the governing building code.

F. Fire Sprinkler System: In areas where sprinkler heads occur, exercise care when installing drywall work. Do not damage or obstruct the heads in any way.

3.03 GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with ASTM C840, GA 201, GA 216 and Section 2508 California Building Code. Use board types as indicated; if not indicated use board types as follows.
   1. Use Type X (fire-rated core) drywall unless indicated otherwise.
   2. Where gypsum wallboard is indicated as base for ceramic tile use board types as follows
      a. Use Type (moisture resistant) board, except as follows
      b. At walls to which plumbing fixtures are mounted and portions of adjoining walls within 2'-0" of a plumbing fixture, install cementitious tile backer board to 4'-0" above the finished floor with Type WR, above, moisture and mold resistant gypsum board.

B. Non-rated: Erect single layer gypsum board parallel or perpendicular on vertical framing, attached to studs and framing members with the specified fasteners spaced at 16" on center with screws and at top and bottom, 12" on center with screws at ceilings. Solid backing not required at joints running perpendicular to studs and framing members for walls.

C. Rated: Erect single or double layer fire-rated gypsum board panels in accordance with Table 705.4, Note a, and Section 708 California Building Code, and GA-600, for one-hour or two hour, fire-rated, non-bearing Fire Walls or Fire Partitions, steel or wood stud construction.
   1. Gypsum board panels installed parallel to vertical studs or framing shall be spaced at 8" on center with screws at vertical edges, and 12" on center with screws in field and at top and bottom, and 12" on center with screws at ceilings. Solid backing not required at joints running perpendicular to studs and framing members for walls. Stagger vertical joints 24 inches on centers each side and opposite sides. Where joints are not staggered required minimum 24 inches, solid backing shall be provided. All joints shall be treated except as provided herein.

D. Place control joints consistent with lines of building spaces as indicated or at maximum of 30 ft on centers. At rated walls, provide with fire rated panels same as wall construction.

E. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

F. Seal all cutout and penetrations: For electrical, mechanical, plumbing and structural framing cutouts and penetration at interior surfaces. Per Section 07 92 00 for non-rated wall, and fire-rated sealant for rated walls per section 07 84 00.

G. Install reveal moldings according to manufacturer's recommendations.

3.04 JOINT TREATMENT

A. Exposed gypsum board in wall areas and ceiling areas shall have joint compound and be taped and sanded per requirements of GA-114 for levels specified and ready for paint.

B. On installations where two layers of gypsum board are required, only the face layer will require finishing of joints and screwheads.

C. Gypsum wallboard joints in walls may either be exposed or covered with joint tape and joint compound for the portion of the wall above a suspended ceiling, which is part of a fire resistive floor-ceiling or roof-ceiling assembly, as listed in U.L. Fire Resistive Ratings (BXUV), when the following conditions are met:
   1. Vertical joints occur over framing members.
   2. Horizontal joints are staggered 24 inches on opposite sides or covered with 6 inch wide strips of gypsum board attached with 1-1/2 inch laminating screws at 8 inches on centers.
   3. Partition is two-ply system with joints staggered 16 inches or 24 inches.
   4. Partition is not part of a smoke or sound control system.

D. Fire-Rated Partitions: Perimeters of fire-rated partitions shall be caulked with fire-rated sealant as specified in Section 07 84 00, both sides of partition.

E. Sound-Rated Partitions: Perimeters and penetrations of sound-rated partitions shall be caulked with acoustical sealant as specified in Section 07 92 00, both sides of partition.

F. Joints, except where excluded above including internal corners, shall be filled and taped. Thin uniform layer of joint compound, approximately 3 inches wide, shall be applied over joint. Tape shall be set in joint compound and finish levels required below. Internal angles, both horizontal and vertical, shall be reinforced and with tape folded to form straight and true angle. Metal external corners shall be set in place. Joints shall be allowed to dry at least 24 hours between each application of cement.

G. Gypsum board finish shall be to the following levels as defined by GA-214:
   1. Plenum areas above ceilings - Level 1.
   2. Substrate for tile, tackable wall panels, tackboards and markerboards - Level 2.
   3. Areas receiving heavy textured paint - Level 3.
   4. Areas receiving vinyl wall covering, high impact wall covering, texture finish or light textured flat paint - Level 4.
   5. All Areas receiving Wall Coverings, non-textured, flat, egg-shell, gloss or semi-gloss paint - Level 5. Backroll application of sealer. Level 5 requires one of the following.
      a. Skim coat: A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to entire surfaces. Surfaces shall be smooth and free of tool marks and ridges.
      b. Acrylic latex-based coating, spray apply: USG SHEETROCK Brand Primer-Surfacer Tuf-Hide or ProForm Surfacer/Primer by National Gypsum or equal. Apply to 15-20 mils wet film thickness to entire surface.
      c. "Smooth Coat" level 5 by Westpac Materials, Orange, CA.
      d. Additionally apply primer coat per Section 09 90 00 Painting.

3.05 CEMENTITIOUS BACKER BOARD INSTALLATION TO RECEIVE CERAMIC TILE-THIN SET

A. Thin-Set Tile Application, Toilet Walls: Install waterproof membrane behind cement board, seal all edges. Secure membrane to studs with tape or adhesive and immediately apply cement board or staple membrane to back of cement board with 1/2-inch crown, 3/8-inch leg galvanized staples. Extend membrane 2 inches to 3 inches beyond board edges and lap membrane at joints in shingle manner to prevent water penetration.

B. Wet Areas as defined by Tile Council of North America.

C. Pre-cut board to required sizes and make necessary cutouts. Stagger end joints in successive courses. Fasten boards to studs or furring channels with screws spaced 6 inches on centers. Prefill joints with tile-setting mortar and immediately embed tape and level all joints. Apply 1/8 inch minimum thick skim coat of latex-fortified mortar uniformly over entire surface, apply ceramic tile per Section 09 30 13.

3.06 CEMENTITIOUS BACKER BOARD INSTALLATION AT TOILET ROOM CEILINGS.

A. In areas with cementitious panels at ceilings, apply 1/16-inch minimum thick, uniform layer of manufacturer's Portland-cement mortar containing dry latex polymers basecoat over entire surface, including taped joints, leaving surface smooth and flat. Allow to cure 24 hours. Trowel apply a 1/16 inch minimum thick uniform layer of manufacturer's acrylic coating exterior finish coat, fine texture, over all base-coated surfaces, in accordance with manufacturer's recommendations. Paint under Section 09 90 00.

3.07 EXTERIOR GYPSUM SHEATHING INSTALLATION

A. Install exterior gypsum sheathing on the exterior face of all exterior walls as indicated on Drawings.

B. Install per manufacturer’s instructions.

C. Erect exterior gypsum sheathing horizontally with edges butted tight and ends occurring over firm bearing. Tack into place sufficiently to hold material until permanent attachment is provided by self-furring lath fasteners for cement plaster application.

D. Treat joints per manufacturer’s system for exterior sheathing.

3.08 ROOF COVER BOARD INSTALLATION

A. DensDeck Roof Board or equal shall be installed according to roofing manufacturer's instructions and to achieve FM 1-90.

B. DensDeck shall be neatly cut to fit around penetrations and projections.

C. Do not install more insulation board than can be covered with roof membrane by the end of the day or the onset of inclement weather.

3.09 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction.

B. Must provide flat finished surface prior to installation of Acoustical Suspension System wall angles and accessories. Coordinate with Section 09 53 23.

END OF SECTION

SECTION 09 30 13

CERAMIC TILE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Ceramic tile at restroom floors using full setting bed application method.

B. Ceramic tile at floor, walls and base using thinset application method.

C. Related Sections:
1. Section 01 35 42, CALGreen Requirements.
2. Section 09 29 00, Gypsum Board.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ADA - Americans with Disabilities Act of 1990 as amended
1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

C. California Green Building Standards Code, CALGreen - 2019.

D. ANSI/TCNA A108.1B - Installation of Ceramic Tile on Cured Portland Cement Mortar Setting Bed with Dry-set or Latex-Portland Cement Mortar.

E. ANSI/TCNA A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.

F. ANSI/TCNA A108.10 - Installation of Grout in Tile Work.

G. ANSI/TCNA A118.6 - Cement Grouts for Tile Installation.

H. ANSI/TCNA A118.1 - Dry-Set Portland Cement Mortar.

I. ANSI/TCNA A118.4 - Latex-Portland Cement Mortar.

J. ANSI/TCNA A118.7 - Polymer Modified Tile Grouts for Tile Installation.

K. ANSI/TCNA A118.10 - Bonded Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installation.

L. ANSI/TCNA A137.1 - Ceramic Tile.

M. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

N. ASTM C144 - Aggregate for Masonry Mortar.

O. ASTM C150 - Portland Cements.

P. ASTM C207 - Hydrated Lime for Masonry Purposes.

Q. ASTM C373 - Water Absorption, Bulk Density, Apparent Porosity and Apparent Specific Gravity of Fired Whiteware Products.

R. ASTM D1056 - Flexible Cellular Materials.

S. ASTM C1178 - Coated Glass Mat Water-Resistant Gypsum Backing Panel.

T. ASTM C171 - Sheet Materials for Curing Concrete.

U. ASTM C920 - Elastomeric Joint Sealants.

V. TCNA (Tile Council of North America) - Handbook for Ceramic Tile Installation, Latest Edition.

W. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.

1.03 SUBMITTALS

A. Product Data: For each type of tile, bond coat, grout, and other products specified.

B. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.D.

C. Shop Drawings: Include following
   1. Tile patterns and locations.
   2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing full range of variations expected.
   1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.
   2. Full-size units of each type of trim and accessory for each color required.
   3. Metal edge strips in 6-inch lengths.

E. Product Certificates: Master Grade Certificate signed by the manufacturer certifying that products furnished comply with requirements of Standard Grade.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in the manufacture of products specified in this Section with minimum five years' experience.

B. Installer Qualifications: Engage experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with record of successful in-service performance. Minimum 5 years of documented experience of tile installation.
   1. Installer-Tile Layer: Journeyman Level Classification required, recognized by California Directory of Industrial Relations or the U.S. Department of Labor. Certification required or Installer employs Certified Tile Installer (CTI) by the Ceramic Tile Education Foundation (CTEF)

C. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from same production run for each contiguous area of consistent quality in appearance and physical properties without delaying Work.

D. California Green Building Standards Code, CALGreen 2019:
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.

E. Source Limitations for Setting and Grouting Materials: Obtain ingredients of uniform quality for each bond coat, and grout component from single manufacturer and each aggregate from one source or producer.

F. Mockups: Before installing tile, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with following requirements, using materials indicated for completed Work.
   1. Locate mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
   3. Demonstrate proposed range of aesthetic effects and workmanship.
   4. Obtain Architect's approval of mockups before proceeding with final unit of Work.
   5. Maintain mockups during construction in undisturbed condition as standard for judging completed Work.
      a. Approved mockups in undisturbed condition at time of Substantial Completion may become part of completed Work.

G. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 01, General Requirements.

H. Tile Adhesives and Joint Sealers: As recommended by the tile manufacturer. Comply with VOC Limits set by SCAQMD Rule 1168.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site only in cartons which have been grade sealed by manufacturer in accordance with ANSI A137.1 and with grade seals unbroken. Seconds grade seal quality not permitted.

B. Tiles delivered to job or installed in Work that do not fall within specified standards of quality or accepted color range shall be removed from jobsite and properly be replaced with acceptable material.

C. Store and protect products in dry, secure areas.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install volatile materials in a closed, unventilated environment.

B. Maintain 50 degrees F or above during installation of adhesive and grout materials.

C. Shade work from direct sunlight during tile installation as needed to prevent rapid evaporation caused by excessive heat.

1.07 MAINTENANCE

A. Extra Materials
1. Extra Materials shall be from same production run as installed materials.
2. Wrap or crate for storage and label for contents and dates and locations of related installations.
3. Deliver Extra Materials to Site as directed by Owner.
4. Tile. For each type, size and color or finish of tile provide, as extra materials, a quantity equal to approximately 2-percent of the quantity required for its installation; round quantity up to next higher full carton.
5. Special Shapes. For each type, size and color or finish of special shaped tile required, provide, as extra materials, a quantity equal to the following.
   a. Coved Base: 10-linear-feet
   b. Formed Coved Base Corners: 6 pieces, each inside and outside
   c. Bullnose Tile: 15-linear feet
   d. Bullnose Corner: 6 pieces

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Slip Resistant: Ceramic Tile Flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

2.02 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.

1. Dal-Tile, Corona, CA./American Olean Tile, City of Industry, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.03 TILE

A. Ceramic Floor Tile: ANSI/TCA A137.1, conforming to following:
1. Moisture Absorption: 0 to 0.5 percent, (impervious) ASTM C373
2. Size: Per Finish Schedule on Drawings.
3. Surface Finish: Per Finish Schedule on Drawings.
4. Colors: Per Finish Schedule on Drawings.
5. Patterns: Per Architectural Drawings.

B. Ceramic Wall Tile: ANSI/TCA A137.1, conforming to following:
1. Moisture Absorption: As permitted by ANSI A137.1.
2. Size: Per Finish Schedule on Drawings.
3. Surface Finish: Per Finish Schedule on Drawings.
4. Colors: Per Finish Schedule on Drawings.
5. Patterns: Per Architectural Drawings.

C. Base: Match wall tile for moisture absorption, surface finish and color, coved bottom and as specified in Finish Schedule on Drawings. Where no wall tile is installed, match floor tile, 6" high.

D. Wainscot Cap: Match wall tile for moisture absorption, surface finish and color, bullnosed top edge. Coordinate sizes and coursing of adjoining tile.

E. Corners: coved at inside corners and bullnose at exterior corners.

F. Colors and Patterns: Refer to Finish Schedule on Drawings.

2.04 BOND COAT

A. ANSI/TCNA A118.1: Dry-Set Portland Cement Mortar.

B. ANSI/TCNA A118.4: Latex Portland Cement Mortar.

2.05 SETTING BED MATERIALS

A. Portland Cement: ASTM C150, Type I.

B. Lime: ASTM C207, Type S.

C. Sand: ASTM C144.

D. Water: Potable.

2.06 GROUT

A. Grout: ANSI/TCNA A118.7 - Factory-prepared cementitious type, dry polymer-modified. Un-sanded type for joints less than 1/8 inches and sanded type for joints 1/8 inch and greater. Colors as selected by Architect and as specified in Finish Schedule on Drawings.
   1. Prism SureColor Grout 1 as manufactured by Custom Building Products.
   2. Or approved equal.

2.07 ACCESSORIES

A. Waterproof Membrane for water-prone surfaces requiring waterproofing:
   1. Hydro Ban by Laticrete (thin set), RedGard Waterproofing and Crack Prevention Membrane (thin set or mortar bed) by Custom Building Products without "field" reinforcing fabric, or equal, ANSI A118.10, ANSI A118.12.
   2. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

B. Reinforcing Mesh: 2 x 2 inch size weave of 16 GA/16 GA wire size; welded fabric, galvanized, ASTM A185 and ASTM A82, galvanized per ASTM A641.

C. Curing Paper: Kraft paper conforming to ASTM C171.

D. Grout Sealer for Walls and Floors, cement based grouts:
   1. Pro Spec Grout Sealer (acrylic), by Bonsal American Co, Charlotte, NC.
   2. Grout Armor Color Sealer (acrylic), by Grout Armor, Fort Lauderdale, FL.
   3. Acrylic Grout Sealer (acrylic), by Glaze ‘ÜN Seal.
   4. MicroGuard AD708 (Silane), by Adsil, Palm Coast, FL.
   5. Silox 8 (Silane), by Bostik, Middleton, MA.
   6. Or equal and as recommended by grout manufacturer.

E. Acoustical Underlayment: QTscu Acoustical Underlayment manufactured by Ecore, Lancaster, PA, or approved equal. Thickness: 2 mm, ASTM C627 Extra Heavy and meets ANSI 118.12 5.4 for crack isolation.

F. Waterproofing and Crack Suppression Membranes for Floors.
   1. General: Manufacturer's standard product that complies with ANSI A118.10.
   2. Laticrete Hydro Ban, RedGard Waterproofing and Crack Prevention Membrane by Custom Building Products without field reinforcing fabric or equal, ANSI A118.10, ANSI A118.12.

G. Edge Strips, Coves:
   1. Angle, L-shape, reducers, or T-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications.
   2. Acceptable manufacturer: Schluter Systems or approved equivalent.
   3. Edge Strip - Floors: Schluter-Reno Series and Schluter-Schiene Series. Size for tile materials specified.
   4. Cove Base: Schluter-DILEX-AHK; anodized aluminum, trapezoid-perforated anchoring leg, 3/8" radius. Thickness per tile specified.

5. Edge Strip - Walls: Schluter-JOLLY edge-protection profile for the outside corners. Size for tile materials specified.
6. Material: Satin Anodized Aluminum (AE).
7. Colors, sized: Refer to Finish Schedule on Drawings.

H. Corner Trims: Aluminum
1. Manufacturer: Profilitec
2. Product: Mosaictec RJF, Invisible Aluminum profile for mosaic.
3. Finish: Silver Anodized aluminum.

I. Cementitious Backer Units: Standard type; 5/8 inch thick; Solid tapered edges, ends square cut, maximum permissible length, DUROCK INTERIOR TILE CEMENT BOARD.

2.08 SETTING MORTARS

A. Conform to Table 2103A.11, California Building Code.

B. Setting Bed Mix for Floors: One part Portland cement, 1/10 part hydrated lime, 5 parts dry sand or 6 parts damp sand by volume.

C. Admixture: Mix in accordance with manufacturer's directions.

D. Consistency: When mixed with water, setting bed material shall be workable and allow maximum compaction during tamping.

E. Mixing: Thoroughly mix dry setting bed ingredients before adding water to obtain proper consistency. When machine mixing, add water first. Discard mix when it has reached its initial set.

2.09 EXPANSION JOINT MATERIALS

A. Joint Sealer: ASTM C920
1. Vertical Joints: One part silicone sealant, non-sag, elongation movements 25/25 percent, Shore A, hardness range 20 -27, Pecora 890FTS and 890FTS-TXTR.
2. Horizontal Joints: Polyurethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use T, M, A and O. Pecora DynaTred or equal.
3. Color: to match grout color.

B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

C. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

D. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 25 percent larger than joint width; Backer Rod Mfg. DENVER FOAM or Nomaco Green rod.

E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application. Apply to bottom of joints that are too shallow to receive foam backer rod.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work. Verify types of materials that may have been in contact with surfaces.

B. Beginning of installation means installer accepts condition of existing substrate.

C. Verify and Backer Units have been installed per Section 09 29 00 for thin set application on walls.

3.02 PREPARATION

A. Protect surrounding work from damage or disfiguration.

B. Vacuum clean existing substrate and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install acoustical underlayment under all floor tile on second floor, except restrooms, per manufacturer's installation instructions.

3.03 MIXING BOND COAT

A. Use brand of prepackaged dry mix specified by manufacturer.

B. Mixing: Mix dryset Portland-cement bond coat or latex Portland-cement bond coat in accordance with manufacturer's instructions.

C. Proper bond coat consistency is such that when applied with recommended notched trowel to backing, ridges formed in bond coat will not flow or slump.

D. During use, remix mortar occasionally. Additional water or fresh materials shall not be added after initial mixing. Mortar shall not be used after initial set.

3.04 INSTALLATION: SETTING BED AT FLOORS

A. Install setting bed in accordance with TCNA Handbook for Ceramic Tile Installation, ANSI/TCNA A108.1B.

B. Install cleavage membrane, solvent welded at joints. Clamp membrane to drains. Extend membrane under expansion joints.
   1. At floor slabs on-grade; Do not install cleavage membrane.

C. Place wire reinforcing and setting bed over cleavage membrane. Lap reinforcing at least one full mesh and support so that reinforcing is approximately in middle of setting bed. Do not butt reinforcing against vertical surfaces.

D. Thickness of Setting Bed: Approximately 1-3/4 inches.

1. Thickness of setting bed at slope to drains: High point shall be not less than 2 inches not more than 9 inches below top of finished dam and shall have a minimum of 1/4 inch per foot pitch toward drain.

E. Firmly tamp setting bed to levels required.

F. Allow setting bed to cure in accordance with ANSI/TCNA A108.1.

3.05 INSTALLATION: THIN SET AT FLOORS AND WALLS.

A. Walls: Install in accordance with TCNA Handbook for Ceramic and ANSI A108.5 and A118.1. Tile Installation for thin-set application:
1. No. W244E for cement board, ASTM C1325

B. Floors: Install in accordance with TCNA Handbook for Ceramic and ANSI A108.5 and A118.1. Tile Installation for thin-set application, No. F113 Dry-set or latex-Portland Cement Mortar.
1. Install waterproofing and crack suppression membrane, Full Coverage TCNA F125A-Full-15.

C. At Wet Locations: install waterproof membrane in accordance with TCNA Handbook for Ceramic No. F-122, weld joints and upturn at wall 6 inches. Clamp membrane to drains at floors. Extend membrane under expansion joints.
1. Bond membrane with manufacturer approved modified thin-set bond coat (acrylic latex Portland cement mortar).
2. At floor slabs on-grade; Do not install cleavage.

D. Align wall tile grout with floor tile grout.

3.06 BOND COAT APPLICATION

A. Clean surface thoroughly. Dampen if very dry, but do not saturate.

B. Apply bond coat with flat side of trowel over an area no greater than covered with tile while bond coat remains plastic.

C. Within ten minutes before applying tile and using a notched trowel of type recommended by bond coat manufacturer, comb bond coat obtain even setting bed without scraping backing material.

D. Cover surface uniformly with no bare spot, with sufficient bond coat to ensure a minimum bond coat thickness of 3/32 inch between tile and backing after tile has been beaten into place. Tile shall not be applied to skinned-over bond coat.

3.07 INSTALLATION OF TILE

A. Refer to mortar and latex manufacturers directions.

B. Do not soak tile.

C. Set tile firmly on bond coat over setting bed or board surfaces with minimum of 95 percent coverage at floors and wet areas. Back-butter ribbed tiles and other tiles in accordance with ANSI/TCNA 108.5. Spacers on tile determine joint width between tile. Strings or pegs may be used to space tile that have no spacers. Bring all surfaces to a true plane at proper position or elevation. Thoroughly beat-in all tile with a beating block while bond coat is still plastic. Beating shall fill minimum of 95 percent of entire space between units and setting bed. 80 percent coverage is permitted for walls in non-wet areas.

D. Lay tile to pattern indicated on Drawings or request tile pattern from Architect. Do not interrupt tile pattern through openings.

E. Place edge strips at exposed tile edges.

F. Cut and fit tile tight to penetrations through tile. Align floor, base and wall joints where floor tiles and wall tiles are same width.

G. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight without voids, cracks, excess setting bed mix or excess grout. All inside corners shall be coved and exterior corners shall be bullnose. No butted 90 degree intersections permitted. All outside corners shall be bullnose. All tile edges and terminations shall have bullnose unless noted otherwise.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep expansion or control joints free of setting bed mix or grout. Apply sealant to joints.

J. Allow tile to set for a minimum of 16 hours prior to grouting.

K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

L. If tile is face-mounted, remove paper within one hour after tile is set and adjust all tiles that are out of line or level. Use no more water than necessary in removing paper.

M. Align wall tile grout with floor tile grout.

3.08 INSTALLATION OF GROUT

A. Remove bond coat from face and edges of tile.

B. Mixing: Refer to manufacturer's directions.

C. Dry blend contents of an entire container of grout prior to mixing with water or latex.

D. Use caution to prevent scratching or damaging tile surfaces.

E. Dampen dry joints prior to grouting. Do not leave puddles of water in joints before grouting.

F. Force maximum amount of grout into joints. Cushion edge tile shall be finished evenly to depth of cushion. Square-edge tile shall be finished flush with surface. Finished joint shall be uniform in color, smooth and without pinholes, voids or low spots.

G. Grout width: 1/16", unless noted otherwise on drawings.

3.09 CURING

A. Damp-Cure grout for a minimum of 72 hours. Remove and replace improperly cured grout.
   1. Cover with 40-pound kraft paper.
   2. Polyethylene curing membrane not permitted.

3.10 GROUT SEALING FOR PORTLAND CEMENT GROUTS

A. Floors: Apply grout sealer after curing, two coats required, throughout surface.

B. Walls: Seal wall and grout, 2 coats required, install per manufacturer’¢s instructions.

C. Verify that grout is dry, clean and properly cured. Ensure grout has been installed minimum of 10 days prior to sealing.

D. Apply undiluted sealer to grout joints in accordance with manufacturer's instructions and recommendations. Maintain abundance of sealer on joint until porosity has been satisfied.

E. Thoroughly remove excess material; allow to dry, minimum 24 hours prior to use.

F. Remove excess sealer that has dried on tile surface.

3.11 EXPANSION JOINTS

A. Install expansion joints over any construction (cold joint), contraction joint, expansion joint, at juncture of floors and walls, changes in material at other restraining surfaces such as curbs, columns, bases, and wall corners and where recommended by TCNA EJ171Afor mortar bed tile or EJ171F for thin set tile.

B. Expansion joint shall penetrate full depth of setting bed.

C. Do not damage waterproofing membrane.

D. Install sealant in accordance with manufacturer's instructions, using hand pointing tools.

E. Measure joint dimensions and size materials to achieve required width/depth ratios. Minimum width: 3/8 inch.

F. Install joint backing to achieve a neck dimension no greater than 1/3 joint width. Concrete shall be fully cured.

G. Install bond breaker where joint backing is not used. Install removable masking material to maintain clean lines and protect adjoining surfaces.

H. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges. Do no install sealant on wet or damp surfaces.

I. Install sealant free of air pockets, foreign embedded matter, ridges and sags.

J. Tool joints concave, channel shaped or as detailed. Use slicking agent type recommended by manufacturer.

3.12 EDGE STRIP

A. Install according to manufacturer's recommended procedures.

3.13 CLEANING

A. Clean tile work and adjacent surfaces.

3.14 PROTECTION

A. Protect finished installation.

B. Do not permit traffic over finished floor surface.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS - LAY-IN

PART 1 - GENERAL

1.01 WORK INCLUDES

A. Acoustical panels, lay-in.

B. Related Sections:
   1. Section 01 35 42, CALGreen Requirements.
   2. Section 09 53 23, Acoustical Suspension Systems.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. CBC - California Building Code, 2019.

C. California Green Building Standards Code, CALGreen - 2019.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. ASTM E1264 - Acoustic Ceiling Products.

1.03 SUBMITTALS

A. Product data for acoustical panels.

B. Three samples illustrating material and finish of acoustic units.

C. Manufacturer's installation instructions.

D. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.C.

1.04 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Company specializing in manufacture of ceiling panels with five years minimum experience.
   2. Installer: Company with three years minimum experience.

B. Fire Classification Requirements: ASTM E84, flame spread of less than 25 and smoke density rating of less than 450, Class I, California Building Code Table 803.11, 2019 CBC.

C. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per Table 5.504.4.3.
   3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Interior wet work shall be completed prior to installation of panels. Windows and doors shall be in place. HVAC systems shall be installed and operable where necessary to maintain a temperature range of 60 to 85 degrees F and maximum 70 percent relative humidity.

1.06 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 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.

1.07 EXTRA STOCK

A. Provide extra quantity of acoustic units in the amount of one box of each type specified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Armstrong World Industries, Lancaster, PA.
   2. USG Corporation, Chicago, IL.
   3. CertainTeed Corporation, Malvern, PA.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Acoustical Panels: ASTM E1264.
   1. Styles, Sizes and Colors: Refer to Finish Schedule on Drawings.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that existing conditions are ready to receive work.

B. Verify that layout of hangers will not interfere with installation of acoustic units.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Conform to manufacturer's installation instructions and Interpretation of Regulations - DSA IR 25-2.13.

B. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Where square units are indicated, lay directional patterned units in basket weave pattern. Fit border neatly against abutting surfaces.

D. Install acoustic units level, in uniform plane, and free from twist, warp and dents. Replace damaged or soiled units.

E. Treat all field cut edges with manufacturer's recommended touch-up paint. Color to match the panel factory finish.

F. Provide for complete accessibility for all units.

END OF SECTION

SECTION 09 53 15

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Acoustical ceiling panels and suspension system.

B. Suspension Accessories and hardware for ceilings.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. Chapter 19A, California Building Code.

D. Chapter 23, California Building Code.

1.03 SUBMITTALS

A. Procedures: Make submittals in accordance with Division 01 General Requirements on submittals.

B. Product Data: Submit manufacturer's product specifications and installation instructions for each ceiling material required. For each suspension system, include certified laboratory test reports and other data as may be required to show compliance with the documents.

C. Samples: Submit 3 each representative samples of each material that is to be exposed in the finished work. Include full range of colors and finishes.

D. Shop Drawings showing complete reflected ceiling plan. Drawings shall clearly show the following:
   1. Layout of ceiling system and panels.
   2. Suspension system layouts showing locations of main runners, cross runners and perimeter trims {suspension points and connections to structural}.
   3. Locations of all ceiling penetrations, including, lights, air diffusers, fire sprinklers, speakers or other penetrations.
   4. Complete installation details.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture of ceiling suspension system with five years minimum experience.

B. Installer: Company with five years minimum experience.

C. Fire Performance Characteristics: Identify acoustical ceiling 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

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery of materials: Deliver materials in original, unopened packages clearly labeled with manufacturer's name, item description, part number, type and class, as applicable.

B. Storage: Store in manner that will prevent warpage, scratches, or damage of any kind. Prevent interference to/by other trades and any other adverse job conditions due to storage locations or methods.

C. Handling: Handle in such manner to ensure against racking, distortion, or physical damage of any kind.

1.06 PROJECT CONDITIONS

A. Commence installation of materials only when conditions are within the limits established by the manufacturer.

B. All work required above ceiling is to be completed prior to installation of ceiling panels.

1.07 WARRANTY

A. Acoustical 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. Acoustical Panels: Sagging and warping
   2. Hanging System: Rusting and manufacturer's defects

B. Warranty Period:
   1. Acoustical panels: 10 years from date of substantial completion.
   2. Hanging: 10 years from date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Armstrong World Industries, Fullerton, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 ACOUSTICAL CEILINGS AND SUSPENSION SYSTEM MATERIALS

A. Soundscapes Shapes Ceiling Units
   1. Soundscapes Shapes - "Acoustical Clouds", by Armstrong World Industries
      a. Panel: 5445WH Trapezoid.
      b. Size: nominal 48" x 48"
      c. Surface Texture: Smooth
      d. Composition: 7/8" thick fiberglass
      e. Finish: DuraBrite scrim on all sides
      f. Edge: Square
      g. Flame Spread: ASTM E 84; Class A.
      h. Suspension Hardware: (4) 30' suspension cable, grouping frames, hanging kits, angle hanging kits, multi-plane hanging kits, panel and grid hooks, splices, minimum 4 kits per panel. Refer to Finish Schedule on Drawings.
      i. Escutcheon Kit: for below existing ceilings.
      j. Colors: Refer to Finish Schedule on Drawings.

B. Hanger Wire: No. 12 gauge galvanized, annealed steel wire.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that existing conditions are ready to receive work.

B. Verify that layout of hangers will not interfere with other work.

C. Verify dimensions prior to installation.

D. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install independent suspended ceiling system per manufacture's details, instructions, and per Section 09 53 23.

3.03 CLEANING

A. Touch up all minor scratches and spots, as acceptable, or replace damaged sections when touch-up is not permitted.

B. Removal of debris: Remove all debris resulting from work of this section.

3.04 TOLERANCES

A. Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 53 23

ACOUSTICAL SUSPENSION SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Perimeter trim.

C. Related Sections:
   1. Section 09 51 00, Acoustical Ceilings - Lay-In.
   2. Section 09 54 27, Specialty Ceilings.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. ASTM E580 - Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.

F. ASCE/SEI 7-16 - American Society of Civil Engineers/Structural Engineering Institute, Standard 7-16.

G. CBC - 2019 California Building Code.

H. Chapter 25, 2019 California Building Code.

I. Chapter 23, 2019 California Building Code.

J. Chapter 19A, 2019 California Building Code.

K. Chapter 16A, 2019 California Building Code.

L. Metal Suspension Systems for Lay-in Panel Ceilings. Interpretation of Regulations - DSA IR 25-2.13.

1.03 SUBMITTALS

A. Shop drawings indicating, grid layout and related dimensioning, junctions with other work or ceiling finishes and interrelation of mechanical and electrical items. Photographic reproductions of the contract drawings shall not be used.

B. Product data.

C. Three samples of each suspension system main runner, cross runner and edge trim.

D. Manufacturer's installation instructions.

E. Submit one copy of ICC-ES Reports Armstrong ICC-ES, ESR-1308

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture of ceiling suspension system with five years minimum experience.

B. Installer: Company with five years minimum experience.

C. Fire Classification Requirements: ASTM E84, all materials shall have Flame Spread Index rating of less than 25 and Smoke Developed Index rating of less than 450.

D. Products must comply with ICC-ES Reports.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Armstrong World Industries. Lancaster, PA. Product: Suprafine XL, 9/16" Exposed Tee.
   2. Chicago Metallic Corp., Los Angeles, CA.
   3. USG Interiors Inc., Chicago, IL.
   4. CertainTeed Corporation, Malvern, PA.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 SUSPENSION SYSTEM MATERIALS

A. Grid: ASTM C635, Armstrong Prelude Heavy Duty XL 15/16", Suprafine XL, 9/16" ceiling system, galvanized components die cut and interlocking.
   1. Main Runners:
      a. Armstrong: Heavy Duty Prelude XL 7301, exposed T, Suprafine XL 7501 (heavy duty) or 7500 (intermediate duty) 9/16".
   2. Cross Tees - "Stake-on end", Stepped End:
      a. Armstrong: XL7328 (24 inch grid), XL7341 (48 inch grid), Suprafine XL, XL7500 series, 9/16".
   3. Edge Trim:

a. Armstrong Angle Molding: 7800, 7/8", Prelude, 7871 Shadow molding with BERC2 Retention Clip .

B. Beam End Retention Clip: slide clip for free end of main-runners and cross-tees with 2-inch movement capability.
1. Acceptable Product: Armstrong, BERC2, or equal,

C. Accessories: adapters, splices, edge trim and all necessary components required for the specified suspended grid system.

D. Grid Materials: main runners, cross runners, splices, expansion devices and intersection connectors, commercial quality cold rolled steel with galvanized coating. Designed to carry a mean ultimate test load on not less than 180 lbs. compression and tension per ASTM E580 Section 5.1.2. The ceiling grid system must be rated as Heavy Duty as defined by ASTM C635.

E. Grid Finish: Refer to Finish Schedule on Drawings.

F. Hanger Wire: No. 12 gauge wire shall be 0.106 inch in diameter conforming to ASTM A641. No. 12 gage wire shall be soft annealed, galvanized steel wire with a Class 1 zinc coating. Minimum Tensile Strength of 70 ksi.

G. Compression Struts, one of the following per DSA IR 25-2.13:
1. Channel Compression Strut Design: Install a 20-gauge stud; Conform to DSA IR 25-2.13, Sheet No. 3.21 for sizes and maximum lengths allowed. Attach to main runner with two (2) 1/4" machine bolts within 2 inches of splay intersection and to structure per Drawings and DSA IR-25.13. Compression strut shall not replace hanger wire.
2. Tube Strut Design: Install a 12 gauge vertical hanger wire and tie to main runner no more than 2 inches from splay intersection. Run the hanger wire inside a sleeved 1/2-inch Steel Electrical Metallic Tubing (EMT) and 3/4-inch Steel Electrical Metallic Tubing (EMT) as indicated on Drawings, extend tubes tight to structure above and ceiling grid below. Steel Electrical Metallic Tubing (EMT) shall be ANSI C80.3/UL 797 Carbon steel with G90 galvanizing. Steel Electrical Metallic Tubing (EMT) shall have minimum yield strength of 30 ksi and minimum ultimate strength of 48 ksi. To secure sleeved tubes drill a 5/32-inch hole and install through a 1/8-inch bolt with locking nut, tubes shall lap one another min. 4 inches in fully extended position. Cut a slot in the 3/4" conduit to straddle the main runner and secure with 1/4" diameter machine bolt.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that existing conditions are ready to receive work.

B. Verify that layout of hangers will not interfere with other work.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install system in accordance with manufacturer's installation instructions, ASTM C636 and Section 5.2 of ASTM E580, CBC Sections 1617A.1.21 , and DSA IR 25-2.13, and as supplemented in this Section.

B. Measure each ceiling area and establish layout to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width grid panel at borders and comply with layout shown on reflected ceiling plans.

C. Exitways shall be installed in accordance with Section 13.5.6.2.2.(1) of ASCE 7 as amended by 2019 CBC Section 1617A.1.21. A main or cross runner shall be installed on all sides of each piece of tile, board or panel and each light fixture or grill. Splices and intersections of such runners shall be attached with through-connectors such as pop rivets screws, pins, plates with bent tabs or by other approved connectors.

D. Ceilings shall not support material or building components other than grilles or light fixtures except as herein provided. Ductwork, plumbing and like work shall have its own support system and shall not utilize the ceiling system or suspension wires.

E. No. 12 gage hanger wires may be used for up to and including 4 ft. by 4 ft. grid spacing and shall be attached to main runners.

F. Provide No. 12 gauge hanger wires at the ends of all main and cross runners within eight (8) inches of the support or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area. Perimeter wires are not required when the length of the end tee is eight (8) inches or less.

G. Ceiling grid members shall be attached to two (2) adjacent walls per ASTM E580 Section 5.2.3 Ceiling grid members shall be at least 3/4 inch clear of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.

H. The width of the perimeter supporting closure angle shall be not less than 2 inches. Grid systems with specialty or proprietary angles and support clips may be acceptable in accordance with Acceptance of Evaluation Reports per DSA IR A-5 and meeting the requirements of CBC Section 1617A.1.21, ASTM C635, C636 and E580.

I. At the perimeter of the ceiling area, where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal stabilizer or a No. 16 gage wire with a positive mechanical connection to the runner may be used and placed within 8 inches of the wall. Where the perpendicular distance from the wall to the first parallel runner is 8 inches or less, this interlock is not required.

J. Expansion Joints, Seismic Separation Joints, and Penetration:
   1. Expansion joints shall be provided in the ceiling at intersections of corridors and at junctions of corridors with lobbies or other similar areas.
   2. For ceiling areas exceeding 2500 square feet a seismic separation joint shall be provided to divide the ceiling into areas not exceeding 2500 square feet. Alternatively comply with ASTM E580, Section 5.2.9.

3. Penetrations through the ceiling for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a two (2) inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of one (1) inch in all horizontal directions. Alternatively, per ASTM E580, Section 5.2.8.5, a flexible sprinkler hose fitting that can accommodate one (1) inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve or adapter.

K. Lateral Force Bracing:
1. Lateral force bracing is required for all ceiling areas. The spacing of the bracing assemblies as indicated on drawings.
   a. Exception: Lateral force bracing may be omitted for suspended acoustical ceiling systems with a ceiling area 144 sq. ft. or less, when perimeter support, in accordance with Paragraph H above or with ASTM E580 Sections 5.2.2 and 5.2.3, are provided and perimeter walls are designed to carry the ceiling lateral forces.
2. Provide lateral-force bracing assemblies consisting of a compression strut and four (4) No. 12 gage splayed bracing wires oriented 90 degrees from each other.
3. The spacing of the bracing assemblies shall be as indicated on the Drawings.
4. There shall be a brace assembly a distance not more than one half (1/2) the calculated spacing from the surrounding wall, expansion joint and at the edges of any ceiling vertical offset.
5. Bracing assemblies spaced at a maximum of 12 feet by 12 feet on centers for school buildings and 8 feet by 12 feet on centers for essential services buildings, and
6. The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and wires shall be taut. Splices in wires are not permitted without special DSA approval.
7. Compression struts shall be adequate to resist the vertical component induced by the bracing wires, and shall not be more than 1 (horizontal) in 6 (vertical) out of plumb.
8. The maximum slenderness ratio (kL/R) of the compression strut is 200 or less.

L. Attachment of Hanger and Bracing Wires:
1. Fasten hanger wires with not less than three (3) tight turns in three inches. Hanger wire loops shall be tightly wrapped and sharply vent to prevent any vertical movement or rotation of the member within the loops. Refer to ASTM E580, Section 5.2.7.2.
2. Fasten bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches.
3. 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.
4. Separate all ceiling hanger and bracing wires at least six (6) inches from all un-braced ducts, pipes, conduits, etc.
5. Hanger wires shall not attach to or bend around interfering materials or equipment. 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.

6. Hanger wires that are more than 1 (horizontal) in 6 (vertical) out of plumb shall have counter-sloping wires. Perimeter hanger wires at main runners that are positively attached to the perimeter closure angle, counter-sloping is optional.
7. When drilled-in concrete anchors or shot-in anchors are used in reinforced concrete for hanger wires, 1 of 10 wire/anchor assemblies must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 wire/anchor assemblies must be field tested for 440 lbs. in tension in the direction of the wire. Power actuated fasteners in concrete are not permitted for bracing wires.

M. Ceiling Fixtures, Terminals, and Devices:
1. All fixture, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with Section 13.5.6.2.2(5) of ASCE 7 as amended by 2019 CBC Section 1617A.1.21 and ASTM E580 Sections 5.3 and 5.4.
2. Attach all light fixtures and ceiling mounted air terminals, to the ceiling grid runners to resist a horizontal force equal to the weight of the fixtures. Screws or approved fasteners are required.
3. Ceiling panels shall not support any light fixtures, air terminals or devices.
4. All light fixtures shall be positively attached to the ceiling suspended systems by mechanical means to resist a horizontal force equal to the weight of the fixture. Screws or approved fasteners are required. A minimum of two attachments are required at each light fixture, per ASTM E580, Section 5.3.1.
5. Light fixtures weighing less than or equal to 10 lb shall have a minimum of (1) #12 gauge slack safety wire connected from the fixture housing to the structure above.
6. Light fixtures weighing greater than 10 lbs but less than 56 lbs may be supported directly on the ceiling runners, but they shall have a minimum of two (2) #12 gauge slack safety wires connected from the fixture housing at diagonal corners and anchored to the structure above.
7. Light fixtures weighing greater than 56 lbs. shall be independently supported by not less than four (4) taut No. 12 gauge wires, each attached to the housing and to the structure above. The four (4) # 12 taut #12 wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.
8. All 4ft. x 4 ft. light fixtures must have slack safety wires at each corner.
9. Surface-mounted fixtures shall be attached to the main runner with at least two positive clamping devices made of material with a minimum #14 gauge. Rotational spring catches do not comply. A #12 gauge suspension wire shall be attached to each clamping device to the structure above. Provide additional supports when light fixtures are eight (8) feet or longer. Maximum spacing between supports shall not exceed eight (8) feet.
10. Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two (2) times the weight of the fixture. A bracing assembly is required where the pendant hanger penetrates the ceiling. If the pendant mounted light fixture is directly and independently braced below the ceiling, i.e. aircraft cables to walls, then brace assembly is not required above the ceiling.

11. If the pendant mounted light fixture is not directly and independently braced below the ceiling, than a bracing assembly is required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit horizontal force. Exception: where the weight of the fixture is less than 20 pounds, the compression strut is not required.
12. Rigid conduit shall not be used for attachment of the fixtures.

N. Partitions: If non-bearing partitions that extend to and terminate at a suspended ceiling are supported laterally by opposing bracing wires spaced a maximum of 8 ft oc along the top edge of the partition or by other equivalent means, they shall be considered as not adding to the lateral load required to be resisted by the ceiling system.

O. Do not eccentrically load system or produce rotation of runners.

P. Install edge angle at intersection of ceiling and vertical surfaces using longest practical lengths. Miter corners. Provide edge angles at junctions with other interruptions. Where curved obstructions occur, provide preformed closers to match edge molding.

Q. Form expansion joints as indicated on drawings.

R. Install Suspension Accent Trims per manufacturer's instructions including all related accessories.

3.03 TOLERANCES

A. Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 54 26.20

WOOD CEILINGS SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fabrication and delivery of wood grille ceiling system.

B. Installation of suspended ceiling system.

C. Accessories: Provide all other necessary items including devices for attachments to overhead construction, secondary members, spines, connecting clips, wall angles, acoustical blanket and other devices required for a complete installation.

D. Related Sections:
1. Section 09 53 23, Acoustical Suspension System.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. CBC - California Building Code, 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications

1.03 SUBMITTALS

A. Shop Drawings, including:
1. Layout of attachment system.
2. Insert and hanger spacing and fastening details.
3. Attachment method for carriers.
4. Change in level details.
5. Locations and dimensions of light fixtures, and detection devices.
6. Develop and coordinate location of all work that is to be located in with the wall sections involved prior to making shop-drawing submittal.

B. Samples: Show the full variation ranges of wood color to be expected in the completed work. Manufacture of ceiling shall not proceed until approval of all submittals has been returned to manufacturer.
1. Samples of each specified suspension system component.
2. Samples of panels with specified finish

C. Manufacturers Approval: Installation contractor and to verify that said contractor has sufficient experience and expertise to complete project in satisfactory and timely manner.

1.04 QUALITY ASSURANCE

A. Manufacturer and Installer: Firm manufacturing specified product shall have adequate capacity required for projects listed and have successfully completed similar projects for period of not less than four years. Installer approved by manufacturer as qualified to perform work required.

B. Fire Classification Requirements
   1. Conform to California Building Code and following performance criteria:
      a. Fire Performance Characteristics: ASTM E84 test procedures.
      b. Finish panel characteristics must equal or exceed flame spread of 20 or less and smoke development of 25 or less. Class "A"

1.05 PRODUCT, DELIVERY, STORAGE AND HANDLING

A. Deliver fabricated units and related components to site for installation in accordance with the schedule. On-site storage shall be such as to ensure that panels and associated materials are protected from damage.

B. Prior to ceiling installation site must be free of all wet and dusty trades and climatic conditions stabilized to normal operational levels. Wood grille shall be allowed to stabilize on site 72 hours prior to installation.

C. Wood Grilles must be stored, installed and maintained only in secured ambient environment (humidity min. 35% - max. 55%, temperature not to exceed 80 degrees).

1.06 WARRANTY

A. All material supplied by manufacturer, Inc, shall be guaranteed against defects by the manufacturer and the installing contractor for one year.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Armstrong World Industries, Lancaster, PA.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Wood Grille Ceiling Panels
   1. Basis of Design: Armstrong Woodworks Grille, Solid Backer and Dowel
   2. Solid Backer Style: 6 slats

a. Item No.: 7265BOGLC
b. Species: Cherry
c. Size of grid: 12" x 96"
d. Slat width: 5/8", UNO.
e. Slat height: 2-1/4"
f. Edge Profile: Square
g. Finish: Refer to Finish Schedule on Drawings.
h. Acoustical Insulation: 5823
i. Accessories: include for complete system.
j. Fire Rating: Class I/A
k. Suspension System: Armstrong Prelude XL per Section 09 53 23.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that suspension grid is ready to receive work, and conform to requirements of ceiling panel manufacturer.

B. Beginning of installation means acceptance of existing surfaces.

3.02 INSTALLATION

A. Ceiling application: Install by mechanically attaching to suspension grid. Install per manufacturer's installation instructions and per Section 09 53 23.

B. System shall be handled and installed with care in order to prevent surface damage. Field cutting shall be kept to a minimum and performed as recommended by the manufacturer.

C. HVAC and Light Fixture Suspension: All HVAC and Light fixtures must be independently supported from the wood ceiling.

D. Installed true and plumb to within manufacturing tolerance of 1/8" over 8’ long.

3.03 CLEANING

A. Clean wood grille of excess dust, dirt and other contaminants.

END OF SECTION

SECTION 09 54 27

SPECIALTY CEILING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wood veneer ceiling panels.

B. Exposed grid suspension system.

C. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

D. Related Sections:
   1. Section 09 53 23, Acoustical Suspension Systems

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society for Testing and Materials (ASTM):
   1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process.
   3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   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.
   7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   8. ASTM E 580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
   9. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
   10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
   11. ASTM E 1264 Classification for Acoustical Ceiling Products.

C. 2019 California Building Code.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

B. Installation Instructions: Submit manufacturer's installation instructions.

C. 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.

D. Shop Drawings: Layout and details of ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.

E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

F. 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.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics:
   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

C. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.

B. Do not store in unconditioned spaces with humidity greater than 70 percent or lower than 20 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.06 PROJECT CONDITIONS

A. Wood veneer ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).

B. The wood veneer panels should not be installed in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.

C. 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 20 percent or exceed 70 percent. Additionally, the fluctuation in relative humidity should not vary more than 30 percent over the life of the ceiling panels.

1.07 WARRANTY

A. Wood Veneer 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:
   1. Ceiling Panels: Sagging and warping
   2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:
   1. Wood veneer panels: Standard - One (1) year from date of substantial completion.
   2. Grid: Ten years 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.

1.08 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. 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

2.01 MANUFACTURERS

A. Ceiling Units/Panels:
   1. Armstrong World Industries, Inc.

B. Or equal in accordance with Division 01 General Requirements.

2.02 WOOD VENEER CEILING UNITS

A. Ceiling Panels: WoodWorks Concealed Suspension, by Armstrong World Industries.
   1. Surface Texture: Perforations W4
   2. Composition: Wood
   3. Finish: Real Wood Veneers "Natural Variations"
   4. Species:
      a. Natural Variations: Light Cherry
   5. Size: 24 in x 96 in x 3/4 in
   6. Reveal: 1/4 inch with factory-applied black fleece
   7. Edge Banding and Trim: To match face veneer
   8. Surface Finish: clear.
   9. Noise Reduction Coefficient (NRC): ASTM C 423
      a. Perforations W4: 0.65 with acoustical infill
   10. Flame Spread: ASTM E 1264; Class A.
   11. Dimensional Stability: Standard
   12. Acoustical infill panel: 5479.
   13. Suspension System: Refer to Section 09 53 23 for remainder of suspension requirements.
      a. Prelude Heavy Duty main beams, 2’ cross tees, 1-11/16" ht. in "Tech Black".
      b. Components: T-Bar Hook, Wood screws, Safety cable, Support Hanger.
      c. Accessories: WoodWork Concealed Trim, T-Bar Connector Clip.
   14. Colors and Perforations: Refer to Finish Schedule on Drawings.

B. Edge Banding - Pre-finished pressure sensitive adhesive banding is available 15/16 inch wide and in 50-foot lengths. Finish to match panel finish.

PART 3 - EXECUTION

3.01 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.

B. Proper design for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.02 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.

3.03 INSTALLATION

A. Install suspension system and panels in compliance with ASTM C636, and Section 09 53 23, and in accordance with the manufacturer's installation instructions.

B. Suspend main beam from overhead construction with hanger wires spaced 4 feet on center along the length of the main runner. Install hanger wires plumb and straight.

C. Install main beams 48 inches on center with a 48 inch cross tee every 24 inches at 90 degrees to the main beam. Install the 24 inch cross tees at midpoints of the 48 inch cross tees.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. Follow the manufacturer's instructions for border treatment of panels.
   1. Re-cut tegular edge, or
   2. Straight cut and use border clips to support the cut edge of perimeter panels.

F. Cut panel edges that are exposed to view will have to be treated to look like factory edges. Pre-finished peel and stick edge banding is recommended for this purpose.

3.04 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

SECTION 09 65 13

RESILIENT BASE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Resilient base, rubber.

B. Accessories.

C. Related Sections:
   1. Section 01 35 42, CALGreen Requirements.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E648 and NFPA 253 - Critical Radiant Flux of Floor Covering Systems.

C. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

D. ASTM F1861 - Resilient Wall Base

E. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications

F. California Green Building Standards Code, CALGreen - 2019.

1.03 FIRE CLASSIFICATION REQUIREMENTS

A. ASTM E648, NFPA 253: Class 1, Critical Radiant Flux Flame Spread Value: minimum 0.45 watts per sq cm.

B. ASTM E662, smoke density less than 450.

1.04 SUBMITTALS

A. Product data on specified products and colors available.

B. Three 6 inch long samples of base material for each color selected.

C. Manufacturer's installation instructions.

D. Maintenance procedures and recommended maintenance materials.

E. CALGreen Submittals:

1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.05.A.

1.05 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Store materials for three days prior to installation in area of installation to achieve temperature stability.

B. Maintain minimum 70 degrees F temperature three days prior to, during and 24 hours after installation of materials.

C. Provide adequate ventilation to carry off volatile fumes.

1.07 WARRANTY

A. Submit under provisions of Division 01, General Requirements.

B. Provide manufacturer's 1 year warranty against defects and wear-through.

1.08 REPLACEMENT MATERIALS

A. Provide minimum three percent of all materials furnished for each color and size of materials installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS, RUBBER

A. Johnsonite, Chagrin Falls, OH.

B. Burke Mercer Flooring Products, San Jose, CA.

C. Nora Flooring Systems, Lawrence, MA.

D. Endura Co., Waltham, MA.

E. Roppe Corp., Fostoria, OH.

F. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 BASE MATERIALS

A. Base: Rubber, 1/8 inch gauge, standard toe unless noted otherwise, 4 inches.

B. Base material shall meet ASTM F1861 Type TS for rubber base, Group 1, Style A Straight (toeless) profile for carpet and Style B Coved profile for hard surface floors.

C. Base Accessories: size and color as base.

D. Adhesive: As recommended by the manufacturer and if full compliance with the California VOC regulations.

E. Styles and Colors: Refer to Finish Schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft and are ready to receive Work.

B. Verify that surfaces are finished, ready to receive base installation.

C. Beginning of installation means acceptance of existing substrate and site conditions.

3.02 INSTALLATION - BASE MATERIAL

A. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.

B. At 90 degree external corners: Cut from 120 foot rolls only, do not use 4 foot segments. At corners more or less than 90 degrees, shave a vertical strip down the back side of the material, 1/4 inch wide and not more than 1/2 the thickness at the point of bend. Bend coved toe to required angle. Bond material firmly to wall on both sides of joint to ensure a tight fit with no open void at top.

C. Inside Corners: Cut an inverted V-shaped notch in the toe of the wall base at the place where the corner is to be formed. Bend the base once or twice at a right angle to shape the corner. Form the corner and check the fit. Apply adhesive completely to the back of the base and to the wall area to be covered by the corner. Press firmly in position on and roll with a small hand roller.

D. Pre-molded units will not be accepted.

E. Install base on solid backing. Bond tight to wall and floor surfaces.

F. Scribe and fit to door frames and other interruptions.

3.03 CLEANING

A. Remove excess adhesive from floor, base and wall surfaces without damage.

B. Protection: Protect work until completion. Repair or make good any damage to this work and other materials damaged during installation of base material.

3.04 SCHEDULE

A. Install at all walls not specified to receive integral base and as scheduled in the finish schedule.

B. Apply base to toe kick at casework.

END OF SECTION

SECTION 09 65 15

COVE CAPS, REDUCERS AND TRANSITIONAL MOULDINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reducers.

B. Related Sections:
1. Section 01 35 42, CALGreen Requirements.
2. Section 09 68 16, Tile Carpeting.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society for Testing and Materials (ASTM)
1. ASTM D-2047 - Static coefficient of friction.
2. ASTM D-2240 - Material hardness.
3. ASTM D-3389 - Resistance to tabor abrasion using H-18 wheels, 500 gram load, at 1,000 cycles.
4. ASTM E-648 - Test method for critical radiant flux of floor covering systems using a radiant energy source.
5. ASTM E-662 - Test method for specific density of smoke generated by solid materials.

C. National Fire Protection Association (NFPA)
1. NFPA 253 - Test method for critical radiant flux of floor covering systems using a radiant energy source.
2. NFPA 255 - Test method of surface burning characteristics of building materials (Steiner Tunnel Test).
3. NFPA 258 - Test method for specific density of smoke generated by solid materials.

D. California Building Code, 2019 CBC, Chapter 11B.

E. California Green Building Standards Code, CALGreen - 2019.

1.03 FIRE CLASSIFICATION REQUIREMENTS

A. ASTM E648, NFPA 253: Class I, Critical Radiant Flux: Minimum 0.45 watts per sq cm.

B. Smoke density not greater than 450 when tested in accordance with ASTM E662~~84~~.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product data, installation instructions, and maintenance recommendations for each material proposed for use.

B. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.05.C.

C. Samples: Verification samples of each product specified in color selected for use.

D. Certificates: Attesting fire rated materials tested by independent testing agency and comply with specifications.

1.05 QUALITY ASSURANCE

A. Manufacturer: Firm with minimum of 10 years experience in production of Cove caps, reducers, transitional mouldings and accessories.

B. Installer's Qualifications: Installer experienced (minimum of 2 years) to perform work of this Section, who has specialized in the installation of work similar to that required for this project and who is acceptable to the product manufacturer.

C. California Green Building Standards Code, CALGreen - 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3

D. Materials: For each type of material required for the work of this Section, provide primary materials, which are the products of one manufacturer. Provide secondary materials, which are acceptable to the manufacturer of the primary materials. Comply with applicable regulations regarding VOC (volatile organic compound) content of the adhesives

1.06 ENVIRONMENTAL REQUIREMENTS

A. Store materials for three days prior to installation in area of installation to achieve temperature stability.

B. Maintain minimum 70 degrees F temperature three days prior to, during and 24 hours after installation of materials.

C. Provide adequate ventilation to carry off volatile fumes.

1.07 WARRANTY

A. Submit under provisions of Division 01, General Requirements.

B. Provide manufacturer's 1 year warranty against defects and wear-through.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Johnsonite, Chagrin Falls, OH
   2. The Roppe Co., Fostoria, OH.
   3. BurkeMercer Products Co., Inc., Orlando, FL.
   4. The Flexco Co., Tuscumbia, AL.
   5. AFCO Rubber Corp., North Canton, OH.
   6. Schluter Systems.
   7. Genotek, Murrieta, GA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 COVE CAPS, REDUCERS, TRANSITIONAL MOULDINGS AND ACCESSORIES

A. Reducers
   1. Style and colors: Refer to Finish Schedule on Drawings.
   2. Series: Johnsonite CRS, SSR, RRS, unless noted otherwise in Finish Schedule.
   3. Material: Homogeneous composition of polyvinyl chloride , high quality additives, and colorants.
   4. Length: 12' (3.66 m)
   5. Abrasion ASTM D-3389, H-18 wheel, 500 gram load Resistance: 1000 cycles, gram weight loss not greater than 1.
   6. Hardness: ASTM D-2240, Shore A, not less than 85.
   7. Slip Resistance: Static coefficient of friction (James Machine), ASTM D-2047, not less than 0.6.
   8. Flammability: ASTM E-648; NFPA 253; result to be not less than.45 watts per square centimeter, Class 1.
   9. Smoke Density: ASTM E-662; NFPA 258, smoke density less than 450.
   10. Asbestos-Free: Products shall contain no asbestos.

2.03 FILLERS AND ADHESIVES

A. Adhesives: As recommended by the manufacturer and in full compliance with California VOC regulations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examination
   1. Verify that materials are suitable for installation. Do not proceed with work until unsatisfactory conditions are corrected. Comply with manufacturer's recommendations including the following:
      a. Substrates shall be clean and dry.
      b. Substrates shall be free of depressions, raised areas, or other defects that would telegraph through the installed resilient material.

c. Temperature of resilient materials and substrate shall be within specified tolerances.

3.02 INSTALLATION

A. Installation of Reducers per manufacturer's instructions. Provide at all edges not covered by trim and at wall openings where abutting other finish flooring. Where doors occur, center edging strip below center of door.

B. Final Inspection - Prior to final inspection the contractor shall clean up the job site and remove all rubbish and debris. Remove excess adhesive from l surfaces. Floors are to be cleaned and readied or the appropriate finish.

3.03 CLEANING

A. Use only cleaning products recommended by manufacturer.

B. Protect installed product from damage and construction operations and inspect immediately before final acceptance of project.

END OF SECTION

SECTION 09 65 20

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Accessories.

C. Related Sections
1. Section 01 35 42, CALGreen Requirements.
2. Section 09 05 61, Common Work Results for Flooring Preparation.
3. Section 09 65 13, Resilient Base.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E648 and NFPA 253 - Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

C. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

D. ASTM F1700 - Standard Specification for Vinyl Solid Floor Tile.

E. ASTM F1869 - Test Method for Measuring Moisture Vapor Emission.

F. ASTM F2170 - Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes.

G. ADA - Americans with Disabilities Act of 1990 as amended
1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

H. Local AQMD - Local Air Quality Management District.

I. California Green Building Standards Code, CALGreen 2019.

1.03 SUBMITTALS

A. Product Data: specified products, describing physical and performance characteristics, sizes, patterns and colors available.

B. CALGreen Submittals:

1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.A.

C. Shop Drawings: indicating layout, with dimensioning.

D. Samples: Three samples, 12 by 12 inches or modular size unit, illustrating color and pattern for each floor material specified.

E. Manufacturer's installation instructions.

F. Maintenance procedures and recommended maintenance materials, and suggested schedule for cleaning, stripping and re-waxing.

G. Moisture and Alkalinity test results.

H. Submit installer's certificates complying with Quality Assurance requirements.

1.04 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen 2019.
   1. Adhesives, sealants, primers and caulks shall comply with air quality management district rules where applicable or SCAQMD rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.

B. Qualifications:
   1. Manufacturer: Company specializing in manufacture of resilient flooring with five years minimum experience.
   2. Installer: Company with verifiable three years minimum experience and have completed at least 3 projects of same scope.

C. Fire Classification Requirements:
   1. ASTM E648: Class I, Critical Radiant Flux: Minimum 0.45 watts per sq cm, Class I.
   2. Smoke density not greater than 450 when tested in accordance with ASTM E662.

1.05 MOISTURE AND ALKALINITY TESTING

A. Contractor shall test all concrete floors to receive resilient flooring for moisture content as described in Division 01 General Requirements for Quality Requirements and this Section.

B. Notify Inspector 24 hours prior to installation of testing and at conclusion of tests.

C. Test concrete flooring in accordance with ASTM F2170 and ASTM F1869.

D. Submit test results and data to Owner and Architect for approval prior to installation of flooring materials.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Store materials for three days prior to installation in area of installation to achieve temperature stability.

B. Maintain minimum 10 and 29 degrees C temperature and 50% relative humidity, 24 hours before, during and after installations.

C. Provide adequate ventilation to carry off volatile fumes.

1.07 EXTRA MATERIALS

A. Provide minimum five percent of all materials furnished for each color and size of materials installed.

B. Maintenance Materials and Supplies: Provide instructions for maintenance of flooring from the manufacturer [and 5 gallons of] including cleaning solution, floor polish recommended by manufactures. Same production line, package products with protective coverings and label accordingly.

1.08 MAINTENANCE

A. Unless badly soiled or scratched, clean, and polish flooring in accordance with this section.

B. Coordinate selection of floor polishing products with Owner’s custodial maintenance representative.

1.09 WARRANTY

A. Submit under provisions of Division 01, General Requirements.

B. Provide manufacturer's 10-year warranty against defects and wear-through.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Slip Resistant: Surfaces shall be stable, firm and slip resistant compliant with CBC 11B-302.1.

2.02 MANUFACTURERS - TILE FLOORING

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Interface, Atlanta, GA.
   2. Armstrong World Industries, Inc., Fullerton, CA.
   3. Tarkett Commercial, Houston, TX.
   4. Mannington Commercial, Calhoud, GA.
   5. Patcraft, Dalton, GA.
   6. Mohawk, Calhoun, GA.
   7. Shaw Industries Group, Dalton GA.

8. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.03 FLOORING MATERIALS

A. Luxury Vinyl Flooring (LVT): ASTM F1700
   1. Class: Class III, Printed Film Vinyl Tile.
   2. Thickness: 4.5 mm.
   3. Size: Refer to Finish Schedule on Drawings.
   4. Styles and Colors: Refer to Finish Schedule on Drawings.

B. Subfloor Leveler System: Johnsonite LS-40, pieces to fit transition condition. Install per manufacture's specifications.

2.04 MANUFACTURERS - REDUCER STRIPS AND ACCESSORIES

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Johnsonite, Chagrin Falls, OH
   2. The Roppe Co., Fostoria, OH.
   3. Mercer Products Co., Inc., Orlando, FL.
   4. The Flexco Co., Tuscumbia, AL.
   5. AFCO Rubber Corp., North Canton, OH.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.05 REDUCER STRIPS AND ACCESSORIES

A. Reducer Strip: 1/8 inch, vinyl RRS-XX-A, B or C JOHNSONITE.

B. Butting Edge: EG Series, thickness on each side of strip to accommodate type of flooring material to be jointed.

2.06 FILLERS AND ADHESIVES

A. Subfloor Filler: cementitious type, as recommended by the manufacturer.

B. Adhesives: as recommended by the manufacturer and in full compliance with California VOC regulation and Local AQMD.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft, and are ready to receive Work.

B. Prior to ordering resilient sheet flooring, conduct Calcium-Chloride Test Method in accordance with ASTM F1869 to verify that concrete floor slabs are dry with maximum moisture vapor emissions of 3 pounds per 1,000 square feet in 24 hours and that slabs exhibit negative alkalinity, carbonation or dusting. Apply the moisture test in four (4) different areas of each floor location, with at least one test for each 1,000 square feet of floor area.

C. Prior to ordering resilient flooring conduct Relative Humidity Test Method in accordance with ASTM F 2170 to verify relative humidity and surface pH in accordance with ASTM F710 of concrete floor slabs, the method
   1. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
   2. Place probe to full depth of test hole, place cap over probe.
   3. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
   4. Remove cap and press button on the probe to obtain reading.
   5. Relative humidity readings for substrates receiving non-permeable flooring are 75 percent or lower.
   6. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
   7. Alkalinity testing: follow procedures per ASTM F710, ranges shall not exceed those recommended by the flooring manufacturer.

D. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to the installation of resilient flooring. Levels of pH shall not exceed the written recommendations of the resilient flooring manufacturer or the adhesive manufacturer, or both.

E. Ordering of flooring materials and beginning of installation means acceptance of existing substrate and site conditions.

3.02 PREPARATION

A. Install Vapor Emission Treatment Systems per Section 09 05 61.

B. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.

C. Apply, trowel and float filler to leave a smooth, flat, hard surface, free of bumps or depressions of any size.
   1. Latex Underlayment - Latex modified, Portland cement-based formulation provided or approved by flooring manufacturer for applications indicated. Which will not disintegrate from moisture, for floor areas less than 1/4 inch buildup. All product to be 100 percent asbestos-free.

D. Prohibit traffic from area until filler is cured.

E. Vacuum clean substrate.

F. Apply primer as recommended by the materials manufacturer.

3.03 INSTALLATION

A. Install in accordance with manufacturers' instructions.

B. Mix flooring materials from container to ensure shade variations are consistent.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Set flooring in place, do not pressure fit into place. Cut and trim material to fit neatly into position without bending or forcing material flat. Roll in both direction with 100lb roller before adhesive cures. Wet adhesives must be immediately removed before allowed to dry. Use only cleaning solutions approved by manufacturer.

E. Lay flooring with joints parallel to building lines.

F. Install flooring to square grid pattern with all joints aligned, with pattern grain alternating with adjacent unit to produce pattern as indicated. Allow minimum 1/2 full size tile width at room or area perimeter, where possible.

G. Terminate flooring at centerline of door at door openings where adjacent floor finish is dissimilar.

H. Install edge strips at unprotected or exposed edges, and where flooring terminates.

I. Scribe flooring to walls, columns, cabinets, floor outlets and other appurtenances to produce tight joints.

J. Install flooring under movable partitions and under open cabinets without interrupting floor pattern.

K. Install edge strips where flooring does not terminate at walls and where indicated. Fit joints tightly.

L. Install wall base in accordance with Section 09 65 13.

M. Installation of Reducers, Transitions or Edging Strips - Provide at all edges not covered by trim and at wall openings where abutting other finish flooring. Where doors occur, center edging strip below center of door.

3.04 PROTECTION

A. Prohibit traffic on floor finish for 24 hours after installation.

B. Cover products installed on floor surfaces with undyed, untreated building paper until final inspection. Protect floors from rolling loads and point loads for 48 hours after installation by covering with hardboard or plywood.

C. Use of dollies with boards underneath whenever normally stationary equipment and/or furnishings must be moved across the floor.

3.05 CLEANING

A. Remove excess adhesive from floor, base and wall surfaces without damage after 48 hours.

B. Maintenance immediately after installation.
   1. Sweep or vacuum floor thoroughly.
   2. Damp mop with a solution of a neutral detergent approved by manufacturer, carefully wiping up black marks, use a scrubbing pad as recommended for the type of floor being maintained.
   3. Finish per manufacturer's instructions.

C. Protection: Cover Work with a heavy non-asphaltic non-staining type building paper where subsequent building operations occur. Protect Work until completion. Repair or make good any damage to this Work and other materials damaged during installation of flooring.

END OF SECTION

SECTION 09 68 16

TILE CARPETING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Modular tile carpeting.

B. Accessories.

C. Related Sections:
1. Section 01 35 42, CALGreen Requirements.
2. Section 09 05 61, Common Work Results for Floor Preparation.
3. Section 09 65 13, Resilient Base.
4. Section 09 65 15, Cove Caps, Reducers and Transitional Mouldings.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM D5116 Standard Guide from Small Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.

C. ASTM E648 and NFPA 253 - Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

D. ASTM E662-Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

E. ASTM F 1869 - Test Method for Measuring Moisture Vapor Emission.

F. ASTM F 2170 - Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes.

G. CBC - California Building Code, 2019 CBC, Chapters 11A and 11B.

H. California Green Building Standards Code, CALGreen 2019.

I. ADA - Americans with Disabilities Act of 1990
1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

J. National Bureau of Standards - NBS.

K. SCAQMD - South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications

1.03 SUBMITTALS

A. Shop drawings showing indicating layout, dimension, and location of all accent tiles.

B. Product data on specified products, describing physical and performance characteristics, sizes, patterns, colors available and method of installation.

C. Three samples of full size tiles illustrating color and pattern for each carpet material specified.

D. Manufacturer's installation instructions.

E. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code, per paragraph 1.05.E this Section.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in carpet with ten years' minimum experience.

B. Installer: Company with three years' minimum experience, certified when required by the manufacturer.

C. Regulatory Requirements: Carpet shall have level loop, textured loop, or level-cut/uncut pile texture, firm cushion, pad or backing (or no cushion or pad) and maximum pile height of 1/2 inch in accordance with CBC Section 11B-302.2. Carpet edges shall comply with CBC 11B-303, and carpet trim to CBC Section 11B-302.2.

D. Fire Classification Requirements
   1. ASTM E648, NFPA 253: Class I, Heat Flux Minimum 0.45 watts per sq cm.
   2. Smoke density not greater than 450 when tested in accordance with ASTM E662.

E. California Green Building Standards Code, CALGreen 2019.
   1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.

F. Adhesives shall comply with VOC content limits defined by: SCAQMD Rule 1168

1.05 OPERATION AND MAINTENANCE DATA

A. Operation and maintenance.

B. Include maintenance procedures, recommended maintenance materials and suggested schedule for cleaning and shampooing.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Store materials in sufficient time prior to installation in area of installation to achieve temperature stability.

B. Maintain minimum 70 degrees F ambient temperature three days prior to, during and 24 hours after installation of materials.

1.07 EXTRA MATERIALS

A. Provide an average of 3 percent in usable size of carpeting of each color specified, not less than 12 inches long by roll width.

1.08 WARRANTY

A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, permanent indentation or compression, and delamination.
   2. Warranty Period: 15 years from date of Substantial Completion.

B. Warranty: Provide for promptly repairing or replacing, at no cost to Owner, carpet which exhibits evidence of defective materials or workmanship, including defects such as fading, unraveling, loss of yarn, and splitting of seams, for a period of two (2) years. Refer to Section 01 70 0 for warranty format.

1.09 MOISTURE AND ALKALINITY TESTING

A. Contractor shall test all concrete floors to receive carpet flooring for moisture content as described in Division 01, General Requirements for Quality Requirements and this Section.

B. Test concrete flooring in accordance with ASTM F1869 and ASTM F 2170.

C. Submit Test results and data to Owner and Architect.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Interface Flooring Systems Inc., La Grange GA.

B. No Substitutions.

2.02 MATERIALS

A. Styles and Colors: Refer to Finish Schedule on Drawings.
   1. Provide carpeting from same print run or dye lot.

2. Installation Method: Interface TacTiles

2.03 MANUFACTURERS - REDUCER STRIPS AND ACCESSORIES

A. Products of following manufacturers form basis for design and quality intended.
1. Duramax Inc./Johnsonite, Chagrin Falls, OH.
2. The Roppe Co., Fostoria, OH.
3. Mercer Products Co., Inc. Orlando, FL.
4. The Flexco Co., Tuscumbia, AL.
5. AFCO Rubber Corp., North Canton, OH.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.04 EDGE GUARDS, ADAPTERS AND ACCESSORIES

A. 3/16 inch carpet edge guard: Johnsonite EG-XX-J.

B. 1/4 inch carpet edge guard: Johnsonite EG-XX-H.

C. Resilient Subfloor Leveler Strips: Subfloor Leveler System by Johnsonite
1. Homogeneous composition of polyvinyl chloride (PVC), high quality additives, and colorants.
2. Exceeds ASTM E 648 Class 1 Flammability

D. Carpet edge guards shall comply with CBC Section 11B-302.2.

E. Colors: Refer to Finish Schedule on Drawings.

2.05 FILLER AND SEALERS

A. Subfloor Filler: Latex based underlayment acceptable to the manufacturer.

B. Primers and Sealers: Type recommended by carpet manufacturer in full compliance with California VOC regulations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft, and are ready to receive Work.

B. Prior to delivery of carpeting, conduct Calcium-Chloride Test Method in accordance with ASTM 1869 to verify that concrete floor slabs are dry with maximum moisture vapor emissions of 3 pounds per 1,000 square feet in 24 hours and that slabs exhibit negative alkalinity, carbonation or dusting. Apply the moisture test in four (4) different areas of each floor location, with at least one test for each 1,000 square feet of floor area.

C. Prior to delivery of carpeting, conduct Relative Humidity Test Method in accordance with ASTMF2170 using a Wagner Rapid RH probe to verify relative humidity and surface pH of concrete floor slabs, the method:
   1. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
   2. Place probe to full depth of test hole, place cap over probe.
   3. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
   4. Remove cap and press button on the probe to obtain reading.
   5. Relative humidity readings for substrates receiving non-permeable flooring are 75% or lower.
   6. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.

D. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to the installation of carpet flooring. Levels of pH shall not exceed the written recommendations of the carpet manufacturer or the adhesive manufacturer, or both.

E. Delivery of flooring materials and beginning of installation means acceptance of existing substrate and site conditions.

3.02 PREPARATION

A. Install Vapor Emission Treatment Systems per Section 09 05 61.

B. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.

C. Apply, trowel and float filler to leave a smooth, flat, hard surface, free of bumps or depressions of any size.

D. Prohibit traffic from area until filler is cured.

E. Vacuum clean substrate.

F. Apply primer as recommended by the materials manufacturer.

G. Maintain dye lot integrity. Do not mix dye lots in same area.

3.03 INSTALLATION - FACTORY INSTALLED DRY ADHESIVE

A. Apply carpet in accordance with manufacturers' instructions.
   1. Securely attach carpet on floor surface as recommended by carpet manufacturer.

B. Lay out rolls of carpet for approval.

C. Verify carpet match before cutting to ensure minimal variation between dye lots.

D. Double cut carpet at 2" overlapped edges to allow intended seam and pattern match. Make cuts straight, true and un-frayed. Edge seal carpet where required to prevent fraying.

E. Fit seams straight, not crowded or peaked, free of gaps.

F. Lay carpet on floors with run of pile in same direction as anticipated traffic.

G. Do not change run of pile in any room where carpet is continuous through a wall opening into another room. Locate change of color or pattern between rooms under door centerline.

H. Cut and fit carpet around interruptions. Extend carpets into cabinets that do not contain bottoms.

I. Fit carpet tight to intersection with vertical surfaces without gaps.

J. Fasten carpet edges to floor surfaces, and provide edge guard along entire length of the exposed edge.
   1. Edge guards shall comply with code requirements for changes in level.

K. Roll with 100 lb roller for complete contact of carpet with adhesive to sub-floor.

L. Install in accordance with CBC Section 11B-302.2.

3.04 CLEANING

A. Remove excessive adhesive from floor, base and wall surfaces without damage.

B. Clean and vacuum carpet surfaces.

3.05 PROTECTION

A. Prohibit traffic from carpet areas for 24 hours after installation.

END OF SECTION

SECTION 09 72 15

VINYL-COATED FABRIC WALL COVERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Wall covering.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E84 - Surface burning characteristics of building materials.

C. FS-CCC-W-408 - Wall Covering, Vinyl-Coated.

D. ASTM G21 - Resistance of Synthetic Polymeric materials to fungi.

E. ASTM D751 - Coated Fabrics.

F. CFFA - Chemical Fabrics and Film Association, CFFA-W-101A - Quality Standard for Vinyl Coated Fabric Wallcovering.

1.03 SUBMITTALS

A. Product data on wall covering and adhesive.

B. Three samples of wall covering illustrating color, finish and texture. Size: Minimum 54 x 36 inches.

C. Manufacturer's installation instructions.

D. Test reports verifying flame and smoke density ratings.

E. Manufacturer's certification that products meet specified minimums.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing commercial wall fabrics with five years experience.

B. Applicator: Company specializing in installing wall fabrics with three years experience.

C. Fire Classification Requirements

1. ASTM E84: Flame spread less than 25, smoke density less than 450.

D. Field Samples
1. Provide three panel field sample panel, full height, illustrating installed wall covering, joint seaming technique.
2. Locate as approved by Architect.
3. Approved sample may remain as part of the Work. Disapproved sample shall be removed and replaced.

1.05 DELIVERY, STORAGE AND HANDLING

A. Inspect roll materials on site to verify acceptance.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 65 degrees F unless required otherwise by manufacturer's instructions.

B. Do not apply primer or adhesive when substrate surface temperature or ambient temperature is below 65 degrees F.

C. Maintain these conditions 24 hours before, during and after installation of adhesive wall covering.

1.07 WARRANTY

A. Provide manufacturer's five-year, no dollar limit, warranty from date of Certified Completion.

B. Warranty shall include manufacturing defects, permanent surface staining due to mildew, bleed-through of foreign impurities embedded in the fabric backing and separation.

1.08 EXTRA STOCK

A. Provide 25 lineal feet of each color of wall covering.

B. Package and label each roll by destination room number; store where approved.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
1. DesignTex
2. R.J.F. International.. Product: KOROSEAL SERIES.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. Wall Covering:
1. Styles and Colors: Refer to Finish Schedule on Drawings.
2. Content: 100% Vinyl.
3. Backing: Acrylic Pressure Sensitive Adhesive.
4. Width: 48 inches.
5. Thickness: 8 Mils
6. Surface Burning Characteristics, ASTM E84: Class B.

B. Substrate Filler: As recommended by wall covering manufacturers; compatible with substrate.

C. Substrate Primer and Sealer: as approved by the wallcovering and adhesive manufacturers.

D. Outside corner Protection: Provide 1-1/2 by 1-1/2 inches vinyl covered PVC Schedule 40. Full height, typical at outside corners.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that substrate surfaces are ready to receive work, and conform to requirements of the wall covering manufacturer.

B. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

C. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

A. Do not apply wall covering to rough surfaces or which have stains that will bleed through the wall covering. Fill cracks and holes and sand rough spots smooth.

B. Surfaces to receive wall covering shall be thoroughly dry. Test moisture content of gypsum board, concrete, and masonry walls with electric moisture meter. Moisture shall not be more than 5 percent.

C. Prime surfaces of walls as required by manufacturer's instructions. Primer shall be completely dry before adhesive is applied.

D. Existing surfaces should be clean; free of mildew or loose or flakey paint; and, smooth before the application of primer, and adhesive.

3.03 INSTALLATION

A. Apply wall covering in accordance with manufacturer's instructions.

B. Use wall covering in pattern sequence, starting from highest to lowest number and each strip the same sequence as cut from roll.

C. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

D. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface. Butt edges tight.

E. Horizontal seams are not acceptable.

F. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

G. Install wall covering before installation of bases, cabinets, hardware, or items attached to or spaced slightly from wall surface. Do not install wall covering more than 1/4 inch below top of resilient base.

H. Cover spaces above and below windows, above doors, in pattern sequence from roll.

I. Do not apply fabric covering to electrical, telephone and wall plates.

J. Where wall covering tucks into door frame reveals, or metal wallboard or plaster stops, apply covering with contact adhesive within 6 inches of wall covering termination. Ensure full contact bond.

K. Remove excess wet adhesive from seam before proceeding to next wallcovering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt and other contaminants.

B. Replace wall plates and accessories removed prior to work of this Section.

END OF SECTION

SECTION 09 72 17

FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fiberglass Reinforced Plastic Wall Panels.

B. Components and moldings.

C. Sealants.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. USDA - United States Department of Agriculture.

C. ASTM E84 - Surface Burning Characteristics of Building Materials.

D. AQMD, Local Regulations.

1.03 SUBMITTALS

A. Product data.

B. Manufacturer's current recommended method of installation.

C. Three (3) sets of samples of panels and molding illustrating color, texture, thickness and physical characteristics.

D. Certification of USDA approval for use of material in food handling facilities.

1.04 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing products specified herein with minimum ten years experience.

B. Applicator: Company specializing in installation of specified products with minimum five years experience.

C. Flame spread classification requirements
   1. ASTM E84, Class I/A flame spread less than 25, smoke density less than 450.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site with manufacturer's labels intact and legible.

B. Handle materials with care to prevent damage.

C. Deliver materials bearing USDA accepted label and required classification numbers.

D. Store materials under cover, stacked flat, off floor.

E. Stack panels so that long lengths are not over short lengths.

1.06 ENVIRONMENTAL CONDITIONS

A. Maintain temperature range between 55 degrees F. to 70 degrees F. for 24 hours before, during and after gypsum wallboard and joint treatment applications.

B. Provide ventilation during and following sealing of joints.

C. Adhesives shall conform to AQMD, Local Regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis for design and quality intended.
1. Marlite Inc., Dover, OH.
2. Kemlite/Crane Co., Joliet, IL.
3. Nudo Products, Inc., Springfield, IL.
4. Glasteel, Division of Stabilit America, Inc., Collierville, TN.
5. Parkland Plastics, Middlebury, IN.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MATERIALS

A. MARLITE FRP PANELS; Class A, 3/32 inch thick, interior liner panels, chemical, stain, odor, moisture and impact resistant. Panels shall not support mold or mildew. Surface: Smooth

B. Colors: Refer to Finish Schedule on Drawings.

2.03 ACCESSORIES

A. Moldings: Aluminum. Designs and thickness shall match panels. Provide at all edges, divider joints, interior corners and exterior corners.

B. Sealant: MS250 clear, one-part silicone, conforming to requirements of Section 07 92 00.

C. Adhesive: C375 neoprene based or C551 latex based construction adhesive, VOC Compliant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive the work of this section.

B. Verify that gypsum board substrate has been taped and sanded, all joints.

C. Beginning of installation means installer accepts existing surfaces.

3.02 INSTALLATION

A. Install panels plumb, level and with all vertical joints on bearing.

B. Verify location and install all trim required. Install all trim and sealant in accordance with the manufacturer's recommendations.

3.03 CLEANING

A. Do not allow the accumulation of debris, immediately remove spilled or splashed material and all trace of residues.

END OF SECTION

SECTION 09 74 13

WOOD WALL COVERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Wall covering.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM E84 - Surface burning characteristics of building materials.

1.03 SUBMITTALS

A. Product data on wood wall covering.

B. Three samples of wall covering illustrating color, finish and texture.

C. Manufacturer's installation instructions.

D. Test reports verifying flame and smoke ratings.

1.04 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing wood wall coverings with five (5) years experience.

B. Applicator: Company specializing in installing wall fabrics with five (5) years experience.

C. Fire Classification Requirements
   1. ASTM E84: Flame spread of less than 25; smoke developed index of less than 50.

D. Field Test Panels
   1. Install not less than three full-width sheets of each pattern specified in an area designated by Architect.
   2. Test installation area shall be reviewed for conformance to manufacture's standard installation instructions.
   3. The approved test area shall remain as part of the finished installation work as standard of comparison for the installation throughout the project

1.05 DELIVERY, STORAGE AND HANDLING

A. Inspect roll materials on site to verify acceptance.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

1.06 PROJECT CONDITIONS

A. Maintain constant temperature range of 50° F to 86° F degrees, with 25 percent to 55 percent relative humidity, for at least 4 days prior to, throughout the installation period and maintained consistently thereafter.

B. Maintain these conditions 24 hours before, during and after installation of wall covering.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturers form the basis for design and quality intended.
   1. Armstrong World Industries

B. Or equal as approved in accordance with Division 01 General Requirements for substitutions.

2.02 MATERIALS

A. Wood Veneer Paneling:
   1. Natural Variations: Light Cherry
   2. Product Number: 5818W4XNLC
   3. Panel Dimensions 23-3/4" x 95-3/4" x 3/4"
   4. NRC: 0.55.

B. Perforation Options: W4 - Rg 6011 (Round Straight).

C. Surface Finish: Clear, UNO.

D. Refer to Finish Schedule on Drawings.

E. Accessories: Provide all neccessary accessories for complete installation as recommended by manufacturer. Provide manufacturer's trims and splines as indicated on Drawings for a complete system. Finish to match panels.

F. Adhesive: as recommended by Manfacturer.

G. Mounting: D-20 Mounting, Manufacturer's standard z-clip mounting system.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that substrate surfaces are prime painted and ready to receive work, and conform to requirements of the wall covering manufacturer.

B. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

C. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

A. Fill cracks and smooth irregularities with filler; sand smooth.

B. Wash surfaces with trisodium phosphate, rinse and neutralize; wipe dry.

C. Sand glossy surfaces.

D. Remove electrical, telephone, wallplates and covers.

E. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Install wall covering in accordance with manufacturer's instructions.

B. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface. Butt edges tight.

D. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

E. Install wall covering before installation of bases, cabinets, hardware, or items attached to or spaced slightly from wall surface. Do not install wall covering more than 1/4 inch below top of base.

F. Cover spaces above and below windows, above doors, in numbered pattern sequence from roll.

G. Do not apply covering to electrical, telephone and wall plates.

3.04 FINISHING

A. Finishing shall be included under this section.

B. Finish Type: Polyurethane varnish, minimum 3 coats, with light sanding between coats, brushed on, as recommended by manufacturer.

3.05 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt and other contaminants.

B. Replace wall plates and accessories removed prior to work of this Section.

END OF SECTION

SECTION 09 81 30

SPRAY-APPLIED ACOUSTICAL PLASTER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Acoustical Plaster Panel System.

B. Related Sections:
   1. Section 09 90 00, Painting.

1.02 SUBMITTALS

A. Manufacturer's installation instructions, test data substantiating compliance with quality assurance.

B. 12 inch square sample of sprayed-on insulation showing texture variations for approval. Resubmit as required until approved. Manufacturer shall certify that samples are representative of the texture acoustically tested in supporting acoustical test reports.

C. Test reports from all suppliers showing material to be 100 percent free of asbestos, mineral fiber, polystyrene and cellulose.

D. Certification of applicator licensing.

E. Acoustical test data for specified finish.

1.03 QUALITY ASSURANCE

A. Provide testing results and procedures which have been certified by a accredited independent testing laboratories. Peak thickness of test samples must be determined and reported by acoustical laboratory. Nominal thicknesses are not acceptable unless peak thicknesses are also reported.
   1. Density, ASTM E605: 1.8 lbs per sq. ft.
   2. Surface Burning Characteristics, ASTM E84: 15, 15
   3. Sound Absorption, ASTM C423: NRC 0.55-0.75.
   4. Compression Strength, ASTM E761: 125 psi.

B. Installer: Licensed by manufacturer.

C. Control Sample: Prior to installation of final cost, apply an area of 50 sq. ft. in presence of Architect, for approval of finish texture, as selected from samples.

1.04 MATERIAL HANDLING

A. Keep material dry until ready for use.

1.05 WARRANTY

A. Manufacturer shall warrant the material to be supplied, agreeing to repair/replace that which has cracked, flaked, dusted excessively, peeled or fallen from substrate, or otherwise deteriorated to a condition where it would not perform effectively as intended for a sound absorbent purpose; due to defective materials and not due to abuse, improper maintenance, unforeseeable ambient exposures, or other causes beyond anticipated conditions by manufacturer. The warranty period will be 10 years from date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Pyrok Inc, Mamoroneck, NY; Product: Starsilent.
   2. Sto Corp., Atlanta, GA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 MATERIALS

A. Spray-applied Acoustical Panel System, StarSilent or approved equal, conforming to the following:
   1. Finish: Smooth and field painted per Section 09 90 00 per manufacturer's recommendations. Colors per Finish Schedule on Drawings.
   2. NRC: 0.85

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

A. Examine all substrates and conditions.

B. Ensure substrate is free of oil, grease, dirt, paint, or other matter that would impair bond or install metal lath as recommended by the manufacturer.

C. Do not proceed until said substrate and conditions are acceptable.

D. Prepare substrate by filling voids and cracks and offsets, remove projections that result in telegraphing presence of imperfections.

E. Do not apply insulation material when temperature is below 44 degrees F (ambient), or substrate is below 40 degrees F.

F. Mask all adjoining surfaces in order to minimize damage from overspray.

G. Provide ventilation if required, and avoid excess drying rates.

H. Provide tarps or temporary enclosures as necessary to confine operations.

I. Perform all patching and repairing of insulation required due to cutting, etc., by other trades.

3.02 APPLICATION

A. Apply in accordance with manufacturer's recommended procedures.

B. Install 1-1/2" cold rolled channel on 4 foot centers and 20 gauge 7/8" hot channel on 16 inch centers.
   1. Fastener panels to ceiling framings.
   2. Apply manufacturer's standard fixing product to panel edges and over fasteners.
   3. Sand over fasteners and panel seams.
   4. Apply StarSilent Top Basic over entire surface.
   5. Apply StarSilent Top Finish over entire surface and trowel to smooth plaster finish.

C. Install to thickness indicated or thickness required for NRC specified.

D. Ensure that texture and color are all as per control sample.

E. Paint per Section 09 90 00, Painting.

3.03 CLEANING AND PATCHING

A. Remove overspray and fall out materials immediately upon completion of the work in each area. Clean surfaces to remove evidence of soiling. Repair or replace damaged work surfaces to acceptable conditions.

B. Coordinate work with other work, to minimize possibility of damage to insulation resulting from performance of subsequent work. As other units of work are completed in each area, patch damaged areas or surfaces of insulation by over spraying to match original installations, or by patching procedures as required to provide acceptable results.

END OF SECTION

SECTION 09 81 33

ACOUSTICAL INSULATION, SEALANTS AND ACCESORRIES

PART 1 - GENERAL

1.01 RELATED WORK

A. Requirements: Provide acoustical insulation, sealants and moldable putty pads in accordance with Contract Documents.

B. Related Sections.
   1. Section 09 2900 – Gypsum Board Assemblies.
   2. Section 09 2216 – Non-Structural Metal Framing

1.02 SUBMITTALS

A. General: Submit the following in accordance with Section 013000 – Submittals.

B. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance with the Contract Documents, excluding material safety data sheets (MSDSs) for products listed below.

C. Manufacturer's Instructions: Submit manufacturer's instructions for proper installation of products listed below.

D. Warranty Documentation: Submit warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.03 QUALITY ASSURANCE

A. Source Limitations: Insulation and accessories must be obtained through one source from the same manufacturer (to ensure compatibility, regulator conformance and a warrantable installation).

1.04 DELIVERY AND STORAGE

A. Delivery: Deliver in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, and size.

B. Storage: Store in unopened containers, off ground and protected from damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unfaced Mineral/Glass Fiber Blanket/Batt Acoustical Insulation: Three-inch thick (minimum) unfaced semi-rigid mineral fiber or glass fiber blankets. Acoustical insulation to comply with ASTM C665, Type I, with maximum flame spread of 25 and smoke development of 50 per ASTM E 84.
   1. Johns Manville Unfaced Fiber Glass Insulation

2. Owens Corning Sound Attenuation Batt Insulation
3. Certainteed NoiseReducer Insulation
4. or approved equal.

B. Sound Attenuating Fire Blanket Insulation: Asbestos-free mineral fiber insulation manufactured from slab and natural occurring rock and conforming to ASTM C665 requirements for Type 1 insulation.
1. Owens Corning Thermafiber SAFB
2. Roxul Safe 45
3. Fibrex FBX Industrial Board Insulations
4. Or approved equal.

C. Acoustical Sealant: Non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
1. USG Sheetrock Brand Acoustical Sealant
2. Tremco Acoustical Sealant
3. Pecora Corp AIS-919 Acoustical Sealant
4. or approved equal.

D. Moldable Sheet Caulk or Firestop Putty Pads for Electrical Outlet and AV Back Boxes: Putty pads should consist of a non-hardening, intumescent compound 1/8-inch thick minimum sheet caulk designed to seal the back and sides of electrical outlet and AV back boxes.
1. Harry A Lowry Outlet Box Pads.
2. 3M Fire Barrier Moldable Putty Pads MPP+.
3. Kinetics Noise Control IsoBacker Putty pads
4. or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examination: Examine substrates, adjoining construction and condition under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.02 OUTLET BOX AND AV BACK BOX PADS (WALL AND SOUND CONTROL CEILINGS)

A. Ensure that the surface of the electrical outlet and AV Back boxes are clean of dirt, rust, oil, release agents, repellants and any other substances that may affect proper adhesion.

B. All wiring shall be completed prior to the installation of the moldable putty pads.

C. Wrap the back and sides of the electrical outlet and AV Back boxes located within acoustic walls and ceilings with 1/8-inch moldable putty pads. The pads shall provide an airtight seal around the perimeter of the boxes.

D. Caulk the joint between the electrical outlet and AV Back boxes and adjacent gypsum board with acoustical sealant.

END OF SECTION

SECTION 09 84 13

ACOUSTIC WALL PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Acoustic wall panels

B. Related Sections:
1. Section 09 22 16, Non Load-Bearing Metal Studs.
2. Section 09 29 00, Gypsum Board Systems.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. AATCC - American Association of Textile Chemists and Colorists
1. AATCC 16 - Test Method 16: Colorfastness to Light

C. ASTM International
1. ASTM C423: Standard Specification for Testing Noise Reduction Coefficient.
2. ASTM C 612 - Mineral Fiber Block and Board Thermal Insulation
3. ASTM D 1117 - Evaluating Nonwoven Fabrics
4. ASTM D 5034 - Breaking Strength and Elongation of Textile Fabrics (Grab Test)
5. ASTM E 84 - Surface Burning Characteristics of Building Materials
6. ASTM E 795 - Mounting Test Specimens During Sound Absorption Tests

D. NFPA - National Fire Protection Association
1. NFPA 265 - Room Fire Growth Contribution of Textile Coverings on Full Height Panels and Walls
2. NFPA 286 - Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

E. NVLAP - National Voluntary Laboratory Accreditation Program, National Institute of Standards and Technology, Technology Services, Standards Services Division

1.03 SUBMITTALS

A. Product Data: For each type of panel edge, core material, and mounting

B. Shop Drawings: Including mounting details, elevations showing panel sizes and direction of fabric weave and pattern matching, panel edges, type and thickness of core materials, and intersections with adjacent construction (e.g. doors, thermostats and switches, casework, etc.)

C. Samples
1. Fabric: From same dye lot to be used for the work, showing full pattern repeat.
2. Panel Edge: 12-inch-long showing edge profile, corner, and finish

3. Core Material: 12-inch-square showing corner
4. Mounting Device
5. Sample Panel: 36-inch-square showing complete fabrication including mounting devices, edge profiles, joints, and corners

D. Test and Evaluation Reports: Independent laboratory test reports for all specified criteria

E. Manufacturer's Installation Instructions

F. Manufacturer's Statement of Qualifications

G. Closeout Submittals
1. Manufacturer's Cleaning and Maintenance Instructions
2. Material Safety Data Sheets
3. Warranty Documentation

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

C. Protect panel edges from crushing and impact.

1.05 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install acoustical wall panels until permanent level of lighting is provided on surfaces to receive acoustical wall panels.

C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

1.06 QUALITY ASSURANCE

A. Qualifications
1. Manufacturer shall have been regularly engaged in the manufacturer of fabric wrapped acoustical panels for a period of no less than 5 years and provide a list of at least 5 completed projects of equivalent size and scope.
2. Testing Agency: Independent testing laboratory, NVLAP accredited.

B. Applicator: Installation by skilled applicators with no less than three years of documented experience installing acoustical wall panels of the types and extent specified for the project.

C. Fire Performance Characteristics: Surface Burning Characteristics: All panel components have a Class 1/A fire rating when tested in accordance with ASTM E 84.

D. Mock-ups:
   1. Install onsite mock-up equivalent to 100 SF of wall panels in an area designated by the Architect. Replace unacceptable panels.
   2. Approved mock-up panels will be used as the standard of performance for the project and will be incorporated into the finished project.

1.07 MAINTENANCE

A. Replacement Materials: Provide full-size units equal to 5 percent of each type of acoustical wall panel installed for maintenance purposes. Furnish replacement materials from the same production run as installed materials. Protect material with clearly marked packaging indicating product identification and project location.

1.08 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.
   1. Failure in performance includes, but is not limited to, acoustical performance.
   2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
   3. Warranty Period: Two years from date of Certified Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURES

A. FilzFelt, Getzville, NY.

B. Or approved equal in accordance with Division 01 General Requirements for Substitutions.

2.02 DESCRIPTION

A. Prefinished, factory assembed, panel construction.
   1. Wall Panels:
      a. FilzFelt Rille (3mm)
         1) Material:
            a) Material: 100% Wool Design Felt and Akustika 10 Substrate.
            b) Panel Thickness: 1/2".
            c) Panel Size: As indicated on Drawings.
         2) Performance Characteristics:
            a) Acoustics: ASTM C 423: NRC - 0.50, SAA - 0.51
            b) Colorfastness to LightClass 4-5 (40 hours)

c) Colorfastness to CrockingClass 3-4 (wet), Class 4-5 (dry)

b. FilzFelt Akustika 10 (2 mm)

1) Material: 100% Wool Design Felt and Akustika 10 Substrate.

2) Panel Thickness: 1/2".

3) Panel Size: As indicated on Drawings.

4) Performance Characteristics:

a) Acoustics, ASTM C 423: NRC - 0.60, SAA - 0.57 (Z-Clip)

b) Colorfastness to LightClass 4-5 (40 hours)

c) Colorfastness to CrockingClass 3-4 (wet), Class 4-5 (dry)

2. Edge: Wrapped Edge.

3. Mounting:

a. Manufacturer's Standard Z-Clip mounting system.

4. Adhesives: As recommended by manufacturer and in full compliance with CA VOC regulations.

5. Colors: Refer to Finish Schedule on Drawings.

2.03 FABRICATION

A. Provide cutouts in panels for flush plates, receptacles, outlets, switches, thermostats, clocks, lights, and similar items.

B. Fabric covering shall be stretched free of wrinkles and then bonded to the edges and back or bonded directly to the panel face, edges, and back of panel a minimum distance standard with the manufacturer.

C. Finish corners even and true to line on face and sides with no wrinkles. Corners shall be finished to prevent unraveling, tearing or other visible defects.

D. Provide minimum amount of adhesive to fasten fabric to the acoustic core. The adhesive shall not reduce the acoustical panel sound absorption.

E. Panel edge construction shall not be visible though finish.

F. Installation hardware shall be concealed spline type and provided by the panel manufacturer. Panels shall be provided with appropriate hardware to securely fasten all edges and corners to the wall and to prevent the center portions of the panel from deflecting more than 1/2 inch in any 10 foot plane. Panels shall be individually removable unless otherwise specified.

G. Where panel ends are exposed, panel shall be constructed to conceal mounting hardware.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Examine substrates, blocking, wall finishes, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.
   1. Paints and wall coverings shall have been applied prior to installation of acoustic wall panels; wall finishes shall fully cover wall behind acoustic panels.

C. Proceeding with installation indicates acceptance of substrate conditions.

3.02 PREPARATION

A. Walls shall be clean, smooth, oil free, contain no protrusions, and prepared in accordance with manufacturers printed instructions.

3.03 INSTALLATION

A. Install wall panels by attaching the panels to an existing wall per the manufacturers written instructions, as shown on Drawings.

B. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
   1. Cut units to be at least 50 percent of unit width, with facing material extended over cut edge to match uncut edge. Scribe acoustical wall panels to fit adjacent work. Butt joints tightly.

C. Secure wall panels: with mechanical, Z-clips to the gypsum board substrate, unless noted otherwise. Butt joint all panels to a fine line, with maximum 1/32 inch openings. Apply adhesive in quantities as required.

D. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.

E. Match and level fabric pattern and grain among adjacent panels.

F. Tolerances
   1. Variation from Level and Plumb: Plus or minus 1/16 inch
   2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide

3.04 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.05 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that acoustical wall panels are without damage or deterioration at time of Certified Completion.

B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Certified Completion.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fluid applied paints and coatings. Upon completion of Work, all visible interior and exterior surfaces, within the Contract limits [including factory primed or factory finished roof mounted mechanical and electrical equipment,] shall be painted unless scheduled "Not to Be Painted in this Section."
   1. Each paint system includes:
      a. Surface preparation, including touch-up of shop applied primers, if needed.
      b. Prime coat application, where scheduled as part of finish system.
      c. Finish coat application, where scheduled apply two or more finish coats.
   2. Paint semi-concealed areas (e.g. inside of light troughs and valances, behind grilles, and projecting edges above and below sight lines, behind wall-mounted items).

B. Surfaces Not to be Painted:
   1. Prefinished wall, ceiling, and floor coverings.
   2. Items with factory-applied final finish [except roof-mounted equipment as defined above].
   3. Concealed ducts, pipes, and conduit.
   4. Glass, plastic laminate, ceramic tile, anodized aluminum.
   5. Surfaces of steel items that will be embedded in concrete.
   6. Surfaces specifically scheduled or noted on the Drawings not to be painted.
   7. Fire-Rating labels on doors and frames.
   8. Performance labels on doors and frames.

C. Related Sections:
   1. Section 01 35 42, CALGreen Requirements.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM International - American Society for Testing and Materials
   1. ASTM D 4442 - Direct Moisture Content Measurement of Wood and Wood-Base Materials.
   2. ASTM D 4444 - Use and Calibration of Hand-Held Moisture Meters.
   3. ASTM D 6386 - Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

C. California Green Building Standards Code, CALGreen 2019.

D. SCAQMD - South Coast Air Quality Management District: SCAQMD-1113 - Rule 1113, Architectural Coatings.

E. SSPC - Steel Structures Painting Council.

1.03 SUBMITTALS

A. CALGreen Submittals:
   1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.06.A.

B. Product Data: For each paint system product and accessory item.

C. Samples: Of each specified finish system color, texture, and sheen; samples shall be minimum 8-1/2 by 11 inches in size.
   1. Prepare transparent wood finish samples on type and quality of wood specified.

D. Certified copies of moisture test results.

E. Informational Submittals:
   1. Statement of Qualifications from manufacturer.
   2. Statement of Qualifications from installer.
   3. Manufacturer’s application instructions.

F. Closeout Submittals
   1. Material Safety Data Sheets.

G. Submit Qualifications data for manufacturer and applicator required under Quality Assurance.

1.04 MAINTENANCE MATERIALS AND SUBMITTALS

A. For each color, type, and gloss of paint used in the work provide, as Extra Materials, a quantity equal to approximately 10 percent of the quantity required for its installation rounded to the nearest gallon, or five gallons, whichever is less.
   1. Extra Materials shall be from the same production run as installed materials.
   2. Label each container with locations and dates of related installations; do not obscure manufacturer’s label.
   3. Deliver Extra Materials to Site as directed by Owner.

1.05 QUALITY ASSURANCE

A. California Green Building Standards Code, CALGreen 2019.
   1. Adhesives, sealants, primers and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
   2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.

B. Manufacturer's Qualifications: Company with minimum 10-years' experience manufacturing quality paint and finish products for commercial projects similar in scale and complexity to those required for this Project.

C. Applicator Qualifications: Company with minimum 5-years' experience painting and finishing commercial projects similar in scale and complexity to those required for this Project.

D. Materials, for each paint system, shall be by, or as recommended by, a single coating manufacturer for use together in commercial quality paint / coating system for the substrate and exposure conditions indicated.

E. Regulatory Requirements
   1. Conform to SCAQMD-1113 for maximum VOC limits.
   2. Comply with applicable codes and regulations of authorities having jurisdiction including those with jurisdiction over airborne emissions and industrial waste disposal. Where those requirements conflict with this Specification, comply with the more stringent provisions.

F. Field Samples: Provide Field Sample of each finish system color, texture, and sheen scheduled. Do not proceed with coating application until sample panel has been approved.
   1. Field Sample shall be full height of wall by 10-feet.
   2. Locate as approved by Architect.
   3. Adjust materials and methods of installation as required to obtain Architect's approval.
   4. Document materials and methods used to obtain Architect’s approval and maintain at least one copy of this documentation on site while related work is in progress.
   5. Maintain access to and protect Field Sample from damage while related work is in progress.
   6. Upon acceptance of related work, approved sample may remain as part of Work.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in their original, sealed, undamaged containers with labels intact and legible.
   1. Labels shall include manufacturer’s name, type of paint, brand name, brand code, color designation, recommended surface preparation, typical coverage, drying times, cleanup procedures, and instructions for mixing and reducing, if permitted.

B. Store paint materials ambient temperatures between 45- and 90-degrees F, in well ventilated area unless permitted otherwise by manufacturer’s instructions.

C. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.07 FIELD CONDITIONS

A. Supply continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45-degrees F for 24-hours before, during and 48-hours after application of finishes, unless permitted otherwise by manufacturer’s instructions.

B. Do not apply exterior coatings during rain, or when relative humidity is above 50 percent, unless permitted otherwise by manufacturer’s instructions.

C. Minimum application temperatures for Latex Paints: 45-degrees F for interiors; 50-degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum application temperature for Varnish and Transparent Finishes: 65-degrees F for interior or exterior, unless permitted otherwise by manufacturer's instructions.

E. Maintain lighting level sufficient to conduct painting operations.

1.08 GUARANTEE

A. Guarantee the painting Work against peeling, fading, cracking, blistering or crazing for a period of two years form the Date of Certified Completion for painting of new surfaces and existing surfaces.

PART 2 - PRODUCTS

2.01 PAINTS AND COATINGS

A. Acceptable Manufacturers: Products of following manufacturers form basis for design and quality intended.
   1. Dunn-Edwards Corporation, Los Angeles, CA.

B. Or equal, approved in accordance with Division 01, General Requirements, for substitutions.

2.02 MATERIALS

A. Coatings: Ready mixed, except field-catalyzed coatings. Process pigments to soft past consistency, capable of being readily and uniformly dispersed to homogenous coating.

B. Colors and Glosses: As scheduled in Finish Schedule on Drawings. Architect will select color and hue to be used in various types of paint specified and will be sole judge of acceptability of various glosses obtained from materials proposed to be used in Work. During actual painting, Architect may make minor modifications in tone and shade to adjust for actual surface and lighting conditions encountered.

C. Undercoats and Thinners: Provide undercoat paint produced by same manufacturer as finish coat. Use only thinners recommended by paint manufacturer and use only to recommended limits. Use undercoat, finish coat and thinner material as parts of a unified system of paint finish.

D. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.

E. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified of commercial quality.

2.03 APPLICATION EQUIPMENT

A. For application of the approved paint, use only such equipment as is recommended by the manufacturer.

B. Compatibility: Prior to actual use of application equipment, use all means necessary to verify that the proposed equipment is actually compatible with the material to be applied and that the integrity of the finish will not be jeopardized by the use of the proposed application equipment.

2.04 FINISHES

A. Refer to schedule at end of Section for surface finish and Finish Schedule. Notwithstanding product numbers listed in schedule, Contractor shall conform to most recent product numbers as published by the manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of Work. Report any condition that may potentially affect proper application.

C. Measure moisture content of new surfaces using an electronic moisture meter. Apply finishes only when moisture content of surfaces are below the following maximums. Conduct moisture measurements in presence of the project inspector, document readings and submit to Architect under Part 1.
   1. Gypsum Wallboard: 12 percent.
   2. Interior Located Wood: 15 percent, measured in accordance with ASTM D 4442 and ASTM D 4444.

D. Beginning installation means acceptance of existing surfaces and conditions.

3.02 MATERIALS PREPARATION

A. Mix and prepare painting material in accordance with manufacturer's recommendations.

B. Store materials not in actual use in tightly covered containers.

C. Maintain containers used in storage, mixing and application of paint in a clean condition, free from foreign materials and residue.

D. Stir all materials before application to produce a mixture of uniform density and as required during the application of materials. Do not stir into the material any film that may form on the surface. Remove the film and strain the material before using.

3.03 SURFACE PREPARATION

A. Remove electrical plates, hardware, light fixture trim and fittings prior to preparing surfaces for finishing.

B. Correct minor defects and clean surfaces which surfaces which affect Work of this section.

C. Shellac and seal marks that may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Insulated Coverings: Remove dirt, grease and oil from canvas and cotton.

F. Gypsum Board Surfaces: Fill minor defects, joints and nail head depressions with spackling compounds. Prime in accordance with primer manufacturer's recommendations. Apply primer over skim coat for Level 5 finish.

G. Surface Preparation for Exterior Metal (Except Galvanized): Preparation in accordance with SSPC-6 Commercial Blast Cleaning.

H. Galvanized Surfaces:
   1. Prepare galvanized steel and nonferrous metal surfaces in accordance with SSPC-SP16 Brush Off Blast Cleaning Method for Coating and Uncoated Galvanized Steel and Non Ferrous Metals OR ASTM D 6386-Surface Preparation of Galvanized Surfaces, and as well as manufacturer's instructions.
   2. Ensure surfaces are dry.
   3. Interior Exposure (Dry/Benign): Remove visible, oil, grease, dirt, dust, protective mill coatings, and other soluble contaminants in accordance with SSPC-SP 1 or manufacturer'¢s instructions as specified for coating system. Hand or Power tool clean to remove all insoluble contaminants.
   4. Interior and Exterior Exposure (moderate to severe): Remove visible oil, grease, dirt, dust, protective mill coatings, and other soluble contaminants in accordance with SSPC-SP 1 or manufacturer'¢s instructions as specified for coating system. Follow initial cleaning with one of the following Methods:
      a. SURFACE PREPARATION METHOD A (Preferred): Prepare Galvanized Steel to be painted according to SSPC-SP16 Brush Off Blast Cleaning for Coated and Uncoated Galvanized Steel and Non Ferrous Metals OR Thoroughly roughen the entire surface to be coated using compressed air brush off blast cleaning with a fine abrasive to achieve a uniform anchor profile of 1-2 mils. reference ASTM D 6386-99 Section 5.4.1.
      b. SURFACE PREPARATION METHOD B (Alternative method when Method A is not feasible): Chemically Treat with one of the following products to etch the galvanized surface to be coated: Henkel Galvaprep 5 or Clean 'Ün Etch by Great Lakes Laboratory. Reference ASTM D 6386-99 Section 5.4.2.

I. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime paint after repairs with Tnemec Series L69 Hi Build Epoxoline II or Carboline 890 VOC or approved in accordance with Division 01, General Requirements for Substitutions.

J. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Spot prime bare steel surfaces to match existing primer.

K. Wood Scheduled to Receive Paint Finish: Remove dust, grit and foreign matter. Seal knots, pitch streaks and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

L. Wood Doors and Cabinet Work schedules for field-applied transparent or solid stain finish:
   1. Sand surfaces thoroughly with a 5/0, 180 grit sandpaper.
   2. Apply coatings as specified in the schedule to all surfaces, sides and edges. Avoid streaking or uneven application. Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail or screw holes, or other surfaces imperfections.
   3. Stains as selected by Architect from manufacturer'¢s full range of colors.
   4. Provide satin finish for final coats.

M. Wood Doors Scheduled for Painting: Seal top and bottom edges with primer. Leave labels intact and readable.

N. Door and Window Frames, Side Lights, Jambs and Headers: clean and light sand smooth.

3.04 PROTECTION

A. Protect elements surrounding the Work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by Work of this Section.

C. Furnish drop cloths, shields and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Remove empty paint containers from site.

3.05 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish. Number of coats specified is a minimum. Additional coats shall be applied at no extra cost, if coatings show evidence of uneven application, uneven pigmentation, brush strokes or otherwise unsatisfactory distribution of material.

D. Under coats shall be lighter and brighter in tint that finish coat.

E. Sand lightly between coats to achieve required finish.

F. Allow applied coat to dry before next coat is applied.

G. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

H. Prime back surfaces of interior and exterior woodwork with primer paint.

I. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with floss varnish reduced 25 percent with mineral spirits.

J. Seal tops, bottoms and cutouts for hardware and accessories of wood doors.

K. Paint Frames: Split paint door frames to match color of walls on each side of opening unless directed otherwise by Architect.

L. Exterior fascia, trims, reveals, and ornamental fences and gates shall receive accent paint colors different from field paint color.

M. Paint finish shall continue through behind all wall-mounted items (e.g. markerboards, chalk and tack boards).

3.06 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Refer to Divisions 22, 23, and 26 for color coding and identification banding requirements of equipment, ductwork, piping and conduit.

1. Unless otherwise indicated, conform to the following color coding system:

PIPING	COLOR	MANUFACTURER
Chilled Water	Vista Gray	Benjamin Moore
Condensed Water	Canvas Tan	Sherwin Williams SW1129
Domestic Hot Water	Admiral Blue	Benjamin Moore 2065-10
Domestic Cold Water	Edison Blue	-
Clinical Air	Bright Yellow	Benjamin Moore
Plant Air	Clear Lacquer	-
Vacuum	Shasta White	-
Oxygen	John Deere Green	Coast-to-Coast 555-2221-2744-02
	Rust-Oleum H-3-matches 594 green	
	Pittsburg 9-15	
	PPG PT-60	
Nitrous Oxide	OSHA Blue	OSHA’s Website
Cold Soft Water	OSHA Violet	OSHA’s Website
Steam Caterpillar	Yellow	Rust-Oleum H-4
Soil Waste	Loam Brown	-

Nitrogen	OSHA Black	OSHA's Website
Fire	OSHA Red	OSHA's Website
Fuel Gas	OSHA Orange	OSHA's Website
Deionized Water	Light Blue	Benjamin Moore

2. Verify appropriate specific color designations with paint manufacturer.
3. Conform to Owner's special requirements for color coding. Match existing coding system where required.

B. Paint shop primed equipment.

C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

D. Paint mechanical wall louvers, grilles to match adjacent wall surfaces at accent paint finish.

E. Prime and paint insulated and exposed pipes, electrical equipment including panelboards and switch gear, conduit, boxes, insulated and exposed ducts, hangers, metal louvers, brackets, collars and supports, when exposed to view in equipment rooms and finished occupied spaces. Except items that are pre-finished.

F. Replace identification markings on mechanical or electrical equipment when painted accidently.

G. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers and grilles to match face panels.

H. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

I. Color code equipment, piping, conduit and exposed ductwork in accordance with requirements indicated. Color band and identify with flow arrows names and numbering, using stencils or other approved systems.

J. Replace electrical plates, hardware, light fixture trim and fittings removed prior to finishing.

3.07 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials and debris.

C. Collect cotton waste, cloths, and material that may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.08 FINISH SYSTEM SCHEDULE - EXTERIOR EXPOSURE

A. Ferrous - Eggshell - Acrylic

1. Primer, 1 Coat
   a. Dunn-Edwards BRPR00
2. Tie Coat, 1 Coat
   a. Dunn-Edwards SSHL30
3. Finish, 1 Coat
   a. Dunn-Edwards SSHL30

B. Ferrous - Factory Primed: If shop primer is compatible with finish materials, clean and touch-up prime coat in lieu of full primer coat then apply paint finish as specified.

C. Galvanized Steel and Aluminum - Eggshell - VOC Compliant:
1. Surface Prep
   a. Dunn-Edwards SCME-01
2. Primer, 1 Coat
   a. Dunn-Edwards ULGM00
3. Finish, 2 Coats
   a. Dunn-Edwards SSHL30

3.09 FINISH SYSTEM SCHEDULE - INTERIOR SURFACES

A. Gypsum Board - Eggshell - Acrylic (Skim Coat Required for Level 5 Finish):
1. Primer, 1 Coat
   a. Dunn-Edwards VNPL00
2. Tie Coat, 1 Coat
   a. Dunn-Edwards SWLL30
3. Finish, 2 Coats
   a. Dunn-Edwards SWLL30

B. Ferrous - Eggshell - Acrylic:
1. Primer, 1 Coat
   a. Dunn-Edwards BRPR00
2. Tie Coat, 1 Coat
   a. Dunn-Edwards SWLL30
3. Finish, 2 Coats
   a. Dunn-Edwards SWLL30

C. Ferrous - Factory Primed: If shop primer is compatible with scheduled finish, clean and touch up prime coat then apply finish as scheduled.

D. Galvanized and Aluminum - Eggshell - Acrylic:
1. Surface Prep
   a. Dunn-Edwards SCME-01
2. Primer, 1 Coat
   a. Dunn-Edwards ULGM00
3. Finish, 2 Coats
   a. Dunn-Edwards SWLL30

3.10 SPECIAL COATING SYSTEMS

A. High Performance Coatings (Special Coatings): Exterior; metal handrails, railings, guardrails, roof sheet metal flashings, ladders, galvanized structural steel, structural steel, Architecturally Exposed Structural Steel (AESS), roof screens, trash and equipment enclosures, exterior metal stairs, roof hatches, and scheduled items in Section 05 50 00 Metal Fabrications. Total 5.0 to 8.5 mil thickness, as recommended by the manufacturer. Colors to be selected by Architect. Prepare surfaces and apply finishes per manufacturer's specifications.
   1. Unprimed or Shop Primed - Ferrous - Gloss - Polyurethane:
      a. Primer, 1 Coat
         1) PPG Amerlock 2 VOC
         2) Tnemec L69
         3) Sherwin Williams B58-620
         4) Carboline Carbomastic 15
      b. Finish, 2 Coats
         1) PPG Amerishield VOC
         2) Tnemec 1080
         3) Sherwin Williams B65-625
         4) Carboline Carbothane 134 MC
   2. Unprimed or Shop Primed - Ferrous - Semi-Gloss - Polyurethane:
      a. Primer, 1 Coat
         1) PPG Amerlock 2 VOC
         2) Tnemec L69
         3) Sherwin Williams B58-620
         4) Carboline Carboguard 890 VOC
      b. Finish, 2 Coats
         1) PPG Amershield VOC
         2) Tnemec 1081
         3) Sherwin Williams B65-630
         4) Carboline Carbothane 133 VOC
   3. Galvanized or Aluminum - Gloss - Polyurethane:
      a. Primer, 1 Coat
         1) PPG Amerlock 2 VOC
         2) Tnemec L69
         3) Sherwin Williams B58-620
         4) Carboline Galoseal WB
      b. Finish, 2 Coats
         1) PPG Amerishield VOC
         2) Tnemec 1080
         3) Sherwin Williams B65-625
         4) Carboline Carbothane 134 MC
   4. Galvanized or Aluminum - Semi-Gloss - Polyurethane:
      a. Primer, 1 Coat
         1) PPG Amerlock 2 VOC
         2) Tnemec L69
         3) Sherwin Williams B58-620
         4) Carboline Carboguard 890 VOC
      b. Finish, 2 Coats
         1) PPG Amerishield VOC

2) Tnemec 1081
3) Sherwin Williams B65-630
4) Carboline Carbothane 133 MC

END OF SECTION

SECTION 10 11 16

MARKERBOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Markerboards, dry-erase, magnetic.

B. Trim, chalkrail and accessories.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM B209 - Aluminum-Alloy Sheet and Plate.

C. ASTM A653/A 653M Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

D. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

E. PEI - Porcelain Enamel Institute - Performance Specifications for Porcelain Enamel Markerboards.

F. ASTM A424 - Sheet Steel for Porcelain Enameling.

G. ANSI A208.1 - Mat Formed Wood Particleboard.

1.03 SUBMITTALS

A. Shop drawings indicating, wall elevations, sizes, dimensions and joint locations between panels, and mounting details.

B. Provide product data on trim and accessories.

C. Three samples illustrating materials and finish, color and texture of markerboard.

D. Include maintenance information on regular cleaning, stain removal and removal of damaged components.

1.04 WARRANTY

A. General Warranty: Special Markerboard warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

B. Markerboard Warranty: Submit written warranty executed by manufacturer agreeing to replace porcelain-on-steel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within specified warranty period, provided manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.

C. Warranty Period: Life of building.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Platinum Visual Systems/ABC School Equipment, Inc., Corona, CA.
   2. Egan Visual, Inc./The Scheffey Group, Los Angeles, CA.
   3. ADP Lemco Inc., Salt Lake City, UT.
   4. Claridge Products and Equipment, Inc., Harrison, AR.
   5. Marsh Industries, New Philadelphia, OH.
   6. Steelcase/Polyvision Corp./Nelson-Adams, Norcross, GA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 MATERIALS

A. Markerboard: Claridge Porcelain Enamel Steel Markerboards, Series 5, Type A, magnetic.

B. Writing Surface Face Sheet - manufactured in accordance with Porcelain Enamel Institute's specification.
   1. Shall be enameling grade cold-rolled steel manufactured from a minimum of 30 percent post-consumer and post-industrial waste.
   2. Enameling grade steel shall be coated with LCS Porcelain Enamel by Claridge Products and Equipment.
      a. 3-Coat Process:
         1) Bottom Ground Coat: 1.5 - 2.2 mils
         2) Top Ground Coat: 2.0 - 2.8 mils
         3) Top Cover (Color) Coat: 3.0 - 4.0 mils
   3. Fire Temperature: Enamel shall be fired at lowest possible temperatures to reduce steel and porcelain stresses and achieve superior enamel and hardness.
   4. Color and Gloss: Refer to Finish Schedule on Drawings.

C. Writing Surface Core:
   1. 7/16" Medium Density Fiberboard composed of approximately 90% post-industrial waste.

D. Writing Surface Backing:
   1. Moisture Barrier Back.

E. Frame and Trim:

1. Trim shall be 6063 alloy grade aluminum with T5 tempering in accordance with ASTM B221, and shall have 201-R1 satin anodize finish.
2. Factory Built Trim:
   a. Series: 5, Type A
3. Accessories:
   a. Marker Tray:
      1) Standard Continuous, solid, blade-type aluminum tray with ribbed section and injection molded end closures at bottom of each markerboard.

F. Refer to Finish Schedule on Drawings.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that surfaces and internal wall blocking are ready to receive Work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of substrate construction.

3.02 INSTALLATION

A. Install markerboards in accordance with manufacturer's instructions.

B. Establish bottom of frame perimeter at 37 inches 10th Grade and higherabove finished floor or as approved by Architect.

C. Secure units level and plumb.

D. Where markerboard adjoins tackboard or chalkboard, join panels with H/Bar divider joint.

E. NO holes in markerboard permitted.

3.03 CLEANING

A. Clean markerboard surfaces and aluminum in accordance with manufacturer's instructions.

B. Cover markerboard surfaces with clear protective covering.

C. Remove protective cover at Date of Notice of Completion.

END OF SECTION

SECTION 10 11 23

TACKBOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Modular tackboard units.

B. Trim and accessories.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ASTM A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

C. ASTM B209 - Aluminum-Alloy Sheet and Plate.

D. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

E. ASTM E84 - Surface Burning Characteristics of Building Materials.

F. Chapter 8, 2019 California Building Code.

1.03 REGULATORY REQUIREMENTS

A. Conform to Table 803.13, California Building Code. Maximum flame spread: 75, maximum smoke density 450, ASTM E84.

1.04 SUBMITTALS

A. Shop drawings indicating, wall elevations, dimensions and joint locations.

B. Product data on tackboard surface covering, trim and accessories.

C. Three samples illustrating materials and finish, color and texture of tackboard surfacing.

D. Manufacturer's installation instructions.

E. Maintenance information on regular cleaning, stain removal and removal of damaged components.

1.05 WARRANTY

A. Provide five year warranty. Include coverage of tackboard surface from delamination.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Steelcase/Polyvision Corp./Nelson-Adams, Norcross, GA.
   2. Platinum Visual Systems/ABC School Equipment, Inc., Corona, CA.
   3. ADP Lemco Inc., Salt Lake City, UT.
   4. Claridge Products and Equipment, Inc., Harrison, AR.
   5. Egan Visual, Inc./The Scheffey Group, Los Angeles, CA.
   6. Chatfield-Clarke Company, Fontana, CA.
   7. Forbo Linoleum, Inc., Hazleton, PA.
   8. LBI/BOYD, Inc., Glendora, CA; Product: FRtack.

B. Or equal as approved in accordance with Division 01 General Requirements for Substitutions.

2.02 MATERIALS

A. Claridge Concept Series Tackboard:
   1. Claridge Cork: Composed of 1/4" thick self-healing, burlap backed cork laminated to a 1/4" hardboard backing
   2. Style and Colors: Refer to Finish Schedule on Drawings
   3. Thickness: Total laminated thickness of core and covering is 1/2"
   4. Trim shall be 6063 alloy grade aluminum with T5 tempering in accordance with ASTM B221, and shall have 201-R1 satin anodize finish.
      a. Factory Built Trim: Concept Series with Narrow 5/16" Aluminum Frame.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that surfaces and internal wall blocking are ready to receive Work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of substrate construction.

3.02 INSTALLATION

A. Install tackboards in accordance with manufacturer's instructions.

B. Establish bottom of frame perimeter above finished floor as indicated or as approved by Architect.

C. Secure units level and plumb.

D. Where tackboard adjoins chalkboard or markerboard, join panels with extruded aluminum trim.

E. No holes in tackboards permitted.

3.03 CLEANING

A. Clean tackboard cork and aluminum surfaces in accordance with manufacturer's instructions.

B. Cover tackboard surfaces with protective cover, taped to frame.

C. Remove protective cover at Notice of Completion.

END OF SECTION

SECTION 10 14 00

IDENTIFICATION SIGNS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Plastic Signs, raised character, tactile, room identification, exit door signs, and non-tactile signs.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. American Society for Testing and Materials (ASTM)
   1. ASTM D4802 - Poly (Methyl Methacrylate) Acrylic Plastic Sheet

C. ADA - Americans with Disabilities Act of 1990 as amended.
   1. ADA/Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

D. CBC - 2019 California Building Code (CBC)
   1. Chapter 10, Egress Requirements
   2. CBC 11B - Chapter 11B, Accessibility for Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing

E. CFC - 2019 California Fire Code.

F. California Code of Regulations (CCR)
   1. CCR 19-3 - Title 19, Chapter 3

G. Fed.Stnd - Federal Standard
   1. Fed.Stnd 595C, Colors Used in Federal Procurement

1.03 SUBMITTALS

A. Shop Drawings of each sign, indicating lettering styles and locations and overall dimensions.

B. Three sample, full size, signs, with different messages of types, styles and colors specified including method of mounting. If accepted, samples may be installed in Project.

C. Manufacturer's Installation Instructions

D. Lettering Samples: 1-inch high, uppercase I, and O letters in each font specified, for required Quality Assurance testing.

1.04 QUALITY ASSURANCE

A. Pre-Installation Conference
   1. Notify Architect when signs are ready for installation. Arrange for conference at site. Do not proceed with installation until Architect's approval of specific locations and methods of attachment has been obtained.
   2. Provide signs from one manufacturer, unless otherwise approved.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site and protect from damage. Store until immediately prior to Notice of Completion.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Signage and Graphics:
   1. Raised characters shall comply with CBC Section 11B-703.2
      a. Depth: It shall be 1/32-inch minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
      b. Height: It shall be 5/8-inch minimum and 2 inches maximum based on the height of the uppercase letter "I". CBC Section 11B-703.2.5.
      c. Finish and contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1
      d. Proportions: It shall be selected from fonts where the width of the uppercase letter "O" is 60% minimum and 110% maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character. CBC Section 11B-703.2.4 and 11B-703.2.6.
      e. Character Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8.
      f. Format: Text shall be in a horizontal format. CBC Section 11B-703.2.9.
      g. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed or rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
      h. Mounting height: Tactile characters on signs shall be located 48" minimum to the baseline of the lowest Braille cells and 60" maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. CBC Section and Figure 11B-703.3.4.1.
      i. Mounting location: A tactile sign shall be located per CBC Section and Figure 11B-703.4.2 as follows:
         1) Alongside a single door at the latch side.
         2) On the inactive leaf at double doors with one active leaf.
         3) To the right of the right hand door at double doors with two active leafs.
         4) On the nearest adjacent wall where there is no wall space at the latch side of a single door or at the right side of double doors with two active leafs.

5) So that a clear floor space of 18" x 18" minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.

2. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40" minimum above finish floor or ground.
3. Pictograms shall comply with CBC Section 11B-703.6.
4. Symbols of accessibility shall comply with CBC Section 11B-703.7.
5. Variable message signs shall comply with CBC Section 11B-703.8.

2.02 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
1. Mohawk Sign Systems, Inc., Schenectady, NY.
2. Roemer Industries, Masury, OH.
3. ASI Modulex, Inc., Dallas, TX.
4. Vomar Products.
5. Apco Signs, Atlanta, GA.
6. Nelson-Harkins Industries, Inc.
7. Mathews International Corporation
8. Vista System

B. Or approved equal in accordance with Division 01 General Requirements for substitutions.

2.03 PLASTIC SIGN MATERIALS

A. Tactile Plastic Sign Materials: Thermosetting high pressure laminate.

B. Non-Tactile Signs: Acrylic Plastic Sheet: ASTM D4802, Category A-1, 1/4 inch overall thickness, laminated acrylic plastic sheets.

2.04 SIGN FABRICATION - GENERAL

A. Plastic Signs
1. Tactile and Braille Copy: **Sand-Carved signs**; thermosetting high pressure laminate using Graphic Process Sand-Carved signs, with square corners, and square cut edges[, exterior-grade.] Graphics, Braille and tactile copy required.
   a. Unframed Signs: Mohawk 1000 ADA System signs, Series 200A, Design M-311 or Design M310A/B window plaques where indicated, by Mohawk Sign Systems or equal. Custom copy by Architect.
2. Non-tactile Plastic Signs: 1/4 inch overall thickness, laminated acrylic plastic sheets, using sub-surface screen-print process graphics and symbols, exterior-grade at exterior locations, 3/8-inch square corners, square cut edge, drilled holes for countersunk screws, polished edges.
   a. Unframed Signs.
3. Apply UV inhibitor overcoat for exterior signs.

B. Fasteners: Stainless steel screws, flat head, pin-in-head torx screws for vandal-proof and clear silicone adhesive.

C. Lettering Type Style: As indicated on Drawings, refer to QUALITY ASSURANCE for letter-proportion compliance.

D. Colors: Per Finish Schedule on Drawings.

2.05 ROOM IDENTIFICATION SIGNS

A. Room Identification Signs: raised character, tactile plastic signs in colors as scheduled in Finish Schedule on Drawings.
   1. ADA Tactile and Braille Signs: Thermosetting high pressure-laminate using Graphic Process Sand-Carved signs.
   2. Non-Tactile Signs: Acrylic Plastic Sheet: ASTM D4802, Category A-1.

B. Size: As indicated on Drawings.

2.06 OCCUPANT LOAD SIGNS

A. Posting of occupant load signage in each room or area use for assembly per CBC 1004.9, CFC & Title 19.

B. Provide maximum occupancy load signs. Post in a conspicuous place near main exits or exit-access doorway of areas as required and indicated.

C. Material:
   1. Non-Tactile Signs: Acrylic Plastic Sheet: ASTM D4802, Category A-1.
      a. Overall thickness of 1/4 inch, colors as selected by Architect.
      b. Upper Layer: Non-glare clear acrylic 1/8 inch thick.
      c. Lower Layer: Opaque acrylic, 1/8 inch thick.
      d. Polished edges.

D. Size: 4 inches high by 8 inches, minimum, long, sub-surface application, 7/8 inch high letters, and 1 inch high numbers.
   1. Message: MAXIMUM OCCUPANCY LOAD ###
   2. Occupant load number as indicated on Drawings.
   3. Conform to Sections 1004.9 California Building Code.

2.07 ELEVATOR EMERGENCY SIGNS

A. Provide approved pictorial sign of standardized design, posted adjacent to each elevator call station, except main entrance level.

B. Sign shall indicate that in case of fire, elevator will not operate and exit stairways shall be used.

C. Conform to Section 3003.2 California Building Code.

2.08 STAIRWAY IDENTIFICATION

A. Stairway identification/emergency procedure signs shall be located at each floor level in enclosed stairways, identifying the stairway, roof access if any, floor level and upper and lower terminus of the stairway.

B. Mount signs 48 inches minimum above the finish floor or ground surface, measured from the baseline of the lowest line of Braille and 60 inches maximum above the finish floor or ground surface measured from the baseline of the highest line of raised characters.

C. Sign size minimum 12 by 12 inches. Copy, in order of:
   1. Stairway location 1 inch block lettering with 1/4 inch strokes.
   2. Upper terminus, such as "Roof Access" or "No Roof Access", in 1 inch block lettering with 1/4 inch strokes.
   3. Floor level number in 5 inch letter or number with 3/4 inch strokes.
   4. Lower terminus and upper terminus, such as "1 through 5", in 1 inch block lettering with 1/4 inch strokes.
   5. Additional Floor level number in separate area shall be accompanied by California Contracted Grade 2 Braille tactile identification. Refer to CBC Section11B-703.3.1.

2.09 ASSISTIVE LISTENING DEVICE SIGNS

A. At minimum 2 locations as indicated. Per CBC Section 11B-216.10, 11B-703.5 and fig. 11B-703.7.2.4.

B. Include International Symbol of Access for Hearing Loss and with text "Assistive-listening System Available", signs per 11B-703.5. Prior arrangements must be made for events after normal business hours.

2.10 TACTILE EXIT SIGNS

A. Conform to Sections 1013.4, 11B.703.1, 11B.703.2, 11B-703.3, 11B.703.4, and 11B.703.5, CBC 2019.

B. Install sign at each exit door as conditions required in CBC Sections 1013.4.
   1. Each grade-level exterior exit door that is required to comply with 1013.1 shall be identified by a tactile exit sign with the word, "EXIT".
   2. Each exit door that is required to comply with Section 1013.4 and that leads directly to a grade-level exterior exit by means of a stairway or ramp shall be identified by a tactile exit sign with the following words as appropriate:
      a. "EXIT STAIR DOWN"
      b. "EXIT RAMP DOWN"
      c. "EXIT STAIR UP"
      d. "EXIT RAMP UP"
   3. Each exit door that is required to comply with Section 1013.1 and that leads directly to a grade-level exterior exit by means of an exit enclosure that does not utilize a stair or ramp, or an exit passageway shall be identified by a tactile exit sign with the words, "EXIT ROUTE".
   4. Each exit access door from an interior room or area that is required to comply with Section 1013.1 shall be identified by a tactile exit sign with the words, "EXIT ROUTE".
   5. Each exit door through a horizontal exit shall be identified by a tactile exit sign with the words "TO EXIT".

2.11 MISCELLENEOUS SIGNS

A. Fire Extinguisher: 2-way Plastic 12 by 4 inches, White/Red. Portable fire extinguishers per CFC 906 and Title 19. Refer to Section 10 44 13.

B. Building address and street signage per CFC 505.1 &.2.

C. Battery/Equipment Room signage per CFC 608.7.

D. Fire department access to equipment/: A/C controls, sprinkler risers & valves, fire alarm panels, or other fire detection, suppression or control elements per CFC 509.

E. Electrical Rooms per CFC 605.3.1.

2.12 FIRE SPRINKLER SIGNS

A. Provide the following signs:
   1. FIRE SPRINKLER RISER ROOM
   2. FIRE ALARM PANEL ROOM
   3. SPRINKLER FIRE ALARM (at each bell)

B. Locate one sign at each fire sprinkler riser room door and fire alarm panel room, whether indicated on drawings or not.

C. Text: Sign to read "Fire Sprinkler Riser Room", "Fire Alarm Panel Room-Sprinkler Fire Alarm", white color letters, 1 inch high on red background.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive Work.

B. Beginning of installation means installer accepts existing surfaces.

3.02 INSTALLATION

A. Install signs only after surfaces are finished, install at all rooms.
   1. At single-leaf doors, locate signs on wall adjacent to latch side of applicable door opening, centered horizontally within 18-inch space adjacent to latch side of door, 60 inches from finish floor to center line of sign. Mounting location shall be located so that a clear space of 18" minimum by minimum by 18" minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position. CBC Section 11B-703.4.2.

B. Mounting
   1. Tactile Plastic Signs: Stainless steel screws, pin torx, vandal-proof.
   2. Non-tactile Plastic Signs:

a. Install with four (4) stainless steel countersunk flathead screws, pin torx, vandal-proof. Pre-drill holes to prevent breaking plastic, use countersunk drill bits to flush screw head with sign surface.

C. For signs installed on glass: a blank vinyl backer is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.

D. Clean and polish signs following manufacturer'¢s instructions.

3.03 FIELD QUALITY CONTROL

A. DSA Inspections: Signs and identifications or other information shall be field inspected after installation and approved by Division of the State Architect prior to the issuance of a final certificate of occupancy, or final approval where no certificate of occupancy is issued. The inspection shall include, but not limited to, verification that Braille dots and cells are properly spaced and the size, proportion and type of raised characters are in compliance with CBC, Section 11B-703.1.1.2.

3.04 SIGN TYPES AND SCHEDULE

A. As indicated on Drawings.

END OF SECTION

SECTION 10 14 19

DIMENSIONAL LETTERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cut metal letters Interior/exterior dimensional letters.

B. Metal Cast Signs specified in Section 10 14 54.

1.02 SUBMITTALS

A. Product Data: Submit product data for specified products. Include material details for each sign specified.

B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.

C. Samples: Submit supplier's standard color chart for selection purposes and selected colors for verification purposes.

D. Installation: Submit supplier's installation instructions.

E. Closeout Submittals per Division 01.

F. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.

G. Submit warranty documents specified herein.

1.03 QUALITY ASSURANCE

A. Supplier: Obtain all products in this section from a single supplier.

B. Regulatory Requirements: Products shall meet requirements of the Americans With Disabilities Act Accessibility Guidelines (ADAAG) and local amendments and modifications.

C. Installer: Installation shall be performed by installer specialized and experienced in work similar to that required for this project.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 01.
   1. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
   2. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

3. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
4. Handle products in accordance with manufacturer's instructions.

1.05 WARRANTY

A. Project Warranty: Comply with requirements of Division 01.

B. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
1. Warranty Period: One year from product ship date. Warranty specifically excludes letter mounting substrate.

PART 2 - PRODUCTS

2.01 SIGNAGE SYSTEMS

A. Acceptable Manufacturers
1. ASI-Modulex, Dallas, TX.
2. A.R.K. Ramos, Oklahoma City, OK.
3. Matthews International Corp.
4. AD/S Design & Signs, Corona, CA.
5. APCO Signs
6. Nelson-Harkin Industries
7. Poblocki Sign Company
8. 3M
9. Gemini Incorporated, Cannon Falls, MN.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 CUT METAL LETTERS - DIMENSIONAL LETTERS

A. Cast letters specified in Section 10 14 54.

B. Graphic Material:
1. Face material: Aluminum.
2. Return material: Aluminum.

C. Fabricated Letter:
1. Letterstyle: Helvetica Normal (Exterior Signs), and Helvetica Normal Italicized (Interior Signs), as indicated on Drawings.
2. Height: As indicated on drawings.
3. Material: Aluminum 5052 Alloy.
4. Depth: thickness: 1/8" (Exterior Signs), 1/2" (Interior Signs).
5. Finish: Clear Anodized.
6. Backing: backs to match face material.

D. Mounting Method: Blind Stud Standard. Provide with stud lengths as required to install letters as indicated on Drawings. Provide metal spacer sleeves at exterior signs.

2.03 FABRICATION - GENERAL

A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Design, fabricate, and install sign assemblies to prevent buckling, opening up of joints, and over-stressing of welds and fasteners.

C. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.

D. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

E. Create signage to required sizes and layout. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.

B. Scheduling of installation by Owner or its representative implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer's acceptance of substrate and conditions.

3.02 INSTALLATION

A. Install product in accordance with supplier's instructions.

B. Install product in locations indicated using mounting methods specified and free from distortion, warp, or defect adversely affecting appearance.

C. Install product level, plumb, and at heights indicated per mounting specified.

D. Install product at heights to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and applicable local amendments and regulations.

E. Install signs within the following tolerances and in accordance with manufacturer's recommendations.

F. Interior Signs: Within 1/4 inch vertically and horizontally of intended location.

G. Exterior Signs: Within 1 inch vertically and horizontally of intended location.

3.03 CLEANING, PROTECTION, AND REPAIR

A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 10 feet.

B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project in accordance with provisions in Division 01.

3.04 SIGN SCHEDULE

A. Schedule: Refer to Drawings for sizes, locations, and layout of signage types, sign text copy, and graphics.

END OF SECTION

SECTION 10 14 23

SIGNS - RESTROOMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Plastic signs at restrooms.

B. Related Sections:
1. Section 10 21 10, Solid Color Reinforced Composite Toilet Partitions.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. CBC - 2019 California Building Code
1. CBC-11 - CBC Chapter 11B, Accessibility for Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing

C. ADA - Americans with Disabilities Act of 1990 as amended.
1. ADA/Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

D. ASTM D4802 - Poly (Methyl Methacrylate) Acrylic Plastic Sheet.

1.03 SUBMITTALS

A. Shop drawings listing sign styles, lettering and locations and overall dimensions of each sign.

B. Two samples illustrating full size sample sign, of type, style and color specified including method of attachment. If accepted, samples may be installed in project.

C. Letters samples: 1 inch high letters for proportions required in REGULATORY REQUIREMENTS.

1.04 QUALITY ASSURANCE

A. Pre-installation Conference
1. Notify Architect when signs are ready for installation. Arrange for conference at job site. Do not proceed with installation until Architect's approval of specific locations and methods of attachment has been obtained.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site and protect from damage. Store until immediately prior to Notice of Completion.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Tactile Character Type: Tactile characters on signs shall be raised 1/32 inch (0.794 mm) minimum, and shall be sans serif uppercase characters accompanied by Contracted (Grade 2) Braille. Italic, oblique script, highly decorative or unusual style forms not permitted. CBS Section 11B-703.2.

B. Character Proportions: Raised characters on signs shall be selected from fonts where the width of the uppercase letter "O" is 60% minimum and 110% maximum of the height of the uppercase letter "I".

C. Tactile Character Height: Raised characters shall be a minimum of 5/8 inch (15.9 mm) and a maximum of 2 inches (51 mm) high. CBC Section 11B-703.2.5.

D. Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character. CBC Section 11B-703.2.6

E. Character spacing measured between the two closest points of adjacent raised characters within a message. Where characters have rectangular cross sections, spacing shall be 1/8" minimum and 4 times the stroke width, maximum. Where characters have other cross sections, spacing between individual raised characters shall be 1/16" minimum and 4 times the stroke width maximum at the base of the cross sections, and 1/8" minimum and 4 times the stroke width maximum at the top of the cross sections. Characters hall be separated from raised borders and decorative elements 3/8" minimum.

F. Line Spacing: Spacing between the baselines of separate lines of raised characters within a message shall be 135% minimum and 170% maximum of the raised character height.

G. Finish and Contrast: Characters and their background shall have a non-glare finish. Characters shall contrast with their background with either light characters on dark background or dark characters on light background.

H. Braille: California (Contracted) Grade 2 Braille. Dot base diameter shall be 0.059 inch (1.5 mm) to 0.063 inch (1.6 mm). Dots shall be 0.100 inch (2.5 mm) on center in each cell with 0.300 inch (7.6 mm) space between corresponding dots in adjacent cells. Distance between corresponding dots from one cell directly below, 0.395 to 0.400 inch. Dots shall be raised 0.025 to 0.037 inch above the background. Braille dots shall be domed or rounded.

I. Mounting Height and Location: Signs with raised characters and Braille shall be located 48" minimum to the baseline of the lowest line of Braille cells and 60" maximum to the baseline of the highest line of raised characters above the finish floor or ground surfaces. Mounting location shall be located so that a clear space of 18" minimum by minimum by 18" minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position. CBC Section 11B-703.4.

2.02 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Mohawk Sign Systems, Inc., Schenectady, NY.
   2. Roemer Industries, Masury, OH.
   3. ASI Modulex, Inc., Dallas, TX.
   4. Vomar Products, Inc.
   5. Apco Signs, Atlanta, GA.
   6. Nelson-Harkins Industries, Inc.
   7. Vista System

2.03 MATERIALS

A. Plastic Signs
   1. Fabrication - General
      a. ADA Tactile and Braille Signs: Sand-Carved signs; thermosetting high pressure laminate using Graphic Process Sand-Carved signs, exterior-grade, graphics, Braille and tactile copy required. Square corners, square cut edges.
         1) Unframed Signs: Model ADA Systems Signs, Series 200A, Design M-311, by Mohawk Sign Systems or equal. Custom copy by Architect.
      b. Non-Tactile Signs: Cast Acrylic Plastic Sheet; ASTM D4802 Category A-1, 1/4 inch overall thickness, laminated acrylic plastic sheets, Sub-surface Screened process graphics and symbols, exterior-grade at exterior locations, square corners, square cut edge, drilled holes for countersunk screws, polished edges.
         1) Unframed Signs.
         2) Finish: Refer to Finish Schedule on Drawings.
   2. Apply UV inhibitor overcoat for exterior signs.

B. Fasteners: Stainless steel screws, flat head, pin-in-head torx screws for vandal-proof and clear silicone adhesive.

C. Lettering Type Style: Helvetica Regular, uppercase letters only, refer to REGULATORY REQUIREMENTS for letter-proportion compliance.

2.04 RESTROOM SIGNAGE

A. Material
   1. ADA Tactile and Braille Signs: Thermosetting high pressure laminate using Graphic Process Sand-Carved signs by Mohawk, Series 200A.
   2. Non-Tactile Signs: Sub-surface, Acrylic Plastic Sheet: ASTM D4802

B. Male Restroom Signage:
   1. Doorways leading to male restrooms shall be identified by equilateral triangle 1/4 inch thick with edges 12 inches long, with vertex pointing upward upon which appears the International Symbol of Accessibility (ISA) in its center, 6 inches high ISA, in contrasting color from door color. Sign shall be mounted in center of door 60 inches from finish floor to center of sign.

2. Room shall be further identified by rectangular room identification sign 1/4 inch thick, 8"H x 6"L minimum unless indicated on Drawings upon which appears a male pictogram 6 inches high, and the word "MEN" immediately below on the same sign in contrasting color. Letters: 5/8 inches min. and 2 inches max. high in contrasting color, raised minimum 1/32 inch fully tactile, accompanied by the California Contracted Grade 2 Braille indicator immediately below. Sign shall be located on wall on latch side of door, 60 inches from finish floor to center of sign, centered horizontally within 18-inch space adjacent to latch side of door or on nearest adjacent wall.
3. Conform to all CBC requirements, CBC 11B.703.1 and 11B-703.7.2.6.1.

C. Female Restroom Signage:
1. Doorways leading to female restrooms shall be identified by circle 1/4 inch thick 12 inches in diameter circle upon which appears the International Symbol of Accessibility (ISA), 6 inches high, in contrasting color from door color. Sign shall be mounted in center of door, 60 inches from finish floor to center of sign.
2. Room shall be further identified by rectangular room identification sign 1/4 inch thick, 8"H x 6"L minimum unless indicated on Drawings upon which appears a female pictogram 6 inches high, and the word "WOMEN" immediately below on the same sign in contrasting color. Letters: 5/8 inches min. and 2 inches max. high in contrasting color, raised minimum 1/32 inch fully tactile, accompanied by the California Contracted Grade 2 Braille indicator immediately below. Sign shall be located on wall on latch side of door, 60 inches from finish floor to center of sign, centered horizontally within 18-inch space adjacent to latch side of door or on nearest adjacent wall.
3. Conform to all CBC requirements, CBC 11B.703.1 and 11B-703.7.2.6.2.

D. Restroom Signage for All-Gender Toilet Facilities (unisex) restroom(s):
1. Doorways leading to unisex restrooms shall be identified by circle 1/4 inch thick, 12 inches in diameter with 1/4 inch thick triangle superimposed on circle and within 12 inch diameter, total 1/2 inch thick upon which appears the International Symbol of Accessibility (ISA), 6 inches high, in contrasting color from door color. Sign shall be mounted in center of door 60 inches from finish floor to center of sign. Color of triangle shall have 70% minimum contrast with color of circle.
2. Room shall be further identified by rectangular room identification sign 1/4 inch thick, 8"H x 6"L minimum unless indicated on Drawings upon which appear the word "RESTROOM" in contrasting color. Letters: 5/8 inches min. and 2 inches max. high in contrasting color, raised minimum 1/32 inch fully tactile, accompanied by California Contracted Grade 2 Braille indicator immediately below, on same sign. The sign shall be located on wall on latch side of door, 60 inches from finish floor to center of sign, centered horizontally within 18 inch space adjacent to latch side of door or on nearest adjacent wall.
3. Conform to all CBC requirement, CBC 11B-216.8, CBC 11B.703.1 and 11B-703.7.2.6.3.

E. Colors: Refer to Finish Schedule on Drawings.

F. Lettering Type Style: Helvetica Regular, uppercase letters only, refer to REGULATORY REQUIREMENTS for letter-proportion compliance.

G. Polished edges, all signs.

H. Fabricate sign so that raised letter cannot be peeled off.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive Work.

B. Beginning of installation means installer accepts existing surfaces.

3.02 INSTALLATION

A. Install signs only after surfaces are finished and in all restrooms, in center of door, or on wall adjacent to latch side as specified herein.

B. Mounting
   1. Tactile Plastic Signs: Stainless steel screws, pin torx, vandal-proof.
   2. Non-tactile Plastic Signs:
      a. Install with four (4) stainless steel countersunk flathead screws, pin torx, vandal-proof. Pre-drill holes to prevent breaking plastic, use countersunk drill bits to flush screw head with sign surface.

C. Clean and polish.

3.03 FIELD QUALITY CONTROL

A. DSA Inspections: Signs and identifications or other information shall be field inspected after installation and approved by Division of the State Architect prior to the issuance of a final certificate of occupancy, or final approval where no certificate of occupancy is issued. The inspection shall include, but not limited to, verification that Braille dots and cells are properly spaced and the size, proportion and type of raised characters are in compliance with CBC, Section 11B-703.1.1.2.

END OF SECTION

SECTION 10 14 54

CAST LETTERS AND GRAPHICS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Individual cast letters and logo.

1.02 SUBMITTALS

A. Shop drawings listing style, lettering, location and overall dimensions of letters.

B. Three samples illustrating material, letter, style and color specified including method of attachment.

C. Manufacturer's installation instructions.

1.03 DELIVERY, STORAGE AND HANDLING

A. Store letter materials and avoid damage to surfaces.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not install sign when ambient temperature is below 40 degrees F.

PART 2 - PRODUCTS

2.01 EXTERIOR SIGNS - INDIVIDUAL CAST LETTERS

A. Manufacturers
   1. Mathews International Corporation.
   2. Gemini Incorporated, Cannon Falls, MN.

B. Mounted letters shall be individual metal letters.
   1. Mounting: Blind stud attachment with aluminum spacers. Refer to drawings for additional information.

C. Mounted Logo shall be cast individual custom raised logo.

D. Height: As indicated on Drawings.

E. Materials: Aluminum - 514 Alloy. Painted, directionally sanded faces, cleaned returns, liquid sprayed with 2-part hardened acrylic polyurethane, oven baked to cure paint.

F. Colors:
   1. Letters: To match PMS Black 100$.
   2. Logo: Red PMS 201, White.

G. Font: Custom (Refer to Owner's graphic style guide for additional information).

PART 3 - EXECUTION

3.01 FABRICATION

A. Fabricate to comply with the requirements indicated. Location and details of installation as indicated on the drawings.

3.02 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means installer accepts existing surfaces.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install letters in locations indicated after surfaces are finished.

C. Locate letters and accessories where indicated or scheduled, using mounting methods of type described and in compliance with the manufacturer's instructions.

D. Install letters level, plumb, and at the height indicated, with surfaces free from distortion or other defects in appearance.

E. At completion of installation, clean soiled surfaces in accordance with the manufacturer's instructions. Protect units from damage.

END OF SECTION

SECTION 10 21 10

SOLID COLOR REINFORCED COMPOSITE TOILET PARTITIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Toilet Compartments

B. Urinal Screens

C. Related Sections
   1. Section 10 28 00, Toilet and Bath Accessories.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. National Fire Protection Association 101 Life Safety Code 2000 Edition, Chapters 5, 6, 8-30.

C. Title 24, California Code of Regulations, Parts 2, 3, and 5.

D. ADA – Americans with Disabilities Act of 1990 as amended.
   1. ADA/Standards – ADA Title II III Regulations and the 2010 ADA Standards for Accessible Design.

E. American Society for Testing and Materials Standards:
   1. ASTM E84-01 Standard Test Method for Surface Burning Characteristics of Building Material. Class B, Flame Spread: Less than 75, Smoke Developed: less than 450.
   2. ASTM D2794-93(1999)e1 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
   3. ASTM D2197-98(2002) Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion.
   4. ASTM D6578-00 Standard Practice for Determination of Graffiti Resistance.

1.03 PERFORMANCE REQUIREMENTS

A. Graffiti Resistance: Partition material shall have the following graffiti removal characteristics when tested in accordance with ASTM D6578-00 Standard Practice for Determination of Graffiti Resistance in accordance with Section 09, "Graffiti Removal Procedure Using Manual Solvent Rubs":
   1. Cleanability: Five (5) required staining agents shall be cleaned off material.

B. Scratch Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2197-98 (2002) Standard Test Method for Adhesion of Organic Coating by Scrape Adhesion, using Gardner Stock #PA-2197/ST pointed stylus attachment on scrape tester:
   1. Scratch Resistance: Maximum Load Value shall exceed 10 kilograms.

C. Impact Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2794-93 (1999)e1 Standard Test Method for Resistance of Organic Coating to the Effects of Rapid Deformation (Impact), using .625" hemispherical indenter with 2-lb impact weight:
   1. Impact Resistance: Maximum Impact Force value shall exceed 30 inch-lbs.

D. Fire Resistance: Partition material shall comply with the following requirements, when tested in accordance with ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials:
   1. Smoke Developed Index: Not to exceed 450.
   2. Flame Spread Index: Not to exceed 75.
   3. Material Fire Ratings:
      a. National Fire Protection Association (NFPA): Class B.
      b. International Code Council (ICC): Class B.

1.04 SUBMITTALS

A. Comply with requirements of Section regarding submittals.

B. Manufacturer's Data
   1. Provide required number copies of:
      a. Product data sheets.
      b. Installation instructions.
      c. Cleaning and maintenance instructions.
      d. Replacement parts information.

C. Shop Drawings
   1. Provide required number of copies of all shop drawings.
   2. Show fabrication and erection of compartment assemblies, to extent not fully described by manufacturer's data sheets.
   3. Show anchorage, accessory items and finishes.
   4. Provide location drawings for bolt hole locations in supporting members for attachment of compartments.

D. Samples
   1. Furnish scale model of compartments, including stile, shoe, door, door hardware, divider panel, and mounting brackets.
   2. Furnish sections showing stile anchoring and leveling devices, concealed threaded inserts, panel, stile, and edge construction.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver items in manufacturer's original unopened protective packaging.

B. Store materials in original protective packaging to prevent physical damage or wetting.

C. Handle so as to prevent damage to finished surfaces.

1.06 WARRANTY

A. Furnish ten-year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.

B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Accessible Toilet Compartments:
1. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.
2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9" high minimum above the finish floor and 6" deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12" high minimum above the finish floor for children's use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the aide partition is not required in a compartment greater than 66" wide.
3. Ambulatory accessible compartments shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more fixtures. Such compartments shall be provided in the same quantity as wheelchair accessible compartments per CBC Section 11B-213.3.1 and shall comply with CBC Section 11B-604.8.2.
4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that if the approach is to the latch side of an ambulatory compartment door, clearance between the door side of the compartment and any obstruction shall be 44" minimum. CBC Figure 11B-604.8.2.
5. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.
6. Ambulatory Accesible Toilet Compartment Doors shall not swing into the clear floor space or clearance required for any fixture or the minimum compartment area required for ambulatory accessible compartments. CBC 11B-604.8.2.2.

2.02 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
1. Bobrick Washroom Equipment Co., Inc., North Hollywood, CA.

B. Or equal as approved in accordance with for substitutions.

2.03 MOUNTING CONFIGURATIONS

A. Toilet Partitions Compartments shall be:

1. Floor to Ceiling Braced (Sierra Series) 1092.67, Continuous Hinge, Institutional Hardware.

B. Urinal Screens:
1. Wall-Hung (1095 Sierra Series)

2.04 COMPONENTS/MATERIALS

A. Stiles, Panels, Doors, and Screens
1. Manufactured from Solid Color Reinforced Composite material. Color: Refer to Finish Schedule on Drawings. Height as indicated on Drawings.

B. Toilet Partition Material
1. Constructed of Solid Color Reinforced Composite material composed of dyes, organic fibrous material, and polycarbonate/phenolic resins. Material having non-ghosting, graffiti-resistant surface integrally bonded to core through series of manufacturing steps requiring thermal and mechanical pressure. Edges of material shall be the same color as the surface.

C. Finish Thickness
1. Stiles and doors: 3/4 inch (19 mm).
2. Panels and benches: 1/2 inch (13 mm).

D. Hardware
1. All hardware to be 18-8, type-304 stainless steel with satin finish.
2. Hardware of chrome-plated "Zamak", aluminum, or plastic is unacceptable.
3. Door Handles at Accessible Compartments: Provide loop or U-shaped handle immediately below latch both faces on both sides of doors mounted at 34 inches – 44 inches above finished floor.

E. Latch
1. Sliding door latch shall require less than 5 pounds force to operate. Twisting latch operation will not be acceptable.
2. Sliding door latch shall be 14-gage (2 mm) and shall slide on nylon track.
3. Sliding door latch shall require less than 5 pounds force to operate. Twisting latch operation will not be acceptable.
4. Latch track shall be attached to door by machine screws into factory-installed threaded brass inserts.
5. Threaded brass inserts shall be factory installed for door hinge and latch connections and shall withstand a direct pull exceeding 1,500 pounds per insert.
6. Through bolted, stainless steel, pin-in-head Torx sex bolt fasteners shall be used at latch keeper-to-stile connections and shall withstand direct pull force exceeding 1,500 pounds per fastener.

F. Hinges
1. Hinges: 16-gage (1.6-mm) Continuous hinges.
2. All doors shall be equipped with self-closing hinges.
3. Hinges shall be attached to door and stile by theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts
4. Fasteners secured directly into the core are not acceptable.

5. Door shall be furnished with two 11-gage (3-mm) stainless steel door stop plates with attached rubber bumpers to resist door from being kicked in/out beyond stile.
6. Door stops and hinges shall be secured with stainless steel, pin-in-head Torx machine screws into threaded brass inserts.
7. Threaded brass inserts shall withstand a direct pull force exceeding 1,500 pounds per insert.

G. Mounting Bracket
1. Mounting brackets shall be 18-gage (1.2- mm) stainless steel and extend full height of panel.
2. U-channels shall be furnished to secure panels to stiles.
3. Angle brackets shall be furnished to secure stiles to walls and panels to walls.
4. Fasteners at locations connecting panels-to-stiles shall utilize through bolted, stainless steel, pin-in-head Torx sex bolt fasteners. Through-bolted fasteners shall withstand direct pull force exceeding 1,500 pounds per fastener.
5. Wall-Hung and floor-Anchored urinal screen brackets: 11 gauge (3 mm), continuous..

H. Leveling Device shall be 7-gage, 3/16 inch (5-mm) hot rolled steel bar; chromate-treated and zinc-plated; through-bolted to base of solid color reinforced composite stile.

I. Stile Shoe shall be one-piece, 4 inch (102-mm) high, type-304, 22-gage (0.8-mm) stainless steel with satin finish. Top shall have 90 degrees return to stile. Shoe will be composed of one-piece of stainless steel and capable of being fastened (by clip) to stiles starting at wall line.

J. Wall Bumper: Stainless Steel wall bumper with rubber tip at outswing doors. BHMA #LO 2251 or equal.

2.05 FABRICATION

A. Hinges: Vandal-Resistant Hardware: Institutional Hardware for 1092.67 Series.

PART 3 - EXECUTION

3.01 INSPECTION

A. Check areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.

B. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.

C. Do not begin installation of compartments until conditions are satisfactory.

3.02 ERECTION

A. Install compartments rigidly, straight, plumb, and level and in accordance with manufacturer’s installation instructions.

B. Installation methods shall conform to manufacturer's recommendation for backing and proper support.

C. Conceal evidence of drilling, cutting, and fitting to room finish.

D. Maintain uniform clearance at vertical edge of doors.

3.03 ADJUSTMENT AND CLEANING

A. Adjust hardware for proper operation after installation.

B. Set hinge cam on in-swinging doors to hold doors open when unlatched.

C. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.

D. Clean exposed surfaces of compartments, hardware, and fittings.

END OF SECTION

SECTION 10 22 19

DEMOUNTABLE PARTITIONS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Non-progressive, moveable and reconfigurable system of unitized panels.
   2. Trim, Sealants, Hardware and Accessories.

B. Related Sections include the following:
   1. Section 08 14 16, Flush Wood Doors
   2. Section 08 71 00, Door Hardware
   3. Section 08 80 00, Glazing
   4. Section 09 29 00, Gypsum Board
   5. Section 09 51 00, Acoustical Ceilings - Lay-In

1.02 REFERENCES

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. Aluminum Association (AA)
   1. AA DAF45-R03, Designation System for Aluminum Finishes, 9th Edition

C. American National Standards Institute (ANSI)
   1. ANSI Z97.1-2004, Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Method of Test.

D. American Society of Testing and Materials International (ASTM)
   1. ASTM B221-06, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profile and Tubes
   2. ASTM C1036, Standard Specification for Flat Glass
   3. ASTM C1396, Standard Specification for Gypsum Board
   4. Correct – replaced ASTM C36 in 2005
   5. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
   6. ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
   7. ASTM E413-04, Classification for Rating Sound Insulation
   8. ASTM E1300, Standard Practice for Determining Load Resistance of Glass in Buildings

E. WI - Woodwork Institute

F. Consumer Product Safety Commission
   1. Regulation 16 CFR 1201, Safety Standard for Architectural Glazing Materials

G. 2019 California Building Code.

H. 2019 California Electrical Code.

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance
   a. Design and size the demountable partitions and components to withstand dead and live loads as calculated in accordance with the 2019 California Building Code.
   b. Design and size demountable partitions and components to withstand seismic loads as calculated in accordance with 2019 California Building Code.
   c. Load Bearing Capacity: Tested to not less than the requirements for panel systems as defined by ANSI/BIFMA X5.6, latest edition. Specifically, a load of 300 lbs. on either side of each panel at both overhead and desktop elevations with a Center of Gravity (CG) of no greater than 8” from the panel face.
   d. Transverse-Load Capacity of Glass Partitions: Lateral deflection of glass framing members not to exceed the lesser of L/175 of length or 3/4-inch (19 mm), when subjected to a uniformly distributed load of 5lbs/sf (240 Pa) in accordance with ASTM E72.
   e. At a minimum, glass thickness shall conform to the requirements of ASTM E1300.
   f. Glazing materials shall comply with the requirements of 16 CFR Part 1201 and/or ANSI Z97.1-2004, and shall bear markings as required by Chapter 24 of the 2019 California Building Code..

B. Sound Transmission Performance
   1. Where STC ratings are indicated, provide partitions with STC rating that was determined by testing a representative sample according to ASTM E90 and classified according to ASTM E413 by an accredited independent testing agency.

C. Surface-Burning Classification: Provide demountable partitions complying with the following requirements:
   1. Surface-Burning Classification: Provide demountable partitions per ASTM E 84:
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

D. Combustibility: Provide demountable partitions constructed in a manner and of materials suitable for installation in non-combustible (Type I or Type II) building.

E. Electrical and Communications Performance

1. Assembled panels with prewired components (boxes, cables, devices and faceplates) fully assembled shall comply with 2019 California Building Code.
2. Electrical components attached to demountable partition assemblies shall comply with:
   a. 2019 California Electrical Code.
3. Powerbase modular electrical components used in demountable partition assemblies shall comply with:
   a. 2019 California Electrical Code.

F. Indoor Air Quality Performance
   1. Products shall comply with California VOC Regulations.

1.04 DESIGN REQUIREMENTS

A. The demountable partition system (the system) shall be rectilinear in design and expression with crisp corners and well defined horizontal and vertical elements.

B. The system shall be 4” (101.6mm) thick minimum, and designed and sized in horizontal and vertical modules to accommodate the partition layout indicated.
   1. Panel heights shall be available in 1/8” (3.2mm) increments from a minimum of 48” (1219.2mm) to maximum of 144” (3657.6mm) as required. Actual floor to ceiling heights shall be verified in field.
   2. Solid panel widths shall be available in 1/16” (1.6mm) increments from a minimum of 8” (203.2mm) to maximum of 48” (1219.2mm) and 60” (1524mm).

C. The system shall be non-progressive, allowing for removal and re-installation of panels, including door frames, at any position**,** without disturbing adjacent panels.

D. Each unitized panel shall be able to be removed, relocated and re-installed in different layouts, with all parts reusable. Scribing and fitting of panels on site to individual locations is not acceptable.

E. The panel/floor interface shall have a reveal, recessed 3/4” (19mm) from the face of the panel on both sides and adjustable in height from 1 1/4” (31.7mm) to 2 1/2” (63.5mm), and 1 1/4” (31.7mm) down to 1/2” (12.7mm). Surface mounted base trim not permitted.

F. The panel/ceiling interface shall have a 1” (25.4mm) nominal height reveal, recessed 3/4” (195mm) from the face of the panel on both sides. Surface mounted top trim not permitted.

G. The system shall provide a vertical adjustment of not less than 2” (50.8mm) in overall height to accommodate floor and ceiling irregularities.

H. The system shall include a freestanding option that does not require a connection or attachment to the ceiling.

I. The system must be erected and removed in a manner to prevent damage to adjacent building surfaces and elements, including floors, walls, ceilings, columns and window

mullions. All system connectors to fixed-in-place building components shall be non-marking, removable and reusable.

J. The system shall be capable of extending in multiple directions using 2-way, 3-way, 4-way and variable angle corner posts.

K. Doors: Single, sliding or butt-hinged doors as indicated, doors utilizing adjustable metal frames. All door panels shall utilize standard panel connection methods.

L. Provide cuttable panels in order to address irregularities in the interface between the panel system and fixed-in-place construction (i.e. sills, columns, bulkheads).

M. Components shall be free of distortion and uniform in dimension, construction and appearance.

1.05 SUBMITTALS

A. Product Data: Manufacturer's product data for each specified product.

B. Shop Drawings: For demountable partitions. Include plans, elevations, sections, details, and attachments to other work.
   1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Indicate partition layout, including doors and hardware, elevations, opening locations, special panels and conditions at adjacent construction.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which penetrations and ceiling-mounted items are shown and coordinated with demountable partitions.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Linear Trim: 12-inch- (300-mm-) long samples.
   2. Door Finish Face: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square. Not less than 3 samples.
   3. Glazing: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of demountable partition.

G. Care and Maintenance Standards: For demountable partitions to include in maintenance manuals.

H. Mock-ups: Before installing demountable partitions, build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Manufacturer Qualifications: All primary products specified within this section will be supplied by a single manufacturer with a minimum of ten (10) years' experience. The manufacturer of the wall system shall operate under an ISO 9001 certified quality management system.

J. Installer Qualifications: All products listed within this section shall be installed by a manufacturer-certified installation company.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver demountable partition system components cartoned or crated to provide protection during direct transit to site or intermediary location. Components shipped from intermediary location to site shall be protected as required to provide protection during transit.

B. Inspect demountable partition system components for damage upon delivery to site and to intermediary location.

C. Minor damages may be repaired, provided finish items are equal to new work and acceptable to Architect. Remove and replace damaged items as directed.

D. Store demountable partition system components on raised platforms with blocking between units to allow air circulation. Keep stored material covered and protected from damage.

1.07 PROJECT CONDITIONS

A. Finished Spaces: Do not deliver or install demountable partition components until building is enclosed and finishing operations, including installation of ceilings, floor coverings, light fixtures, HVAC equipment, and fire suppression systems, are complete.

B. Field Measurements: Indicate all relevant measurements on Shop Drawings.

1.08 WARRANTY

A. Submit, for Owner's acceptance, manufacturer's standard limited warranty document executed by authorized company official.
   1. Warranty period: Ten (10) years from date of substantial completion.
   2. Installer Qualifications: Minimum of two (2) year's documented experience in the installation of products in this section and must be approved by the manufacturer.

PART 2 - PRODUCTS

2.01 DEMOUNTABLE PARTITIONS

A. Subject to compliance with requirements, provide panel system scheduled in Finish Schedule on Drawings or indicated on Drawings, or a comparable product by one of the following:
   1. Haworth Inc., Holland, MI.
   2. KI Inc.
   3. Herman Miller, Inc., Zeeland, MI.
   4. Teknion Furniture Systems, Mt. Laurel, NJ.

B. Or equal, as approved in accordance with Division 01 requirements for Substitutions.

C. Complete partition system shall be from single manufacturer, individual components from other manufacturers shall be as supplied by the panel system manufacturer as standard parts of its system.

2.02 MATERIALS

A. Basis of Design:
   1. DP-1: Haworth Enclose.
   2. DP-2: Haworth Enclose Frameless.

B. Core Framing Components: Manufacturer's standard, extruded aluminum ASTM B221, within manufacturer’s tolerance and free from defects impairing strength and/or durability.

C. Insulation: Factory-installed in all solid panels, urea-formaldehyde free batt insulation.

D. Cladding/Panel Faces:
   1. Steel Panels: Manufacturer’s standard, minimum 18 gauge steel, factory-applied epoxy powdercoated.

E. Glass and Glazing Materials:
   1. Glazing: Fully tempered clear float glass complying with Section 08 80 00, Glazing.
      a. Maximum thickness: 3/8” (10mm)
      b. Glazing sections: Resilient ABS, extruded glazing section to suit glazing channel retaining slot placed into demountable partition system for setting glass.

2.03 UNITIZED PANEL TYPES

A. Glazed Panels:
   1. Core Framing Components: Extruded aluminum minimum 0.05” (1.3mm) thick, stile and frame with corner brackets, installed for full frame rigidity.

2. Panels for frameless system shall consist of frameless glass installed vertically between the top and bottom rail components.
   a. Vertical and bottom edges are polished chamfer. Top edges are to be seamed or polished.
3. Panel Types:
   a. Monolithic: 3/8” (10mm) thick glass pane, Tempered, ceiling height, fit to frame with ABS glazing gaskets.
   b. Segmented: 3/8” (10mm)] thick glass panes, Tempered, in up to five (5) segments as per approved elevations, fit to aluminum frame with ABS glazing gaskets and supported/separated horizontally by muntins.
4. Horizontal Muntins: Maximum 7/8” (22.23mm) wide.

B. Combination Panels: Full height, extruded aluminum frame, with horizontally segmented solid panel faces and glazed panels, separated by horizontal, extruded aluminum cross member, heights as indicated on Drawings..

C. Cuttable Panels: Solid panels with the inclusion of extended panel faces on one (1) vertical edge providing cuttable surfaces to fit to irregularities in fixed-in-place construction (i.e. sills, columns, bulkheads) where required.

2.04 DOORS, DOOR FRAMES AND HARDWARE:

A. Butt Hinge Doors: Manufacturer’s standard 1-3/4” (45mm) thick Wood glazed.
   1. Door Finishes: Wood.
   2. Door Glass Thickness:
      a. Wood Glazed –3/8” (10mm).
   3. Wood Species and Finish: Light Maple VP-LM.

B. Sliding Doors: Manufacturer’s standard 1-3/4” (45mm) thick Wood glazed.
   1. Door Finishes: Wood
   2. Door Glass Thickness:
      a. Wood Glazed – 3/8” (10mm).
   3. Color, Texture and Pattern:
      a. Wood Species and Finish: Light Maple VP-LM

C. Door Frames: Manufacturer’s standard aluminum frames for 1-3/4” (45mm) thick doors, Factory prepared to receive hardware.
   1. Thickness: Manufacturer’s standard, 4” (101.6mm)
   2. Finish: Factory-applied powder-coat finish
   3. Color: Smoke TR00E.

D. Hardware: Refer to Section 08 71 00, Door Hardware.

E. Accessory Hardware:
   1. Butt Hinge Doors (HW Group No. 17): For Doors 115D-A, 115E-A, 115G-A, 115H-A, 115K-A, 115L-A, 115N-A.
      a. 1/4" brush strip (astragal), on 3 sides of door frame (strike side vertical, hinge side vertical, top horizontal).

b. Include KN Crowder CT-51 Auto Door Bottom with Neoprene Seal, or, Zero International Type 355 or 364 automatic door bottom, or, equivalent.

2. Butt Hinge Doors (HW Group No. 18): For Door 214-A.
   a. 1/4" brush strip (astragal), on 3 sides of door frame (strike side vertical, hinge side vertical, top horizontal).
   b. Include KN Crowder CT-51 Auto Door Bottom with Neoprene Seal, or, Zero International Type 355 or 364 automatic door bottom, or, equivalent.
   c. Include Rutherford L6505 electric strike, or equivalent.
   d. Prep door for client supplied Von Duprin panic hardware.
3. Butt Hinge Doors (HW Group No. 19) For Doors 214N-A, 214N-B.
   a. 1/4" brush strip (astragal), on 3 sides of door frame (strike side vertical, hinge side vertical, top horizontal).
   b. Include KN Crowder CT-51 Auto Door Bottom with Neoprene Seal, or, Zero International Type 355 or 364 automatic door bottom, or, equivalent.
   c. Prep door for client supplied Von Duprin panic hardware.
4. Sliding Doors (HW Group No. 20): For Doors 115Q-A, 115R-A, 214B-A, 214C-A, 214D-A, 214E-A, 214F-A, 214G-A, 214H-A, 214J-A, 214K-A, 214L-A.
   a. FSB ESS RC-B, 1070 Lever.
   b. Include LFIC Primus Core per HW Schedule.

F. Door Glazing: Laminated clear float glass complying with Division 08 Section “Glazing”.
   1. Maximum thickness 3/8-inch (10 mm)
   2. Minimum and maximum values do not apply to doors.

G. Refer to Finish Schedule on Drawings.

2.05 FABRICATION

A. Fabricate demountable partition system off-site in a controlled factory environment and deliver panels fully finished to site for installation with no additional assembly, construction or finishing required.

B. Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members. Fabricate systems to accept installation of PVC-free continuous light and sound seals at floor, ceiling, and other locations where partitions abut fixed construction.

2.06 CONNECTION METHODS

A. Demountable Partition System to Ceiling: Extruded aluminum track, attached to ceiling grid using non-marking clip, lined with closed cell neoprene seal. Ceiling track shall support extruded ABS top reveal profile, friction fit to track providing a continuous top channel for panel system. ABS channel shall fit securely against interior panel faces to ensure integrity of acoustic and visual barrier.

B. Demountable Partition System to Floor: Integrated extruded aluminum channel/base assembly, designed to grip and hold to carpet flooring without damage to floor surface.

Partition systems over hard floor surfaces require separate non-marring shoe. Threaded adjustable leveling legs with leveler saddles set into floor channel. Sidewalls of channel shall fit securely against interior panel face on both sides of panel without gaps.

C. Demountable Partition System to Fixed-in-Place Construction: Extruded aluminum wall starter with PVC-free light and sound seal at all abutments between demountable partition system and fixed-in-place construction.

D. Panel to Panel, Door Frame or Post Connector: Continuous, extruded ABS connector applied to aluminum frame providing a 5/16” (8mm) reveal, recessed 3/16” (5mm) from panel face and ensuring integrity of light and sound seal.

E. Panel Face to Frame: Continuous, extruded ABS retention clip affixed to back of panel face secured to aluminum frame.

F. Demountable Partition System to Furniture: Solid panels shall be capable of supporting furniture components at any elevation, by means of slotted channels incorporated in the upright sections of the extruded aluminum panel frame.

G. Cuttable Panel to Fixed-in-Place Construction: Panels cut on site, fitted with extruded aluminum end cap and closed cell PVC-free neoprene seal providing a continuous, clean interface with the panel and fixed-in-place elements.

H. Exposed Ends and Corners: Supply and install one-piece aluminum extrusion to match panel finish, attached to end panel with standard panel-to-panel connector.

I. Frameless System:
   1. Wall system connects to the ceiling by locking the top rail to the ceiling grid or the finished ceiling using manufacturer's recommended clips.
   2. Wall system connects to floor by mechanically fastening the bottom rail to the slab.
   3. Wall system connects to fixed-in-place construction by lightly touching the construction vertically with starters that provide a variety of adjustment levels and connection methods.
   4. Vertical Adjustment: Up 5/8” (16mm), or down 3/4" (19mm)
   5. Glass pane to glass pane connections are done using layout specific glazing connectors. The exact connector depends on whether the run is straight, angular or faceted.

2.07 GLAZING VERTICALS TO POSTS OR TO DOOR FRAME CONNECTIONS ARE ACCOMPLISHED BY USING A REMOVABLE 5/16” (8MM) CONNECTOR.FINISHES, GENERAL

A. Aluminum Surfaces: Finish exposed surfaces of aluminum components in non-metallic or metallic powdercoat finishes, Color: Smoke TR00E Non-repairable, anodized aluminum finishes are unacceptable.

B. Wood Surfaces: Wood veneer, Color: Light Maple.

C. ABS Extrusions: Selected from manufacturer's samples.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Locations scheduled to receive partitions shall be inspected for compliance with manufacturer's requirements.

B. Floor and ceiling dimensions shall be verified in accordance with approved shop drawings.

C. Floor under partitions shall be level to within 1/8-inch in 10 feet, non-accumulative.

D. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting of work shall be construed as acceptance of conditions.

3.02 PREPARATION

A. Conditions which may adversely affect the partition installation shall be corrected before installing partitions.

3.03 INSTALLATION

A. Install partitions in accordance with details in the drawings, approved shop drawings, and manufacturer's published instructions.

B. The system shall be assembled and erected with the least possible drilling and cutting of existing construction and shall be capable of disassembly by means of ordinary tools.

C. The partition installation shall be complete with accessories to meet specified requirements.

D. Installation shall include concealed fastening devices and pressure-fit components that will not mar the floor, wall and ceiling surfaces and shall be free of exposed screws, nuts, rivets or bolts.

E. Panels shall be installed in a rigid manner, straight and plumb, with horizontal lines level.
   1. Installation Tolerance: Install each demountable partition so surfaces vary not more than 1/8-inch from the plane formed by the faces of adjacent partitions.

F. Seals shall be installed to prevent light and sound transmission at connections to ceilings, floors, fixed walls and abutting surfaces.

G. Doors shall be hung to swing freely and hardware shall be carefully fitted.

H. Install accessories including ceiling trim, base moldings, corners, and similar items in strict accordance with manufacturer's instructions.

I. Partition base covers shall snap on. Base shall tightly adhere to wall surfaces.

J. Install door-and-frame, and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

3.04 CLEANING

A. Upon completion of installation, partition components and finishes shall be cleaned in accordance with partition manufacturer's recommendations.

B. Alkaline or abrasive agents shall not be used.

C. Precautions to avoid scratching or marring partition finish surfaces shall be exercised.

3.05 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative to demonstrate and train District's maintenance personnel to adjust, operate, and maintain demountable partitions.

END OF SECTION

SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Toilet accessories.
2. Underlavatory guards.
3. Custodial accessories.

B. Related Requirements
1. Section 08 80 00, Glazing, for frameless mirrors.

1.02 SUBMITTALS

A. Product Data
1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicate types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

C. Closeout Submittals
1. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.03 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

1.04 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Accessories required to be accessible shall be mounted at heights according to CBC Section 11B-603.

B. Grab Bars in toilet facilities and bathing facilities shall comply with CBC Section 11B-609 and DSA IR-16-12. Grab Bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
   1. 1-1/2" between the grab bar and the wall.
   2. 1-1/2" minimum between the grab bar and projecting objects below and at the ends.
   3. 12" minimum between the grab bar and projecting objects above.

2.02 OWNER-FURNISHED PRODUCTS

A. Refer to specific products below for indication of Owner-furnished, Contractor-Installed (OFCI) or Owner-Furnished, Owner-Installed (OFOI) products.

2.03 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.04 TOILET ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Specialties, Inc., Yonkers, NY.
   2. Bobrick Washroom Equipment, Inc., North Hollywood, CA.
   3. Bradley Corporation, Menomonee Falls, WI.

4. Or equal, as approved under provisions of Division 01.

B. Toilet Tissue (Roll) Dispenser:
1. Basis-of-Design Products:
a. Recessed:
1) ASI: 0033.
2) Bobrick: B-3888.
3) Bradley: 5412.
4) Or approved equal.
b. Surface Mounted:
1) ASI: 9030.
2) Bobrick: B-2888.
3) Bradley: 5402.
4) Or approved equal.
c. Single-Roll
1) ASI: 7402.
2) Bobrick: B-667.
3) Bradley: 5102.
4) Or approved equal.

C. Combination Toilet Tissue Dispenser:
1. Basis-of-Design Products:
a. Recessed:
1) ASI: 0482/0485.
2) Bobrick: B-3474/3574.
3) Bradley: 5912/5922.
4) Or approved equal.
b. Surface Mounted:
1) ASI: 0483/0486.
2) Bobrick: B-3471/3571.
3) Bradley: 5911/5921.
4) Or approved equal.
c. Partition (Through) Mounted:
1) ASI: 0481/0484.
2) Bobrick: B-347/357.
3) Bradley: 591/592.
4) Or approved equal.

D. Paper Towel (Folded) Dispenser:
1. Basis-of-Design Products:
a. Recessed:
1) ASI: 0457.
2) Bobrick: B-359.
3) Bradley: 244.
4) Or approved equal.
b. Surface Mounted:
1) ASI: 0210.
2) Bobrick: B-262.
3) Bradley: 250-15.
4) Or approved equal.

E. Combination Towel (Folded) Dispenser/Waste Receptacle
1. Basis-of-Design Products:
a. ASI: 0469.
b. Bobrick: B-3944.
c. Bradley: 2037-10.
d. Or approved equal.

F. Liquid Soap Dispenser
1. Basis-of-Design Products:
a. ASI: 0347.
b. Bobrick: B-2111.
c. Bradley: 6562.
d. Or approved equal.

G. Grab Bar
1. Basis-of-Design Products:
a. ASI: 3800 Series.
b. Bobrick: B-6806 Series.
c. Bradley: 812 Series.
d. Or approved equal.

H. Sanitary-Napkin Disposal Unit
1. Basis-of-Design Products:
a. Recessed:
1) ASI: 0473.
2) Bobrick: B-353.
3) Bradley: 4731-15.
4) Or approved equal.
b. Surface Mounted:
1) ASI: 0473-A.
2) Bobrick: B-254.
3) Bradley: 4722-15.
4) Or approved equal.

I. Seat-Cover Dispenser
1. Basis-of-Design Products:
a. Recessed:
1) ASI: 0477.
2) Bobrick: B-301.
3) Bradley: 584.
4) Or approved equal.
b. Surface Mounted:
1) ASI: 0477-SM.
2) Bobrick: B-221.
3) Bradley: 5831.
4) Or approved equal.

J. Mirror Unit
1. Basis-of-Design Products:
a. Framed Glass Mirror:
1) ASI: 0620.

2) Bobrick: B-165.
3) Bradley: 781.
4) Or approved equal.

b. Polished Stainless Steel Mirror:
1) ASI: 8287.
2) Bobrick: B-1556.
3) Bradley: 7481.
4) Or approved equal.

K. Clothes Hook
1. Basis-of-Design Product:
a. Bobrick: B-6727
b. Or approved equal.

2.05 WARM-AIR DRYERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Dryer, Inc., Livonia, MI.
2. American Specialties, Inc., Yonkers, NY.
3. Bobrick Washroom Equipment, Inc., North Hollywood, CA.
4. Bradley Corporation, Menomonee Falls, WI.
5. Dyson Inc., Chicago, IL.
6. Excel Dryer Corporation, East Longmeadow, MA.
7. World Dryer Corporation, Berkeley, IL.
8. Or equal, as approved under provisions of Division 01.

B. Warm-Air Dryer
1. Basis-of-Design Products
a. Dyson: Airblade V.
b. Or approved equal.

2.06 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.
3. Or equal, as approved under provisions of Division 01.

B. Underlavatory Guard
1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.07 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Specialties, Inc., Yonkers, NY.
   2. Bobrick Washroom Equipment, Inc., North Hollywood, CA.
   3. Bradley Corporation, Menomonee Falls, WI.
   4. Or equal, as approved under provisions of Division 01.

B. Utility Shelf
   1. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
   2. Size: 24 inches unless indicated otherwise.
   3. Material and Finish: Not less than nominal 0.05-inch- thick stainless steel, No. 4 finish (satin).
   4. Basis-of-Design Products: Bobrick B295x24.

C. Mop and Broom Holder:
   1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
   2. Length: 36 inches unless indicated otherwise.
   3. Hooks: Three unless indicated otherwise.
   4. Mop/Broom Holders: Four unless indicated otherwise, spring-loaded, rubber hat, cam type.
   5. Material and Finish: Stainless steel, No. 4 finish (satin).
      a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
      b. Rod: Approximately 1/4-inch- diameter stainless steel.
      c. Basis-of-Design Products: Bobrick B223x36.

2.08 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 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. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 10 44 13

FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Cabinets.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. NFPA 10 - 2012 - Standard for Portable Fire Extinguishers.

C. CFC - California Fire Code 2019, Chapter 9, Section 906 Portable Fire Extinguishers.

D. Title 19, CCR, California Code of Regulations, Public Safety, State Fire Marshal Regulations, Division 1, Chapter 3.

E. UL Underwriters Laboratories Inc., Fire Protection Equipment.

F. ADA - Americans with Disabilities Act of 1990
   1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

1.03 SUBMITTALS

A. Product data showing physical dimensions, operational features, color and finish, anchorage details, rough-in measurements, location and details.

B. Manufacturer’s installation instructions.

C. Manufacturer’s operation and maintenance data. Include test, refill or recharge schedules, procedures and re-certification including requirements applicable to Work.

1.04 QUALITY ASSURANCE

A. Conform to Title 19-CCR, Division 01, Chapters 1 and 3, and 2019 CFC, Section 906 requirements for extinguishers.

B. Fire extinguishers shall have current certification tag attached.

C. Fire extinguishers must be UL certified.

D. Cabinets shall comply with CBC Chapter 11B, Sections: 11B-307, 11B-308, 11B-309 and 11B-403.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperatures may cause freezing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Larsen's Manufacturer's Company, Ft. Lauderdale, FL.
   2. Potter-Roemer, Inc., Santa Ana, CA., UL No. EX 3697.
   3. Amerex Corporation, Los Angeles, CA, UL No. EX 2835.
   4. Ansul Inc., Marinette, WI., UL No. EX 21993
   5. Kidde Mebane, NC., UL No. EX 966.
   6. JL Industries Inc., Bloomington, MN.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 EXTINGUISHERS

A. ABC Multi-Purpose Dry Chemical:
   1. Red glossy polyester coated steel cylinder with pressure gauge and nozzle.
   2. Size: 5 lbs.
   3. Class: 2A:10B:C
   4. Positioning: 48 inches max. to handle.

2.03 CABINETS

A. Model: Larsen's - Model: 2409-6R (2-1/2" trim), provide Fire-Rated cabinets at rated assemblies (Larsen's Fire Shield "FS").
   1. Size: To accommodate extinguisher specified herein.
   2. Mounting Style: Semi-Recessed, bottom of cabinet at 32 inches above finished floor, 4 inches maximum projection.
      a. Stainless Steel: No. 304 stainless with No. 4 finish.
   3. Door Style(s):
      a. Duo Vertical Panel with lock.
   4. Glazing:
      a. Clear Tempered safety glass.
   5. Lettering
      a. Vertical: White

B. Accessibility Type Latching and locking hardware be operable with a single effort by lever type hardware, or other hardware designed so as to not require grasping the opening hardware and not require a force greater than 5 lbs to open.
   1. Force required to activate controls shall not exceed 5 lbs.
   2. Be recessed or semi-recessed in order not to protrude more than 4 inches from face of wall.

3. Mount so handle of fire extinguisher is 48" maximum AFF.

2.04 FABRICATION OF CABINETS

A. Form body of cabinet with tight inside corners and seams.

B. Pre-drill holes for anchorage.

C. Form perimeter trim and door stiles by welding, filling and grinding smooth.

D. Hinge doors for 180 degree opening with continuous piano hinge.

E. Glaze doors with resilient channel gasket glazing.

F. Pull Handle: U-pull type with roller catch, 5 pounds maximum operating force.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify rough openings for cabinet are correctly sized and located.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install cabinets plumb and level in wall openings. Locate cabinets to a height to yield a maximum of 48 inches from finish floor to top of handle of fire extinguisher unit.

B. Secure rigidly in place.

3.03 INSPECTION BY REGULATORY AGENCIES

A. Schedule inspection with agencies and Owner.

B. Furnish approval certificates issued by jurisdictional authorities.

3.04 SCHEDULE: FIRE EXTINGUISHERS AND CABINETS

A. As indicated in drawings: Class 2A:10B:C fire extinguisher and cabinet.

END OF SECTION

SECTION 10 80 00

MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous specialty items applicable to Work and not specified under individual technical sections.

1.02 SUBMITTALS

A. Shop drawings and product data for all components, hardware and accessories under provisions of Division 01, General Requirements. Show construction and fabrications details, procedures, layout and erection diagrams, anchorages and pertinent information for specified specialty item.

B. Samples sufficiently sized to illustrate clearly all sizes, available colors, materials, patterns and finishes.

C. Manufacturer's installation instructions and maintenance recommendations under provisions of Division 01, General Requirements.

1.03 FIELD MEASUREMENTS

A. Verify site conditions. Obtain accurate dimensions of openings, levels, locations and arrangements of embedded and concealed anchorages. Report discrepancies between drawings and field dimensions to Architect before commencing work.

PART 2 - PRODUCTS

2.01 SPECIALTY ITEMS

A. LOCK BOX - INDIVIDUAL SECURITY LOCKER
   1. Heavy Duty 3200 Knox-Box surface-mounted. Furnish separate boxes for fire and sheriff’s departments at each location shown. Confirm installation locations with local authorities prior to installation.
   2. Capacity: 10 keys and access cards.
   3. Finish: Polyester powder coat, aluminum.
   4. Manufacturer: The Knox Co., Newport Beach, CA, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment specialties according to manufacturer's recommended procedures.

B. Provide electrical connections to building systems. Wire internal connections when part of units functionality.

C. Install with wall anchors per manufacturer's recommendations.

END OF SECTION

SECTION 10 81 13

BIRD DETERRENCE SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electronic bird deterrence system.

B. Holographic Bird Gel.

1.02 SUBMITTALS

A. Wire System: Product data and attachment methods.

B. Electronic Bird Deterrence System: Shop drawings indicating track section layouts, wiring, track attachment, and all product and accessory data.

1.03 QUALITY ASSURANCE

A. Installers: Company familiar with bird deterrence systems. Utilized certified installation company skilled in installation of deterrence system. Manufacturer certified for electronic bird deterrence system.

B. Test wiring system for insulation to ground.

1.04 WARRANTY

A. Provide under provision of Division 01, General Requirements.

B. One (1) year Warranty, warrants entire Work against defects in materials and workmanship for twelve (12) months from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Electronic Bird Deterrence System: Bird-B-Gone, Inc. Mission Viejo, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 MODEL DESCRIPTION

A. Electric Bird Deterrence System: Bird-B-Gone, Bird Jolt Flat Track.
   1. 110 volt charge unit, 800V output, UL approved, Model CHG-AC750.
   2. Model Designation: Bird Jolt Flat Track - Electric Bird Abatement System
   3. Height: 1/4" at the highest point.
   4. Width: 1-1/2"

5. Patented anti-arcing design
6. Two (2) strips of corrosion resistant copper, ETP (ElectrolyticTough Pitch) .005" dia., tin-plated per ASTM B-33 Knitted WireMesh (continuous knitted wire mesh stocking) .25" high; .032" thick, sewn into the top of the track.
7. Two (2) glue troughs running on bottom of strip for easy installation and maximum adhesion.
8. Base Strip: Flexible. Can bend 360 degrees on vertical plane.
9. Length: 100 ft. rolls.
10. Packaging: 100 ft. kits with all installation hardware needed.
11. Color: To match adjacent finishes, from manufacturer's standard colors.
12. Number of rows based on project conditions.
13. Mounting Systems: As determined based on project conditions. Steel, Brick, Stone or Concrete: Attach Bird Jolt Flat Track and Bird Jolt Flat Track connectors using an outdoor construction adhesive that is non-silicone based. Purchase directly from the manufacturer or call for recommended adhesives.
14. Lead-in Wire: Use 14-gauge copper lead-in wire.
15. Bird Jolt Flat Track System Kit Components: Flexible U.V. stabilized PVC base with corrosion resistant copper, ETP (Electrolytic Tough Pitch) .005" dia., tin-plated per ASTM B-33 knitted wire mesh (continuous knitted wire mesh stocking) sewn into base strip.
16. Furnish and Install Bilingual Warning labels at a minimum of 1 per every 10 LF of parapet
17. Provide anti-damming risers every 5 LF of track. Where more than one row of track occurs on a parapet, ensure that dams are aligned on all rows to ensure proper water flow.
18. Charging Systems: TBD.

B. Spectrum V Holographic Bird Gel.
1. Bird Pressure: Light to Medium.
2. Material: UV Protected PVC Dish containing non-toxic gel that provides bird deterrence control with sight, sense and smell.
3. Quantities: As required for complete installation.
4. Install at all horizontal roof ledges not specified to receive Item 2.02.A above.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine work area, and note any detrimental work conditions.

B. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

A. Clean surfaces thoroughly before work.

B. Pre-drill any screw attachments into concrete, stone or plaster.

C. Remove or repair surfaces that may damage Electric Bird Abatement System including overhanging foliage, brush and loose parts on the structure.

3.03 INSTALLATION

A. Install per manufacturer’s instructions.

B. Electronic Bird Deterrence System: Install Bird Jolt Flat Track-Electric Bird Abatement System
   1. Warning: Electrical track systems should not be used if contact with flammable liquids, vapors, or fumes is possible. Electric track systems should never be used in and around gas stations.
   2. Install with appropriate anchors or fasteners for each substrate.
   3. Glue track to mounting surface.
   4. All Flat Track strips should be adhered (glued or secured) to surface area being treated.
   5. Space materials in accordance with the manufacturer’s recommendations.
   6. Follow angles and contours closely.
   7. Install bilingual warning labels near power source and no more than 10’ apart on buildings.

C. Holographic Bird Gel: Install per manufacturer's installation instructions.
   1. Install at all horizontal roof ledges not specified to receive Item 2.02.A above.
   2. Install at spacing required per manufacturer's recommendations.

3.04 DEMONSTRATION AND TRAINING

A. Perform Owner training and demonstrate equipment, proper use and maintenance of equipment per Division 01 General Requirements

3.05 INSPECTION

A. Visually inspect for debris, loose connections, and mounting.

B. Test electrical circuits for proper functioning.

C. Correct all deficiencies.

END OF SECTION

SECTION 11 52 13

PROJECTION SCREENS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Automatic, electrically operated, roll-up projection screens, controls, and accessories.

1.02 RELATED SECTIONS

A. Section 05 50 00 - Metal Fabrications.

B. Section 26 00 10 – Electrical Work.

C. Section 09 22 16 - Non-structural metal framing

D. Section 09 53 15 - Acoustical Ceilings.

E. Section 08 31 13 - Access Doors and Panels

1.03 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Manufacturer's installation, operation, maintenance, and cleaning instructions.

C. Shop Drawings: Indicate dimensions, fabrication and installation details, and electric wiring diagrams. Indicate all dimension of screen in elevation.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm with 10 years minimum successful experience manufacturing electric projection screens.

B. Installer Qualifications: Authorized and trained by the manufacturer to install systems required.

C. Definition of Terms for Specifications:
   1. Fresnel lens: Lens composed of many small lenses arranged to produce a short focal length.

2. Gain: Indication of screen's luminance or brightness measured perpendicular of screen center and measured relative to a block of magnesium carbonate which serves as the standard for 1.0 gain. Higher numbers indicate greater brightness. Gain shall be determined in accordance with SMPTE RP 94-2000.
3. Keystone: Distortion of projected image when screen is not perpendicular with center line of projected image.
4. Lenticulated: Surface onto which a pattern of small convex lenses have been impressed.
5. Viewing angle: Angle from perpendicular center of screen at which the gain or brightness is decreased by 50 percent

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction

1.06 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

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
1. Draper, Inc.

2.02 PROJECTION SCREENS

A. Basis of Design
1. Items specified are to establish a standard of quality for design, function, materials, and appearance.

B. Type A – Wall Mounted Electric Projection Screens - Draper Targa XL:
1. Viewing Surface: Matt White XT1000E
2. Viewing format: See attached screen schedule.
3. UL Label: Recessed installed in return air ceiling plenums shall be certified by Underwriters Laboratory (UL), Inc. and shall bear UL label.
4. Size: See attached screen schedule.
5. Masking: Black masking borders.
6. Extra Drop Masking: See attached screen schedule
7. Finish: Coordinate finish with Architect.
8. Low voltage control: Single Motor Low Voltage Control (LCV) – built-in.
9. RS232 Serial Control
10. Wall switch: Low voltage, wall mounted, three position switch.
11. Limit switches: Pre-set, adjustable switches to automatically stop viewing surface, and case closure door where scheduled, in up or down positions.

12. Silent motor with LVC: Silent Motor with Integrated LVC for sizes up to 9 by 12 feet.
13. Ceiling trim/finish kit: Include manufacturer's recommended ceiling trim/finish kit accessory as required.
14. Mounting assemblies: Include manufacturer's recommended mounting brackets, hanging hardware, and all required attachment accessories required for a full and complete install.

2.03 VIEWING SURFACES CONSTRUCTION AND PERFORMANCE

A. Viewing Surfaces: Screen A
1. Matt White XT1000E: Flame retardant, mildew resistant, white, vinyl coated fiberglass screen that can be rolled and cleaned with mild soap and water solution.
2. Gain: 1.0.
3. Viewing angle: 60 degrees.
4. Masking: Black.
5. Drop: Refer to drawings for floor to ceiling height.
6. Drop Color: Black.
7. Seams: To the extent possible screen surfaces shall be seamless. Where required by size, provide a minimum number of flat, horizontal seams.
8. Vertical seams are not acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Coordinate provision of screens with locations of other wall and ceiling mounted components such as visual display boards, casework, structural framing, light fixtures, air diffusers, ducts, and fire sprinklers to eliminate potential conflicts.

B. Coordinate requirements for blocking, construction of recesses, and auxiliary structural supports to ensure adequate means for installation of screens.

C. Coordinate requirements for power supply, conduit, and wiring required for electric screen and controls.

D. For installation in non-accessible ceilings, coordinate a 24" x 24" access panel adjacent to low voltage connections at screen case.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Installation hardware: Provide attachment hardware, fasteners, and other components of type, size, and spacing recommended by manufacturer for complete, functional, secure installation of screens.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion

TABLE 1. AV PROJECTION SCREEN SCHEDULE

Room Number	Room Name	Screen Type	Viewable Image Size (Inches)	Distance from Bottom of Image to Finished Floor (Inches)	Total Black-drop (Inches)	Qty Per room
101	Event Space	A	190 x 106	72	42	1

END OF SECTION

SECTION 11 52 14

PROJECTOR MOUNTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Ceiling projector mounts.

B. Accessories

1.02 SUBMITTALS

A. Shop Drawings showing mounting requirements and materials. Shop Drawings shall also include anchor typed and structural calculations by a California Structural Engineer confirming conformance with Section 1613A, California Building Code.

B. Indicate anchorage and accessory items, details signed by licensed Structural Engineer. Costs relating to engineering, calculations, and stamps by Structural Engineer shall be borne by Contractor.
   1. Manufacturer's Installation Instructions: Indicating installation procedures and component installation sequence, clearances and tolerances from adjacent construction and maintenance.

1.03 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.04 COORDINATION

A. Coordinate the work with ceiling construction.

B. Coordinate with Details.

C. Coordinate with OFOI Projectors.

1.05 REGULATORY REQUIREMENTS

A. Architect will submit drawings and calculations to the Division of State Architect for approval prior to fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of the following manufacturer or supplier form the basis for design and quality intended.
   1. Draper Inc., Spiceland, IN.
   2. Chief Manufacturing Company, Savage, NM.

3. Premier Mounts, Anaheim, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.02 COMPONENTS

A. Product: Chief Manufacturing company Model RPAU Universal Projector Mount.
1. Operation: Universal Ceiling Mount. Quick projector connect and disconnect with convenient lamp and filter access on most projectors
2. All-Points Security Systems provides exclusive steel into steel locking hardware at all connection points to protect against thef
3. Steel construction finish in black color.
4. Fixed extension column, 1.5" NPT, Refer to drawings for length from structure to finish ceiling and projector unit. Provide length as required.
5. Provide support Bracket and cable assembly (splay arrangement) for extensions longer than 36 inches.
6. Suspended Ceiling assembly: Escutcheon ring accessories

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that ceiling structure are ready to receive work.

3.02 INSTALLATION

A. Install unit assembly in accordance with manufacturer's instructions.

B. Provide electrical, accessories, hook-up for complete operation.

3.03 ERECTION TOLERANCES

A. Maximum Variation of Unit From Plumb: Zero tolerance.

END OF SECTION

SECTION 12 24 13

ROLLER SHADES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Manually operated roller shades with single rollers.
   2. Motor-operated roller shades with double rollers.

B. Related Requirements:
   1. Section 05 40 00 "Cold-Formed Metal Framing" for backing and grounds for mounting roller shades and accessories.
   2. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.02 REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ANSI - American National Standards Institute WCMA - Window Covering Manufacturers Association
   1. A100.1 - Safety of Corded Window Covering Products

C. CEC - 2019 California Electrical Code, 24 CCR Part 3.

D. NEMA - National Electrical Manufacturers Association
   1. ICS 6 - Industrial Control and Systems: Enclosures

E. Chapter 8, California Building Code.

F. NFPA - National Fire Protection Association
   1. 701 - Flame Propagation of Textiles and Films

G. UL - Underwriters Laboratories
   1. 325 - Door, Drapery, Gate, Louver, and Window Operators and Systems

1.03 COORDINATION

A. Verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.04 SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each type of roller shade.
1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Installation Accessories: Full-size unit, not less than 10 inches long, for each color and finish proposed.

D. Roller-Shade Schedule: Use same designations indicated on Drawings.

E. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

F. Closeout Submittals
1. Maintenance Data: For roller shades to include in maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.
2. Provide additional 5% of the total length of qualified stainless steel chain required on the project, not to exceed the quantity of one 500' spool.
3. Provide additional 5% of each type of shade mounting hardware or brackets, but not less than one pair of each type.
4. Provide additional 5% of each motor type used on project, but not less than quantity of one each.
5. Provide additional 5% of each motor control component used on project, but not less than quantity of one each.
6. Clearly label all spare components and supply to Owner upon completion in original packaging for storage on site by Owner.
7. Maintenance Service: Provide as a separate bid amount the cost for annual maintenance contract providing service ‘on demand’ for repair and maintenance as may be generally anticipated for the conditions of this project.

1.06 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: 10 years minimum experience manufacturing products comparable to those specified in this section.
2. Installer: 3 years minimum experience installing products comparable to those specified in this section.

B. Fire Classification Requirements
   1. ASTM E84 and Chapter 8 California Building Code for Fire Resistive Standards. All materials shall have flame spread of less than 25 and smoke developed of less than 450.
   2. NFPA 701 Fire Tests for Flame Propagation of Textiles and Films.

C. Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.
   2. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.09 WARRANTIES

A. Operating Components: 5 years from Date of Substantial Completion and contain provisions that installation is to remain operational without fault for the warranty period and include all operating parts, including shade-cloth.

B. Shade Drives and Motor Control System Electrical Components: 5 years from Date of Substantial Completion for shade motors and for all other control components containing provisions that installation will remain operational without fault for the warranty period and include all operating parts.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, acceptable manufacturers include, but are not limited to, the following:
   1. Castec Inc, North Hollywood, CA.
   2. Draper Inc, Spiceland, IN.
   3. Hauser Shade Co, Richmond, CA.
   4. Hunter Douglas Fabrication Co, Poway, CA.
   5. Mariak Contract, Rancho Dominguez, CA.
   6. MechoShade Systems Inc, Long Island City, NY.
   7. Roll-A-Shade, Lake Elsinore, CA.
   8. Skyco Shading Systems Inc, Santa Ana, CA.

9. Solar Shading Systems, Costa Mesa, CA.
10. Or equal, as approved in accordance with Division 01 requirements for Substitutions.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.02 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Bead Chains: Stainless steel, rated 90 lbs breading strength.
a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb or sill mounted.
2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands: Light-filtering or light-blocking fabric as indicated.
1. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum, enclosed in sealed pocket of shadeband material.

2.03 MOTOR-OPERATED, DOUBLE-ROLLER SHADES

A. Motorized Operating Systems: Provide factory-assembled, shade-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
1. Electrical Components: UL 325, listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
a. Electrical Characteristics: Single phase, 110 V, 60 Hz.

3. Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for control activation of shades:
    a. Microprocessor Control: Where indicated, provide electronic programmable means for setting, changing, and adjusting control features; isolated from voltage spikes and surges. All motorized shades shall have 24VDC Poer and BACnet IP options to tie into the building management system.
        1) Coordinate with building management system as specified in Division 25.
4. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop shade movement automatically at fully raised and fully lowered positions.
5. Operating Features:
    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
    b. Capable of interface with audiovisual control system.
    c. Capable of accepting input from building automation control system.
    d. For sensor- or timer-controlled systems, provide override switch.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.
    1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under.
    2. Inside Roller:
        a. Roller Drive-End Location: Right side of inside face of shade.
        b. Direction of Shadeband Roll: Regular, from back of roller.
    3. Outside Roller:
        a. Roller Drive-End Location: Left side of inside face of shade.
        b. Direction of Shadeband Roll: Regular, from back of roller.
    4. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Inside Shadebands: Light-filtering fabric.
    1. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum, enclosed in sealed pocket of shadeband material.

F. Outside Shadebands: Light-blocking fabric.
    1. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum, enclosed in sealed pocket of shadeband material.

G. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

2.04 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant, as scheduled in Finish Schedule on Drawings.
   1. Orientation on Shadeband: Up the bolt.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant, as scheduled in Finish Schedule on Drawings.
   1. Orientation on Shadeband: Up the bolt.

2.05 INSTALLATION ACCESSORIES:

A. Surface-mounted type Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
   1. Shape: L-shape
   2. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 3 inches.
   3. Provide where face-of-wall mounting is indicated.

B. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
   1. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 6 inches.
   2. Provide pocket with lip at lower edge to support acoustical ceiling panel.
   3. Provide where above-ceiling installation is indicated.

C. Endcap Covers: To cover exposed endcaps.

D. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
   1. Closure-Panel Width: 2 inches.

E. Side and Sill Channels: With light seals and designed to eliminate light gaps at sides and sill of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
   1. Provide where light-blocking fabric is indicated.

F. Installation Accessories Color and Finish: As scheduled in Finish Schedule or, if not scheduled, manufacturer’s standard baked enamel or powder-coat finish in custom color to match adjacent wall.

2.06 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with ANSI/WCMA A100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
   2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
   1. Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
   2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, operational clearances, [accurate locations of connections to building electrical system,] and other conditions affecting performance of the Work.

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

3.02 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
   1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.03 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.04 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.05 INSTRUCTIONS/TRAINING TO OWNER'S PERSONNEL

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades

B. Instruct Owner’s personnel in proper operation and maintenance of all systems, equipment and similar items which were provided as part of Work.

C. Contractor shall provide schedule to Owner for approval for each of instruction periods required. Total hours of training, not less than 1 hour for each individual equipment specified or scheduled.

D. Instruction sessions will be held in Owner designated area on project site and at Owner’s convenience.

E. Instructors shall be qualified by product manufacturer in subject matter presented at training session.

END OF SECTION

SECTION 12 59 17

WALL SYSTEMS FURNITURE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Structural wall framing system

B. Wall skins.

C. Frames for doors and glazed openings.

D. Doors and door hardware.

E. Glass and Glazing.

F. Misc. trims for junctions and building interface.

G. Modular power, monitor shrouds and other technology interface

H. Acoustic insulation.

I. Related Sections:
   1. Section 08 71 00, Door Hardware.

1.02 PERFORMANCE REQUIREMENTS AND REFERENCE STANDARDS

A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.

B. ANSI/BIFMA
   1. Wall units will support a maximum load of 331 lbs. per linear foot per side in compliance with ANSI/BIFMA X 5.6.

C. ASTM: American Society for Testing and Materials
   1. ASTM E84 “Standard Method for Surface Characteristics of Building Materials”.
   2. ASTM E 72 “Standard Test Methods of Conducting Strength Tests of Panels for Building Construction”.
   3. ASTM E 90 “Method for Laboratory Measurements of Airborne Sound Transmission Loss of Building Partitions”.

D. Underwriters Laboratories
   1. Pre-wired modular power components shall be UL 183 listed

E. 2019 California Building Code.

F. 2019 California Electrical Code.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product data for specified products.

B. Submit detailed shop drawings, showing all elements of the system, including fabrication and installation details, fastenings, accessories, types of material and finishes.

C. Shop drawings to include product reference detail to link individual wall components to factory orders and packing lists.

D. Product certification of compliance with specified performance characteristics and criteria, and physical requirements.

E. Manufacturer’s installation and assembly instructions.

F. Closeout Submittals

G. Warranty documents as specified.

H. Maintenance data.

1.04 QUALITY ASSURANCE

A. Installation shall be by manufacturer’s or a qualified dealer's trained personnel.

B. Supplier shall take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of the work.

1.05 DELIVERY, HANDLING AND STORAGE

A. Deliver wall components containerized, cartoned or crated to provide protection during transit. Include with bid any necessary storage precautions required for the product being offered.

B. Installation shall not commence until building is enclosed and climate controlled, and finishing operations, including adjacent walls, ceiling (including lighting, sprinklers & HVAC), floor-covering and painting, are complete.

C. Relocatable wall installer to inspect partition components upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the owner’s representative. Remove and replace damaged items as described.

D. It shall be the responsibility of the wall supplier to properly package all components for storage and define storage program to be provided on site by General Contractor at no charge, to ensure product performance.

E. Relocatable wall components shall be tagged and labeled with identification numbers that correspond to product reference numbers as called out on shop drawings.

1.06 WARRANTY

A. Submit manufacturer's standard warranty document. Product shall be covered under limited lifetime warranty.

PART 2 - PRODUCT

2.01 ACCEPTABLE MANUFACTURERS AND MODELS

A. Steelcase, Grand Rapids, MI Model: IRYS POD

B. Or approved equal in accordance with Division 01, General Requirements for Substitutions.

2.02 RELOCATABLE WALL SYSTEM

A. Refer to Finish Schedule on Drawings for Finishes.

B. Relocatable, non-progressive, capable of four direction lateral expansion with reusable components.
   1. Wall Thickness: 4" nominal
   2. Wall height: 8'-1.25" high
   3. Vertical and horizontal joinery: ¼" reveal
   4. Utility Wireways: Provide access through structural framing, junctions, end conditions and utility panels.

C. Performance Requirements
   1. Solid painted wall assemblies to have a Class-A rating in accordance with ASTM E84-97a "Standard Method for Surface Characteristics of Building Materials".
   2. All solid and framed glass systems are in compliance with ASTM E 72 "Standard Test Methods of Conducting Strength Tests of Panels for Building Construction".
   3. Solid wall sound attenuation capabilities will range from a minimum (requiring no field additive insulation or gaskets) of 42 STC to a maximum STC level of 52.
   4. Glazed wall sound attenuation capabilities will range from a minimum of 30 STC to a maximum STC level of 33 for single glazed construction, and

will range from a minimum of 42 STC to a maximum STC level of 44 for double glazed construction.

5. Solid wall units will support a maximum load of 331 pounds per linear foot per side in compliance with ANSI/BIFMAX5.6.

D. Wall design will accommodate ceiling heights up to 12'-0"

E. Solid skins and glass frames shall be vertically oriented up to 142" high or landscape oriented up to 120" wide

F. Vertically oriented skins and glass frames shall be a maximum of 60" wide. Landscape oriented skins and glass frames shall be a maximum of 60" high

G. Design must permit extension in two, three or four way conditions without removal of adjacent panels or floor track

H. All solid and fabric skins shall be capable of field cutting to accommodate end filler conditions or other modifications to overall partition length

I. The system shall provide a 3" vertical adjustment (+/-1½ ") in overall height to accommodate floor and ceiling irregularities, allowing for a maximum of +/- 3/4 " at the floor and +/- 3/4 " at the ceiling, including wall assemblies, doors and door frames.

2.03 WALL COMPONENTS

A. Solid skins shall be ¾" thick, with surfaces of powder coat painted steel (22 gauge), fabric wrapped steel, veneer, or laminate (LPL or HPL), enclosing a particle board substrate.

B. Markerboard skins will be clad with ceramic steel dry-erase surfaces.

C. Markerboard skin options to include embedded technology for interacting with projectors and computers.

D. Monitor shrouds will allow for surface mounting of display monitors with minimal projection from face of wall.

1. Different monitor sizes can be used without changing wall components
2. Monitors will not be enclosed behind glass for ease of accessibility.
3. Shrouds will include a minimum of two internal simplex receptacles for power.
4. Shrouds will allow for internal data terminations.
5. Monitors are not included.

E. End fillers for relocatable wall adjacent to fixed walls and columns shall be similar in construction to solid wall skins and fit into end channel on the abutting wall. End channels and Mini-ends will include a continuous light and sound seal.

F. End fillers may utilize solid skins that are field cut to narrower unit width as indicated on drawings. Cut skins will be manufactured in the same manner and with same materials as all other solid skins.

G. Skins glass frames and corresponding framing elements shall be manufactured in widths as indicated on shop drawings.

H. Solid skins and glass frames shall be mounted to structural frame by engaging an operable mechanical bracket that securely engages the framing components. The mechanical bracket will be designed to ensure that un-engaged brackets are easily identified.

I. The installation and removal of solid skins shall require a special tool to limit accessibility to authorized personnel and to ensure security.

J. Solid skins shall be removable for access to wall cavity to facilitate electrical installation and inspection.

K. Solid skins shall be interchangeable with glass frames of equal sizes, and vice versa.

L. Wall structure to accommodate integral lighting fixtures as provided by the relocatable wall manufacturer.

2.04 STRUCTURAL FRAMING COMPONENTS

A. Structural framing posts will include a threaded leveler for adjusting to floor variations

B. Ceiling track shall be one-piece continuous formed steel with continuous factory-installed resilient light and sound.

C. Primary structural components will be formed of 16 gauge steel.

D. Horizontal and vertical framing components will be joined with 11 gauge corner brackets.

E. Vertical structural framing components shall incorporate integral slotting for direct mounting of panel-hung components on either or both sides of the wall, including side-by-side mounting. Continuous seals will conceal all slots. Structural framing components shall allow for direct mounting of panel-hung furniture without the need for any additive, field installed components. Structural framing can accommodate the direct interface of overhead storage and shelving without the use of any additional adapter/transition brackets.

F. Slotting will allow for wall mounted components to be positioned vertically at 1” increments from 18” to 120” AFF.

G. The system shall allow for installation on hard surface, or carpeted flooring, without the use of mechanical fasteners (in non-seismic applications).

H. The system can be installed to the underside of suspended ceilings without the use of destructive fasteners, with a one-piece continuous steel ceiling track.

I. Structural framing elements will be factory prepared for all connections and joinery hardware, and pre-punched for cable management.

J. Structural posts will be factory punched to optimize all required segmentation configurations, so that posts are interchangeable and share common hole locations.

K. Framing components to include factory applied polypropylene gaskets to serve as light and sound seals between the relocatable wall and fixed architectural elements.

2.05 DOOR COMPONENTS

A. Butt hinge door frames shall be reversible, allowing the installer to change the door swing as part of the installation process.

B. Butt-Hinged door frames shall be formed steel and aluminum and shall include continuous resilient sound seal at side and top jambs. Frame shall be designed to provide vertical adjustment to compensate for floor and ceiling irregularities without the need to cut doors on site. Frames shall be mortised and reinforced for hardware as specified in section 08 71 00.

C. Wall manufacturer to provide offset hinges for planar alignment of door with corridor side of wall.

D. Reversible door frames and door leaves to be capable of receiving automatic door bottoms for improved sound control.

E. Slide Door Units shall include fascia, header and track, finished opening frame, and sliding door. Track Shall be aluminum. Roller assemblies will be steel, with high quality ball bearing wheels. Hardware assembly to include pneumatic braking mechanism.

F. Slide door frames and door leaves to be capable of receiving automatic door bottoms for improved sound control.

G. Slide door track will be fully supported by wall structure, without requiring additional structural support from other architectural elements.

H. Solid door leaves shall be 1-3/4" thick; available in wood particleboard core with factory finished medium density overlay face or veneer. Doors shall be pre-finished and pre-mortised for hardware specified in section 08 71 00.

I. Polished glass doors to be ½” thick tempered glass. Doors shall be prepared and pre-drilled for hardware as specified in section 08 71 00.

J. Hardware shall be

1. Furnished and installed by the relocatable wall manufacturer.
2. (OR) Furnished by the finish hardware contractor to the relocatable wall contractor for this installation.

K. The following hardware is to be furnished and installed by the relocatable wall contractor:
1. Steelcase offset hinges for reversible door frame
2. Slide door track, hardware, door pull and/or lock

L. Cylinders and cores that are configured to specific master-key requirements will be provided and installed by others – see Section 08 71 00.

2.06 GLAZED OPENING COMPONENTS

A. All glass frames to be flush glazed.

B. Captured glass frame assemblies shall accommodate single glazed or double glazed configurations. Single glazed assemblies shall be capable of retrofit to double glazed, and vice-versa.

C. The structural frame and glass frame configuration will allow for glass frames to be exchanged for solid skins and vice-versa, without having to alter the structural frame components.

D. Captured glass frames shall be pre-glazed prior to arriving at site.

E. All glass framing components will be constructed of extruded aluminum, either powder coat paint and/or clear anodized as called for in finish schedule.

F. All glass and glazing for relocatable walls shall be furnished under this section.

G. All unitized glass shall be factory installed using extruded non-PVC glazing strips. Foam tape or PVC glazing is not acceptable.

H. All glass shall comply with Federal Safety Standard for Architectural Glazing Materials (16 CFR, Part 1201).

I. Glass Types:
1. Refer to Section 08 80 00, Glazing.

2.07 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Relocatable wall construction shall allow for field installation of modular and/or hard-wired electrical components.

B. If specified, modular power shall be furnished under this section and shall include:
1. UL 183 4-circuit, 8-wire prefabricated/pre-wired power distribution system.

2. The modular power system shall be comprised of power blocks, receptacles, power harnesses and infeeds.
3. Modular power system shall be electrified by using either a floor infeed, top infeed, or power harness.
4. The modular power block shall provide for the insertion of receptacles of either the same or different circuits.
5. Modular power components will allow for modular electrical receptacles, such that the circuit assignment for any termination can be easily changed by exchanging modular receptacles.
6. Modular power receptacles will include an acoustical back-box to minimize sound transmission at power cutouts and terminations.

2.08 LED LIGHTING COMPONENTS

A. LED light fixtures will be provided by the wall manufacturer to supplement general lighting in video conferencing rooms. Refer to plans for locations and switching requirements.

B. Fixtures shall be factory assembled and integrated into the wall structure to be flush to the surface of the wall.

C. Light fixtures will be interchangeable with solid skins of same sizes.

D. Light source to be 24V LED light strip.

E. Lighting to include transformer and LED dimming controller for dimming switch device.

F. Light Output Characteristics:
   1. Correlated Color
   2. Temperature: CCT 3,000 K +/- 250 per ANSI color bin
   3. Color Rendering Index: CRI 80 minimum
   4. Intensity (Surface Brightness): 1250 cd/m2 +/- 350 cd/m2

G. The following components will be provided and installed by others, see Division 26 - Electrical:
   1. Electrical enclosure for transformer & dimming controller
   2. Switches or other control devices and related wiring
   3. Final wiring and connections from light fixture to transformer.
   4. Final wiring and connections to building power source

2.09 MATERIALS

A. All metal painted panel surfaces, glass frames, doorframes, base trim and ceiling track will be cold-formed steel or extruded aluminum.

B. Where noted in drawings, aluminum will be extruded aluminum (6063-T6 Aluminum alloy) with a clear anodized finish.

C. All glass shall comply with Federal Safety Standard for Architectural Glazing Materials (16 CFR, Part 1201).

D. Light and sound seals to be polypropylene.

E. Finishes: Refer to Finish Schedule on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that building conditions are ready to receive wall components and that field measurement dimensions are as indicated on shop drawings.

B. Verify that floor level does not vary by more than plus/minus ¾" from specified height.

C. Verify that ceiling level does not vary by more than plus/minus ¾" from specified height.

D. Verify that adjacent *surfaces do not exceed 1/8 inch in 8'-0" variation from plumb.*

E. Verify that floor flatness complies with the American Concrete Institute (ACI) floor flatness (FF) requirements per AC117 and ASTM E1155 for Moderately Flat floors (maximum of 3/8" gap over 90% of samples and 5/8" gap over 100%).

3.02 INSTALLATION

A. Walls shall be installed without permanent fastenings over finished floor tile, carpeting or raised floor to provide for complete flexibility of future changes without having to patch floor material (unless required for door/hardware operation, or to meet structural or code requirements).

B. Partition shall be scribed and neatly fitted to existing building conditions all in accordance with details approved on shop drawings

C. Installer to provide touch-up of all nicks and scratches that may occur to the wall during handling and installation with touch up paint supplied by the manufacturer in matching color.

D. Installation shall not commence until building is enclosed and finishing operations, including ceiling, floor-covering and painting, are complete.

3.03 CLEANING

A. Upon completion of work, this contractor shall remove all of his cartons, trash, crates, etc. and leave the premises broom clean.

B. Washdown of walls shall not be part of this section, but shall be considered normal pre-occupancy cleaning responsibility of G.C., owner or occupant.

3.04 MAINTENANCE

A. It shall be the responsibility of the relocatable wall bidder to include in this proposal, the location of the nearest service facility established to service occupant changes of material requirements.

END OF SECTION

SECTION 14 21 00

ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies electric traction elevators.

B. Work Required:
1. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.
2. All work shall be performed in a first class, safe and workmanlike manner.
3. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the California Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Section 300 for hydraulic elevators. State or local requirements must be used if more stringent.
1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
4. Elevator hoistways shall have barricades, as required.
5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. Machine room to be enclosed and protected.
10. Machine Room temperature must be maintained between 55º and 90º F.
11. If machine room is remote from the elevator hoistway, clear access must be available above the ceiling or metal/concrete raceways in floor for oil line and wiring duct from machine room.

12. Access to the machinery space and machine room must be in accordance with the governing authority or code.
13. Provide an 8” x 16” cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.
14. All wire and conduit should run remote from either the hoistways or the machine room.
15. When heat, smoke or combustion sensing devices are required, connect to elevator machine room terminals. Contacts on the sensors should be sided for 120 volt D.C.
16. Install and furnish finished flooring in elevator cab.
17. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
18. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
19. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
20. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
21. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
22. General Contractor shall fill and grout around entrances, as required.
23. Elevator sill supports shall be provided at each opening.
24. All walls and sill supports must be plumb where openings occur.
25. For applications with jack hole, free and clear access to the elevator pit area for the jack hole-drilling rig is required.
26. Where jack hole is required, remove all spoils from jack hole drilling.
27. When not provided by Elevator Contractor, jack hole shall accommodate the jack unit. If required the jack hole is to be provided in strict accordance with the elevator contractor's shop drawings.
28. Locate a light fixture and convenience outlet in pit with switch located adjacent to the access door.
29. A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).
30. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway (or in the machine room).
31. For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch. For car light and fan: provide a feeder and branch wiring circuits, including main line switch.
32. Wall thickness may increase when fixtures are mounted in drywall. These requirements must be coordinated between the general contractor and the elevator contractor.
33. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc..
    Locate telephone and convenience outlet on control panel.

D. Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
   1. Section 03 30 00 - Cast-In-Place Concrete: elevator pit, and elevator machine foundation.
   2. Section 05 50 00 - Metal Fabrications: pit ladder, divider beams, and supports for entrances, rails and hoisting beam at top of elevator hoistway.
   3. Section 07 13 26 - Self-Adhered Sheet Waterproofing: waterproofing of elevator pit.
   4. Division 23 - Heating, Ventilating, and Air Conditioning: ventilation and temperature control of elevator equipment areas.
   5. Division 26 - Electrical:
      a. Main disconnects for each elevator.
      b. Electrical power for elevator installation and testing.
      c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
      d. The installation of dedicated GFCI receptacles in the pit and overhead.
      e. Lighting in controller area, machine area and pit.
      f. Wiring for telephone service to controller.
   6. Division 26 - Emergency (Standby) Power Supply Systems: emergency generator for elevator operation.
   7. Division 28 - Fire Alarm Systems: The installation of fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine area.
   8. Division 27 - Telephone Systems: ADAAG-required emergency communications equipment.

E. Applicable Codes: Comply with applicable building and elevator codes at the project site, including but not limited to the following:
   1. California Building Code.
   2. ADAAG, Americans with Disabilities Act Accessibility Guidelines.
   3. California Electrical Code.
   4. ANSI/NFPA 80, Fire Doors and Windows.
   5. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
   6. ANSI/UL 10B, Fire Tests of Door Assemblies.
   7. Local Building Codes
   8. All other local applicable codes.

1.02 SYSTEM DESCRIPTION

A. Equipment Description: Otis Elevator Gen2® gearless machine-room less elevator

B. Equipment Control: Elevonic® Control System.

C. Drive: Regenerative

D. Quantity of Elevators: One (1) Passenger Car

E. Elevator Stop Designations: 1, 2

F. Stops: Two (2)

G. Openings: Two (2) in Line

H. Travel: 15'-0"

I. Rated Capacity: 3,500 lb.

J. Rated Speed: 150 fpm

K. Platform Size: 6'-6 ¾" W x 6'-1 1/8" D (Passenger Car)

L. Clear Inside Dimensions: 6'-5 9/16" W x 5'-5 9/16" D

M. Cab Height: 7'-9"

N. Entrance Type and Width: Single-Slide 42" Wide

O. Entrance Height: 7'-0"

P. Main Power Supply: 208 Volts + or - 5% of normal, Single-Phase, 60 Hz and a separate equipment grounding conductor.

Q. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.

R. Machine Location: Inside the hoistway at the top.

S. Signal Fixtures: Manufacturer's standard with metal button targets

T. Controller Location: Adjacent to Hoistway at Lowest Level

U. Performance:
   1. Car Speed: ± 3 % of contract speed under any loading condition or direction of travel.
   2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
   3. Ride Quality:
      a. Vertical Vibration (maximum): 20 milli-g
      b. Horizontal Vibration (maximum): 12 milli-g
      c. Vertical Jerk (maximum): 4.59 ± 1.0 ft./ sec^3 (1.4 ± 0.3 m/ sec^3)
      d. Acceleration/Deceleration (maximum): 2.62 ft./ sec^2 (0.8 m/ sec^2)
      e. In Car Noise: 55 – 60 dB(A)
      f. Stopping Accuracy: ± 0.375 in. (± 10 mm) max, ± 0.25 in. (± 6 mm) Typical
      g. Re-leveling Distance: ± 0.5 in. (± 12 mm)

V. Operation:
   1. Simplex Collective Operation (Service Car): Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

W. Operating Features - Standard
   1. Full Collective Operation
   2. Anti-nuisance.
   3. Fan and Light Protection.
   4. Load Weighing Bypass.
   5. Independent Service.
   6. Full Collective Operation.
   7. Firefighters' Service Phase I and Phase II
   8. Top of Car Inspection.

X. Door Control Features:
   1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
   2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
   3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

Y. Provide equipment according to seismic zone: 4 in accordance with Seismic Design Criteria

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each system proposed for use. Include the following:
   1. Signal and operating fixtures, operating panels and indicators.
   2. Cab design, dimensions and layout.
   3. Hoistway-door and frame details.
   4. Electrical characteristics and connection requirements.
   5. Expected heat dissipation of elevator equipment in hoistway (BTU).
   6. Color selection chart for Cab and Entrances.

B. Shop Drawings: Submit approval layout drawings. Include the following:
   1. Car, guide rails, buffers and other components in hoistway.
   2. Maximum rail bracket spacing.
   3. Maximum loads imposed on guide rails requiring load transfer to building structure.
   4. Clearances and travel of car.
   5. Clear inside hoistway and pit dimensions.
   6. Location and sizes of access doors, hoistway entrances and frames.

C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.04 QUALITY ASSURANCE

A. Manufacturer: Minimum of fifteen years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program.

B. Installer: Elevators shall be installed by the manufacturer.

C. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.05 DELIVERY, STORAGE AND HANDLING

A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

B. Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.06 WARRANTY

A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.07 MAINTENANCE AND SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of twelve (12) months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator

contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

B. The periodic lubrication of elevator components shall **not** be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc

C. The elevator control system must:
   1. Provide in the controller the necessary devices to run the elevator on inspection operation.
   2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
   3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
   4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
   5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
   6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
   7. Provide the means from the controller to reset elevator earthquake operation.

D. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
   1. Remotely diagnose elevator issues with a remote team of experts
   2. Remotely return an elevator to service
   3. Provide real-time status updates via email
   4. Remotely make changes to selected elevator functions including:
      a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode, activate independent service
      b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
      c. Improve passenger experience**:** Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Elevators provided for passengers shall comply with 11B-407. Where multiple elevators are provided, each elevator shall comply with 11B-407.
   1. General - 11B-407.1
      a. Elevators shall be passenger elevators as classified by ASME A17.1 and shall comply with 11B-407 and with ASME A17.1.

b. Elevator operation shall be automatic.
c. When the only elevators provided for use by the public and employees are combination passenger and freight elevators, they shall comply with 11B-407 and ASME A17.1.

2. Elevator landing requirements - 11B-407.2
   a. Call controls - Where elevator call buttons or keypads are provided, they shall comply with 11B-407.2.1 and 11B-309.4.
   b. Height - Call buttons and keypads shall be located within one of the reach ranges specified in 11B-308, measured to the centerline of the highest operable part.
   c. Size and shape - Call buttons shall have square shoulders, be 3/4 inch minimum in the smallest dimension and shall be raised 1/8 inch plus or minus 1/32 inch above the surrounding surface. The buttons shall be activated by a mechanical motion that is detectable.
   d. Clear floor or ground space - A clear floor or ground space complying with 11B-305 shall be provided at call controls.
   e. Location - The call button that designates the up direction shall be located above the call button that designates the down direction.
   f. Signals - Call buttons shall have visible signals that will activate when each call is registered and will extinguish when each call is answered. Call buttons shall be internally illuminated with a white light over the entire surface of the button.
   g. Keypads - Keypads, where provided, shall be in a standard telephone keypad arrangement and shall comply with 11B-407.4.7.2.
3. Hall signals - Hall signals, including in-car signals, shall comply with 11B-407.4.2.2.
   a. Visible and audible signals - A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call and the car's direction of travel. Where in-car signals are provided, they shall be visible from the floor area adjacent to the hall call buttons.
   b. Visible signals - Visible signal fixtures shall be centered at 72 inches minimum above the finish floor or ground. The visible signal elements shall be a minimum 2-1/2 inches high by 2-1/2 inches wide. Signals shall be visible from the floor area adjacent to the hall call button.
   c. Audible signals - Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that indicate the direction of elevator car travel. Audible signals shall have a frequency of 1500 Hz maximum. Verbal annunciators shall have a frequency of 300 Hz minimum and 3000 Hz maximum. The audible signal and verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the hall call buttons.
   d. Differentiation - Each destination-oriented elevator in a bank of elevators shall have audible and visible means for differentiation.
4. Hoistway signs - Signs at elevator hoistways shall comply with 11B-407.2.3.
   a. Floor designation - Floor designations complying with 11B-703.2 and 11B-703.4.1 shall be provided on both jambs of elevator hoistway entrances. Floor designations shall be provided in both raised characters and Braille. Raised characters shall be 2 inches high. A raised star, placed to the left of the floor designation, shall be provided on both jambs at the main entry level. The outside diameter of the star shall be 2 inches and all points shall be of

equal length. Raised characters, including the star, shall be white on a black background. Braille complying with 11B-703.3 shall be placed below the corresponding raised characters and the star. The Braille translation for the star shall be "MAIN". Applied plates are acceptable if they are permanently fixed to the jamb.

5. Two-way Communication - 1009.8.
   a. Provide a two-way communication system with both audible and visible signals at the elevator landing on each accessible floor that is one or more stories above or below the story of exit discharge. Such systems are not required at elevator landings where they are provided within areas of refuge in accordance with 1009.6.5.
   b. Directions for the use of the two-way communication system and the instructions for summoning assistance via such system and written identification of the specific story, floor location and building address or other building identifier shall be posted adjacent to the two-way communication system. 1009.8.2.
6. Directional Signage - 1009.10.
   a. Provide directional signage complying with 11B-703.5 at elevator landings indicating the locations of the other means of egress and which are accessible means of egress.
7. Elevator door requirements - 11B-407.3
   a. Type - Elevator doors shall be the horizontal sliding type. Car gates shall be prohibited.
   b. Operation - Elevator hoistway and car doors shall open and close automatically.
   c. Reopening device - Elevator doors shall be provided with a reopening device complying with 11B-407.3.3 that shall stop and reopen a car door and hoistway door automatically if the door becomes obstructed by an object or person.
      1) Height - The device shall be activated by sensing an obstruction passing through the opening at 5 inches nominal and 29 inches nominal above the finish floor.
      2) Contact - The device shall not require physical contact to be activated, although contact is permitted to occur before the door reverses.
      3) Duration - Door reopening devices shall remain effective for 20 seconds minimum.
   d. Door and signal timing - The minimum acceptable time from notification that a car is answering a call or notification of the car assigned at the means for the entry of destination information until the doors of that car start to close shall be calculated from the following equation:
      1) T = D/(1.5 ft/s) or T = D/(455 mm/s) = 5 seconds minimum where T equals the total time in seconds and D equals the distance (in feet or millimeters) from the point in the lobby or corridor 60 inches directly in front of the farthest call button controlling that car to the centerline of its hoistway door.
   e. Door delay - Elevator doors shall remain fully open in response to a car call for 5 seconds minimum.
   f. Width - The width of elevator doors shall comply with Table 11B-407.4.1.
8. Elevator car requirements - 11B-407.4

a. Car dimensions - Inside dimensions of elevator cars and clear width of elevator doors shall comply with Table 407.4.1. Where elevators are provided in buildings four or more stories above, or four or more stories below, grade plane, not fewer than one elevator shall be provided for fire department emergency access to all floors (80" x 54" inside care dimensions or otherwise accommodate requirement) per 3002.4 and 3002.4.3.a.
b. Floor surfaces - floor surfaces in elevator cars shall comply with 11B-302 and 11B-303.
c. Platform to hoistway clearance - The clearance between the car platform sill and the edge of any hoistway landing shall be 1 1/4 inches maximum in compliance with 11B-407.4.3.
d. Leveling - Each car shall be equipped with a self-leveling feature that will automatically bring and maintain the car at floor landings within a tolerance of 1/2 inch under rated loading to zero loading conditions.
e. Illumination - The level of illumination at the car controls, platform, car threshold and car landing sill shall be 5 foot candles minimum.
f. Elevator car controls - Where provided, they shall comply with 11B-407.4.6 and 11B-309.4.
    1) Location - Controls shall be located within one of the reach ranges specified in 11B-308.
    2) Buttons - Car control buttons with floor designations shall comply with the following:
        a) Size and Shape - Buttons shall have square shoulders, be 3/4 inch minimum in the smallest dimension and shall be raised 1/8 inch plus or minus 1/32 inch above the surrounding surface.
        b) Arrangement - buttons shall be arranged with numbers in ascending order. When two or more columns of buttons are provided they shall read from left to right.
        c) Illumination - Car control buttons shall be illuminated.
        d) Operation - Car control buttons shall be activated by a mechanical motion that is detectable.
    3) Keypads - Car control keypads shall be in a standard telephone keypad arrangement and shall comply with 11B-407.4.7.2.
    4) Emergency controls - Emergency controls shall comply with 11B-407.4.6.4.
        a) Height - Emergency control buttons shall have their centerlines 35 inches minimum above the finish floor.
        b) Location - Emergency controls, including the emergency alarm, shall be grouped at the bottom of the panel.
g. Designations and indicators of car controls - they shall comply with 11B-407.4.7.
    1) Buttons - Car control buttons shall comply with 11B-407.4.7.1.
        a) Type - Control buttons shall be identified by raised characters or symbols, with on a black background, complying with 11B-703.2 and Braille complying with 11B-703.3.
        b) Location - Raised characters or symbols and Braille designations shall be placed immediately to the left of the control button to which the designations apply.

c) Symbols - The control button for the emergency stop, alarm, door open, door close, main entry floor, and phone, shall be identified with raised symbols and Braille as shown in Table 11B-407.4.7.1.3.

d) Visible indicators - buttons with floor designations shall be provided with visible indicators to show that a call has been registered. The visible indication shall extinguish when the car arrives at the designated floor.

e) Button spacing - A minimum clear space of 3/8 inch or other suitable means of separation shall be provided between rows of control buttons.

2) Keypads - Keypads shall be identified by characters complying with 11B-703.5 and shall be centered on the corresponding keypad button. The number five key shall have a single raised dot. The dot shall be 0.118 inch to 0.120 inch base diameter and in other aspects comply with Table 11B-703.3.1.

h. Car position indicators - Audible and visible car position indicators shall be provided in elevator cars.

1) Visible indicators - Visible indicators shall comply with 11B-407.4.8.1.

a) Size - Characters shall be 1/2 inch high minimum.

b) Location - Indicators shall be located above the car control panel or above the door.

c) Floor arrival - As the car passes a floor and when a car stops at a floor served by the elevator, the corresponding character shall illuminate.

2) Audible indicators - Audible indicators shall comply with 11B-407.4.8.2.

a) Signal type - The signal shall be an automatic verbal annunciator which announces the floor at which the car is about to stop.

b) Signal level - The verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the annunciator.

c) Frequency - The verbal annunciator shall have a frequency of 300 HZ minimum to 3000 HZ maximum.

i. Emergency communication - Emergency two-way communication systems shall comply with 11B-308. Raised symbols or characters, white on a black background, and Braille shall be provided adjacent to the device and shall comply with 11B-703.2 and 11B-703.3. Emergency two-way communication systems between the elevator and a point outside the hoistway shall comply with ASME A17.1.

j. Support rail - Support rails shall be provided on at least one wall of the car.

1) Location - Clearance between support rails and adjacent surfaces shall be 1-1/2 inches minimum. Top of support rails shall be 31 inches minimum to 33 inches maximum above the floor of the car. The ends of the support rail shall be 6 inches maximum from adjacent walls.

2) Surfaces - Support rails shall be smooth and any surface adjacent to them shall be free of sharp or abrasive elements.

3) Structural strength - Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds is

applied at any point on the support rail, fastener, mounting device, or supporting structure.

2.02 DESIGN AND SPECIFICATIONS

A. Provide machine-roomless Gen2™ traction passenger elevators from Otis Elevator Company or approved equal. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
   1. Controller located in separate control room.
   2. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
   3. Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.
   4. LED lighting standard in ceiling lights and elevator fixtures.
   5. Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator Company

2.03 EQUIPMENT: CONTROLLER COMPONENTS

A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
   1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
   2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
   3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
   4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
   5. A separate control room is required.

B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.04 EQUIPMENT: MACHINE AND GOVERNOR

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

B. Governor: The governor shall be a tension type car-mounted governor.

C. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.

D. Hoistway Operating Devices:
   1. Emergency stop switch in the pit.
   2. Terminal stopping switches.

E. Positioning System: Consists of an encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. All driving sheaves and deflector sheaves should have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.

I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.

J. Hoistway Entrances:
   1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
   2. Sills shall be extruded aluminum.
   3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
   4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour
   5. Entrance Finish: Painted. Paint color shall be selected from manufacturers standard color chart.
   6. Entrance marking plates: Entrance jambs shall be marked with 4” x 4” plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
   7. Sight Guards: sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel and gold satin doors.

2.05 EQUIPMENT: CAR COMPONENTS

A. Refer to Finish Schedule on Drawings.

B. Car frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.

C. Cab**:** Standard Steel Shell Cab with Laminated Vertical Panels. Laminate color shall be selected from manufacturers standard color chart. Brushed stainless steel finished vertical trim pieces optional. Brushed stainless steel finished base plate located at top and bottom.

D. Car Front Finish: #4 Satin Stainless Steel

E. Car Door Finish: #4 Satin Stainless Steel

F. Ceiling Type: Flush Ceiling with Four (4) Down Lights and a Real White (EWO) Paint Finish

G. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.

H. Fan: A one-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.

I. Handrail: Handrail shall be provided on the rear wall of the car enclosure. Handrail shall be 1 ½" diameter round bar handrail with a #4 Satin Stainless Steel Finish.

J. Threshold: Extruded Aluminum

K. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

L. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom.

M. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.

N. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.

O. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

2.06 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: One (1) applied car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a #4 satin stainless steel finish.

B. Car operating panel shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the

landings served. All buttons to have raised numerals and Braille markings with 1/8" satin stainless steel projecting button with blue illuminating halo.

C. The car operating panel shall be equipped with the following features:
   1. Raised markings and Braille to the left hand side of each push-button.
   2. Car Position Indicator at the top of and integral to the car operating panel.
   3. Door open and door close buttons.
   4. Inspection key-switch.
   5. Elevator Data Plate marked with elevator capacity and car number.
   6. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
   7. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
   8. In car stop switch (toggle or key unless local code prohibits use)
   9. Firefighter's hat (standard USA)
   10. Firefighter's Phase II Key-switch (standard USA)
   11. Call Cancel Button (standard USA)
   12. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.

D. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.

E. Hall Fixtures: Hall fixtures shall be located in the entrance jamb and provided with necessary push buttons and key switches for elevator operation. Hall fixtures shall have a 1/8" satin stainless steel projecting button with blue or white illuminating halo.

F. In-Car Direction Lantern: Rides in car entrance column. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

G. Access key-switch at top floor in entrance jamb.

H. Access key-switch at lowest floor in entrance jamb.

PART 3 - EXECUTION

3.01 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

B. Prior to start of Work, verify projections greater then 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less then 75 degrees from horizontal.

C. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.

D. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.

E. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.

F. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.02 INSTALLATION

A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.

B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.

C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.

D. Lubricate operating system components in accordance with manufacturer recommendations.

E. Perform final adjustments, and necessary service prior to substantial completion.

3.03 TESTING AND INSPECTIONS

A. Perform recommended and required testing in accordance with authority having jurisdiction.

B. Obtain required permits and provide originals to Owner's Representative.

3.04 DEMONSTRATION

A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION

SECTION 21 13 13
WET PIPE SPRINKLER SYSTEM

PART 1 – GENERAL

1.1 GENERAL AND SPECIAL CONDITIONS

A. Contractor to furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said systems being made ready for operation in accordance with the requirements of the Division of the State Architect.

1. The purpose of the permit drawings and specifications is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable.
2. Any omission by the District of any necessary system component as required by the Division of the State Architect in the specifications shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the District.
3. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions that may be material to the performance of his work.
4. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so.
5. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the District, Architect, and Engineer for clarification prior to the bid due date.

B. Contractor to provide all devices and equipment required by these specifications.

C. Under no circumstances will the Contractor delete any equipment or devices without an approved Change Order.

1.2 SYSTEM ABBREVIATIONS AND DEFINITIONS

A. AHJ – Authority Having Jurisdiction (Division of the State Architect [DSA]).

B. ANSI – American National Standards Institute.

C. Approved – Unless otherwise stated, materials, equipment or submittals approved by the Engineer.

D. Architect – HMC Architects

E. ASTM – American Society for Testing and Materials.

F. AWS – American Welding Society.

G. AWWA – American Water Works Association.

H. Concealed – Where used in connection with installation of piping or conduit and accessories, shall mean, “Hidden from sight” as in shafts, furred spaces, in soffits or above suspended ceilings.

I. Contractor – The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers, or fabricators.

J. Engineer – Architect's engineering consultant.

K. Exposed – Where used in connection with installation of piping or conduit and accessories, shall mean “visible” or “not concealed.”

L. FM – FM Global.

M. FM Approved – Materials or equipment approved by Factory Mutual and included in the most recent edition of the FM Approval Guide.

N. Furnish – Supply materials.

O. GPM – Gallons per minute.

P. Install – Install materials, mount, and connect equipment or assemblies.

Q. IRI – Industrial Risk Insurers.

R. ISO – Insurance Services Office.

S. NFPA – National Fire Protection Association.

T. PIV – Post indicating valve.

U. Provide – Furnish, install, and connect.

V. PSI – pounds per square inch.

W. QR – Quick Response Sprinkler

X. Remove – Remove material and equipment and restore surface.

Y. UL – Underwriters Laboratories, Inc.

Z. UL Listed – Materials or equipment by Underwriters Laboratories and included in the most recent edition of the UL Fire Protection Equipment Directory.

1.3 SCOPE OF WORK

A. Provide complete fire protection system as outlined in the project specifications, including all labor, materials, permits, shop drawings and hydraulic calculations needed to furnish and install complete and functional automatic sprinkler system, and all the following:

1. Wet pipe automatic sprinkler systems throughout, complete with supervised control valves, combination inspector’s test and main drain assembly, vane type water flow switch, and pressure gauge.
    a. Connect to underground fire line with stainless steel riser sweep approximately 5’-0” from face of building.
    b. Earthquake bracing and flexible couplings.
    c. Furnish, install, and adjust all water flow and valve supervisory switches.
    d. Coordinate all work with other trades. Install offsets as required for coordination with other trades.
    e. Install pipe offsets as required to coordinate around other trades.
    f. Coordination and interface of alarm initiating and supervisory devices with the fire alarm system.
    g. Provide access panels where valve(s) are concealed in walls or ceilings.
    h. Shop drawings.
    i. Two (2) sets of operating instructions and valve diagrams.

j. Record drawings. The Contractor will be required to provide record drawings in AutoCAD format, in addition to required reproducible paper drawings.
k. On-site project supervision.
l. Required signs in English at all control valves, main drains, auxiliary drains and inspector's test connections, etc., including hydraulic placards, in accordance with NFPA 13 requirements as amended by the 2019 California Fire Code Chapter 80.
m. All required system testing in accordance with NFPA 13, 24, and 25.
n. Warranty on all materials and labor.
o. All permits, taxes and fees, including AHJ inspection and testing fees necessary to complete the specified work.

1.4 RELATED WORK

A. Materials and methods specified in other sections, included but not limited to:
   1. Cutting and patching.
   2. Fire extinguishers, cabinets, and accessories.
   3. Painting of finished surfaces at pipe penetrations by other than installing sprinkler subcontractor.
   4. Excavation, trenching, and backfill.
B. Materials furnished and installed in this section but wired by others:
   1. Valve supervisory devices shall be furnished and installed by the sprinkler subcontractor but wired by the alarm subcontractor.
   2. Water flow switches shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.

1.5 APPLICABLE STANDARDS

A. DSA Policies and Guidelines.
B. ANSI A21.10 a – Gray-Iron and Ductile-Iron Fittings, 2 inch through 48 inch for Water and Other Liquids.
C. ANSI A21.11 - American National Standard for Rubber Gasket Joints For Cast Iron and Ductile Iron Pressure Pipe and Fittings; current edition.
D. ANSI B16.1 – Cast-Iron Pipe Flanges and Flanged Fittings, 24, 125, 250, and 800 pounds.
E. ANSI B16.3 – Malleable-Iron Threaded Fitting, Class 150 and 300.
F. ANSI B16.4 – Cast-Iron Threaded Fitting, Class 125 and 250.
G. ANSI B18.2.1 – Square and Hex Bolts and Screws.
H. ANSI B18.2.2 – Square and Hex Nuts.
I. ANSI B36.10 – Welded and Seamless Wrought Steel Pipe.
J. ANSI B112.1 – Hose Valves for Fire Protection Services.
K. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013.

L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

M. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength; 2012 is current; use 2004e01 as indicated in 2019 CBC Referenced Standards.

N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014.

O. AWS D10.9 - Specification for Qualification of Welding Procedures and Welders for Piping and Tubing; 1980.

P. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010 (ANSI/AWWA C105/A21.5).

Q. AWWA C200 - Steel Water Pipe, 6 In. (150 mm) and Larger; 2012 (ANSI/AWWA C200).

R. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Size 4 In. Through 144 In. (100 mm Through 3,600 mm); 2007 (ANSI/AWWA C205).

S. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; 2009 (ANSI/AWWA C500).

T. FM Publications: Approval Guide.

U. FS GG-G76D – Gages, Pressure and Vacuum, Dial Indicating, (for Air, Steam, Oil, Water, Ammonia, and Chloro-Floro Hydrocarbon Gases).

V. FS WW-P-421c – Pipe, Cast Gray and Ductile Iron, Pressure (for Water and Other Liquids).

W. FS WW-P-521f – Pipe Fittings, Flange Fittings and Flanges, Steel and Malleable Iron (Threaded and Butt-Welding) 150 Pound.

X. FS WW-V-51E – Valve, Angle, Check and Globe, Bronze (125, & Int. AM-2 150 and 200 Pound, Threaded End, Flange Ends, (GSA-FFS) – Solder Ends and Brazed End, for Land Use).

Y. FS WW-V-58B – Valves, Gate, Cast Iron; Threaded and Flanged (for Land Use).

Z. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016, as amended in 2019 CBC Referenced Standards.

AA. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2016; as amended in 2019 CBC Referenced Standards.

BB. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems; 2013CA; as amended in 2019 CBC Referenced Standards.

CC. Underwriters Laboratories, Inc. (UL) Publication:

1. Fire Protection Equipment List (Annually with Quarterly Supplements).

1.6 QUALITY ASSURANCE

A. Testing Agency: All materials shall be UL listed or FM approved for their intended use.

B. Regulatory Agencies: State and local building codes and ordinances, and fire department requirements shall apply.

C. The Contractor shall be fully experienced and licensed in all aspects of the fire protections systems herein specified.

D. Similar materials shall be from a single manufacturer.

1.7 SUBMITTALS

A. Administrative Requirements, for submittal procedures.
   1. Contractor shall submit complete system packages.
   2. Partial system submittals will be rejected.

B. Manufacturer's Product Data:
   1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. At a minimum, the following data sheets shall be provided:
      a. Sprinklers and escutcheons.
      b. Pipe, fittings, and hangers.
      c. Control valves.
      d. Fire department connection.
      e. Check valves.
      f. Water flow devices.
      g. Valve supervisory devices.
      h. Electric bell.
      i. Fire stopping materials (including installation detail). Coordinate with Section 07 84 00.
      j. Where any devices that are provided or furnished involve work by someone other than the installer sprinkler subcontractor, submit additional data copies directly to the Contractor.

C. Shop Drawings
   1. Prepare shop drawings with a minimum scale of 1/8 inch = 12 inches for plans, and 1/4 inch = 12 inches for details.
   2. All drawings shall be prepared using AutoCAD compatible software.
   3. Prepare per NFPA 13 for review and approval by Division of the State Architect. A complete submittal shall include the following:
      a. Shop drawings, coordinated with the work of other trades.
      b. Location of all switches, bells and electrical connections for alarm system, as described in this specification.
      c. Location of connections to drain receptors for test and drain discharge.
      d. Dimensioned layout of all sprinklers, including type of sprinklers used and identification numbers.
         1) Layout, diameter and schedule of all piping.
         2) Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, type of roof construction, and occupancy of each area, including ceiling and roof heights as required by NFPA 13.
      e. Locations of grooved couplings and fittings, and designation of flexible couplings where required.
      f. Type and location of all hangers, supports, restraints and seismic bracing.

1) Hanger and bracing locations shall be coordinated with building structure.
2) Include details of earthquake sway bracing, including the appropriate calculations.

g. Details of construction and anchorage for all system components as required by good practice and DSA.
h. Details of underground thrust blocking/restraints.

4. When welding is planned, shop drawings shall indicate the sections to be shop welded and the type of welded fittings to be used.

D. Calculations:

1. Hydraulic calculations shall include a water supply graph and hydraulic cover sheet.
2. Include documentation of flow test data, current to within 6 months of DSA intake.
3. The cover sheet shall include:
   a. Name and location of the calculated area.
   b. Ceiling height.
   c. Occupancy.
   d. Design criteria.
   e. Sprinkler spacing.
   f. System type.
   g. Sprinkler make, model, size, K-factor and temperature rating.
   h. Flow requirements.
   i. C-factor used.
   j. Water supply data and source of information (to be current within 6 months of submittal).

E. Changes

1. Make no changes in installation from layout as shown on the approved drawings unless change is specifically approved by the Architect, Engineer, and DSA.
2. Any pipe fabricated and/or installed before all approvals are obtained at the Contractor's own expense and responsibility.
   a. Any changes made to the approved drawings other than as stated above are at the Contractor's own expense and responsibility.

F. Samples

1. Provide one sample of each type of sprinkler and escutcheon.

G. Final Inspection and Test

1. The Contractor shall make arrangements with the District, Architect, and Engineer for final inspection and witnessing of the final acceptance tests.
   a. The District, Architect, and Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the Division of the State Architect, and the District.

3. Architect and consultants are to visit the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for testing and inspections.
   a. If the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Architect's and consultant's extra time and expenses for reinspection and witnessing the retesting of the work.
   b. Such extra fees shall be deducted from payments by the District to the Contractor.
4. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate to District, Architect, Engineer, and Division of the State Architect.

H. Record Drawings
1. Maintain at the site an up-to-date marked set of as-built drawings, which shall be corrected and delivered to the District upon completion of work.
2. Upon completion, furnish the District with 3 sets of reproducible prints, and one set in electronic PDF and AutoCAD "DWG" format of each reviewed shop drawing, revised to show "Record" conditions.

I. Operating Instructions
1. At the completion of the work, provide a small-scale plan of building indicating the locations of all control valves, low point drains, and inspector's test valves.
   a. The plan(s) shall be neatly drawn and color-coded to indicate the portion of the building protected by each system, framed under glass and permanently mounted on the wall at the sprinkler room.
2. Furnish one copy of the California NFPA 25 Edition and bound set of printed operating and maintenance instructions to the District, and adequately instruct the District's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

J. Spare Parts:
1. Provide and install one spare sprinkler cabinet, complete with 12 sprinklers consisting of all types and temperature ratings used throughout the installation.
   a. The cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
2. Confer with the Architect for exact location of cabinet.

1.8 GUARANTEE

A. Guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the District.

B. Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by themselves or his/her subcontractors' work, materials, or equipment.

1.9 PRODUCT DELIVERY

A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.

B. Storage of Materials, Equipment, and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.

C. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

1.10 JOB CONDITIONS

A. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.

B. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

1.11 PERMITS AND FEES

A. Pay for all permit fees, and charges required for this work.

PART 2 – PRODUCTS

2.1 GENERAL

A. All components shall be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.

B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.

C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner or Owner's Representative in writing.

2.2 DESIGN CRITERIA

A. Sprinkler System

1. Light Hazard Areas - Wet system with a K-Factor of 5.6 spaced to a maximum of 225 square feet per sprinkler or limited per hydraulic calculations, whichever is less. The system design shall provide a minimum density of .10 gallons per minute per square foot over the most remote 1,500 square feet. Light Hazard areas include offices, group study areas, work rooms, public areas, stairs, classrooms, common areas, etc.

2. Ordinary Hazard Group II Areas - Wet system with a K-Factor of 5.6 or 8.0 spaced to a maximum of 130 square feet per sprinkler or limited per hydraulic calculations, whichever is less. The system design shall provide

a minimum density of .20 gallons per minute per square foot over the most remote 1,500 square feet. Ordinary Hazard Group II areas include custodial rooms, electrical rooms, mechanical rooms, data rooms, storage areas, multi-purpose roomr, elevator machine rooms, etc.

B. Water Supply

1. Pipe sizing shall be determined by hydraulic calculations in accordance with NFPA 13 requirements and will be based upon a current water supply test validated within six months prior to submittal to the Division of the State Architect.

2.3 ABOVEGROUND PIPE

A. Feed Mains and Branch Line Piping

1. Pipe shall be new, rated for 175 psi working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.
   a. Pipe shall be black steel and must comply with the specifications of the American Society for Testing and Materials, ASTM A 53 for welded and seamless steel pipe.
   b. Schedule 40 piping is required for all branch lines and arm-overs.
   c. Schedule 40 piping is required for mains, regardless of pipe diameter.
   d. Schedule 7 or similar thin wall piping is not permitted.
   d. Galvanized pipe shall be used when exposed to the outside.
   e. Galvanized pipe shall be used for drain pipe.
   f. A seismic separation assembly shall be installed where sprinkler piping crosses building seismic separation joints (if present).
   g. System shall be designed to facilitate flushing of all cross mains and branch lines.

2.4 UNDERGROUND PIPING INSTALLATION REQUIREMENTS

A. New fire service line pipe shall be designed for 350 psi working pressure, conforming to ASTM and AWWA specifications, and have the manufacturer's name and brand along with the applicable standard marked on each length of pipe.

1. Ductile Iron: Pipe shall be pressure class 51 (350 psi) in accordance with ANSI 21.51, with cement lining in accordance with ANSI 21.4, and mechanical/push on joints.
   a. Polyethylene encasement shall be provided on all ductile or cast iron pipe and fittings in accordance with ANSI 21.5.
2. Polyvinyl Chloride (PVC) shall be pressure class 305 (DR 14) in accordance with AWWA C-900.
3. Polyethylene (PE): Pipe shall be FM approved high-density polyethylene made from raw materials meeting the requirements of ASTM D 1248 and ASTM D 3350. Pipe shall have stub-ends with slip on flanges. Dimensions shall be in accordance with ASTM F 714.

B. Changes of direction shall be accomplished by the use of fittings suitable for joining the piping to be installed and rated for expected pressure.

1. Ductile iron pipe shall be joined by rubber gasket mechanical joint/push on joint in accordance with AWWA C 110, AWWA C 111, ANSI A 21.10 and ANSI A 21.11.
    a. Fittings shall be cement lined in accordance with AWWA C 104 and ANSI A 21.4.
2. Polyvinyl Chloride (PVC) pipe shall be joined by rubber gasket PVC couplings.
    a. Fittings shall be push on or mechanical joint ductile iron.

C. Control valves shall be non-rising stem with roadway box. Valves shall have resilient seats and open to left.
    1. Butterfly valve discs shall be of symmetrical design to achieve low friction loss.

D. Supervisory Devices:
    1. Valve supervisory devices on the OS&Y valves shall be installed to transmit a supervisory signal within the first two turns of the control valve handle.

E. Thrust Blocks:
    1. Thrust blocks shall be used in lieu of the tie rods whenever practical.
    2. The Contractor will provide calculations based on NFPA 24.

2.5 FITTINGS AND JOINTS

A. Steel Pipe:
    1. Screwed fittings shall be cast iron, 175-pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 175-pound class, black and in accordance with ANSI B 16.3. Bushings shall not be used.
    2. Weld fittings shall be steel, standard weights, black, and in accordance with ASME B 16.9, ASME B 16.25, ASME B 16.5, ASME B 16.11 and ASTM A 234.
    3. Grooved fittings and couplings shall be produced by the same manufacturer.
    4. Grooved couplings shall be dimensionally compatible with pipe.

2.6 SPRINKLERS

A. Listed lead-coated or corrosion-proof sprinklers shall be installed in all areas exposed to outside atmosphere or to corrosive conditions.

B. Sprinklers in light hazard and ordinary hazard occupancies shall be upright or pendent, quick response type with intermediate temperature rating.

C. Sprinklers in unfinished areas shall be rough brass finish. Sprinklers in finished areas shall have chrome-plated or white paint finish as selected at time of final design by the Architect.

D. Pendent sprinklers installed in areas where ceilings are located shall be of the semi-recessed type. Sprinklers shall be installed in the quarter points or center of ceiling tiles.

2.7 VALVES

A. Control valves shall be listed/approved indicating type.
    1. OS & Y valves shall be resilient seat type.

2. Butterfly valves shall be gear operated with internal tamper switches.
3. Ball valves shall be gear operated with full port.

B. Drain, trim, and test valves shall be approved.

C. Check Valves

1. Check valves for water supply, fire department connections and risers shall have removable covers for maintenance without removing the valve from the system.
2. Check valves in the trim shall be approved.

2.8 SLEEVES FOR WALL/FLOOR PENETRATIONS

A. Sleeves through walls and floors shall be of a type that can be made watertight and fire stopped.

1. Sleeve sizes shall be as required by NFPA 13 for Earthquake Protection.
2. Provide fire stopping penetrations per Section 07 84 00.

2.9 WATER FLOW ALARM AND SUPERVISORY DEVICES - SEE DIVISION 28

A. Devices shall be listed/approved for the intended application and compatible with the alarm system.

1. Supervisory (Tamper) switches provided with butterfly/ball valves by the valve manufacturer shall be listed/approved as an assembly.

B. Water Flow Switches.

1. Vane type flow switches shall be compatible with the alarm system and provided by the fire sprinkler contractor.

2.10 SIGNAGE

A. Provide standard metal signs in English in accordance with NFPA 13.

B. Provide hydraulic calculation information signs at risers in accordance with NFPA 13 and the 2019 CBC requirements.

2.11 HANGERS

A. All hanger components shall be of an approved and listed type.

1. Earthquake bracing steel shapes listed in NFPA 13 shall be limited to maximum length indicated. The slenderness ratio shall not exceed 200 in accordance with NFPA.
2. The Contractor shall submit calculations with shop drawings indicating least radius of gyration and maximum permissible length for each shape.

PART 3 – EXECUTION

3.1 GENERAL

A. Product Delivery

1. Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.

2. Storage of Materials, Equipment, and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
3. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

B. Clean-up
1. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
2. At the completion of the work, removed all surplus materials, tools, etc., and leave the premises clean.

C. Leak Protection
1. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.
2. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the fire protection system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

3.2 FABRICATION

A. Pipe Ends
1. Ream and remove burrs after cutting pipe. Standard wall pipe ends shall be welded, threaded, cut grooved, or plain end.
2. Thin wall pipe ends shall be plain end, welded or roll grooved in accordance with the fitting manufactures' recommendation.
3. Threads shall be in accordance with ASME B1.20.1. Each thread on light wall pipe shall be gauged before the fitting is made-up.

B. Grooved Ends
1. Pipe minimum thickness, squareness, and out-of roundness shall be in accordance with the coupling manufacturers specifications.
2. Pipe surface shall be free of indentations, projections, or roll marks from the end of the pipe to the groove.

C. Welding
1. No field welding of sprinkler piping shall be permitted.
2. Headers risers, feed mains, cross mains and branch lines may be shop welded using acceptable welding fittings. Welding methods shall comply with all the requirements of AWS B2.1.
3. Certified records shall be maintained upon the completion of each weld, welder shall stamp an imprint of their identification into the side of the pipe adjacent to the weld.

3.3 EXCAVATION

A. General

1. Perform all excavation, including necessary shoring, and all backfilling required for the completion of work under this contract that is to be installed underground, outside, or within building walls.
2. The arrangement of shoring shall be such as to prevent any movement of the trench banks and consequent strain on the pipes.
3. Place all surplus dirt where directed by the construction manager.

B. Excavation

1. Excavate to the required depth and grade to the bottom of the trench to secure the required slope.
2. Rock or concrete, where encountered, shall be excavated to a minimum depth of 6 inches below bottom of pipe.
3. Where mud, cinders, or otherwise unstable or undesirable soil is encountered in the bottom of the trench, such soil shall be removed to firm bearing and the trench shall be backfilled with sand or bank run gravel to the proper grade and tamped to provide uniform firm support.
4. When water is encountered in the trench work, furnish and operate necessary approved pumping equipment and provide approved drainage facilities to keep excavation free of water.
5. The maximum width of the trench at a point 1 foot above the top of the pipe shall not exceed the nominal size of the pipe, plus 24 inches.

3.4 BACKFILLING

A. The pipe joints shall remain exposed until the pipe has been tested by the Contractor and test witnessed by the Owner's representative(s) and local AHJ.

B. Backfill shall be free of organic material, cinders, ash etc.

1. Remove all material used in shoring or trench banks before backfilling.
2. Backfill consisting of sand or bank run gravel shall be placed to a depth of 1 foot above the top of the pipe and compacted by hand tamping.
3. Backfill for remainder of the trench shall consist of clean excavated material free of rocks, stones, or debris.
4. Place fill in 12-inch layers and tamp to compact each layer thoroughly and evenly to 95 percent of maximum density.
5. Pavement shall match existing paving in every respect.
6. Submit certificates from a testing laboratory certifying that the backfilling and compaction thereof is in accordance with the requirements, before final pavement is installed.

3.5 INSTALLATION

A. General

1. A clean set of prints or shop drawings shall be maintained at the site and marked up to show any changes.

2. Piping shall be installed above ceilings except in areas where there is no ceiling. Install piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.

3.6 SPRINKLERS

A. General

1. Sprinklers below ceilings of exposed piping shall be listed and approved regular bronze frame upright type, in upright position.
   a. Listed and approved regular bronze pendent type may be used where necessary due to clear height requirements, duct interference, etc.
2. Sprig-ups shall be provided wherever necessary to provide proper deflector distances in accordance with NFPA 13 requirements.

B. Sprinkler Guards and Water Shields

1. Provide guards on sprinklers within 7 feet of finished floor or wherever sprinklers may be subject to mechanical damage. Guards shall be listed for use with sprinkler the make & model.

C. Drains

1. Provide main drain valve at system control valve, sized in accordance with NFPA 13 and AHJ requirements that extend piping to exterior or to hub drain per plumbing documents.
2. Provide all auxiliary drains where necessary.
3. Pipe all drains and auxiliary drains to locations where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.
4. Plugs used for auxiliary drains shall be brass.
5. All piping and fittings downstream of drain valve shall be galvanized.
6. The contractor shall comply with all water discharge restrictions.

3.7 VALVES

A. General

1. Valves shall be installed with sufficient clearance for operation, testing, and maintenance.
2. Where wafer bodied valves are used, they shall be installed so that the discs do not interfere with other components.

B. Control valves shall be installed so that valve position indicator is visible.

C. Drain, test, and trim valves.

1. Valves shall be installed no more than 7 feet 0 inches above the finished floor and shall be accessible.

3.8 FIRE DEPARTMENT CONNECTION

A. Refer to Civil drawings.

3.9 PRESSURE GAUGES

A. Gauges shall be located where not subject to freezing.

B. Gauges shall be installed vertically, with three-way valve with ¼-inch plugged outlet, and as follows:
   1. Above and below wet system riser check valves.
   2. At each water supply and inlet of floor control valve.

3.10 HANGERS, SUPPORTS, AND EARTHQUAKE BRACING

A. General
   1. All piping must be substantially supported from building structure and only approved types of hangers by the structural engineer of record are to be used.
      a. Piping lines under ducts shall not be supported from duct work, but shall be supported from building structure with trapeze hangers where necessary or from steel angles supporting duct work in accordance with NFPA 13.
   2. All thread rods shall not be bent.
   3. Hanger components shall be ferrous.
   4. Powder driven studs shall be specifically listed for use in the required seismic zone.

B. Feed and Cross Mains
   1. Install at least one hanger per length of pipe up to 8 feet in length joined by grooved couplings.

C. Risers
   1. Risers shall be supported at lowest level and alternate levels above using riser clamp.
   2. Install flexible couplings in risers.

D. System Headers
   1. Install pipe saddle supports complete with flange bolted to floor.

E. Earthquake Protection
   1. Install flexible joints and sub bracing as provided in NFPA 13 section 9.3.2.

3.11 SLEEVINGS, WALL & FLOOR PENETRATIONS - SEE SECTION 07 84 00

A. Set Schedule 40 sleeves in place for all pipes passing through openings in fire resistance rated construction when required by UL listing for fire stopping method utilized.

B. Provide clearance between the sprinkler piping and sleeves in accordance with NFPA and/or FM.
   1. The space between sleeve and pipe shall be filled with noncombustible, UL listed fire- stopping materials.
   2. Provide chrome wall plates at each side of wall.

C. Sleeves through floors shall be watertight.
   1. Penetrations through fire rated construction shall be adequately fire stopped to maintain the fire resistance rating required.

3.12 SIGNAGE

A. Valves

1. Secure to each valve with corrosion resistant wire or chain with signage indicating the valves use.

B. Hydraulic Design Information

1. Secure to each system riser with corrosion resistant fasteners.

3.13 WATER FLOW ALARMS & SUPERVISORY DEVICES

A. Alarm Bells

1. Electric bells and wiring diagrams shall be delivered to the alarm contractor for installation and wiring.

B. Alarm and Supervisory Switches

1. Deliver wiring diagrams to alarm contractor.
2. Install alarm water flow switches in accordance with switch and valve manufacturer's instructions.
3. Install and adjust valve supervisory switches in accordance with switch manufacturer's instructions.

3.14 INSPECTOR'S TEST

A. Provide inspector's test connections, as specified in NFPA 13, at required points for testing each water flow alarm device.

1. Discharge orifice shall have same size orifice as smallest orifice sprinklers installed.

B. Provide 1-inch sight glass if inspector's test discharge cannot be readily observed while operating valve.

C. Pipe all inspector's test connections discharging to atmosphere to location where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.

D. Splash blocks shall be provided where inspector's test discharge could produce damage to surroundings.

E. All pipe and fittings downstream of inspector's test valve shall be galvanized.

3.15 SYSTEM ACCEPTANCE

A. Tests

1. General system test shall be coordinated with the District, Architect, and Engineer for training and witnessed by the AHJ.
   a. Problems noted during testing such as air or water leaks, difficulty in operating valves, alarm failures, etc. shall be corrected before the installing subcontractor leaves the job.
2. Hydrostatically test all piping, including fire department connections between the check valve and connection, at 200 psi for two hours.

a. If the highest static pressure at the lowest point in the system exceeds 150 psi, the system shall be tested at 50 psi more than the highest static pressure.

3. Flow Tests
   a. Main drain shall be opened wide until pressure stabilizes then slowly closed, noting and recording flowing (residual) and static (non-flow) pressures. Test data to be affixed to riser assembly for future reference.

B. Valve Operation
   1. Operate each valve through its entire range. Adjust valve packing glands.
      a. Hose valves shall be capped during the test.
   2. Threads for hose valve/wall hydrant outlets and fire department inlets shall be verified to conform to those used by the AHJ.

C. Water Flow and Supervisory Devices
   1. Coordinate testing of electric components with the alarm contractor.
   2. Each water flow device shall be tested in accordance with NFPA 72 by opening the inspectors test or alarm test valve.
   3. Each valve supervisory device shall be tested by operating the valve wheel/crank.
   4. Verify all signals have been noted by the fire alarm control panel and each audible alarm device operates.

D. Contractor's material and test certificates and all required NFPA certificates shall be completed for each system/floor, signed by the Contractor, witnessed by the owner's representative/AHJ and be provided to the owner, local fire marshal, architect and DSA.

E. Training
   1. General – In addition to the tests required in Parts A through C and witnessed by the owner's representative(s), conduct one/two-hour training sessions to familiarize the representatives with all operating features of the system, including control valve, drain and test valve locations and operations.
   2. Provide owner's representatives with:
      a. A small-scale plan of the system/building showing locations of control, drain and test valves.
      b. Component manufacturer's inspection and testing manuals.
      c. Two copies of the California NFPA 25 Edition.
   3. Spare Parts
      a. Provide 12 spare sprinklers consisting of all types and ratings that are installed, in a steel cabinet complete with special sprinkler wrenches. Install cabinet as directed by owner.

3.16 ADJUSTMENT AND CLEANING

A. Cleaning: Flush all piping in accordance with NFPA Standards for test procedures.

3.17 TRAINING

A. Conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation and maintenance of the sprinkler systems.

B. Training sessions shall be scheduled by the District at a mutually agreeable time to the Contractor.

3.18 EMERGENCY SERVICE

A. The installing subcontractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the District during the warranty period.

B. This service shall be available on a 24-hour per day, seven-day per week basis.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
   2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Flexible-hose packless expansion joints.
   2. Alignment guides and anchors.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.02 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Flex-Hose Co., Inc.
      b. Flexicraft Industries.
      c. Metraflex Company (The).
   2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
   3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
   4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
      a. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
   5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with flanged end connections.
      a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
   6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
      a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
   7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
      a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

2.03 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Flex-Hose Co., Inc.
      b. Flexicraft Industries.
      c. Metraflex Company (The).
   2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:
   1. Steel Shapes and Plates: ASTM A36/A36M.
   2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
   3. Washers: ASTM F844, steel, plain, flat washers.
   4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
      a. Stud: Threaded, zinc-coated carbon steel.
      b. Expansion Plug: Zinc-coated steel.
      c. Washer and Nut: Zinc-coated steel.
   5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
      a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
      b. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
      c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.01 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-PSJ-703.

D. Install grooved-joint expansion joints to grooved-end steel piping.

3.02 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:
   1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
   1. Anchor Attachment to Steel Structural Members: Attach by welding.
   2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Grout.
   4. Silicone sealants.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Thunderline Link Seal
   2. Metraflex Metraseal

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.03 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.04 SILICONE SEALANTS

A. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Approved equal.
b. Smooth-On.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves.
   2. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
   3. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Stack-sleeve fittings.

END OF SECTION

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Chicago Specialty
   2. Producers Specialty
   3. Sanitary-Dash

2.02 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.

2.03 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
      b. Chrome-Plated Piping: One-piece cast brass or split-casting brass with polished, chrome-plated finish.
      c. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece cast brass with rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor plate.

3.02 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 22 05 19

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Filled-system thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

B. Related Requirements:
1. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 DIGITAL THERMOMETERS (DOMESTIC WATER)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Trerice, H. O. Co.
   b. Weiss Instruments, Inc.
   c. Weksler Instruments Corp.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

2.02 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.03 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    a. Ashcroft Inc.
    b. Trerice, H. O. Co.
    c. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.04 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.05 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Trerice, H. O. Co.
2. WATTS.
3. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.06 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Trerice, H. O. Co.
2. Texas Fairfax Company
3. Sisco Co, Spedco, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:
   1. Inlet and outlet of each water heater.

J. Install pressure gages in the following locations:
   1. Building water service entrance into building.
   2. Inlet and outlet of each pressure-reducing valve.
   3. Suction and discharge of each domestic water pump.

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
   1. Liquid-filled, bimetallic-actuated type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

3.06 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:
   1. Liquid-filled Sealed, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
   1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Test plug with EPDM self-sealing rubber inserts.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Brass ball valves.
   2. Iron ball valves.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61and NSF 372.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and soldered ends.
   3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.5 for flanges on steel valves.
   4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   5. ASME B16.18 for solder-joint connections.
   6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
   2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.
   2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
   3. Memory stops that are fully adjustable after insulation is applied.

2.02 BRASS BALL VALVES

A. Soldered Ends:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-110 or MSS SP-145.
      b. CWP Rating: 600 psig.
      c. Body Design: Two piece.
      d. Body Material: Forged brass.
      e. Ends: Threaded and soldered.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel, vented.
      i. Port: Full.

2.03 IRON BALL VALVES

A. Iron Ball Valves, Class 125:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Apollo Flow Controls; Conbraco Industries, Inc.
      c. WATTS.
   2. Description:
      a. Standard: MSS SP-72.
      b. CWP Rating: 200 psig.
      c. Body Design: Split body.
      d. Body Material: ASTM A126, gray iron.
      e. Ends: Flanged or threaded.
      f. Seats: PTFE.
      g. Stem: Stainless steel.
      h. Ball: Stainless steel.
      i. Port: Full.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.04 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded or solder-joint ends.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron ball valves, Class 150.

END OF SECTION

SECTION 22 05 23.13

BUTTERFLY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Iron, single-flange butterfly valves.
   2. Iron, grooved-end butterfly valves.
   3. Chainwheels.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B16.5 for flanges on steel valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B31.9 for building service piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
   1. Gear Actuator: For valves NPS 8 and larger.
   2. Handlever: For valves NPS 6 and smaller.
   3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.

H. Valves in Insulated Piping: With 2-inch stem extensions.

2.02 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating, NPS 12 and Smaller: 200 psig.
      c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
      d. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
      e. Seat: EPDM.
      f. Stem: One- or two-piece stainless steel.
      g. Disc: Stainless steel.

2.03 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Babbitt Steam Specialty Co.
   2. Roto Hammer Industries.
   3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
   1. Sprocket Rim with Chain Guides: Bronze, of type and size required for valve.
   2. Chain: Brass, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger:
   1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.
   2. Ductile-Iron, Grooved-End Butterfly Valves: 175 CWP.

END OF SECTION

SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.
   1. Certification that products comply with NSF 61 and NSF 372.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded end valves.
   2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   3. ASME B16.18 for solder joint.
   4. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 150:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. Milwaukee Valve Company.
      c. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 300 psig.
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B62, bronze.
      e. Ends: Threaded or soldered. See valve schedule articles.
      f. Disc: Bronze.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.
   1. Swing Check Valves: In horizontal position with hinge pin level.

F. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered-ends.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.

3.05 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze swing check valves with bronze disc, Class 150, with soldered or threaded end connections.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe-positioning systems.
8. Equipment supports.

B. Related Requirements:
1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.02 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
   3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. B-line, an Eaton business.
      b. G-Strut.
      c. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: No coating.

2.05 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carpenter & Paterson, Inc.
2. National Pipe Hanger Corporation.
3. Pipe Shields Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. B-line, an Eaton business.
b. Hilti, Inc.
c. MKT Fastening, LLC.
2. Indoor Applications: Zinc-coated steel.
3. Outdoor Applications: Stainless steel.

2.07 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:
   1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Hardware: Galvanized steel or polycarbonate.
   4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
   2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
   3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
   5. Pipe Supports: Strut clamps.
   6. Hardware: Galvanized steel.
   7. Accessories: Protection pads.
   8. Height: 12 inches above roof.

D. High-Profile, Single-Base, Single-Pipe Stand:
   1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Single vulcanized rubber or molded polypropylene.
   3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
   4. Horizontal Member: One adjustable-height, galvanized steel, pipe-support slotted channel or plate.
   5. Pipe Supports: Roller.
   6. Hardware: Galvanized steel.
   7. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: Two or more; vulcanized rubber.
   3. Vertical Members: Two or more, galvanized-steel channels.
   4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
   5. Pipe Supports: Strut clamps.
   6. Hardware: Galvanized steel.
   7. Height: 36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.08 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.10 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with requirements in Section 07 84 00 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.02 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. MetalFraming System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.

G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 90 00 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.07 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers, supports, metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   6. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   7. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   8. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   10. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
   11. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
   12. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
   13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Pipe-riser resilient supports.
5. Resilient pipe guides.
6. Snubbers.
7. Restraint channel bracings.
8. Restraint cables.
9. Seismic-restraint accessories.
10. Mechanical anchor bolts.

B. Related Requirements:
1. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.03 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
   a. Component Importance Factor: 1.0.
   b. Component Response Modification Factor: Per structural drawings.
   c. Component Amplification Factor: per structural drawings.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Per structural drawings.
4. Design Spectral Response Acceleration at 1.0-Second Period: 0.600.

5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.02 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.

2.03 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.
2. Mounting Plates:
    a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.04 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    a. Housing: Cast-ductile iron or welded steel.

b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.05 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.06 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.07 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Management Corp.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.08 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
2. Hilti, Inc.
3. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.09 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CADDY; a brand of nVent.
   2. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.10 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business.
   2. CADDY; a brand of nVent.
   3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.11 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. B-line, an Eaton business.
   2. Hilti, Inc.
   3. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:
   1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:
   1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Brady Corporation.
   b. Craftmark Pipe Markers.
   c. Seton Identification Products.
2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.

4. Background Color: White.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Brady Corporation.
2. Craftmark Pipe Markers.
3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Red

D. Background Color: White.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Brady Corporation.
   2. Craftmark Pipe Markers.
   3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
   1. 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.
   2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.04 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Brady Corporation.
   2. Craftmark Pipe Markers.
   3. Seton Identification Products.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.05 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Brady Corporation.

2. Craftmark Pipe Markers.
3. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
2. Fasteners: Reinforced grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:
   1. Domestic Water Piping
      a. Background: Safety green.
      b. Letter Colors: White.
   2. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: Safety gray.
      b. Letter Color: Black.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Cold Water: 1-1/2 inches, round.
      b. Hot Water: 1-1/2 inches, round.
   2. Valve-Tag Colors:
      a. Cold Water: Safety green.
      b. Hot Water: Safety green.
   3. Letter Colors:
      a. Cold Water: White.
      b. Hot Water: White.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Domestic recirculating hot-water piping.
   4. Supplies and drains for handicap-accessible lavatories and sinks.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic and tapes, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Pittsburgh Corning Corporation.
      b. Approved Equal.
   2. Block Insulation: ASTM C552, Type I.
   3. Special-Shaped Insulation: ASTM C552, Type III.
   4. Preformed Pipe Insulation without Jacket: Comply with ASTM C552, Type II, Class 1.
   5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C552, Type II, Class 2.
   6. Factory fabricate shapes according to ASTM C450 and ASTM C585.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Foster Brand; H. B. Fuller Construction Products.
      b. Approved equal.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Mon-Eco Industries, Inc.

D. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Consumer Solutions.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Speedline Corporation.

2.03 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Vimasco Corporation.
   3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   4. Service Temperature Range: 0 to plus 180 deg F.
   5. Color: White.

2.04 SEALANTS

A. Joint Sealants for Cellular-Glass Products:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Foster Brand; H. B. Fuller Construction Products.
      c. Pittsburgh Corning Corporation.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.
   4. Color: White or gray.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Approved Equal.
   b. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.05 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.06 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Approved Equal.
      b. Childers Brand; H. B. Fuller Construction Products.

2.07 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Alpha Associates, Inc.
      b. Approved equal

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Johns Manville; a Berkshire Hathaway company.

b. Proto Corporation.
c. Speedline Corporation.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Knauf Insulation.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Knauf Insulation.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.
2. Stainless Steel: ASTM A167 or ASTM A240/A240M, or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Approved Equal.
b. C & F Wire.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGuire Manufacturing.
b. Plumberex Specialty Products, Inc.
c. Truebro.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 00 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without

damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.08 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 90 00 "Painting".
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.09 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, two locations of threaded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR AND OUTDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:
1. NPS 1-1/2 and Smaller: Insulation shall be the following:
   a. Cellular Glass: thickness of the insulation shall be not less than the diameter of the pipe per CPC 609.11.2.
2. NPS 2 and Larger: Insulation shall be the following:
   a. Cellular Glass: thickness of the insulation shall be not less than 2 inches thick per CPC 609.11.2.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. None.

D. Piping, Exposed:
   1. PVC: 30 mils thick.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.

B. Related Requirements:

1.03 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.04 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint or threaded ends.

G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Apollo Flow Controls; Conbraco Industries, Inc.
      b. NIBCO INC.
      c. Viega LLC.
   2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
   3. Minimum 200-psig working-pressure rating at 250 deg F.

2.03 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
   1. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Standard-Pattern, Push-on-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Gaskets: AWWA C111/A21.11, rubber.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.04 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.05 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: natural.

2.06 TRANSITION FITTINGS

A. General Requirements:
1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dresser, Inc.
b. Jay R. Smith Mfg Co; a division of Morris Group International.
c. Smith-Blair, Inc.

2.07 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. WATTS.
b. Wilkins.
c. Zurn Industries, LLC.
2. Standard: ASSE 1079.

3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 175 psig minimum at 300 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 175 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Grinnell G-Fire by Johnson Controls Company.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. 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.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."

T. Install thermometers on inlet and outlet piping from each water heater.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. 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.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.05 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.06 INSTALLATION OF HANGERS AND SUPPORTS

A. Refer to Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.08 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.09 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   2. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
      f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
      a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
      b. Adjust calibrated balancing valves to flows indicated.
   5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
   6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
   8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building-service piping, NPS 2-1/2 and smaller, shall be the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and larger, shall be the following:
   1. Push-on-joint, ductile-iron pipe; standard- or compact-pattern, push-on-joint fittings; and gasketed joints.

E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
   1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

F. Aboveground domestic water piping, NPS 2-1/2 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 3 to NPS 4, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; cast-or wrought-copper, solder-joint fittings; and brazed joints.

H. Aboveground domestic water piping, NPS 5 and larger, shall be the following:
   1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron pipe appurtenances; and grooved joints.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Hose stations.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer valves.
12. Trap-seal primer systems.
13. Flexible connectors.
14. Water meters.

B. Related Requirements:
1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 22 11 16 "Domestic Water Piping" for water meters.
3. Section 22 47 13 "Drinking Fountains" for water filters for water coolers.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

B. Comply with NSF 372 for low lead.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.04 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Watts Industries Inc..
   b. Zurn Industries, LLC.
   c. Conbraco Industries, Inc.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: refer to plumbing drawings.
6. Design Flow Rate: refer to plumbing drawings.
7. Selected Unit Flow Range Limits: refer to plumbing drawings.
8. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:
    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.05 BALANCING VALVES

A. Thermostatic self-actuating balancing valve:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. ThermOmegaTech
    b. Approved Equal
2. Furnish and install Thermostatic self-actuating balancing valve as indicated on the plans. Self-actuating balancing valve shall be self-contained and fully automatic without additional piping or control mechanisms. Self-actuating balancing valve shall be a CircuitSolver® as manufactured by ThermOmegaTech®, Inc., or equivalent.
3. Self-actuating balancing valve shall regulate the flow of recirculated domestic hot water based on water temperature entering the valve regardless of system operating pressure.
    a. As the water temperature increases the valve proportionally closes dynamically adjusting flow to meet the specified temperature.
    b. The Self-actuating balancing valve never fully closes, even at the desired set point. There is always sufficient bypass flow back to the recirculating pump to prevent overheating or “dead heading” of the pump.
    c. Self-actuating balancing valve shall be set at the factory for the desired return temperature, no field adjustments shall be required.
4. Self-actuating balancing valve body and all internal components shall be made with lead free materials with major components constructed of type 303 SS A.
5. Self-actuating balancing valve shall be rated to 200 PSIG maximum working pressure.
    a. All self-actuating balancing valves shall be standard tapered female pipe thread, NPT.
    b. All Self-actuating balancing valves shall be rated to 250° F maximum working temperature.
    c. Thermal actuator shall be spring loaded and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.

2.06 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves **TMV-1**:
1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Type: **Exposed-mounted**, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.

5. Connections: Threaded **union** inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle, mounting bracket for exposed wall installation.
7. Tempered-Water Setting: 125 deg F.
8. Tempered-Water Design Flow Rate: **10** gpm.
9. Selected Valve Flow Rate at 45-psig Pressure Drop: **25** gpm.
10. Pressure Drop at Design Flow Rate: **11** psig.
11. Valve Finish: Rough bronze.
12. Piping Finish: **Copper**.

B. Individual-Fixture, Water Tempering Valves **TMV-2**:
1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: **110** deg F.
8. Tempered-Water Design Flow Rate: 0**.35** gpm.

2.07 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron[with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and] for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
6. Drain: [Pipe plug] [Factory-installed, hose-end drain valve].

2.08 HOSE BIBBS

A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: [Rough bronze] [Chrome or nickel plated].
10. Finish for Finished Rooms: Chrome or nickel plated.

11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include **integral** wall flange with each chrome- or nickel-plated hose bibb.

2.09 WALL HYDRANTS

A. Wall Hydrants:
1. Standard: ASME A112.21.3M for **concealed**-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Inlet: NPS ¾”.
5. Outlet:
   a. Garden-hose thread complying with ASME B1.20.7, and integral or field-installed, non-removable and drainable hose-connection vacuum breaker
6. Type: Recessed
7. Finish: Nickel bronze
8. Locking cover
9. Operating Key: One with each wall hydrant.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
   1. Standard: ASSE 1010 or PDI-WH 201.
   2. Type: Metal bellows or piston type with pressurized cushioning chamber.
   3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device **TP-1**:
   1. Standard: ASSE 1018.
   2. Pressure Rating: 125 psig minimum.
   3. Body: Bronze.
   4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.13 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems **TP-2**:
   1. Standard: ASSE 1044.
   2. Piping: NPS 3/4, ASTM B88, Type L; copper, water tubing.
   3. Cabinet: **Surface**-mounted steel box with stainless-steel cover.
   4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
      a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   5. Vacuum Breaker: ASSE 1001.
   6. Number Outlets: Four
   7. Size Outlets: NPS 1/2

2.14 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: Minimum **200 psig**.
   2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum **200 psig**.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves **and bypass with memory-stop balancing valve**. Install pressure gages on inlet and outlet.

C. Install thermostatic self-actuating balancing valves in each domestic hot water return piping branch beyond last hot water device in that branch.
   1. Provide suitable line size isolation valves, unions, and strainer as indicated in piping detail shown on the drawings.
   2. Provide suitable access panel as required in non-accessible ceilings and walls.
   3. Pay close attention to flow arrow, especially with valves that have an integrated check valve.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Y-Pattern Strainers: For water, install on supply side of each **pump**.

F. Hose Stations: Install with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."

G. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.

H. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

J. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

C. Comply with requirements for grounding equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.03 IDENTIFICATION

A. Refer to section 220553 Identification for Plumbing Piping and Equipment

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SECTION 22 11 23

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. In-line, sealless centrifugal pumps.

1.03 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:
   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.08 COORDINATION

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

PART 2 - PRODUCTS

2.01 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, products by one of the following:
   1. Armstrong Pumps, Inc.
   2. Bell & Gossett; a Xylem brand.
   3. Grundfos Pumps Corp. (Model No. UP 15-10 B7/TLC)

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

C. Pump Construction:
   1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
   2. Casing: Bronze, with threaded or companion-flange connections.
   3. Impeller: Corrosion-resistant, Composite, PES.
   4. Motor: Integrated Variable Speed Drive.

D. Capacities and Characteristics:
   1. Capacity: Refer to drawings. Built-in timer.

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.03 CONTROLS

A. Aquastat: Field adjustable for control of hot water circulating pump.
   1. Description: Thermostatic switch.
   2. Type: Bi-metallic disc, snap acting.
   3. Enclosure: Environmentally sealed.
   4. Mounting: Clip-on mount for ¾” copper tube.
   5. Similar to Grundfos No. 595657.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install horizontal mounted, in-line, separately-coupled and close-coupled centrifugal pumps with shaft(s) horizontal.

D. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using elastomeric pads restrained spring isolators.
   1. 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.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.
   5. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

E. Install thermostats in hot-water return piping.

3.03 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Horizontal mounted, in-line, close-coupled centrifugal pumps.
      b. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as

connected piping. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping," and comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties."

1. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

E. Connect aquastat to hot water return pumps that they control.

3.04 IDENTIFICATION

A. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set aquastat and timer for automatic starting and stopping operation of hot water return pumps.
5. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.06 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Hubless, cast-iron soil pipe and fittings.
   2. Specialty pipe fittings.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.05 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste 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 Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

1.06 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

C. Pipe, fittings and couplings shall be manufactured in the United States.

D. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry; a part of the McWane family of companies.
   2. Charlotte Pipe and Foundry Company.
   3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings: ASTM A 888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Fernco Inc.
   2. Standards: ASTM C 1277 and CISPI 310.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. ANACO-Husky.

b. Charlotte Pipe and Foundry Company.
c. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with four (4) stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. MG Piping Products Company.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company, LLC; a division of MCP Industries.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:
1. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Watts; a Watts Water Technologies company.
2) Wilkins.
3) Zurn Industries.

b. Description:
1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly .

3) Pressure Rating: 125 psig at 180 deg F.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2. Dielectric Nipples:
   a. 6” brass nipple

PART 3 - EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 23 33 "Trenching, Backfilling and Compaction."

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

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 above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
   1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.

2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
   a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
   a. Reducing size of waste piping in direction of flow is prohibited.

L. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: install with no slope per California Plumbing Code.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install steel piping according to applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
   a. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
   a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
   b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary waste gravity-flow piping.
   a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
   c. Do not use pipe sections that have cracked or open welds.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.
5.

3.05 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Install hanger rod sizes per table 313.6 of the California Plumbing Code:

TABLE 313.6
HANGER ROD SIZES

PIPE AND TUBE SIZE (inches)	ROD SIZE (inches)
½ – 4	⅜
5 – 8	½
10 – 12	⅝

For SI units: 1 inch = 25.4 mm

G. Install hangers and supports for multiple pipe materials per table 313.3 of the California Plumbing code:

TABLE 313.3
HANGERS AND SUPPORTS

MATERIALS	TYPES OF JOINTS	HORIZONTAL	VERTICAL
Cast	Lead and Oakum	5 feet, except 10 feet where 10 foot lengths are installed[1, 2, 3]	Base and each floor, not to exceed 15 feet
	Compression Gasket	Every other joint, unless over 4 feet then support each joint[1, 2, 3]	Base and each floor, not to exceed 15 feet
Cast-Iron Hubless	Shielded Coupling	Every other joint, unless over 4 feet then support each joint[1,2,3,4]	Base and each floor, not to exceed 15 feet
Copper & Copper Alloys	Soldered, Brazed, Threaded, or Mechanical	1½ inches and smaller, 6 feet; 2 inches and larger, 10 feet	Each floor, not to exceed 10 feet[5]
Steel Pipe for Water or DWV	Threaded or Welded	¾ inch and smaller, 10 feet; 1 inch and larger, 12 feet	Every other floor, not to exceed 25 feet[5]
Steel Pipe for Gas	Threaded or Welded	½ inch, 6 feet; ¾ inch and 1 inch, 8 feet; 1¼ inches and larger, 10 feet	½ inch, 6 feet; ¾ inch and 1 inch, 8 feet; 1¼ inches every floor level
Schedule 40 PVC and ABS DWV	Solvent Cemented	All sizes, 4 feet; allow for expansion every 30 feet[3]	Base and each floor; provide mid-story guides; provide for expansion every 30 feet
CPVC	Solvent Cemented	1 inch and smaller, 3 feet; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides
Lead	Wiped or Burned	Continuous Support	Not to exceed 4 feet
Steel	Mechanical	In accordance with standards acceptable to the Authority Having Jurisdiction	
PEX	Cold Expansion, Insert and Compression	1 inch and smaller, 32 inches; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides
PEX-AL-PEX	Metal Insert and Metal Compression	½ inch, ¾ inch, 1 inch: All sizes 98 inches	Base and each floor; provide mid-story guides
PE-AL-PE	Metal Insert and Metal Compression	½ inch, ¾ inch, 1 inch: All sizes 98 inches	Base and each floor; provide mid-story guides
PE-RT	Insert and Compression	1 inch and smaller, 32 inches; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides
Polypropylene (PP)	Fusion weld (socket, butt, saddle, electrofusion), threaded (metal threads only), or mechanical	1 inch and smaller, 32 inches; 1¼ inches and larger, 4 feet	Base and each floor; provide mid-story guides

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm

Notes:

1. Support adjacent to joint, not to exceed 18 inches (457 mm).
2. Brace not to exceed 40 foot (12 192 mm) intervals to prevent horizontal movement.
3. Support at each horizontal branch connection.
4. Hangers shall not be placed on the coupling.
5. Vertical water lines shall be permitted to be supported in accordance with recognized engineering principles with regard to expansion and contraction, where first approved by the Authority Having Jurisdiction.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:
   1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Equipment: Connect waste piping as indicated.
   a. Provide shutoff valve if indicated and union for each connection.
   b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
   1. Sanitary Sewer: To exterior force main.
   2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. 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.

3.07 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
   a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
   b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
   c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
   a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
   c. Air pressure must remain constant without introducing additional air throughout period of inspection.
   d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
   a. Isolate test source and allow to stand for four hours.
   b. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Cleanouts.
   2. Roof flashing assemblies.
   3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:
   1. Section 22 14 23 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.02 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Jay R. Smith Mfg. Co.
      b. Josam Company.

c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required only above ground.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Josam Company.
c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
a. Brass.
b. Countersunk or raised head.
c. Drilled and threaded for cover attachment screw.
d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.03 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn Engineering Company.
      b. Thaler Metal Industries Ltd.
      c. Zurn Industries, LLC.
   2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
      a. Open-Top Vent Cap: Without cap.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains HD-1:
   1. Description: Shop or field fabricate from ASTM A74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
   2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch- minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:
   1. Standard: ASME A112.6.4.
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment Mounting:
   1. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

A. Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.04 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.05 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.06 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 13 19.13

SANITARY DRAINS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Floor drains.
2. Floor sinks.
3. Channel drainage systems.

1.03 DEFINITIONS

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required for above ground installation.
8. Outlet: Bottom.

9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Required.
12. Top or Strainer Material: Bronze.
13. Top of Body and Strainer Finish: Polished bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 5 inch diameter with heel proof grate.
16. Top Loading Classification: Medium Duty.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and no-hub outlet, and trap-seal primer valve connection.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep-seal P-trap.
21. Trap Features: Trap-seal primer valve drain connection.

B. Cast-Iron Floor Drains FD-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Not required.
6. Anchor Flange: Required.
7. Clamping Device: Required for above ground installation.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Required.
12. Top or Strainer Material: Gray iron.
13. Top of Body and Strainer Finish: Rough bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 12” diameter with tractor grate and sediment bucket.
16. Top Loading Classification: Heavy Duty.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and no-hub outlet, and trap-seal primer valve connection.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep-seal P-trap.
21. Trap Features: Trap-seal primer valve drain connection.

C. Stainless-Steel Floor Drains, (ASME A112.3.1) FD-3:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. WATTS.

c. Zurn Industries, LLC.
2. Outlet: Bottom.
3. Top or Strainer Material: Stainless steel.
4. Top Shape: Round.
5. Dimensions of Top or Strainer: 5” diameter strainer with heel proof grate.
6. Seepage Flange: Required.
7. Anchor Flange: Required.
8. Clamping Device: Required for above ground installation.
9. Trap-Primer Connection: Required.
10. Trap Material: Cast iron.
11. Trap Pattern: Deep-seal P-trap.

2.03 FLOOR SINKS

A. Cast-Iron Floor Sinks FS-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. WATTS.
c. Zurn Industries, LLC.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Anchor Flange: Required.
6. Clamping Device: Required for above ground installation.
7. Outlet: Bottom, no-hub connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Not required.
10. Internal Strainer: Dome.
11. Internal Strainer Material: Aluminum.
12. Top Grate Material: Cast iron, loose.
13. Top of Body and Grate Finish: Nickel bronze.
14. Top Shape: Square.
15. Dimensions of Top Grate: not required.
16. Top Loading Classification: No traffic.
17. Funnel: Not required..

B. Stainless-Steel Floor Sinks, (ASME A112.6.7) FS-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. WATTS.
c. Zurn Industries, LLC.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Stainless steel.
5. Anchor Flange: Required.
6. Clamping Device: Required for above ground installation.
7. Outlet: Bottom, no-hub connection.

8. Sediment Bucket: Required.
9. Internal Strainer: Dome.
10. Internal Strainer Material: Stainless steel.
11. Top Grate Material: Stainless steel, loose.
12. Top of Body and Grate Finish: Stainless steel.
13. Top Shape: Square.
14. Dimensions of Top Grate: 12” x 12”x 6”H half grate.
15. Top Loading Classification: No traffic.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Set with grates depressed according to the following drainage area radii:

      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

      a. Maintain integrity of waterproof membranes where penetrated.
   5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install channel drains at low points of surface areas to be drained.
   1. Set grates of drains flush with finished surface, unless otherwise indicated.

C. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
   1. Install on support devices, so that top will be flush with adjacent surface.

D. Install open drain fittings with top of hub 2 inches above floor.

3.02 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Hubless, cast-iron soil pipe and fittings.
   2. Specialty pipe and fittings.
   3. Encasement for underground metal piping.

B. Related Requirements:
   1. Section 33 40 00 "Storm Drains" for storm drainage piping outside the building.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof drainage system. Include calculations, plans, and details.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which drainage piping will be attached or suspended from.

B. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.06 FIELD 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 Construction Manager no fewer than two days in advance of proposed interruption of storm drainage service.

2. Do not proceed with interruption of storm drainage service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AB & I Foundry; a part of the McWane family of companies.
   2. Charlotte Pipe and Foundry Company.
   3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings:
   1. Marked with CISPI collective trademark and NSF certification mark.
   2. Standard: ASTM A 888 or CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Mission Rubber Company, LLC; a division of MCP Industries.
   2. Couplings shall bear CISPI collective trademark.
   3. Standards: ASTM C 1277 and CISPI 310..
   4. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. ANACO-Husky.
      b. Charlotte Pipe and Foundry Company.
      c. Mission Rubber Company, LLC; a division of MCP Industries.
   2. Standard: ASTM C 1540..
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Charlotte Pipe and Foundry Company.
    b. MG Piping Products Company.
2. Standard: ASTM C 1277..
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Dallas Specialty & Mfg. Co.
        2) Fernco Inc.
        3) Mission Rubber Company, LLC; a division of MCP Industries.

    b. Standard: ASTM C 1173.
    c. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. Sleeve Materials:
        1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.

2.04 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: High-density, crosslaminated polyethylene film of 0.004-inch or linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: natural.

PART 3 - EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 23 33 "Trenching, Backfilling and Compaction."

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
   1. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

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 above accessible ceilings to allow sufficient space for ceiling panel removal.

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. Install piping to allow application of insulation.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
   1. Do not change direction of flow more than 90 degrees.
   2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
      a. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building piping beginning at low point of each system.
   1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
   2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   3. Maintain swab in piping and pull past each joint as completed.

L. Install piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
   a. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping.
   a. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints:
1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Joint Restraints and Sway Bracing:
1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
   a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
   b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
   c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in ODs.
   2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.05 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical cast-iron piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
   2. Comply with requirements for cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."

C. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.07 IDENTIFICATION

A. Identify exposed storm drainage piping.

B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
   a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
   a. Expose work that was covered or concealed before it was tested.
3. Test Procedure:
   a. Test storm drainage piping on completion of roughing-in.
   b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.09 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.

C. Underground storm drainage piping shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.

2. hubless-piping couplings; and coupled joints.

END OF SECTION

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Metal roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Channel drainage systems.

B. Related Requirements:
1. Section 07 62 00 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 07 84 00 "Penetration Firestopping" for firestopping roof penetrations.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, combination Roof Drain and Overflow Drains RD/OD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Main Drain Body: Nominal 12-to 16-inch diameter.
5. Dimension of Overflow Drain Body: Nominal 12-to 16-inch diameter.
6. Combination Flashing Ring and Gravel Stop: Required for overflow drain body.

7. Flow-Control Weirs: Not required.
8. Outlets: Bottom.
9. Outlet Type: No hub.
10. Extension Collars: Not required.
11. Underdeck Clamp: Required.
12. Expansion Joint: Not required.
13. Sump Receiver Plate: Required.
14. Dome Material: Aluminum.
15. Perforated Gravel Guard: Not required.
16. Vandal-Proof Dome: Required.
17. Water Dam: 2 inches high for overflow drain bodu.

B. Metal, Medium-Sump, Promenade Drains AD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: 6- to 8-inch diameter.
5. Dimension of Frame and Grate: Nominal 6 1/2 inches square.
6. Outlet: Bottom.
7. Outlet Type: No hub.
8. Grate Material: Cast iron.
9. Vandal-Proof Grate: Required.
10. Extension Collars: Required.
11. Underdeck Clamp: Required for above ground installation.
12. Expansion Joint: Not required.
13. Sump Receiver Plate: Required.

C. Metal, Large-Sump, Planter Drains PD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: 12-inch diameter.
5. Dimension of Frame and Grate: Nominal 9 inches round X 4 ½” high dome with stainless steel mesh screen.
6. Outlet: Bottom.
7. Outlet Type: No hub.
8. Grate Material: Cast iron.
9. Vandal-Proof Grate: Required.
10. Extension Collars: Not Required.
11. Underdeck Clamp: Not Required.

12. Expansion Joint: Not required.
13. Sump Receiver Plate: Not required.

D. Metal, Scupper Drain, Planter Drains PD-2:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.4.
3. Body Material: Stainless Steel.
4. Dimension of Body: 11” long X 8 ½” high X 7” wide.
5. Dimension of Frame and Grate: Nominal 10 ¾” long X 6 1/2" high X 5 5/8” wide, provide with stainless steel mesh.
6. Outlet: horizontal (side outlet).
7. Outlet Type: No hub.
8. Grate Material: Stainless Steel.
9. Vandal-Proof Grate: Not required.
10. Extension Collars: Not required.
11. Underdeck Clamp: Not required.
12. Expansion Joint: Not required.
13. Sump Receiver Plate: Not required.

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Cover DSN-1:
1. Description: Stainless steel body with hinged perforated cover and stainless teel wall flange with mounting holes.
2. Size: Slightly larger than connected conductor to fit over cast iron pipe.

2.03 CLEANOUTS
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Body Material: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts FCO:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: No hub.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts WCO:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: No-hub, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass.
   b. Countersunk head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as, or not more than, one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

D. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.

2.
3. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
4. Size: Same as connected drainage piping.
5. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
6. Closure Plug: Countersunk, brass.

7. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

2.04 CHANNEL (LINEAR) DRAINAGE SYSTEMS

A. Narrow, Sloped-Invert, stainless steel, Channel Drainage Systems TD-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. ACO USA.
      b. ID Infinity Drain.
      c. Zurn Industries, LLC.
   2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
      a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps.
         1) Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated.
         2) Include extension sections necessary for required depth.
         3) Dimensions: 2 3/4-inch inside width and 4-inch inside depth. Include number of units required to form total lengths indicated.
         4) Frame: Not required.
      b. Grates: Manufacturer's designation " medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
         1) Material: Stainless steel.
         2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
      c. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
      d. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install test tees in vertical conductors and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

H. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
1. Comply with requirements in Section 07 84 00 "Penetration Firestopping."

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.04 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 33 00

ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Commercial, electric, domestic-water heat pumps.
   2. Domestic-water heater accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for commercial domestic-water heaters, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of commercial domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.06 COORDINATION

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

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of controls.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Periods: From date of Substantial Completion.
      a. Electric Hybrid, Heat Pump Domestic-Water Heaters: Six Years
      b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. Seismic Performance: Commercial, electric, domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.02 HEAT PUMP WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:
   1. Manufacturers: A.O.Smith
   2. Approved Equal

B. Commercial-Grade, Residential Hybrid Electric Heat Pump Water Heater:

1. Description: The heater shall be Commercial – Grade Residential Hybrid Electric Heat Pump Model Number HPTU-80 as manufactured by A. O. Smith Water Products Company or equivalent. Heater shall be rated at 4.5 kW @ 208V, single phase, 60 cycle AC as listed by Underwriters' Laboratories.
2. The water heater shall meet National Sanitation Foundation NSF-5 requirements.
3. Built-in tank shall be 80-gallon capacity with 160 psi working pressure and equipped with a commercial grade anode.
4. The heat pump water heater shall be capable of operating in Efficiency, Hybrid, Electric or Vacation modes. 3/4" NPT inlet and outlet water connections shall be provided.
5. The water heater tank shall have a six year limited warranty; the compressor, refrigeration components and all other parts shall have a one year limited warranty.
6. Fully illustrated instruction manual to be included. Meets or exceeds the efficiency and standby loss requirements of the U.S. Department of Energy and current edition of ASHRAE 118.1.

2.03 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. A.O. Smith Corporation
   c. Approved equal
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
5. Capacity and Characteristics:
   a. Working-Pressure Rating: 150 psig (1035 kPa).
   b. Capacity Acceptable: 2 gal. (7.6 L) minimum.
   c. Air Precharge Pressure: 55 PSI.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1 or ASHRAE 90.2.

D. Heat-Trap Fittings: ASHRAE/IES 90.1 or ASHRAE 90.2.

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.

H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

K. Provide a manual chain and pulley hoist system directly above the water heater. Coordinate with owner’s rep for additional information.

2.04 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test electric-hybrid heat pump water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric-hybrid heat pump water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Install commercial grade residential electric-hybrid heat pump water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping"

B. Install commercial grade residential electric-hybrid heat pump water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

H. Fill commercial grade residential electric-hybrid heat pump water heaters with water.

I. Charge domestic-water expansion tanks with air to required system pressure.

J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.02 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain, commercial grade residential electric-hybrid heat pump water heaters. Training shall be a minimum of one hour.

END OF SECTION

SECTION 22 42 13.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Water closets.
   2. Flushometer valves.
   3. Toilet seats.
   4. Supports.

1.03 DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:
   1. Product Data: For water consumption.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.01 WALL-MOUNTED WATER CLOSETS

A. Water Closets WC-1 & WC-2: Wall mounted, top spud, accessible.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. American Standard, Afwall Flow-Wise. No substitutions.
   2. Bowl:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Color: White
      d. Style: Flushometer valve.
      e. Height: Standard (WC-1) and accessible height (WC-2).
      f. Bowl configuration: Elongated.
      g. Water Consumption: 1.28 gal. per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
   3. Flushometer Valve: FV-1
   4. Toilet Seat: TS-1.
   5. Support: Water closet carrier.
   6. Water-Closet Mounting Height: 15” above finished floor (regular height WC-1) and 16-1/2” above finished floor (ADA compliant WC-2). Coordinate mounting heights with Architectural drawings

2.02 FLUSHOMETER VALVES

A. Flushometer Valves FV-1: Exposed, Sloan, Royal 111, low consumption, max. 1.28 gpf. No substitutions.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Sloan Valve Company.
   2. Standard: ASSE 1037.
   3. Minimum Pressure Rating: 125 psig.
   4. Features: Include integral check stop and backflow-prevention device.
   5. Material: Brass body with corrosion-resistant components.
   6. Exposed Flushometer-Valve Finish: Chrome plated.
   7. Panel Finish: Chrome plated or stainless steel.
   8. Style: Exposed.

2.03 TOILET SEATS

A. Toilet Seats TS-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bemis Manufacturing Company.
      b. Church Seats; Bemis Manufacturing Company.
   2. Standard: IAPMO/ANSI Z124.5.

3. Material: Plastic.
4. Type: Commercial Heavy duty.
5. Shape: Elongated rim, open front
6. Hinge Material: Noncorroding metal.
7. Seat Cover: Required
8. Color: White

2.04 SUPPORTS

A. Water Closet Carrier:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam.
   b. Jay R. Smith.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

3.02 INSTALLATION

A. Water-Closet Installation:
1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:
1. Use carrier supports with waste-fitting assembly and seal.
2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:
1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
   3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

F. Joint Sealing:
   1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to water-closet color.
   3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.03 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.04 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 13.16

COMMERCIAL URINALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Urinals.
   2. Flushometer valves.
   3. Supports.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:
   1. Product Data: For water consumption.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
   1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.01 WALL-HUNG URINALS

A. Urinals UR-1: Wall hung, back outlet, washout, accessible.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. American Standard, Pintbrook. No substitutions.

2. Fixture:
   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Washout with extended shields.
   d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
   e. Water Consumption: Water saving, 0.125 gpf max.
   f. Spud Size and Location: NPS 1-1/2, top.
   g. Outlet Size and Location: NPS 2, back.
   h. Color: White.
3. Flushometer Valve: FV-1.
4. Waste Fitting:
   a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
   b. Size: NPS 2.
5. Support: fixture support for off-the-floor urinals for washout type urinal, with bearing plate
6. Urinal Mounting Height: Handicapped/elderly according to ICC A117.1. Coordinate mounting heights with Architectural drawings.

2.02 URINAL FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves FV-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Sloan Valve Company, Royal 186 flush valve, low consumption, 0.125 gpf. No substitutions.
   2. Standard: ASSE 1037.
   3. Minimum Pressure Rating: 125 psig.
   4. Features: Include integral check stop and backflow-prevention device.
   5. Material: Brass body with corrosion-resistant components.
   6. Exposed Flushometer-Valve Finish: Chrome plated.
   7. Panel Finish: Chrome plated or stainless steel.
   8. Style: Exposed
   9. Consumption: 0.125 gal. per flush.
   10. Minimum Inlet: NPS 3/4.
   11. Minimum Outlet: NPS 1-1/4.

2.03 SUPPORTS

A. Type I Urinal Carrier:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Jay R. Smith Mfg Co; a division of Morris Group International.
      b. Josam Company.
      c. WATTS.
   2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

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

3.02 INSTALLATION

A. Urinal Installation:
   1. Install urinals level and plumb according to roughing-in drawings.
   2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
   3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:
   1. Install supports, affixed to building substrate, for wall-hung urinals.
   2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.

C. Flushometer-Valve Installation:
   1. Install flushometer-valve water-supply fitting on each supply to each urinal.
   2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
   3. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:
   1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
   2. Install deep-pattern escutcheons if required to conceal protruding fittings.
   3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Joint Sealing:
   1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
   2. Match sealant color to urinal color.
   3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.03 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.04 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 16.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Lavatories.
   2. Faucets.
   3. Supply fittings.
   4. Waste fittings.
   5. Supports.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:
   1. Product Data: For faucet flow rate.

C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. Servicing and adjustments of automatic faucets.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.01 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory L-1 & L-2: Vitreous china, wall mounted, with back.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. American Standard, Lucern. No substitutions.
   2. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: For wall hanging.
      c. Nominal Size: 20-1/2 by 18-1/4 inches
      d. Faucet-Hole Punching: Three holes, 4-inch centers.
      e. Faucet-Hole Location: Top.
      f. Color: White.
      g. Mounting Material: Chair carrier.
   3. Faucet: Solid-Brass, Manually Operated Faucet, self-metering
   4. Support: concealed-arm lavatory carrier, floor-mounted with uprights.
   5. Lavatory Mounting Height: Regular mounting height for lavatory L-1 and handicapped/elderly according to ICC A117.1 for L-2. Coordinate mounting heights with Architectural drawings.

2.02 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets : Manual-type, single-control mixing commercial, solid-brass valve.
   1. Chicago Faucets, 3400ABCP, with Econo-Flo non-aerating outlet, 0.35 gpm. No substitutions.
   2. Standard: ASME A112.18.1/CSA B125.1.
   3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
   4. Body Type: Single hole
   5. Body Material: Commercial, solid brass.
   6. Finish: Polished chrome plate.
   7. Maximum Flow Rate: 0.35 gpm.
   8. Maximum Flow: 0.2 gal. per metering cycle.
   9. Mounting Type: Deck, exposed
   10. Spout: Integral
   11. Spout Outlet: Non-Aerating
   12. Trap: Chicago P-trap. No substitutions.
   13. Drain: Chicago Grid drain. No substitutions.
   14. Mixing Valve TMV-2: Provide single fixture point of use thermostatic mixing valve similar to Bradley S59-4007 (minimum flow shall be rated for 0.35 GPM) refer to section 22 11 19 “Domestic Water Piping

2.03 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
   1. Supply Stops: Chicago Angle stops. No substitutions.

2.04 SUPPORTS

A. Type II Lavatory Carrier:
   1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

3.02 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.05 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 42 16.16

COMMERCIAL SINKS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Service basins.
2. Sinks
3. Sink faucets.
4. Supply fittings.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics**,** and furnished specialties and accessories.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.01 Countertop Drop-in Sinks SK-1 & SK-2:

A. Manufacturers:
a. Elkay
b. Just
c. Approved Equal

2. Fixture:
   a. Material: Stainless steel, type 304
   b. Gauge: 18 gauge
   c. Type: Single compartment sink; self-rimming, 3-hole punch
   d. Nominal Size: 25 by 21-1/4 by 6-7/8 inches
   e. Inside bowl dimensions: 21 inches by 15-3/4 inches
   f. Mounting: Counter mounting. Coordinate mounting heights with Architectural drawings.
   g. Drain: Mounting adapter for garbage disposal
   h. Trap: Chicago P-trap. No substitutions.
3. In-Sink-Erator: Model F-GN 1100 hot water dispencer with In-Sink-Erator, Model SST stainless steel hot water tank; 120V/1ph; 750 watts.

2.02 SINK FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Chicago, single lever post mount, circular base; 10-inch high spout; 8-inch reach.

2.03 SERVICE BASINS MS-1

A. Service Basins: Enamel, cast iron.
1. Manufacturers:
   a. American Standard
   b. Kohler
   c. Crane Plumbing/Fiat

2. Fixture:
   a. Standard: IAPMO PS 99.
   b. Shape: Rectangular
   c. Nominal Size: 22 by 18 inches
   d. Inside bowl dimensions: 18 inches by 14 inches by 10-1/2 inches
   e. Material: Enameled cast iron with plain back and rim guard.
   f. Mounting: Wall mounted. Coordinate mounting heights with Architectural drawings.
   g. Drain: Chicago Grid drain with NPS 3 outlet.

2.04 SINK FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Chicago exposed yoke wal-mount utility faucet with bucket hook and threaded hose end. No substitutions.
1. Commercial, Solid-Brass Faucets :
2. Standard: ASME A112.18.1/CSA B125.1.

3. Vacuum Breaker: Required for hose outlet.
4. Spout Outlet: Hose thread according to ASME B1.20.7.

2.05 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Risers:
1. NPS 3/4.

2.06 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine floors, and counters for suitable conditions where sinks will be installed.

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

3.02 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Set floor-mounted sinks in leveling bed of cement grout.

C. Install water-supply piping with stop on each supply to each sink faucet.
1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."

2. Install stops in locations where they can be easily reached for operation.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.03 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.05 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 47 13

DRINKING FOUNTAINS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes drinking fountains and related components.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 DRINKING FOUNTAINS

A. Drinking Fountains DF-1: Stainless steel, recessed, wheelchair accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Haws Corporation, Model 3150. No substitutions.

2. Standards:

   a. Comply with ICC A117.1.

3. Receptors number: One

4. Material: Chrome-plated or stainless steel

5. Shape: Rectangular
6. Bubbler: One, with adjustable stream regulator
7. Maximum Water Flow: 0.15 gpm.
8. Control: Push button.
9. Drain: Grid with NPS 1-1/4 tailpiece.

10. Supply: NPS 1/2 with shutoff valve.
11. Support: Pedestal
12. Access to internal components: Panel in pedestal

2.02 ELECTRIC WATER COOLERS

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   Elkay, Model EZH2O Bottle Filling Station with Bi-level ADA Non-filtered unit. Mod. # EMABFTL8WSSK. No substitutions.

1. Bottle-Filling Station (located directly above accessible bowl**)**
   1) Comply with ASME A112.19.3/CSA B45.4.
   2) Comply with NSF 61 and NSF 372.
   3) Comply with ICC A117.1.

b. Stainless steel wall-hung water cooler with side-mounted bubbler with mount guard, integral refrigerated air-cooled water chiller, 8 gph @ 90 degree F ambient; 80 degree F inlet water; 50 degree F outlet water; front and side self-closing push bars with feather touch water control and secured bottom access panel. Provide with bottle filling station. Unit shall be lead-free and certified to NSF/ANSI 61 & 372. Provide 18-gauge stainless steel back splash, extend 4-inch beyond EWC all sides. Provide ½-inch supply, 1-1/4-inch trap, P-trap, shut-off valve and cleanout.
c. Dual wall-mounted
d. ADA installation
e. Chilled water spout
f. Junction box for solid wiring
g. Power requirements: 120 V. 60 Hz.
h. FLA: 6
i. Supply: NPS 1/2 with shutoff valve.
j. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.

2.03 SUPPORTS

A. Type I Water Cooler Carrier: provided with drinking fountain.
   1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.02 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Install recessed drinking fountains secured to wood blocking in wall construction.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.05 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 00 00

HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Division 01.

B. The requirements of the General Conditions and Supplementary Conditions.

1.02 SUMMARY

A. Furnish and install a complete (fully tested, adjusted, and ready for operation) mechanical system and fully automatic indoor space thermal conditioning and ventilation (commonly “HVAC”) system with associated controls as described by the Contract Drawings and Specifications.

B. The HVAC systems and design described in the Project documents reflect a building designed for low consumption of energy and water and minimum environmental footprint. Any modifications to the systems described herein shall maintain or improve on the sustainability and energy efficiency features of the project.

C. All design modifications that pertain to system selection, system energy efficiency and energy use, material selection and indoor air quality issues shall require the approval of Integral Group.

D. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

E. Check, verify, and coordinate Work with Contract Drawings and Specifications prepared by all other trades. Include modifications, relocations, and adjustments necessary to complete work or avoid interference with other trades.

F. Where architectural features govern location of Work, refer to Architectural Drawings.

G. Contractor may install additional piping, fittings, and valves, not shown on the drawings, for testing purposes or convenience of installation. Where such materials are installed, they shall comply with the specifications and shall be properly sized for the system and operation. Remove such installed materials when they interfere with design conditions or as directed by the Architect.

H. Commissioning: The scope of work for the Contractor shall not include the duties of the Commissioning Authority (CxA). Contractor will be required, however, to include in their scope of work duties relevant to the commissioning process, including but not limited to training of owner's personnel in the operation of the HVAC equipment, providing manufacturer's startup and pre functional checklists and contractor-provided pre-functional and startup checklists to Commissioning Authority, performing and documenting pre-functional tests for HVAC equipment, performing and documenting functional tests for HVAC equipment, supporting DDC Contractor and Test and Balance Contractor in the performance of their duties, and providing operations and maintenance manuals.

1.03 CODES AND STANDARDS

A. All work and materials shall be in full accordance with the latest local rules and regulations, applicable sections of the California Code of Regulations, Title 24, State Fire Marshal, the Safety Orders of the Division of Industrial Safety, the California Electric Code and applicable State requirements. Nothing in these Plans and Specifications is to be construed to permit work not conforming to these requirements.

B. HVAC system installers shall be trained and certified in the proper installation of HVAC systems including ductwork, pipework, and equipment by a nationally or regionally recognized training or certification program. Uncertified persons may perform HVAC installations when under the direct supervision and responsibility of a person trained and certified to install HVAC systems or a contractor licensed to install HVAC systems.

C. Wherever the Specifications call for or describe materials or construction of better quality or larger sizes than are required by the above rules and regulations, these Specifications shall govern. Should there be any direct conflict between the above rules and regulations and the Specifications the rules shall govern.

D. Equipment shall have UL label listing.

1.04 DESIGN CONDITIONS

A. Ambient Temperature for condensing equipment: 100 deg F.

B. Design Winter Temperature: 32 deg F.

C. Design Wetbulb Temperature for evaporative equipment: 69 deg F .

D. Altitude: 88 feet above sea level.

1.05 DRAWINGS

A. Layout of the equipment and work is diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. Any interference noted between different drawings, and between drawings and actual field conditions shall be brought to the attention of the Architect and Engineer of Record for a decision. The right is reserved to make any reasonable change in location of equipment without additional expense to the Owner.

B. For purposes of clarity and legibility, drawings are diagrammatic to the extent that many offsets, bends, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping and ductwork and locations of equipment shall be governed by structural conditions and obstructions. Contractor shall make use of all data in Contract Drawings and Specifications and field conditions.

C. In the event a major re-routing of a system appears necessary, Contractor shall prepare and submit for approval, shop drawings of the proposed rearrangement. Because of the diagrammatic nature and small scale of the Contract Drawings, all necessary offsets, adjustments, and transitions required for the complete installation are not shown. Contractor shall carefully investigate the structural and finish conditions affecting all the Work and shall arrange such Work accordingly, furnishing such fittings, equipment, accessories, etc., as may be required to meet such conditions, at no increase in Contract Sum.

D. The construction documents for this project were prepared by the design team using BIM (Building Information Modeling). Using this software by the design team does not relieve the Contractor from performing the necessary coordination to provide complete, code compliant and operational building systems. The plans and sections provided are diagrammatic and show the design intent, these are not intended to be used for fabrication or installation. Contractor is responsible for generating shop drawings for fabrication that meet the design intent as shown on the Contract Documents. The exact location of the piping, ductwork, electrical and support components are to be determined by the Contractor. All building sections and details provided are for information only and do not relieve the Contractor from performing final coordination. Contractor is responsible for coordinating with all other trades.

E. All dimensions and locations of equipment, doors, partitions, etc., are to be taken from the architectural plans but shall be verified at the site.

1.06 MECHANICAL SUBMITTAL PROCEDURES

A. See Division 01 “Administrative Requirements”, for submittal procedures.

B. Mechanical and related submittals are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.

C. For DDC Building Automation Systems, see also SUBMITTALS in Part 1 of Section 25 50 00 for additional submittal requirements and a detailed submittal schedule.

D. Engineer of Record will review submittals and provide comments within the following timeframe after receipt by the Engineer:
   1. For typical submittals, allow 10 working days.
   2. For large or complex submittals, allow 15 working days. Determination of “large and complex” submittal shall be at the discretion of the Engineer of Record.
   3. Do not send Engineer of Record more than 10 submittals in a contiguous period of 5 working days. If excess submittals are received, review period will be extended as necessary to perform proper review. Submittals will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.
   4. These submittal review periods supersede and take precedence over periods defined in Division 01, unless Division 01 allows for longer review periods.
   5. Submittal review periods shall not be reduced from the times herein except by agreement with the reviewing entity, in advance and in writing.

E. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Use the same identifiers (e.g. equipment tags) used in Contract Drawings.

F. Submittals shall be provided in digital format.
   1. Provide a separate file for each submittal. For submittal packages, provide a separate file for each subsection (e.g. hardware cutsheets and shop drawings for the same Section shall be provided as separate files).
   2. Product cutsheets, test forms and other text documents shall be provided in word searchable digital format. Acceptable formats are MS Word, PDF (generated from another electronic document and word-searchable; scans of paper documents are not acceptable), and HTML; other formats require approval prior to submission.
   3. Drawings and schematics shall be provided in PDF format and in AutoCAD compatible format.
   4. Scanned paper documents are not acceptable
      a. Exception: original signed documents, such as qualifications, inspection certificates, and warranty documents.
   5. Hardcopy (paper) submittals are not acceptable and shall not be provided except as noted elsewhere).
   6. Submittals provided in the wrong format will be returned without action.

G. Submission and Resubmission Procedure

1. Optional Pre-Submittals: At Contractor's option, material may be submitted unofficially via email directly to the Engineer of Record for review and comment prior to formal submission. Comments provided by the Engineer are not official and may be changed or additional comments may be provided on the formal submittal. The intent of pre-submittals is to reduce paperwork and review time, and to provide a venue to discuss technologies, products, designs or implementation strategies that are novel or unique.
2. Each submittal shall have a unique serial number that includes the associated Specification Section followed by a number for each sub-part of the submittal for that Specification Section, such as SUBMITTAL 230000-01. There is no requirement to assign particular serial numbers to any specific submittals – serial number assignment is arbitrary. The only requirements are that the serial numbers be sequential (to avoid confusing gaps) and, most importantly, consistent across all submittal correspondence.
3. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 230000-01 REVISION 1.
4. Submit one copy of submittal in electronic format. Submissions made in the wrong format will be returned without action.
5. Include with each submittal and resubmittal a copy of the relevant specification section(s) noting on each paragraph and sub-paragraph(s) the following:
    a. CONFORMS: Contractor has verified that the submitted product conforms to the noted requirement(s).
    b. CONFORMS AS NOTED: Contractor has verified that the submitted product conforms to the noted requirement(s) by means of being equal to or higher quality and / or performance.
    c. NON-CONFORM: Contractor has verified that the submitted product does not conform to the noted requirement(s) and delineates each deviation from the specification requirements.
    d. NOT APPLICABLE: Contractor has verified that the noted requirement(s), in their opinion do not apply to this product, delineating the reasons for this decision.
    e. Include with each submittal and resubmittal a copy of the relevant specification section(s) the printed name of the contractor reviewer, their signature, the company name, and date of review.
6. Revise submittal
    a. Respond to all comments:
        1) Revise initial submittal to resolve review comments and corrections.
        2) Provide complete responses to comments or suggestions which are not practical to implement in the opinion of the Contractor.
    b. Indicate any changes that have been made other than those requested.
    c. Clearly identify resubmittal by original submittal number and revision number.
    d. Resubmittals that are not responsive to all comments will be returned without action.
7. Resubmit revised submittals until no exceptions are taken.
8. Once submittals are accepted with "No Exceptions Taken" or "Approved As Noted", provide:

a. Complete submittal of all accepted drawings and products in a single electronic file.
b. Copies for coordination with other trades, if and as required by the General Contractor or Owner's Representative.

H. Submit shop drawings, a list of proposed material and equipment manufacturers and the names of Subcontractors.

I. Shop drawings shall be provided for all mechanical systems for all floors of the building. Mechanical shop drawings shall also be provided for the underslab systems (under the foundation slab) and slab-embedded systems such as hydronic radiant loops and controls.

J. Materials and methods with which the words "for approval" or "approved" are used, and materials and methods which differ from those specified, shall be submitted.

K. Prepare and submit shop drawings, sections, details and diagrams to minimum scale 1/4" = 1'-0". Pump rooms and mechanical rooms shall be 1/2" = 1'-0" minimum scale. Drawings shall be coordinated, dimensioned and indicate equipment, pipe, duct, fire protection, and electrical in relation to architectural and structural features. Include minor piping, drains, air vents, etc. Indicate exact locations and elevations of valves, piping specialties, access doors, dampers, etc. Electronic submittal is encouraged.

L. Submit manufacturer's specifications, product source, data sheets, certified equipment drawings and installation instructions, including installation dimensions, clearances, weights, materials, finishes, color selection, accessories, acoustical characteristics, capacity and full load and part load performance curves; complete with electrical data, motor horse power, KW; motor efficiency, amperage, voltage phases and wiring diagrams. Identify the particular specification section number, paragraph and equipment identification number per equipment schedule. Note that suppliers (wholesalers and distributors) data sheets are not acceptable unless they are also manufacturers of the product being submitted.

M. Fan and pump systems, with equipment in parallel, shall have performance curves noting single equipment operation and all iterations of additional equipment.

N. Certified Equipment Drawings (8-1/2" x 11" sheets) shall be indexed in accordance with Specification Section. Drawings to be submitted at a later date shall be marked with a page as a placeholder for insertion when submitted. The original submittal shall note which shop drawings will be submitted later. Marked-up catalogs are not acceptable and will be returned without action. Electronic submittal is required.

O. Engineer of Record's review of submittals is for limited purpose of verifying conformance with information given and design concept expressed in Contract Drawings and Specifications. Engineer's review is not for purpose of determining accuracy or completeness of items such as dimensions and quantities, which remain responsibility of Contractor.

P. Contractor shall not commence with fabrication or installation of any equipment or system until the associated submittals have been approved by the Engineer of Record and returned with “no exceptions” taken. Contractor shall be solely liable for any costs incurred from starting fabrication before approved submittals are returned.

Q. All final approved submittals and equipment datasheets shall be provided, in PDF format, to the owner as part of the as-built drawing set and shall be text searchable.

1.07 COORDINATION DRAWINGS

A. Utilize the latest version of 3D AutoCAD, Navisworks, and/or Revit software for the Coordination Drawings. No proprietary software of any kind shall be used other than that indicated. Drawing paper size shall not be larger than FULL SIZED Contract Drawings, and in no case larger than 30” x 42”. Coordinate available space with ALL other trades involved.

B. Provide Coordination Drawings in digital electronic format. Provide both native file format (AutoCAD, Navisworks, or Revit) and PDF format files. Hardcopy drawings are not acceptable.

C. These drawings are to show registers, grilles, diffusers, duct sizes, elevation of bottom of duct, pipe sizes, valves and accessories, elevation of bottom of pipe, all elevations of materials and/or systems throughout each floor inclusive of hanger components, seismic bracing if applicable, and any component of construction that impacts vertical and/or horizontal space. In addition, the locations of all valves, dampers, and other items requiring access for service and maintenance are to be shown. The drawings are to also show electrical, structural beams, architectural bracing, structural bracing, ceiling heights, access doors, walls, floor to floor dimensions, columns, doors and other major architectural and structural features as shown on the architectural and structural drawings. Where the routing of work differs from that indicated on the Contract Drawings, such areas are to be indicated by highlighting with a note describing the reason for the change.

D. Rerouting of any system or part thereof shall be submitted separately in order to obtain concurrence of the Engineer of Record. Submitted rerouting must include fully documented proposed solutions with all trades coordinated. Contractor is fully responsible for coordination of systems included herein. Any effort by Engineer of Record beyond answering Contractor's questions will be at Contractor's expense, including attending coordination meetings, review of interim plans, or review of incomplete questions (routing issues without suggested solutions).

E. The Contractor and subcontractors are responsible to review and resolve any real or apparent interferences or conflicts as indicated by the coordination drawings produced by each trade.

F. After all conflicts or interferences are resolved, develop a final composite drawing showing the agreed upon routing, layout and juxtaposition of all duct work, conveyers, piping, major conduit, valves, panels, lighting fixtures and all other major mechanical, plumbing and electrical installations. In the preparation of all the final Coordination Drawings, large scale details as well as cross and longitudinal sections are required to fully delineate all conditions.

G. Submit the Coordination Drawings as digital electronic files to Engineer of Record for review and comment, as indicated under “Shop Drawings” above. Coordination Drawings shall be digitally signed-off by all other trades.

H. Contractor shall not commence with fabrication or installation of any equipment or system until the associated shop drawings have been reviewed and returned by the Engineer of Record. Engineer’s review of shop drawings shall not be taken as approval of their contents. Contractor shall be solely liable for any costs incurred due to deviations from the Contract Drawings.

I. No extra compensation will be paid for relocating any duct, pipe, conduit, or other material that has been installed without proper coordination between all trades involved. If any improperly coordinated work, or installed work that is not in accordance with the approved coordination composites, or is specifically noted by the Architect or Engineer of Record for a valid reason, necessitates additional work by the other trades, the costs of all such additional work is to be borne solely by the Contractor.

J. All changes in the scope of work due to revisions formally issued and approved are to be shown on both the individual subcontractor's Shop Drawings and the Coordination Drawings.

1.08 REQUESTS FOR INTERPRETATION AND CLARIFICATION

A. See Division 01 “Project Management”, for RFI procedures and forms.

B. Mechanical RFIs are, in addition, subject to the requirements of this Article. In the event of a conflict between the requirements of Division 01 and this Article, the requirements of this Article shall supersede and take precedence over those of Division 01.

C. Limit each RFI to a single issue or group of related issues.

D. Each RFI shall include a workable no-cost or lowest cost solution recommendation by Contractor.

E. Allow 3 working days from time of RFI receipt by Engineer of Record for review and response.

F. Do not send Engineer of Record more than 10 RFIs in a contiguous period of 5 working days. If excess RFIs are received, review period will be extended as necessary to provide a professional response. RFIs will be reviewed in priority determined by Engineer of Record in consultation with Architect and Contractor.

1.09 MATERIALS AND SUBSTITUTIONS

A. Comply with Division 01 “Product Requirements”.

B. Requests for product or equipment substitution shall be accompanied by a marked up copy of the Engineer of Record’s original specification. For each specified product feature or requirement, Contractor shall note the equivalent feature or attribute of the proposed substitute product or equipment.

C. Shop drawings of proposed material and equipment that differ from the specified materials and equipment, shall be accompanied by drawings that define changes. These drawings shall show modifications of architectural, plumbing, electrical and mechanical work required by the proposed materials and equipment, such as relocation of flues, drains, revised electrical circuits, relocation of roof or wall penetrations, revised foundations, etc.

1.10 COORDINATION WITH OTHER WORK

A. Contractor performing Work under this Section shall become thoroughly familiar with the Drawings and Specifications. Contractor shall adjust the Work to conform with the conditions shown on these drawings to provide the best possible assembly of the combined Work.

B. Obtain necessary information from the other trades regarding location of their work in order that the Work in this Section may be placed in correct position.

C. The inclusion and proper location of supports, pads, sleepers, openings, anchorages, etc. provided by others is the responsibility of the Contractor under this Section. Cutting and/or boring shall be permitted under this Section only with the written approval of the Architect.

D. It shall be the Contractor's responsibility to coordinate and have provided by other trades where not covered by the Contractor's scope of work, all electrical wiring and power to equipment, controls and devices, and any other work from other trades as required to provide fully functioning HVAC systems per the Contract Drawings and Specifications.

E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no cost impact to the owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.11 MANUFACTURER'S DIRECTIONS

A. Manufacturer's directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Contract Drawings and Specifications.

1.12 PROTECTION OF WORK

A. Equipment and materials shall be stored on dunnage and remain wrapped at all times until installed.

B. Duct and piping shall be remain capped during delivery and storage.

C. During installation, all installed duct and piping shall be capped and protected at the end of each working day.

D. Equipment shall be protected from weather and stored in an enclosed, indoor location.

E. Until final acceptance of the work, protect materials from damage and provide adequate and proper storage facilities. Replace damaged or defective work, material, and equipment before requesting final acceptance.

1.13 WORKMANSHIP

A. Equipment and materials shall be installed in a neat and workmanlike manner. Materials and equipment not so installed shall, upon order of the Architect or Engineer of Record, be removed and replaced in a satisfactory manner, without change in Contract Sum or additional cost to the Owner.

1.14 CLOSING IN UNINSPECTED WORK

A. Do not allow or cause any work to be covered up or enclosed until it has been inspected, tested, and accepted by the Architect, Engineer of Record, and/or Commissioning Authority.

B. Any work enclosed or covered-up prior to inspection and testing shall be uncovered. After the work has been tested, inspected and accepted, repair such materials as may be necessary to restore disturbed work to its original and proper condition at no extra cost to the Owner.

1.15 EQUIPMENT ANCHORING

A. Equipment shall be securely anchored to the building structure to prevent shifting or overturning during earthquakes.

1.16 PRELIMINARY OPERATION

A. Under this section, Contractor shall supervise and direct preliminary operation of systems should the Owner demand that any portion of the plant, apparatus, or equipment be operated previous to the final completion and acceptance of the work. Expenses for such preliminary operation will be paid by the Owner. Such preliminary operation or payment shall not be construed as an acceptance of the work.

1.17 "AS-BUILT" DRAWINGS

A. Comply with Section Division 01 “Project Closeout”.

B. For DDC Building Automation systems, see also COMPLETION REQUIREMENTS in Part 1 of Section 25 50 00 for additional as-built and closeout submittal requirements.

C. As-built drawings shall be furnished in an electronic format. Provide in drafting software (AutoCAD or Revit) native format and also in PDF format.

1.18 FINAL INSPECTION

A. At the time of final inspection, a service representative shall be available to make final adjustments.

1.19 FINAL OPERATION

A. After acceptance of the installation, instruct the Owner's Representative in operation and maintenance, for a period of three (3), non-consecutive working days at a time requested by the Owner during the first year of warranty.

B. At the beginning of the instruction period, deliver to the Owner three (3) copies of a durable binder as described under "Operating Instructions".

1.20 OPERATING INSTRUCTIONS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these Specifications.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the General Contractor for inclusion in the O&M manuals prior to the training of Owner personnel.

C. In addition, DDC Contractor shall provide O&M material as required by “Completion Requirements” in Part 1 of Section 25 50 00.

D. Provide a summary of operating sequences (start-up, normal run, and shut-down), and control shop drawings in the main mechanical room.

E. Provide three (3) complete sets of Operating Instructions. These instructions shall include brochures, diagrams, maintenance, and operating instructions and parts lists.

F. Provide a copy of the O&M manuals to the Commissioning Authority for review.

1.21 TRAINING OF OWNER PERSONNEL

A. The General Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The Commissioning Authority (CxA) shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

C. The Mechanical Contractor shall have the following training responsibilities:
   1. Provide the CxA with a training plan two weeks before the planned training.
   2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, air conditioning units, air handling units, fans, boilers, terminal units, controls, water treatment systems, etc.
   3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
   4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
   5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
   6. The DDC Contractor shall attend sessions other than the DDC System training, as requested, to discuss the interaction of the DDC System as it relates to the equipment being discussed.
   7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
   8. Training shall include:
      a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
      b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
      c. Discussion of relevant health and safety issues and concerns.
      d. Discussion of warranties and guarantees.
      e. Common troubleshooting problems and solutions.

f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
g. Discussion of any peculiarities of equipment installation or operation.
h. Instruction in the use of equipment controls that are integral to equipment or are provided by the equipment manufacturer, such as VRF System controls. This is in addition to and separate from DDC System training (see below) and does not replace or satisfy the requirement for such training, if specified. Equipment controls training shall include at least the following:
   1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system and any interface with security and communication systems.
   2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
   3) If system supports trending, all trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
   4) Every screen shall be completely discussed, allowing time for questions.
   5) Use of keypad or plug-in laptop computer for mobile control access.
   6) Use of remote access to the system via phone lines or networks, if applicable.
   7) Graphics generation, if applicable.
   8) Point database entry and modifications, if applicable
i. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.
j. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate. A video record of the training session is suggested but not required.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
10. The Mechanical Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
11. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

D. DDC Contractor.

1. See TRAINING in Part 3 of Section 25 50 00 for DDC System training requirements and DDC Contractor obligations.
2. DDC Contractor shall coordinate with Mechanical Contractor and Commissioning Authority regarding training on equipment-integrated or manufacturer-supplied control systems as described above. Such training is the responsibility of Mechanical Contractor but may be adopted by DDC Contractor by mutual agreement, to facilitate a more integrated training experience.

E. Test and Balance (TAB) Contractor. The TAB Contractor shall have the following training responsibilities:
1. TAB Contractor shall meet with facility staff after completion of TAB and instruct them on the following:
a. Go over the final TAB report, explaining the layout and meanings of each data type.
b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
e. Other salient information that may be useful for facility operations, relative to TAB.

1.22 WARRANTY

A. In accordance with Division 01 Project Closeout requirements, Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.

B. Contractor shall leave entire installation in complete working order and free from defects in material, workmanship, or finish.

C. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a minimum period of one (1) year from date of Certificate of Occupancy, or per Division 01, whichever is longer.

D. Warranty also services including instructions, adjusting, testing, noise, balancing, etc.

E. For each piece of equipment or device with a manufacturer's warranty in excess of one year, Contractor shall furnish certificate of manufacturer's warranty and contact information for manufacturer's warranty service. Contractor shall also provide a list or table of all equipment with warranties exceeding one (1) year in duration.

F. Provide new materials, equipment, apparatus, labor and/or service, and support to correct or replace that determined by the Owner to be defective or faulty.

G. The Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding the guarantees or relieving responsibility during the guarantee period.

H. For DDC System, see WARRANTY and WARRANTY MAINTENANCE in Part 1 of Section 25 50 00. DDC System warranty commences upon the acceptance of COMPLETION REQUIREMENTS described in Part 1 of that Section, which may occur after the Certificate of Occupancy.

I. After a period of 90 calendar days from date of acceptance of systems by Owner, provide, at no cost to the Owner, one service mechanic for an 8-hour period over as many working days as required to repair, replace any latent deficiency.

1.23 SUBMITTALS

A. Welding certificates.

1.24 ACTION SUBMITTALS

A. Product Data: For each type of product in Part 2.

1.25 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe 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.

PART 2 - PRODUCTS

2.01 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is 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 or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

2.02 SLEEVES

A. Galvanized-Steel Sheet: 0.0239 inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE or PP: Reusable, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.03 SLEEVE SEAL SYSTEMS

A. Manufacturers:
   1. Link-Seal
   2. Advance Products & Systems, Inc.
   3. CALPICO, Inc.
   4. GPT; an EnPro Industries company.
   5. Metraflex Company (The).

B. Description:
   1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   2. Designed to form a hydrostatic seal of 20-psig.
   3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
   4. Pressure Plates: Carbon steel.
   5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 of length required to secure pressure plates to sealing elements.

2.04 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening. Polished chrome-plated finish.
   1. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass.
   2. One-Piece, Cast-Brass Type: With set screw.
   3. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

2.05 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1 inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 4 inches above finished floor level.
   3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch (6.4 mm) annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for fire-stopping and fill materials specified in Division 07.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls Above Grade: Cast-iron sleeves or Galvanized Steel pipe sleeves.
   2. Exterior Concrete Walls Below Grade: Cast-iron pipe sleeves with sleeve-seal system or Galvanized Steel pipe sleeves with sleeve-seal system.
      a. Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade: Piping Smaller Than: Cast-iron pipe sleeves with sleeve-seal system or galvanized Steel pipe sleeves with sleeve-seal system.
      a. Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.
   4. Concrete Slabs Above Grade:
      a. Piping Smaller Than NPS 6: Galvanized Steel pipe sleeves.
      b. Piping NPS 6 and Larger: Galvanized Steel pipe sleeves.
   5. Interior Partitions: Galvanized-steel sheet sleeves.

3.04 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.05 CUTTING AND OPENINGS

A. Comply with Division 01 “Cutting and Patching”.

3.06 EQUIPMENT INSTALLATION

A. Install equipment to minimize pressure drop and allow adequate access headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated in drawings (note that in some cases non-parallel installation is indicated in the drawing to reduce pressure drop).

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.07 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 the 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, 145 PCF, 56-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for mechanical 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 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Related Sections include the following:
   1. Section 23 34 00 “HVAC Fans”.
   2. Section 26 29 23 “Variable-Frequency Motor Controllers”.

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors

C. Duty: Continuous duty at ambient temperature of 104 deg°F (40 deg C) and at altitude of 3300 feet (1000 m) above sea level.

D. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

E. Motors for submersible pumps shall be hermetically sealed.

F. All motors to have visible nameplate affixed, indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor and efficiency.

G. Minimum Motor Service Factor: 1.15.

2.02 MOTOR ENCLOSURES

A. Totally Enclosed, Fan Cooled (TEFC):

B. Open Drip Proof (ODP)

C. Totally Enclosed, Wet Down (TEWD): TEFC motor designed to withstand high pressure wash down, other high humidity and wet environments.

D. Explosion Proof Enclosure (EXPL)

E. Hazardous Location (HAZ)

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficiency, as defined in NEMA MG 1.

C. Polyphase motors shall be suitable for use with Variable-frequency Motor Controllers.

D. Construction:
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes to 1600 volts, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Provide motor shaft grounding ring.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Insulation: Class F.

E. Multispeed Motors: Separate winding for each speed.

F. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.04 SINGLE-PHASE MOTORS

A. Single-phase motors larger than 1/20 HP shall be Electronically Commutated (ECM) unless not offered by the manufacturer.

B. Electronically Commutated Motors (ECM)
   1. Motor shall be brushless DC type specifically designed for HVAC applications with heavy duty ball bearings and Electronic Commutation. It shall contain internal circuitry that converts single phase power into a DC signal. Speed control is achieved through a 0-10 volt DC control signal input through the pre-wired controls wires.
   2. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.

C. Non-ECM
   1. Motors shall be one of the following, to suit starting torque and requirements of specific motor application (listed in order of preference):
      a. Permanent-split capacitor.
      b. Capacitor start, capacitor run.
      c. Capacitor start, inductor run.
      d. Split phase.
   2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
   3. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
   4. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

PART 3 - EXECUTION (Not Applicable)

3.01 APPLICATION

A. All motors installed within the air stream to be Totally Enclosed Fan Cooled (TEFC).

B. All motors installed indoors and out of the air stream to be Totally Enclosed Fan Cooled (TEFC).

C. Motors drawing less than 250 Watts and intended for intermittent service may be standard of equipment manufacturer and need not conform to these specifications.

D. Motors located in hazardous location outside air stream: explosion proof enclosure, hazardous rating.

E. Motors located in hazardous air stream: explosion proof enclosure, hazardous rating.

F. Motors located in wet air streams: totally enclosed wet down.

G. Motors located in exterior locations: totally enclosed wet down.

H. Motors less than 3/4 HP: single phase.

I. Motors equal to or greater than 3/4 HP: polyphaser unless stated otherwise.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 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. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.02 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.
8. Firestopping
9. Sleeves
10. Miscellaneous Materials

B. Related Sections:
1. Division 01
2. Division 03 – Concrete (as applicable)
3. Division 07 – Firestopping, Joint Sealants (materials as applicable)
4. Section 230548 "Vibration and Seismic Controls for HVAC" Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
5. Division 23 HVAC Piping Insulation, HVAC Equipment Insulation, HVAC Hydronic piping (as applicable)
6. Section 233113 "Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. The calculations shall be stamped and signed by a Professional Engineer licensed in the same state as the project site.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 and the following parameters:
   1. SDS = per structural engineer
   2. lp = per structural engineer
   3. ap = as appropriate for element to be braced
   4. Rp = as appropriate for element to be braced
   5. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   6. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   7. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities have jurisdiction.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Pipe stands.
   4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Submit firestopping systems for every application.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with the following: Supports for Sprinkler Piping: NFPA 13; Supports for Standpipes: NFPA 14

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel stainless steel.
   3. Padded Hangers: All uninsulated copper piping shall use plastic coated hangers.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts. 12 gauge channel complete with nuts, pipe clamps, drive-in end caps, and pipe straps. Cast iron roll and stand for hot pipe sizes 6 inches and over. Cushion strip for all uninsulated copper piping.

2.03 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. B-line, an Eaton business.
      b. Flex-Strut Inc.
      c. Unistrut; Part of Atkore International.
   2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   3. Standard: MFMA-4.
   4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Electroplated zinc, Hot-dipped galvanized, Mill galvanized, In-line, hot galvanized, or Mechanically-deposited zinc.

2.04 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. National Pipe Hanger Corporation.
2. Pipe Shields Inc.
3. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used; must be rated for seismic applications in cracked concrete use.

2.06 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Stainless steel.
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   2. Bases: One or more; stainless steel.
   3. Vertical Members: Two or more protective-coated-steel channels.
   4. Horizontal Member: Protective-coated-steel channel.
   5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.07 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.08 FIRE STOPPING

A. Materials and installation shall comply with U.L. "Fire Resistance Directory", for Through-Penetration for Firestop Devices, latest edition. See Division 07 Section "Penetrating Firestopping".

2.09 SLEEVES

A. Adjust-To-Crete, AMI Products, or equal, 24 gauge, electro-galvanized adjustable sleeve, up to 6" diameter. For 8 inches (200 mm) and larger, provide galvanized standard weight steel pipe sleeves

B. Sleeves for Round Ductwork: Form with galvanized steel.

C. Sleeves for Rectangular Ductwork: Form with galvanized steel or wood.

D. Caulk: Acrylic sealant of quality specified in Division 07 Section "Joint Sealants".

E. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

C. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize steel parts after fabrication where used outdoors or inside the penthouse.

D. Fasteners: Bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. Bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. Ferrous metal components below grade shall be stainless steel.

E. Sheet Metal Screws: Plated, size 10 minimum.

F. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.

G. Counter Flashing; Unless specified or shown otherwise in drawings or Division 07
   1. Metal Flashing: 26-gauge galvanized steel.
   2. Flexible Flashing: 47-mil thick sheet butyl; compatible with roofing.
   3. Caps: Steel, 16 gauge.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. No fasteners may be installed in slab containing radiant tubing without explicit approval.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Prime-paint exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

B. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous .

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

E. Hot-dip galvanized outdoors.
   1. Repair damage to galvanizing at welds, scratches, etc. using Z.R.C. (no known equal) cold galvanizing compound.

F. Clean any hand marks and remove stickers or labels when complete.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling. Must be rated for seismic applications in cracked concrete use.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT AND PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work in this section includes, but is not necessarily limited to, furnishing all labor, materials, and equipment for the installation of vibration isolation mounts, brackets, base frames where required, seismic restraints, flexible connectors, pipe isolation hangers, and ductwork isolation hangers. The installation shall be complete in every respect, tested, and adjusted to be in excellent working order.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. HVAC Equipment including (but not limited to) Air-Cooled Condensing Units, Fan Coil Units and Exhaust Fans.

B. Internally-isolated Equipment.

C. Plumbing Equipment including (but not limited to) Pumps and Piping.

D. Concrete for equipment bases (housekeeping pads) and inertia blocks.

E. Flexible electrical connections to motors and vibrating equipment.

F. Flexible duct connections to fans and other vibrating elements.

1.03 GENERAL REQUIREMENTS

A. Schedules: Consult vibration isolation schedule(s) in drawings or specifications for equipment types and required isolation devices including types, static deflections, bases, seismic restraints, etc. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.

B. Equipment: Provide vibration isolators, base frames, inertia bases and seismic restraints of sufficient size and distribution to assure that deflection, stability and seismic restraint requirements are met. For typical units, no fewer than four isolators shall be provided. Isolators shall be provided to deflect uniformly under operating gravity <u>and</u> equipment thrust loadings to within ±10% of specified deflection values.

C. Specific Equipment: Specific manufacturer's equipment items are listed in this specification. All current and complete requirements from the listed manufacturer of these items shall be integral to this specification, unless such requirements conflict with requirements herein.

D. Instructions to Contractor:

1. Provide written installation instructions to the Contractor.

2. Provide a visit or visits to the jobsite before equipment is installed for the purposes of instruction. During the visit the manufacturer will inspect intended equipment locations and instruct installers in correct equipment installation procedure and sequence

E. Final Inspections: Provide a visit or visits to the jobsite after equipment is installed for the purposes of inspection. Identify all improperly installed vibration isolation equipment and instruct the contractor in corrective work.

F. Short-Circuiting: Rigorously avoid short-circuiting to the building any vibration-isolated piece of equipment, pipe, duct or other component. Short-circuits with or via rigid conduits, drain lines, rigid braces, rigid sleeves, framing, etc. all shall be avoided. The Contractor shall oversee trades to prevent the short-circuiting of any vibration isolation system and shall bring any unresolved conflicts to the Architect's attention.

G. Extra Parts: Supply and install any incidental equipment or parts needed to meet the requirements stated, even if not specified or shown on drawings, without claim for additional payment.

H. Package Units: Where equipment within Package Units is provided with separate isolators by the equipment manufacturer and the package enclosure is scheduled to be on an isolator assembly, the internal isolators shall be removed or permanently blocked and the isolated components they supported shall be rigidly attached to the enclosure.

I. Pre-Installation Instruction by Manufacturer: Make installers of vibration isolation equipment available for instruction by the equipment Manufacturer as required in Section 1.3.D.2.

J. Post-Installation Inspection and Adjustment:

1. After each equipment unit installation is complete and under full operational load, vibration isolators shall be adjusted so that loads are transferred to them and away from temporary blocking washers and shims. Blocks and shims then shall be removed and used as gauges to judge required clearances. Washers shall be moved away.

2. Inspect all vibration-isolated equipment, coordinate the work of all involved trades, and see that vibration isolators are not short-circuited by seismic restraints, drain lines, conduits, stanchions, control tubing, duct connections, pipe connections, etc. Ensure that hanger isolators and their rods or wires do not touch any other building component.

3. Obtain "rough-in" inspection and approval from the Architect of any installation to be covered or enclosed, prior to such closure.

4. Schedule final inspection(s) by the equipment Manufacturer after installation as required in Section 1.3.E. Obtain "rough-in" inspection by the Manufacturer of any installation to be covered or enclosed, prior to such closure.

K. Response to Punchlists: Upon completion of the work, the Architect or Architect's representative will carry out an inspection of the project and of final project record documents and will inform the installing contractor via punchlists of any further work that must be completed. Correct, at no additional cost to the Owner, all installations that are deemed defective in workmanship or materials by the Architect or Architect's representative.

1.04 MATERIAL REQUIREMENTS

A. Design Life: Bases, vibration isolation equipment, and seismic restraint equipment shall be capable of surviving the life of the equipment served.

1. All materials, components and parts shall be new.

2. All metal parts of vibration isolators to be installed out of doors shall be hot-dip galvanized after fabrication. Galvanizing shall comply with ASTM A 123, A 153, and A 386 as applicable.

B. Springs: Springs shall be so selected and installed that the ratio of spring diameter to final compressed height shall be no less than 0.8 and no more than 1.2. Further, each spring shall have a minimum additional travel to solid equal to 50% of its actual deflection.

C. Neoprene Elements: All elastomeric mounts, pads, bushings, sleeves, grommets, washers, etc., shall have a Shore-A hardness of 30 to 50 durometer after minimum aging of 20 days or corresponding oven-aging.

D. Bases: For equipment that is not constructed with a base structure compatible with vibration isolation mounts, a base frame shall be supplied with the isolators. A base frame shall also be supplied where an item or equipment and its drive motor require a common rigid base.

E. Seismic Restraints: Seismic restraints shall resist a seismic acceleration in any direction in accordance with all relevant codes without damage or deformation to equipment, building or mounts. Restraints shall not short-circuit vibration isolators during normal operation. Generally, there shall be as many seismic restraints as there are vibration isolators on a piece of equipment. Restraints and isolators shall be located close together on equipment or frames.

1.05 SPEED AND BALANCE REQUIREMENTS FOR ROTATING EQUIPMENT

A. Speed Limits: Fans and other rotating mechanical equipment shall not operate at speeds in excess of 80% of their true critical speed.

B. Balancing: Fans shall be balanced so that their vibration levels do not exceed 0.09-inches per second. The maximum velocity level (measured in all directions at the fan bearing(s)) shall not be exceeded when the equipment is installed per the fan manufacturer’s recommendations.

C. Remedial Work: Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work

required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question or exceeding the above displacement values.

1.06 SUBMITTALS BY MANUFACTURER

A. Compliance: Comply with the requirements of the General Conditions Section.

B. Specifications: Submit Manufacturer's specifications and other data needed to prove compliance with all specified requirements.

C. Installation Instructions: Submit Manufacturer's recommended installation instructions and procedures.

1. Written instructions and checklists to be delivered to the Contractor to aid in proper installation of manufacturer's equipment

D. Schedules and Shop Drawings: Submit schedules and large scale Shop Drawings clearly showing all pertinent data including, but not limited to.

1. Schedule: Submit a schedule indicating tag number, location and type of all vibration isolators. This shall be sufficiently clear to suffice as a checklist and index for information outlined below.

2. Design Tabulation: Submit a complete tabulation showing for each vibration isolator:

a. Design load.

b. Static deflection expected under the design load.

c. Specified minimum static deflection.

d. Additional deflection to solid under design load.

e. Ratio of spring height to spring diameter under design load.

3. Details: Submit details of seismic restraints, steel brackets, steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, and vibration isolator and seismic restraint mounting attachment methods

4. Galvanization: Submit certified statement by the galvanizer at the time of shipment indicating that outdoor equipment conforms with all ASTM specifications.

E. Structural Requirements: Submit the following:

1. Seismic Restraint: Submit calculations by a structural engineer licensed in the state in which the building is to be erected, certifying that all seismic restraints, bolts, cables and associated components will conform with all pertinent seismic- related requirements.

F. Exceptions: Identify all proposed changes, differences and/or discrepancies, including verbiage, terms and definitions between Contract Documents and submittals.

G. Samples: Submit samples of any or all proposed equipment at no charge to the owner.

H. Detrimental Field Conditions: Submit a list of all field conditions which the manufacturer has determined will limit the specified operational performance requirements specified for isolation devices.

1.07 SUBMITTALS BY CONTRACTOR

A. Compliance: Comply with the requirements of the General Conditions Section.

B. Contract Closeout: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.

1. A complete tabulation showing for each vibration isolator:

a. the actual static deflection measured at the project.

b. the specified minimum static deflection.

2. A report certifying:

a. that each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.

b. that each piece of isolated equipment or equipment component (ducts, pipes, conduit, etc.) is not short-circuited by any means.

c. that the requirements of Part 2.00 are satisfied for all equipment.

1.08 QUALITY ASSURANCE

A. Manufacturer's Responsibility: A single firm shall be responsible for the design, fabrication and delivery of vibration isolation equipment, including all components and seismic restraints.

B. Manufacturer's Experience: The Manufacturer shall have successful experience in vibration isolation and seismic control equipment fabrication, including no less than five year’s experience in fabrication and delivery of equipment equal in quantity or complexity to this work.

C. Structural Certification: The seismic resistance capability of all equipment shall be certified by a registered professional engineer in the state in which the project resides. The requirements of Chapter 16 Division III, Earthquake Design, in the latest version of the Uniform Building Code and all other applicable local codes shall be met.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent provisions of Division 1.

B. Package equipment at factory prior to shipping using manufacturer's standard method.

C. Protect equipment during transit, storage and handling to prevent damage and deterioration. Comply with requirements of manufacturer's instructions.

D. Identify each base or vibration isolation or seismic restraint item with individual tag numbers that correlate with the equipment tag system used on shop drawings.

1.010 PRODUCT CONDITIONS

A. Field Measurements: Check actual equipment sizes by accurate field measurements before fabricating bases or vibration isolation and seismic restraint equipment. Show resulting measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in installation.

B. Discrepancies: Note all discrepancies in surrounding construction which are likely to affect the operational or structural performance of the equipment. Provide a list of such discrepancies to the Contractor and directly to the Architect.

1.011 WARRANTY

A. Bases, vibration isolation equipment, and seismic restraint equipment shall be warranted against defective workmanship, operation and materials for the life of the equipment supported by these items.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. M.W. Saussé & Company, Inc. (Vibrex) (Basis of Design), Valencia, CA 661-257-3311

2. Mason Industries Inc., Anaheim, CA

3. Kinetics Noise Control, Inc, Dublin, Ohio 877-457-2695

2.02 VIBRATION ISOLATION MATERIALS

The listing of a Manufacturer's product in sections below does not certify that it fully complies with these specifications. All modifications of a listed product required to bring it into compliance with these specifications shall be indicated in submittals and made prior to jobsite delivery.

A. Type NWB: Neoprene Washer Bushing: A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt or hanging rod and have a

flat washer face to avoid metal to metal contact. Neoprene bushings shall be type HG by Mason or approved equal.

B. Type ETNP: Extra Thick Neoprene Pad(s) and Bearing Plate(s): Neoprene pad shall be waffled, 3/4 inch thick, 30 or 40 or 50 durometer, as scheduled, with a minimum 1/16-inch thick steel bearing plate on top. Pad areas shall be selected so no more than 15% and no less than 10% deflection occurs due to the supported load. Provide single or multiple pads and plates in series as needed to achieve specified static deflection with 1/16-inch-thick steel shim between layers. Provide "Super W + plate(s) or SWM" by Mason or approved equal.

C. Mount UHSM: Unhoused Spring Mount: Springs shall be designed and installed so their ends are parallel before and after installation and during equipment operation. All mounts shall have equipment leveling bolts. Each isolator shall have a steel base plate with mounting bolt holes and a ribbed or waffled neoprene friction pad permanently adhered to the bottom. The pad shall be 5/16 to 1/2 inch thick, 40 durometer hardness, and sized for a load of 60 psi. Provide "SLFH" by Mason, or "FDS" by Kinetics or approved equal.

D. Type SSRVTL: Spring with Seismic Restraint and Vertical Travel Limit: Same as Mount UHSM with the addition of steel columns on either side of the spring to provide seismic restraint and accommodate vertical travel limit stops. Mount shall resist a seismic acceleration in any direction of at least 0.5 G or as required by the relevant codes. Travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of 1/4 inch shall be maintained around restraining bolts and between the limit stops and the spring so as not to interfere with the spring action. Each isolator assembly shall have a friction pad of ribbed or waffled neoprene permanently adhered to the bottom. The pad shall be 5/16 to 1/2 inch thick, 40 durometer hardness, and sized for a load of 60 psi. Provide "SLR" by Mason, "FLS" by Kinetics or approved equal.

E. Type CNM: Captive Neoprene Mount: Double deflection neoprene mountings shall have a minimum static deflection of 0.20 inches. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads on both top and bottoms. Captive Neoprene elements shall be arranged in opposition within a steel or ductile iron housing to provide positive mechanical restraint in all directions. Neoprene elements shall prevent metal to metal contact during normal operation. Bonded assemblies without mechanical interlocks are not acceptable. Neoprene elements shall be of bridge bearing quality as tabulated. All mountings shall have minimum 1.0 horizontal G ratings and anchorage preapproval “OPM” numbers from the Office of Statewide Health Planning and Development (OSHPD) in the state of California prior to 2010, attesting to the maximum horizontal and vertical load ratings. All mountings shall have bolts for rigid attachment to the equipment and adequate base bolting provision. Mountings shall have a minimum static deflection of 0.2” (5 mm). In seismic zones, submittals shall include calculations showing that the intersection of the horizontal and vertical seismic loads fall below the OSHPD approved curves. Anchorages must be designed to meet the applicable building codes. All calculations must be signed by a professional engineer. Provide “BR” by Mason, "RDS" by Kinetics or approved equal.

F. Type NH: Neoprene Hanger: Vibration isolation hangers shall consist of a double-deflection neoprene-in-shear element contained in a steel housing. It shall be formed

with a projecting neck bushing for the hole in the hanger housing that will prevent metal-to-metal contact between the hanger rod and the housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30o arc before contacting the hanger housing. Neoprene shall be no harder than 50 durometer. Provide "HD" by Mason, "RH" by Kinetics or approved equal.

G. Type SH: Standard Spring Hanger: Vibration isolation hangers shall contain a laterally-stable steel spring set in a neoprene cup manufactured with a bushing to prevent short-circuiting of the hanger rod as it passes through the hanger housing. The cup shall contain a steel washer designed to properly distribute the spring load on the neoprene and prevent its crushing. Spring diameters and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the housing. Neoprene cup shall be minimum 1/4-inch thick and maximum 50 durometer. Provide "30" by Mason or approved equal.

H. Curb C1: Standard Vibration Isolation Curb: Vibration isolation curb shall be a prefabricated assembly consisting of an extruded aluminum frame and spring vibration isolation system. The aluminum frame shall be sufficiently rigid to support the equipment load without detrimental deflection. Frame and spring connections to include resilient snubbing to resist wind and seismic forces. Spring isolators shall be selected and positioned along the two long sides of curb no closer than 7-feet apart to achieve the minimum static deflection called for in the schedule. The static deflection of each individual isolator shall differ from the other by no more than 10%. Galvanizing requirements shall apply to each spring used in the curbs. Provide "CMAB" by Mason, "KSR" by Kinetics or approved equal.

I. Curb C2: High Deflection Vibration Isolation Curb: Vibration isolation curbs shall be a prefabricated assembly consisting of a lower frame of steel tubes topped by steel springs resting on neoprene pads in turn topped with an upper frame which provides continuous equipment support. Upper frame and spring connections to be adjustable and to include resilient snubbing to resist wind and seismic forces. Springs to be galvanized, accessible and stable. Springs shall be placed no less than 7' apart along the 2 long sides of the curb. The static deflection of any individual spring shall differ from the others by no more than 10%. It shall be possible to replace individual springs while the isolated equipment is operating normally, without affecting its performance. Provide "RSC" by Mason or approved equal.

J. Type RPAG: Resilient Pipe Anchor or Guide: All-directional acoustical pipe anchors, consist of two sizes of steel tubing separated by a minimum 1/2-inch thickness of 60 durometer or softer neoprene. Vertical restraint shall be provided by similar material arranged to prevent up or down vertical travel. Allowable loads on the isolation material shall not exceed the manufacturer’s recommendations. Provide "ADA/GDA" by Mason, "RSF" by Kinetics or approved equal.

2.03 BASE MATERIALS

A. Type SFFMB: Steel Frame for Floor Mounting Base: Steel frames for floor-mounted equipment shall consist of structural steel sections sized, spaced, and connected to form a rigid base that will not twist, rack, deform, or deflect in any manner that will negatively affect the equipment or isolation mounts. Frames shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports,

duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Frames may be rectangular or tee-shaped in plan. The depth of steel frame base members shall be minimum one-tenth the longest dimension of the base. Frame bases shall include side-mounting height-saving brackets for attachment to vibration isolators. Provide "WF" by Mason, "SFB" by Kinetics or approved equal.

B. Type IBFMB: Inertia Base for Floor Mounting Base: Concrete inertia bases for floor-mounted equipment shall be formed of stone-aggregate concrete (150 lb/cu ft) and appropriate steel reinforcing cast between perimeter structural steel sections. Inertia bases shall be built to form a rigid base that will not twist, rack, deform, deflect, or crack in any manner. Inertia bases shall be adequately sized to support basic equipment units and motors plus all attached equipment requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base thickness shall be minimum one-twelfth the longest base dimension but not less than 8 inches. Inertia bases shall include side-mounting, height-saving brackets for attachment of vibration isolators. Minimum clearance between bottom of base and structure beneath must be either 2" or 3% of the shorter base dimension, whichever is greater. The steel frame and reinforcement shall be supplied by the vibration isolator manufacturer. Concrete shall be provided and poured by the Contractor on site. Provide "K" by Mason, "CIB" by Kinetics or approved equal.

2.04 SEISMIC RESTRAINTS

A. Type FMSR: Floor-Mounted Seismic Restraint: Separate earthquake restraints shall be provided for all floor-mounted equipment on vibration isolation mounts that do not include seismic restraint housings. Provide a minimum of four all-directional earthquake restraints that are located as close to the vibration isolators as possible to facilitate attachment to both the equipment base and the structure. The restraints shall consist of interlocking steel members restrained by a shock-absorbent neoprene bushing. Bushing shall be a minimum of 1/4 inch thick. Restraints shall be manufactured with an air gap between hard and resilient material of 3/16 to 1/4 inch. snubbers shall be installed with factory-set clearances. Snubber end shall be removable to allow inspection of internal clearances. Restraints shall comply with the requirements of the most recent version of the Uniform Building Code and shall resist a seismic acceleration in any direction of at least 0.5 G without damage to themselves, the building or the equipment. Provide "Z-1011 or Z-1225" by Mason or approved equal.

B. Type SCSR: Slack Cable Seismic Restraint: Provide slightly slack steel aircraft cables of appropriate sizes and lengths and with appropriate fittings and anchorages for all isolated ceiling-suspended equipment, all isolated roof-mounted equipment, and all isolated pipes and ducts. Hanger rods shall be reinforced against upward vertical loads where required. Cable systems shall be designed to comply with the requirements of the most recent version of the Uniform Building Code and shall resist a seismic acceleration in any direction of at least 0.5 G without damage to themselves, the building or the equipment. Use seismic restraint cables as engineered and fabricated by Mason or approved equal.

2.05 PIPING ISOLATION MATERIALS

A. Type FPC: Flexible Pipe Connectors: Flexible pipe connectors shall be fabricated of multiple plies of nylon cord, fabric, and neoprene, vulcanized so as to become inseparable and homogeneous. Straight connectors shall be formed into a double sphere shape. Elbow connectors shall have a single sphere shape at the curve of the unit. Flexible connectors shall be able to accept compressive, elongating, transverse, and angular movements. Flexible connectors shall be selected and specially outfitted if necessary to suit the system temperature, pressure, and fluid type. Connectors for pipe sizes 2 inches and smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings. Control cables shall be provided if required. Provide "MFDEJ” or “SFDEJ" by Mason or approved equal.

B. Type FLPS: Felt Lined Pipe Sleeve: Sleeve shall consist of a formed and stiffened galvanized steel sleeve lined on the inside with moisture and vermin resistant felt bonded to the metal sleeve and 1/2 inch thick. Sleeve inside diameter shall equal pipe outside diameter in each application. Sleeve shall be split longitudinally so it can be snapped over pipes and reclosed without damage. Sleeve lengths shall be as recommended by the manufacturer for the given diameters, but shall not be less than 3 inches. Provide Tolco Isolator for Copper Tubing (Fig 83 or 84) or approved equal.

C. Type CHFL: Clevis Hanger or Clamp with Felt Lining. The felt material shall be a minimum 1/4" thick and shall extend above the center-line of the suspended pipe. The felt material shall withstand a maximum temperature of 650 degrees F. The finish of the hanger shall be as specified for other clevis hangers utilized for the plumbing piping system. The isolator shall be Tolco "Clevis Hanger with Felt Lining" or approved equal.

2.06 FLEXIBLE DUCT CONNECTORS

A. Type FDC: Provide flexible neoprene-impregnated fabric duct connectors between all exhaust fans, fan coil units and forced air units and ducts. Connector material shall be impervious to air. The flexible duct connectors shall be Dynair Neoprene “ConnectorPlus™” or approved equal.

2.07 FLEXIBLE ELECTRICAL CONNECTORS

A. Type FEC: Use "flexible" conduit at least 24-inches long at all electrical connections to vibrating mechanical equipment. Conduit shall be sufficiently slack at mid-point to allow for 1-inch movement of flexible conduit in any direction.

2.08 CUSTOM RESILIENT AND AIRTIGHT SLEEVE MATERIALS

A. Type CRPS: Sleeve shall be custom-fabricated. It shall be formed from pipe or sheet metal that is 1 inch larger in each cross-sectional dimension than the penetrating element and is 2 inches longer than the thickness of the construction penetrated. The annular space between the sleeve and the penetrating element shall be packed tightly with long-fiber glass fiber of 2- to 3-pcf density to within 1/2 inch of the ends of the sleeve. The remaining 1/2-inch space at each end shall be filled completely with acoustical sealant to form an airtight seal. Glass fiber insulation by CertainTeed, Johns Manville, or Owens-Corning. Acoustical Sealant by DAP, Tremco or U.S. Gypsum, choice depending on application and as approved by Architect.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS PRIOR TO INSTALLATION

A. Prior to installation of vibration isolators, frames, guides, seismic restraints and related materials, the following conditions shall be met.

1. All submittals for equipment shall be approved by the Architect.

2. Written and oral instructions from the vibration isolation equipment Manufacturer shall be obtained.

3. Any conflicts between trades resulting in unavoidable rigid contact of vibrating equipment piping or ductwork due to inadequate space or other unforeseen conditions shall be brought to the Architect's attention. If these conflicts are not resolved before installation, all corrective work shall be at the Contractor's expense.

4. Any discrepancies between the specifications and field conditions or any changes due to specific equipment selection shall be brought to the Architect's attention. If these discrepancies are not resolved before installation, all corrective work shall be at the Contractor's expense.

3.02 GENERAL REQUIREMENTS FOR INSTALLATION

A. Furnish and install vibration isolators, bases, seismic restraints and related materials and insure the following:

1. No mechanical equipment or piping shall make rigid contact with the "building" unless it is approved in this specification or by the Architect. "Building" includes, but is not limited to: roofs, floors, beams, columns, walls, partitions, ceilings, studs, ceiling framing and suspension systems. Space all vibration-isolated equipment and isolated components and all vibration isolators (including rods and wires) so as to be entirely free of any contact with any building element in any reasonable operating position.

2. The installation or use of vibration isolators shall not cause any change of position of equipment or piping or ducts that results in stresses in any connections or misalignment of shafts or bearings. In order to meet this objective, equipment, piping, and ducts shall be maintained in a rigid position during installation. The load shall not be transferred to the isolators until the installation is complete and in operational condition.

3. No equipment unit shall bear directly on or be suspended from vibration isolators or brackets unless its own frame or casing is suitably rigid to span between isolators without any significant or noticeable deformation and such support is approved by the manufacturer.

4. All rigidly or resiliently-installed equipment, piping and ducts shall be capable of resisting seismic input from the building in any direction without damaging the building, equipment or mounting system.

3.03 INSTALLATION OF FLOOR AND ROOFTOP MOUNTED EQUIPMENT

A. Provide vibration isolation and seismic restraint for base-mounted equipment as scheduled and per all instructions in this specification.

B. Unless otherwise shown or specified, all base-mounted equipment shall be set on 6-inch thick, hardrock concrete housekeeping pads. Vibration isolators and seismic restraints shall be bolted to the housekeeping pad. The pad dimensions shall exceed the equipment footprint (including floor mounts) by at least 24-inches in each direction (i.e. 12-inches per side).

C. Unless otherwise indicated, a minimum clearance of 1 inch shall be provided between the top of a housekeeping pad or floor or roof and the underside of an equipment unit or steel base frame that is vibration-isolated. This space shall be cleaned thoroughly of all dirt and debris.

D. For isolation equipment (Mounts UHS and SSRVTL) with neoprene pads bearing directly on structure, fasten the isolator base plates to the building structure with suitable bolts. Isolate steel bolts from steel base plates with neoprene bushings or washers and sleeves minimum 1/4 inch thick and maximum 40 durometer hardness. Provide steel washers to distribute bolt head loads to neoprene bushings or washers below. Size bolt holes in isolator bases to account for neoprene bushings or sleeves.

E. All bases for pumps shall be of sufficient area to support any required pipe stanchions below pipe elbows.

F. Bases for boilers shall be of sufficient area to support draft fans, if included.

G. Fans and pumps and their respective motors shall always be mounted on a common base.

H. Wind loads shall be accounted for in rooftop installations, including appropriate snubbers and slack-cable restraints.

3.04 INSTALLATION OF CEILING AND ROOF SUSPENDED EQUIPMENT

A. Provide vibration isolation and seismic restraint for suspended equipment as scheduled and per all instructions within this specification.

B. Ceiling or roof-suspended equipment shall be supported from the heaviest possible structure, such as trusses or joists. If necessary, provide heavy extra sub-structure between the building's existing heavy structure in order to support vibration-isolated equipment. Do not suspend equipment from roof decks or floors without approval of the Architect. Connect vibration isolation hangers directly to, or as close as possible to, heavy structure.

C. Hanger rods shall be aligned and free of contact with hanger boxes.

3.05 INSTALLATION OF RESILIENT PIPE SUPPORTS

A. Size, select, and install all seismic restraints so as to resist seismic forces from the building in any direction without damage to equipment, isolators, restraints, or building. Restraints shall not short-circuit vibration isolators during normal operation. Restraints

shall comply with Chapter 16, Section III, Earthquake Design, in the latest version of the Uniform Building Code and all other applicable local codes.

B. One seismic restraint shall be provided for each vibration isolator supporting floor or rooftop-mounted equipment, pipes or ducts.

C. Seismic restraint cables shall be provided for all vibration isolated ceiling or roof-suspended equipment, pipes or ducts. Adjust cables with care to handle required forces but do not short-circuit isolation.

D. Hanger rods supporting ceiling or roof-suspended equipment shall be reinforced by cross-bracing or sleeves to resist lateral and upward vertical seismic loading.

E. All vibration isolators, seismic restraints, springs with seismic restraint housings, and seismic restraint cables shall be suitably secured to appropriate structure so that the fastenings and structure can handle the seismic load.

3.06 INSTALLATION OF RESILIENT PIPE CONNECTIONS TO EQUIPMENT

A. Unless otherwise specified, provide resilient support for all HVAC and plumbing water pipes throughout the building. No such piping is to come into rigid contact with the building.

B. Where "piping systems" are required to be vibration-isolated in a certain room or for a certain distance from an equipment unit, "piping systems" shall include all pipes, valves, strainers, tanks, converters, and other connected hardware.

C. Support all piping in mechanical equipment rooms and yards on Type UHSM or SH springs sized for minimum 1-inch static deflection, unless otherwise noted.

D. Vibration isolate all piping outside of mechanical equipment rooms that is connected to and within a 50-foot distance from the equipment room walls. If the piece of equipment is supported on neoprene isolators, support pipes on Type NM or NH isolators sized for minimum 0.20-inch deflection. If the piece of equipment is supported on spring isolators, support pipes on Type UHSM or SH springs sized for minimum 1-inch deflection.

E. Throughout the rest of the building not covered in C or D above, use FLPS resilient pipe sleeves for support. An alternate to this is 1-inch-thick, 10-pcf-density glass fiber pipe insulation with suitable bearing plates to prevent crushing of insulation and without any steel pin or other rigid connection from plate to pipe through insulation.

F. Provide Type CRPS custom resilient pipe sleeves wherever pipes penetrate construction.

G. Provide Type RPAG resilient pipe anchor/guide where anchors and/or guides are required in horizontal and vertical piping. Connect RPAG units to heavy structure only.

H. Release restraining washers and nuts in order to "free" all precompressed spring hangers.

3.07 INSTALLATION OF RESILIENT DUCT CONNECTIONS TO EQUIPMENT

A. Piping connected to vibration-isolated equipment shall be installed so that it does not strain or force out of alignment vibration isolators supporting either the equipment or the piping. For all project air-handling units, chillers, condensing units, cooling towers, fan coil units, packaged HVAC equipment and pumps, provide Type FPC flexible pipe connectors.

B. For the remaining pipe connections, any flexible connector approved by the Architect is acceptable.

3.08 INSTALLATION OF FLEXIBLE ELECTRICAL CONNECTIONS TO EQUIPMENT

A. Provide flexible connections between ducts and vibration mechanical equipment such as fan coil units and exhaust fans. Use neoprene-impregnated fabric material unless loaded vinyl is specifically scheduled.

B. Provide flexible electrical conduit installed grossly slack so that there is at least 1 inch movement in any direction at the midpoint of the conduit.

3.09 INSTALLATION OF PIPE AND DUCT PENETRATIONS

A. Pipe and Duct Acoustical Penetrations:

1. Cut a clean opening in the penetrated construction very nearly the size of the sleeve for each penetrating element. Provide lintels above, relief structure below, and vertical framing between and to the sides as required. Provide the above, escutcheon plates, and anything else necessary to make the penetrated structure as solid and massive near the penetrations as away from the penetrations.

2. Set the metal sleeve into the penetrated construction in an airtight manner around its outer periphery, using grout, dry packing, plaster, or drywall compound full depth and all around--but only to a maximum width of 1-inch or the requirements of the above paragraph shall not have been satisfied.

3. Pack the 1/2-inch wide annular opening with glass fiber between metal sleeve and penetrating element full depth all around to a firm degree of compaction. Leave a 1/2-inch deep annular opening free at each end of the metal sleeve; fill this fully with acoustical sealant.

3.010 VIBRATION ISOLATION SCHEDULE

Mechanical Equipment (Note 1)	**Isolator Type**	**Min. Isolator Design Static Deflection, Inches**	**Seismic Restraint** (Notes 2 and 3)
DOAS	C1	1	-
RTU-1, 2, 3.1, 3.2	C1	2	-
VRF-1,2	SSRVTL	1	-

Mechanical Equipment (Note 1)	Isolator Type	Min. Isolator Design Static Deflection, Inches	Seismic Restraint (Notes 2 and 3)
FCU-106, 112, 206, 212	NWB	-	-
FCU-114	SH	1	SCSR
CU-1,2	SSRVTL	1	-
Ducted FCUs	SH	1	SCSR

NOTES:

1. Verify with the equipment manufacturer that the factory supplied equipment base can accommodate point loading from vibration isolators without deformation. If the unit base is unable to be point loaded, a supplemental steel base frame will be required between the equipment and vibration isolators.

2. Where Type SSRVTL spring mounts with vertical travel limit stops are specified, additional seismic restraints are not required if a Licensed Structural Engineer verifies that limit stop on SSRVTL mount will provide sufficient seismic restraint to conform with local Code requirements.

3. Provide seismic restraint calculations for all connections of equipment to support structure.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Pair of Stainless-steel rivets or self-tapping screws. Where equipment is installed in piping utilize a pair of chains.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include building number or designation and equipment's unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Brady Corporation.
   2. Carlton Industries, LP.
   3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, (1.6 mm)1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Markers for underground piping: 1/8-inch thick, 3” wide, florescent yellow polyethylene tape with imprint to read “Caution – Buried Pipe Below”.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. 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.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.04 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. Self-Adhesive duct Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.05 CEILING EQUIPMENT MARKERS

A. Adhesive 10mil vinyl 7/8-inch diameter color ceiling grid marker.

2.06 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches (100 by 178 mm).
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Provide markers on ceiling to locate equipment above T-bar type panel ceiling. Locate in corner of panel closest to equipment. Dots shall be following colors:
1. HVAC dampers, valves and terminal boxes: Blue
2. Plumbing Valves: Green
3. Control Devices and Panels: Red

3.04 PIPE LABEL INSTALLATION

A. Pipe Label Locations: 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:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet (15 m) along each run. Reduce intervals to 10 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:
   1. Refrigerant Piping: Black letters on a safety-orange background.

3.05 DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

   1. Blue with white lettering: For cold-air supply ducts.
   2. Yellow with black lettering: For hot-air supply ducts.
   3. Green with white lettering: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system. Identify air handling unit number at each location.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

B. Warning Sign at Fume Exhaust Plenums: Place warning sign on each fume exhaust plenum access - "WARNING. HAZARDOUS ATMOSPHERE INSIDE. USE BREATHING APPARATUS" when breaching containment.

C. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters. See Section 3320, Article 7, Subchapter 7, General Industry Safety Orders, Title 8, California Code of Regulations.

D. Fire dampers and fire smoke dampers: at each fire damper or fire smoke damper access panel, label "FIRE DAMPER" or “FIRE SMOKE DAMPER” in minimum 1 inch (25 mm) high letters. Fire smoke dampers shall be provided with tags to identify each fire smoke dampers with 2 lines as follows: the first line “FSD-NUMBER SEQUENCES-BLDG NUMBER” (e.g. FSD-001-15). The second line “ZONE FIRE ALARM-zone” that

activates the damper (e.g. ZONE L1-03). Tags shall be engraved plastic with white letters on red background.

E. Underground plastic pipe markers: install 6 to 8 inches [**150 to 200 mm**] below finished grade, directly above buried pipe.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

1. Balancing Air Systems:
   a. Constant-volume air systems.
   b. Variable-air-volume systems.
   c. Multizone systems.
   d. Induction-unit systems.
2. Balancing Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
   b. Variable-flow hydronic systems.
   c. Primary-secondary hydronic systems.
3. Control system verification
4. Testing, adjusting, and balancing existing systems and equipment.

1.03 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.04 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:
   a. The Contract Documents examination report.
   b. The TAB plan.
   c. Needs for coordination and cooperation of trades and subcontractors.
   d. Proposed procedures for documentation and communication flow.

1.05 ACTION SUBMITTALS

A. Sustainable Design Submittals:
   1. Air-Balance Report: Documentation indicating that Work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
   2. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.07 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB.

   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.

2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.08 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:
1. Engage any AABC or NEEB contractor.

3.02 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.03 PREPARATION

A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.04 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" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and ASHRAE 111 and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation”.

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 IP .

E. Report shall include the as-found condition, all iterative balancing measurements, as well as the final balanced state.

3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 23 31 13 "HVAC Metal Ducts."

3.06 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.07 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following at the controls interface level:

1. Verify temperature control system is operating within the design limitations.

2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.08 GENERAL PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.09 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Relief, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Hydronic Systems Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.
   3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

3.12 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner’s Representative.

B. Owner’s representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
   1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
   3. If the second verification also fails, Owner’s representative may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13

HVAC DUCT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Duct insulation.
   2. Fire-rated insulation.
   3. Insulation jackets.

B. Related Sections:
   1. Division 01 - Volatile Organic Compound (VOC) Content Restrictions.
   2. Division 07 - Firestopping.
   3. Division 09 - Painting and Coating: Painting insulation jackets.
   4. Section 23 31 13 – HVAC Metal Ducts

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

D. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).

G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.

H. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2013.

L. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 ACTION SUBMITTALS

A. See Division 01 and Section 23 00 00 “HVAC General Requirements” for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved. Include details for removable insulation sections at access panels.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum five (5) years of experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping. Any insulation subjected to moisture shall not be used.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

1.08 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.09 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Requirements for all products of this section:
   1. Surface Burning Characteristics:
      a. Indoor insulation: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
      b. Outdoor insulation: Flame spread/Smoke developed index of 75/150, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
   2. Products shall not contain PVC, asbestos, lead, mercury, or mercury compounds.
   3. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
   4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

B. Mineral Glass fiber, flexible:
   1. Manufacturer:
      a. Knauf Insulation.
      b. Johns Manville Corporation.
      c. Owens Corning Corporation.
      d. CertainTeed Corporation.
   2. Insulation: ASTM C553; flexible, noncombustible blanket with a thermosetting resin, Type II with factory applied FSK jacket.
      a. Density / Thermal Conductivity ('K' value):
         1) 0.75 pcf / K = 0.29 at 75 degrees F, when tested in accordance with ASTM C518.
         2) 1.0 pcf / K = 0.0.27 at 75 degrees F, when tested in accordance with ASTM C518.
         3) 1.5 pcf / K = 0..24 at 75 degrees F, when tested in accordance with ASTM C518.
      b. Maximum Service Temperature: 250 degrees F, tested by ASTM C 411.
      c. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Mineral Glass fiber, rigid:
   1. Manufacturer:
      a. Knauf Insulation.
      b. Johns Manville Corporation.
      c. Owens Corning Corp.
      d. CertainTeed Corporation.
   2. Insulation: ASTM C612; rigid, noncombustible board.
      a. Density / Thermal Conductivity ('K' value):
         1) 1.6 pcf / K = 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
         2) 3.0 pcf / K = 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
         3) 6.0 pcf / K = 0.22 at 75 degrees F, when tested in accordance with ASTM C518.
      b. Maximum service temperature: 450 degrees F.
      c. Maximum Water Vapor Sorption: 5.0 percent.

2.02 FIRE-RATED INSULATION

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a fire rating by an NRTL acceptable to authorities having jurisdiction.

B. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a fire rating by an NRTL acceptable to authorities having jurisdiction.

C. Fire Rating: to suit architectural assembly, refer to Architectural Drawings.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Dow Corning Corporation.
    b. Johns Manville; a Berkshire Hathaway company.
    c. P.I.C. Plastics, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Vimasco Corporation.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F .
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.05 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.

d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils .
   3. Adhesion: 90 ounces force/inch width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches .
   2. Thickness: 6 mils .
   3. Adhesion: 64 ounces force/inch width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch width.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   a. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   b. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.08 FIELD APPLIED JACKETS

A. Aluminum Jacket (Alum): ASTM B209 (ASTM B209M).

1. Thickness: 0.016 inch sheet.
2. Finish: Stucco embossed.
3. Joining: Longitudinal slip joints and 2inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
6. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.

B. Aluminum Outdoor Jacket (Alum Outdoor).
1. 60-mil- Composite membrane consisting of a multi-ply embossed aluminum foil/polymer laminate and rubberized asphalt.
2. UV-resistant.

C. Stainless Steel Jacket: ASTM C1767.
1. 304 Stainless Steel.
2. Thickness: 0.010 inch sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.010 inch thick die shaped fitting covers with factory attached protective liner.
6. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
7. Moisture Barrier for Outdoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.

2.09 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M,Type 304; $0.015\ \text{inch}$ thick, $3/4\ \text{inch}$ wide.

B. Insulation Pins and Hangers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been pressure tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

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

3.02 INSTALLATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Install in accordance with manufacturer's instructions.

C. Install in accordance with NAIMA National Insulation Standards.

D. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and/or bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

J. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

K. Apply insulation with the least number of joints practical.

L. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Where service access is required,

provide removable insulation sections that allow for removal and replacement without damaging surrounding insulation. At nameplates, bevel and seal ends of insulation.Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

M. Hangar Inserts.

1. For support points of rectangular or oval ducts supported by trapeze hangers, place weight supporting insulation at bottom of duct over trapeze. Weight supporting insulation shall be rigid glass fiber insulation having minimum of 6 pcf density and 200 lb/ft compression strength at 10% deformation and minimum 6" long with same thickness as insulation specified. Weight supporting inserts similar to HAMFAB H-block by ICA Inc. may be used for rectangular ducts less than 18". Follow manufacturer's recommendation for number of inserts.
2. For support points of round ducts smaller than 16" diameter, weight supporting insulation is not required for either rigid or flexible glass fiber insulation.
3. For support points of round ducts 16" diameter and larger, place weight supporting insulation between duct and strap or trapeze.
4. Flexible glass fiber insulation may be installed outside of support for round ducts 24" diameter or smaller, provided vapor barrier integrity is maintained at rod / strap penetration.
5. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

N. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

O. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches . Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

P. Cut and install insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Q. External Duct Insulation Application:
   1. Secure insulation with vapor barrier and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples or tape.
   3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches .
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally

insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches .

1. Comply with requirements in Section 07 84 00 "Firestopping" irestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 00 "Firestopping."

3.04 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces or as recommended by insulation manufacturer.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not compress insulation more than 75% during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory-

or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches .

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces or as recommended by insulation manufacturer..
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches , space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches .

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.05 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

    1. Draw jacket material smooth and tight.
    2. Install lap or joint strips with same material as jacket.
    3. Secure jacket to insulation with manufacturer's recommended adhesive.
    4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
    5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

    1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.06 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 07 84 00 "Penetration Firestopping."

3.07 FIELD QUALITY CONTROL

A. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to locations for each duct system.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.08 SCHEDULES

A. Items Not Insulated:
1. Double-wall metal ducts which comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.
7. Supply Ductwork exposed in directly conditioned space
8. Return air ducts concealed in conditioned space or shaft
9. Transfer air ducts.

B. Location definitions:
1. Concealed: ductwork in ceilings and shafts.
2. Exposed: ductwork that is not concealed, but also not in occupied spaces such as ductwork in mechanical rooms.
3. Occupied: ductwork in occupied and conditioned rooms.

Type	Location	Insulation	Minimum Thickness	Jacket
Supply	Concealed	Fiber Wrap 0.75pcf	1.5 inch	None

	Exposed up to 8’ AFF	Fiber Board 3.0pcf	1.5 inch	None
	Exposed above 8’ AFF	Fiber Wrap 0.75pcf	1.5 inch	None
Return	Exposed up to 8’ AFF	Fiber Board 3.0pcf	1.5 inch	None
	Exposed above 8’ AFF	Fiber Wrap 0.75pcf	1.5 inch	None

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:
   1. Cooling generation systems, direct-expansion systems.
   2. Distribution systems, including air distribution (heating and cooling) systems, exhaust systems, air-handling units.
   3. Terminal and packaged units, including fan-coil units.
   4. Vibration and sound systems, including sound attenuation, vibration isolation devices and seismic restraints.
   5. Controls and instrumentation, including BAS energy monitoring and control system.
   6. Systems testing and balancing verification, including heating-water piping systems, domestic hot-water circulating systems, supply-air systems return-air systems, and exhaust-air systems.

B. Related Requirements:
   1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. DDC: Direct digital controls.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. TAB: Testing, adjusting, and balancing.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For BAS and HVAC&R Testing Technician.

B. Construction Checklists: See related Sections for technical requirements for the following construction checklists:

1. Vibration and seismic controls for HVAC&R piping and equipment.
2. Instrumentation and control for HVAC&R.
3. Refrigerant piping.
4. Metal ducts and accessories.
5. Fans.
6. Rooftop units.

1.05 QUALITY ASSURANCE

A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
   1. Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.
   2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
   3. International Society of Automation (ISA) Certified Control Systems Technician (CCST) Level I.

B. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
   1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associates degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
   2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
   3. One of the following:
      a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.
      b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
      c. Owner retains the right to waive NEBB or AABC Certification.

C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:
   1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
      a. Equipment/instrument identification number.
      b. Planned commissioning application or use.
      c. Manufacturer, make, model, and serial number.
      d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
   2. Test equipment and instrumentation shall meet the following criteria:

a. Capable of testing and measuring performance within the specified acceptance criteria.
b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
c. Be maintained in good repair and operating condition throughout the duration of use on this Project.
d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
1) Instrument or tool identification number.
2) Equipment schedule designation of equipment for which the instrument or tool is required.
3) Manufacturer, make, model, and serial number.
4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.
c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL TESTING REQUIREMENTS

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

F. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

G. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.
   1. Contributors to the development of construction checklists shall include, but are not limited to, the following:
      a. HVAC&R systems and equipment installers.
      b. TAB technicians.
      c. HVAC&R instrumentation and controls installers.

H. Perform tests using design conditions, whenever possible.
   1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
   2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
   3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

J. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

K. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.

L. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.

M. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
   1. Performance tests.
   2. Demonstration of a sample of performance tests.
   3. Commissioning tests.
   4. Commissioning test demonstrations.

3.02 TAB COMMISSIONING TESTS

A. TAB Verification:
   1. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

2. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
3. Scope: HVAC&R air systems and hydronic piping systems.
4. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.
5. Conditions of the Test:
    a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
    b. Systems operating in full heating mode with minimum outside-air volume.
    c. Systems operating in full cooling mode with minimum outside-air volume.
    d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.
6. Acceptance Criteria:
    a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
    b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
    c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

END OF SECTION

SECTION 23 09 00

BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The scope of work for this project is to expand the existing InetSupervisor™ - based system that is the campus standard.

B. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

C. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.

D. Design, provide, and install all equipment cabinets, panels, conduit as required, data communication network cables needed, and all associated hardware.

E. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

F. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.

G. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.

H. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.

I. Provide a comprehensive operator and technician training program as described herein.

J. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

K. Provide new sensors, damper actuators, valve actuators, and install only new components. No used components shall be used as any part or piece of installed system.

1.02 SYSTEM DESCRIPTION

A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be based on CEA 709.3 Standard. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc., and all air handlers, boilers, chillers,

and any other listed equipment using LonWorks devices. Gateways or proprietary equipment or systems shall not be acceptable and are specifically prohibited.

B. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.

C. Room sensors shall be provided with occupancy override and setpoint adjust. User shall be able to adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor.

D. All application controllers for every terminal unit (VAV, HP, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully configurable and require no programming. Application controllers shall be mounted next to controlled equipment and communicate with building controller through the LonWorks LAN.

E. All control logic to satisfy the Sequence of Operation must reside in standalone configurable controllers, except for non-critical global supervisory functions such as optimized scheduling or setpoint offsets.

1.03 APPROVED MANUFACTURERS AND INSTALLERS

A. Approved Control Manufacturers
   1. InetSupervisor™ by Quark Communications Inc. Contact Adam Guzik 760.634.6845 ext. 200, adam@InetSupervisor.com

1.04 QUALITY ASSURANCE

A. The BAS shall be designed, installed, commissioned, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 2 hours response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.
   1. The Bidder shall be regularly engaged in the design, installation and maintenance of BAS systems and shall have demonstrated technical expertise and experience in the design, installation and maintenance of BAS systems similar in size and complexity to this project. Bidders shall provide a list of at least 10 projects, similar in size and scope to this project completed within the past 3 years.

B. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.

C. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category.

D. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

E. Control system shall be engineered, programmed and supported completely by factory office that must be within 100 miles of project site.

1.05 REFERENCE STANDARDS

A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
   1. LonMark Interoperability Association www.LonMark.org
   2. CEA 709.3, LonWorks.
   3. Uniform Building Code (UBC), including local amendments.
   4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
   5. National Electrical Code (NEC).
   6. FCC Part 15.
   7. Title 24, Part 6: 2019 California Building Energy Efficiency Standards.

B. City, county, state, and federal regulations and codes in effect as of contract date.

1.06 SUBMITTALS

A. Drawings
   1. The system supplier shall provide a fully complete submittal including point to point engineered drawings, control sequences of operations, bill of materials, and cut sheets for all control devices for approval. Incomplete submittals will be rejected. Partial submittals are not acceptable.
   2. Drawings shall be submitted in the following standard sizes: 11” x 17” (ANSI B) PDF electronic file format.

B. System Documentation
   1. Include the following in submittal package:
      a. System architecture drawing.
      b. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
      c. Complete bill of materials, valve schedule and damper schedule. Valve schedules shall include corrected actual valve pressure drops per selected Cv at full flow.
      d. Cut sheets of all control devices.
      e.

C. Project Management
   1. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents, and shall indicate timing and dates for system installation, debugging, and commissioning.

1.07 WARRANTY

A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one (1) year from completion of system acceptance. Control devices that fail

during the warranty period shall be adjusted, repaired or replaced at no additional cost to the owner.

B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday, and 48 hours on Saturday and Sunday.

C. This warranty shall apply equally to both hardware and software.

D. DDC System manufacturer shall provide campus hardware for maintenance on the Mitsubishi VRF System. Device requirements:

1. OS – Windows8.1/10
2. CPU – 2GHz or faster
3. RAM – 4 GB
4. HDD – Available space 8 GB or more
5. LCD 0 Screen resolution: 1024x768 or more
6. Operating Environment – NET Framework 3.5 or later
7. Serial Port – 1 RS232C serial port (Used when connecting MN convertor)
8. Pointing device – Mouse or track ball or any other pointing device

E. Additional Materials needed for operating Mitsubishi Maintenance tool

1. Routing via MN Convertor
   a. MN Convertor, Personal computer RS-232C cross cable, USB cable and modem in case of remote connection, are required. RS-232C is to be straight cable in this case.
2. Routing via Centralized Controller
   a. Centralized controller, computer, LAN cable and hub
3. Routing via USB/Serial conversion cable
   a. USB/Serial conversion cable, computer and Relay cable.
   4. Maintenance Tool Interface hardware shall be included. Mitsubishi Model – PAC-USCMS-MN-1

PART 2 - PRODUCTS

2.01 OPERATOR’S WORKSTATION [SERVER AND OPERATING SOFTWARE]

A. The InetSupervisor Operator’s Workstation and Server are existing on site. The scope of work for this project is to expand the existing system.

B. General structure of server interaction shall be a standard client/server relationship. Server shall be used to archive data and store system data. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 simultaneous clients.
   1. A customized menu label (pushbutton) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label pushbuttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
   2. The BAS displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a web browser resolving to a specified web address.
   3. The BAS system shall have the ability to run multiple, concurrent displays windows showing continuously updated data.

C. Password Protection
   1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
   2. Each operator's terminal shall provide security for a minimum of 9999 users. Each user shall have an individual User ID, User Name, and Password. System shall enforce strong passwords. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs. No Passwords can be store in clear text.

D. Operator Activity Log
   1. Operator Activity Log that tracks all operator changes and activities shall be included with system. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.
   2. Log shall be gathered and archived to [the server] hard drive on operator's workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
   3. The capacity of the log shall be at minimum 10 years.

E. Scheduling
   1. The graphical user interface shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for the day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.

2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
4. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.

F. Alarm Indication and Handling.
1. The BAS shall provide audible, visual, printed, and email means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s) currently running. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).
4. System shall retain alarm and archived alarm information for a minimum of 10 years.

G. Trendlog Information
1. System server shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 500 million records before needing to archive data. Samples may be viewed at the graphic user interface. Operator shall be able to view all trended records, both stored and archived. All trendlog records shall be displayed in standard engineering units.
2. Software that is capable of graphing the trend logged object data shall be included. Software shall be capable of creating two-axis (X, Y) graphs that display up to 15 object types at the same time in different colors. Graphs shall show object values relative to time. Each trendlog shall support a custom scale setting for the graph view that is to be stored continuously. System shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. Operator shall be able to change trendlog setup information. This includes the information to be logged as well as the interval at which it is to be logged. All

input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.

4. System shall use Microsoft SQL as the system database.

H. Energy Log Information

1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
2. All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.
5. System shall feature energy analytics for data display in bands of relevant information i.e. display energy consumption in bands of OSA temperature of 10°F, and filtered only for occupied times. There shall be no limits on number of filters or type of values used for bands.

I. Demand Response

1. System shall include demand response program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system. Binary shedding shall include minimum of five (5) priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one, the loads shall be shed/restored in a “first off-first on” mode, and in the other the loads are just shed/restored in a “first off-last on” (linear) fashion.
2. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.
3. Status of each and every load shed program shall be capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

J. Reports

1. System server shall be capable of periodically producing reports of trend logs, alarm history, tenant activities, device summary, energy logs and override points. The frequency, content and delivery are to be user adjustable.
2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed or saved to a folder, either on the server hard drive or on any network drive location.

K. Configuration/Setup: Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

L. Field Engineering Tools
1. The BAS software shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled.
5. System shall automatically notify the user when a device that is not in the database is added to the network.
6. System shall include backup/restore function that will back up system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.

M. Software
1. At the conclusion of project, BAS contractor shall leave with owner a DVD ROM that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner how to completely restore the system in the case of a computer malfunction.

2.02 GRAPHICAL INTERFACE

A. General: BAS supplier shall provide remote access to the system as part of standard installation. User must be able to access all displays of real-time data that are part of the BAS using a standard web browser or an APP on windows or Android devices. Web browser shall tie into the network through owner-supplied Ethernet network connection. Webpage host shall be a separate device that resides on the BAS TCP/IP network. The webpage software shall not require a per-user licensing fee or annual

fees. The webpage host must be able to support on average 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.

B. Browser Technology: Browser shall be the most current version of Internet Explorer, Firefox, Google Chrome. Mobile client support: Android or Microsoft APP. No special vendor-supplied software shall be needed on computers running browser. All displays shall be viewable and the webpage host shall directly access real-time data from the BAS network. Data shall be displayed in real-time and update automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate user name and password.

C. Communications
   1. Enterprise server gather real-time data from all the Air-Bus, Q-Bus, Connex, Modbus, BACnet and LonWorks devices that form the BAS. This network shall communicate, allowing the webpage host to gather data directly from units on the local LAN or from other projects connected over a WAN.
   2. The enterprise server shall act as a physical barrier between the BAS network and the WAN or Internet connection that allows the browser to receive webpages and data.
   3. The enterprise server shall provide for complete isolation of the IP and device networks by not routing networking packets between the two networks.
   4. Ethernet network shall be provided and installed by the owner. Owner shall provide and incur any monthly charges of WAN/Internet connection.
   5. All communications between the enterprise server and remote browser or the enterprise server and remote mobile app shall be encrypted. Only FIPS grade encryption is allowed.

D. Display of Data
   1. Graphics shown on display pages shall be created once and used in browsers and APPs. Webpage and App displays shall include animation just as BAS displays. Fans shall turn, pilot lights shall blink, coils shall change colors, and so on.
   2. Real-time data shall be shown on all display pages. This data must be directly gathered using the BAS network and automatically updated on display pages without any user action. Data on the display page shall automatically refresh as changes are detected without re-drawing the complete display.
   3. It shall be possible for user from display page to change data if the user is logged on with the appropriate password. Clicking on a button or typing in a new value shall change digital data. Using pull-down menus or typing in a new value shall change analog data.
   4. Display pages shall be navigated using pushbuttons, tabs and menus on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.

E. Time Schedule Adjustment: Schedule display page shall allow user to view and edit all schedules in the system. This includes standard, holiday and event schedules as described in BAS specification. Display of schedules shall show interaction of all schedules on a single display page so user sees an overview of how all work together. User shall be able to edit schedules from this display. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors

on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled.

F. Logging of Information: User shall use trend display page to view all trend logs in system. User shall be able to view logged data in tabular form or graphical format. User shall be able to adjust time interval of logged data viewed and shall be able to adjust Y axis of data viewed in graphical format. User shall also be able to download data through the web interface to local computer. Data shall be in CSV format.

G. Alarm Handling: Alarm display page shall show alarms as they occur. User shall be able to acknowledge alarms using browser technology. In addition, user shall be able to view history of alarm occurrence over a user-selected time frame. In addition, those alarms may be filtered for viewing per user-selected options. A single selection shall display all alarms that have not been acknowledged.

H. Display Page Generation: Display pages are created using graphical utility or using Display Page Generator which interrogates the network and builds graphics automatically.

I. Password Security and Activity Log: Access through web browser shall utilize the same hierarchical security scheme as BAS system. User shall be asked to log on once the browser makes connection to webpage host. Once the user logs in, any and all changes that are made shall be tracked by the BAS system. The user shall be able to change only those items he or she has authority to change. A user activity report shall show any and all activity of the users who have logged in to the system, regardless of whether those changes were made using a browser or through the BAS workstation.

J. BAS Communication: Enterprise server shall directly communicate to all devices on the BAS network. Only routers and Ethernet switches are allowed in the network between the server and field devices.

2.03 ENTERPRISE NETWORK APPLIANCE (ENA)

A. General Requirements
1. ENA at a minimum, shall consist of a power supply, a BACnet IP Ethernet, and LonWorks FT capabilities. Those projects that require special interfaces may use Modbus as needed. However, all Ethernet communications and all controllers—including central plant controllers, advanced application controllers and unitary controllers—supplied by BAS manufacturer shall utilize the BACnet or LonTalk protocol standards.
2. ENA shall be panel-mounted, shall be interconnected using a simple cable pair.
3. ENA shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the ENA or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.

4. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. Programming block library at minimum shall contain math, logic, IO, communication such as email, alarm, trend blocks. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on the server. The same tool shall be used for all controllers.
5. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing.
6. ENA shall have minimum of 8Gb of RAM memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in min of 60GB of nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.
7. Global control algorithms and automated control functions shall execute using 32 or 64-bit processor and be only limited in complexity and length by the ENA physical memory. There shall not be any license limitations.
8. Schedules
    a. Each ENA shall support a minimum of 999 Schedule Objects.
    b. ENA shall provide normal 7-day scheduling, holiday scheduling and event scheduling.
    c. Logging Capabilities
    d. Each ENA shall log as minimum 9999 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the graphical user interface.
    e. Logs may be viewed both on-site or off-site using WAN or remote communication.
    f. ENA shall periodically upload trended data to enterprise server for long-term archiving if desired.
    g. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
9. Alarm Generation
    a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
    b. Each alarm may be dialed out as noted elsewhere.
    c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
    d. ENA must be able to handle up to 3000 alarms.
10. Demand Limiting
    a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.
    b. Load shedding programs in building controller modules shall operate as defined in section 2.1 of this specification.
    c. Energy Manager shall compare buildings' energy consumption to demand limit and automatically adjust shedding command to prevent consumption from exceeding the set limit.

B. Ethernet –

1. ENA shall support every function as listed under section 1.1 of this section and the following.
2. All communication with the enterprise server and all application controllers shall be through BACnet IP or LonTalk protocols. ENA Ethernet shall incorporate as a minimum, the functions of a 2-way BACnet or LonTalk router. ENA shall route messages between the high-speed LAN (Ethernet 10/100/1000MHz) and BACnet Ft. BACnet IP Ethernet logic module shall also route messages from all other building controller modules onto the BACnet Ethernet network.
    a. BACnet Ft must be a 78Kbps high throughput encrypted bus. Encryption shall be of FIPS compliant grade. For system reliability, no EIA-485 transceivers are allowed.
    b. The RJ-45 Ethernet connection must accept either 10base-T or 100base-TX BACnet over twisted pair cable (UTP).

C. ENA BACnet Ft Module
1. BACnet Ft module shall support every function as listed under section 1.1.
2. BACnet Ft module shall also route messages to Ethernet – BACnet IP for communication over LAN/WAN.
    a. BACnet Ft must be a 78Kbps high throughput encrypted bus. Encryption shall be of FIPS compliant grade. For system reliability, no EIA-485 transceivers are allowed.

D. Power Supply Module
1. Power supply shall be adequately sized for the application with minimum of 25% headroom.

E. ENA Modbus Module
1. ENA Modbus module communications shall be via one of type: EIA-485 for Modbus RTU or Ethernet for Modbus TCP. Modbus module shall convert Modbus data into BACnet or LonMark objects. Modbus module shall also route messages to Ethernet-BACnet IP module for BACnet IP communication over WAN.
    a. Modbus Module shall support RTU Modbus communication at 33.6k, 19.2k, 9600 or 4800 baud.
    b. EIA-485 connection shall support connection of up to 247 Modbus units.
2. BACnet Translation
    a. All Modbus data shall be translated into BACnet or LonMark objects by the Modbus module. All configuration tools shall be supplied to assure data is translated as necessary to the correct format and value.
    b. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
    c. ENA LED Lighting Module
    d. LED module shall be capable of directly driving at minimum of 12 LED lighting fixtures up to 2A DC each.
    e. Flicker shall be maintained below 0.1%.
    f. Lighting sequence shall be freely programmable.

g. LED module shall be capable of driving tunable circadian cycle LED fixtures with choices of several human centric algorithms. Algorithms shall focus on educational institutions, health care and follow the WELL standards.
h. ENA EnOcean module
i. EnOcean module shall provide a seamless interface for standard wireless EnOcean devices.
j. Compatible EnOcean devices at minimum shall include switches, temperature, humidity, CO2 sensors, motion and light level sensors.
k. EnOcean data objects shall be on the fly translated into BACnet IP or LonMark objects for seamless integration with the rest of the network devices.
l. ENA Local Display Panel (LDP)
m. Industrial grade touch panel with minimum screen size of 17inch.
n. LDP shall provide graphic display, schedule, alarm and override capabilities.
o. LDP shall utilize Ethernet for communication with the server and other network devices.

2.04 PROGRAMMABLE CENTRAL PLANT CONTROLLERS (PCP)

A. Provide application programmable controllers as needed for central plant control that adequately cover all objects listed in object list. All controllers shall interface to ENA or Enterprise Server through BACnet or LonTalk protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on server and be the same tool as used for the building controller.

B. Programmable controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0–10VDC, Platinum 1000 Ohm RTD, 0–5VDC, 4–20mA and dry contact signals. Inputs on a controller, analog or digital with a minimum of three (3) inputs that accept pulses. Controller shall include binary and analog outputs on board. Analog outputs with 8-bit resolution shall support 0–10VDC. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs.

C. EnOcean module shall provide a seamless interface for standard wireless EnOcean devices. At minimum compatible EnOcean devices shall include switches, temperature, humidity, CO2 sensors, motion and light level sensors, and lighting controllers LC. EnOcean data objects shall be on the fly translated into BACnet IP or LonMark objects for seamless integration with the rest of the network devices.

D. All program sequences shall be stored on board application controller in EEPROM or FLASH nonvolatile memory. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.

E. Programming of application controller shall be completely modifiable in the field over installed BACnet or LonTalk LANs. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

F. Schedules: The controller shall support a minimum of three (3) Schedule Objects and have a real-time clock on board with battery backup to maintain time through a power loss.

G. Logging Capabilities:
   1. Controller shall support a minimum of 50 trendlogs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the graphical user interface.
   2. Controller shall periodically upload trended data to system server for long-term archiving if desired. Archived data stored in MS SQL database form and shall be available for use in third-party spreadsheet or database programs.

H. Alarm Generation
   1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.
   2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
   3. Controller must be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

I. The controller processor shall be a 32-bit processor (minimum).

J. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

2.05 APPLICATION SPECIFIC CONTROLLERS (ASC) (HEAT PUMPS, AC UNITS, FAN-COILS, AIR-HANDLERS)

A. Provide one application specific controller for each piece of unitary mechanical equipment that adequately covers all required functionality for controlled equipment. All controllers shall interface to ENA through BACnet or LonTalk protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. Application specific controllers shall include universal inputs with 12-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of three (3) pulse inputs. Any input on controller may be either analog or digital. Controller shall include binary outputs on board with analog outputs as needed. Analog Outputs shall be capable of driving 20mA loads.

C. All program sequences shall be stored on board controller in EEPROM or FLASH nonvolatile memory. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of minimum of 10 PID loops for control of multiple devices. Logic of application

controller shall be modifiable in the field over installed BACnet or LonTalk LANs. Operator shall change logic sequences by graphical GUI. No programming shall be required other than simple configuration screens. All software tools shall be provided and installed as part of system.

D. Application controller shall include support for intelligent room sensor. All button functions and display data shall be capable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

E. ASC Application controller shall be capable of driving minimum of 6 heating stages and minimum of 6 cooling stages. Heating and cooling stages shall be properly staged with dead band and delays.

F. ASC shall feature configurable energy reset strategies based on: terminal load, space, return, and outdoor temperatures, space and return humidity. Resets shall be positive or negative and the reset amounts shall be adjustable.

G. To maximize energy savings, ASC shall feature configurable supply air pressure reset.

H. ASC shall feature fully configurable Title 24 compliant CO2 indoor air quality control.

I. Supply fan control strategies shall at minimum include: incremental, incremental with rotation, step, step with rotation, parallel, and parallel with rotation.

2.06 AUXILIARY CONTROL DEVICES

A. Intelligent Room Sensor
   1. Sensor shall contain software configurable user function keys along with temperature sensor, light level sensor and motion sensor. Controller shall function as room control unit and allow occupant to raise and lower setpoint and activate terminal unit for override use—all within limits as programmed by building operator.
   2. Sensor shall contain multiple software configurable LEDs to provide system feedback to the user. Custom label shall be used to clearly identify function of each key and led indicator.

B. Temperature Sensors
   1. Duct mount, indoor: Veris TF series 10K ohm, type II thermistor with stainless steel probe and junction box, or equal. Accuracy ±1ºF
   2. Duct mount, outdoor: Veris TF series 10K ohm, type II thermistor with stainless steel probe and weather-tight junction box, or equal. Accuracy ±1ºF
   3. Outside air: Veris TO series 10K ohm, type II thermistor with stainless steel probe encased in durable radiation shield with weather-tight junction box, or equal. Accuracy ±1ºF
   4. Pipe insertion: Veris TIG series 10K ohm, type II thermistor with corrosion resistant stainless steel probe, thermo well, and standard or weather-tight junction box as required, or equal. Accuracy ±1ºF
   5. Averaging: Veris TA series 10K ohm, type II thermistor encased in flexible copper tubing to enhance response time, or equal. Provide with standard or weather-

tight junction box as required. Mounting of tubing shall utilize AA64 mounting clips. Accuracy ±1ºF

C. Humidity Sensors Wall Mount: Veris HW series or Senva humidity, 3% accuracy thin film capacitive replaceable sensor element, LED display, or equal.

D. Humidity Sensors Outside air: Veris HO series or Senva humidity sensor, 3% accuracy thin film capacitive replaceable sensor element, with weatherproof housing, or equal.

E. Humidity Sensors Duct: Veris HD series or Senva humidity sensor, 3% accuracy thin film capacitive replaceable sensor element, with die cast metal housing, or equal.

F. Humidity Sensors Wall mount, with temperature: Veris HW series or Senva combination humidity and temperature sensor. Temperature accuracy ±1ºF, RH 3% accuracy. Thin film capacitive replaceable sensor element, LED display, push button override and setpoint slider, or equal.

G. Humidity Sensors Outside Air, with temperature: Veris HO series or Senva combination humidity and temperature sensor. Temperature accuracy ±1ºF RH 3% accuracy. Thin film capacitive replaceable sensor element, with weatherproof housing, or equal.

H. Humidity Sensor Duct, with temperature: Veris HD series or Senva combination humidity and temperature sensor. Temperature accuracy ±1ºF, RH 3% accuracy. Thin film capacitive replaceable sensor element, with die cast metal housing, or equal.

I. Humidity High Limit Switch, Duct: Honeywell H6045A1002 duct mount hygrostat with insertion probe, adjustable trip dial, and NO and NC contacts, or equal.

J. Dewpoint Sensors
1. Wall mount: Kele Vaporstat 9002 wall mount dew point transmitter with non-dispersive infrared sensor and blank cover, or equal. Accuracy +/- 3.6° F.
2. Pipe mount, strap on: Honeywell model HSS-DPS early warning dew point switch, strap on, with status light with NO and NC alarm terminals, or equal.

K. CO2 Sensors
1. Room, wall mount: Veris CWE series or Senva with non-dispersive infrared sensor, repeatable to +/- 20 ppm, or equal.
2. Outdoor and Duct: Veris CDE series or Senva with non-dispersive infrared sensor, repeatable to +/- 20 ppm, or equal.

L. CO2, Humidity, Temperature Combined Sensor (Duct and Wall)
1. Veris C Series Deluxe or Senva Duct and Wall CO2 sensor with set point slider and LCD display, or equal.
   a. CO2 sensor with non-dispersive infrared sensor, repeatable to +/- 20 ppm.
   b. Humidity Sensor digitally profiled thin-film capacitive, plus or minus 2% RH.
   c. Temperature Sensor: Thermistor. Accuracy ±1ºF

M. Leak Detector condensate pan overflow detection: Veris SD-R01 detector, 24V AC, with automatic reset, and 14 foot cable, or equal.

N. Differential Pressure Transmitter:
   1. Duct Static Pressure Transmitter: Veris PX series or Senva differential pressure transducer with selectable range, +/- 1% accuracy, with push button auto-zero, LCD display, or equal.
   2. Building Static Pressure Transmitter: Veris PX series or Senva differential pressure transducer with selectable range, +/- 1% accuracy, with push button auto-zero. Provide with AA05 ceiling mount static pressure pick up, LCD display, or equal.
   3. Water differential pressure transmitter: Veris PW2 series or Senva differential pressure transmitter, wet/wet, switch selectable pressure ranges, jumper selectable port swap, LCD display and NEMA 4 enclosure, or equal.

O. Differential Pressure Switch:
   1. Filter differential pressure switch for status: Dwyer Series ADPS or Senva adjustable differential pressure switch, dual scale adjustable knob, silicone diaphragm and NEMA 13 enclosure, or equal.
   2. Duct static pressure hi-low pressure safety switch for fan shut down: Dwyer Series 1900MR with adjustable trip and manual reset, or equal.

P. Current Sensors
   1. Current sensing switch for fans, pumps, etc.: Hawkeye Hx08 series or Senva current switch with split core, adjustable trip, pilot light, self-gripping split core housing and mounting bracket, or equal.
   2. Current sensing switch for VFD's: Hawkeye H614 Automatic VFD current switch split core, self-learning adjustable trip, pilot light, self-gripping split core housing and mounting bracket, or equal.
   3. Current sensing switch with relay for fan start: Hawkeye H 900 series current switch with split core, integral relay, adjustable trip, pilot light, self-gripping split core housing and mounting bracket, or equal.
   4. Current sensing transmitter: Hawkeye H921 current sensing transmitter with self-gripping split core, preset slide switches, and removable mounting bracket, or equal.
   5. Current sensing transmitter with relay for fan start: Hawkeye H931 current sensing transmitter with integral relay, slide switches, self-gripping split core, and removable mounting bracket, or equal.

2.07 ACTUATORS

A. Electronic Actuators for general valve duty
   1. Manufactured, brand labeled or distributed by Belimo or equal.
   2. Size for valve close off at 150 percent of total system (head) pressure for two-way valves; and 100 percent of pressure differential across the valve or 100 percent of total system (pump) head differential pressure for three-way valves
   3. Coupling: directly couple and mount to valve stem, shaft ISO-style direct-coupled mounting pad. V-bolt dual nut clamp with a V-shaped, toothed cradle.
   4. Overload protected electronically throughout rotation.
   5. Fail-Safe Operation (as noted on the plans): Mechanical, spring-return mechanism. Electronic Fail-Safe Operation: Shall incorporate a visual indication of the fail-safe status on the face of the actuator. The power fail position shall be

field adjustable between 0 to 100% in 10° increments. The electronic fail safe shall have a 2-10 second adjustable operational delay.

6. Power Requirements (Spring Return): 24 V ac, maximum 10 VA at 24-V ac or 8 W at 24-V dc (running). Maximum 1 VA at 24-V ac or 1 W at 24-V dc (holding).
7. Proportional Actuators shall be fully programmable through an onboard EEPROM by using an external cable and software interface.
8. Temperature Rating: -22 to +122ºF.
9. Housing: Minimum requirement NEMA type 2 mounted in any orientation.
10. Agency Listings: ISO 9001, cULus, CE or CSA.
11. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

B. Electronic Actuators with torque requirements exceeding 360 inch-pounds
1. Manufactured, brand labeled or distributed by Belimo or equal.
2. The combination of valve and actuator shall meet the close-off requirements as specified in Section 2.16.H – Butterfly Valves.
3. Coupling: ISO 5211 mounting standards.
4. Overload Protection: A self-resetting thermal switch embedded in the motor.
5. Manual Override: Actuator shall be equipped with a hand wheel or shaft for manual override to permit operation of the actuator in the event of an electrical power failure
6. Power Requirements: 24VAC, 120VAC, or 230VAC single phase.
7. Auxiliary Switches: 2 SPDT rated 3A at 250 VAC.
8. Temperature Rating: -22 to +150ºF.
9. Duty Cycle Rated 75% minimum.
10. Housing: Minimum requirement NEMA type 4X/ IP67 with an industrial quality coating. Actuator shall have an internal heater to prevent condensation within the housing. A visual indication beacon shall indicate position status of the device.
11. Agency Listing: ISO, CE, CSA
12. The manufacturer shall warrant for 2 years from the date of production.

C. Electronic Actuators for Dampers
1. Manufactured, brand labeled or distributed by Belimo or equal.
2. Size for torque required for damper seal at load conditions.
3. Outside air and exhaust air damper actuators shall be mechanical spring return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
4. Economizer actuators shall utilize analog control 2–10 VDC; floating control is not acceptable.
5. Electric damper actuators (including VAV box actuators) shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
6. One (1) electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one (1) actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.

7. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One (1) electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)
8. The mechanical contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The sheet metal contractor shall install all dampers unless provided with packaged equipment.
9. All dampers used for modulating service shall be opposed blade type and arranged for normally open or normally closed operation as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
10. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
11. Damper linkage hardware shall be constructed of aluminum or corrosion-resistant zinc and nickel-plated steel and furnished as follows:
    a. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
    b. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
12. Damper manufacturer shall supply alignment plates for all multi-section dampers.

2.08 CONTROL ENCLOSURES

A. All controllers, power supplies and relays shall be mounted in enclosures.

B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.

C. Enclosures shall be NEMA 4 when located in an outdoor environment.

D. Enclosures shall have hinged, locking doors.

E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 0.125 inches thick and appropriately sized to make label easy to read.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.

B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.

C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 230900 work with work of others. BAS Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.02 COORDINATION

A. Site:
1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, BAS Contractor shall correct conditions without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Test and Balance:
1. Provide Test and Balance Contractor a single set of necessary tools (if needed) to interface to control system for testing and balancing.
2. Train Test and Balance Contractor to use control system interface tools.
3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

C. Coordination with Other Controls: Integrate with and coordinate controls and control devices furnished or installed by others as follows.
1. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation.
2. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

3.03 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

C. Install equipment in accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.

D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.04 FIELD QUALITY CONTROL

A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 230900 Article 1.5 (Reference Standards).

B. Continually monitor field installation for code compliance and workmanship quality.

C. BAS Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.05 WIRING

A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 230900 differ from Division 26, Section 230900 shall take precedence.

B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.

C. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.

D. Conduit: All conduit shall comply with the minimum requirements of the local authority having jurisdiction.
   1. Secure conduit with conduit clamps fastened to structure and spaced according to code requirements. Conduit and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
   2. Size conduit and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
   3. Include one pull string in each conduit 1 in. or larger.
   4. Install Class 1 and Class 2 wiring in separate conduits. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
   5. Do not install wiring in conduit containing tubing.
   6. Conceal conduit except within mechanical, electrical, or service rooms. Maintain minimum clearance of 6 in. between raceway and high-temperature equipment such as steam pipes or flues.
   7. Adhere to requirements in Division 26 where conduit crosses building expansion joints.
   8. Flexible metal conduit and liquid-tight flexible metal conduit shall not exceed 3 ft. in length and shall be supported at each end. Do not use flexible metal conduit less than 1/2 inch electrical trade size. Use liquid-tight flexible metal conduits in areas exposed to moisture including chiller and boiler rooms.
   9. Install conduits rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join conduit sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations outside of boxes with bushings.

E. Locate control transmitters, high/low limit switches, status relays, etc., in control panels only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

F. Field wiring of all safety switches shall be brought back individually to discrete terminals in the control panel. Serial wiring of safeties is not permitted. Where safeties (e.g. freeze-stat) must be mounted in a plenum, the locations shall be clearly described in documents, and clearly field-labelled on access doors as per the diagram designation.

G. All terminal box controls (controller, power supply, actuators, sensors, pressure ports) shall be field-mounted to permit calibration and service from a single ladder location, coordinated wherever feasible with the furniture layout. Components shall not be installed in a manner that obstructs the factory-provided performance curve data.

H. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.

I. BAS Contractor shall provide stepdown 24V transformers.

3.06 COMMUNICATION WIRING

A. BAS Contractor shall comply with all wiring requirements previously listed.

B. Install communication wiring in separate conduit and enclosures from other Class 2 wiring.

C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.

D. Verify entire network's integrity following cable installation using appropriate tests for each cable.

E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.

F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.

G. Label communication wiring to indicate origination and destination.

H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

I. Control Network Wiring Control network wiring shall be twisted pair in accordance with CEA-709.3 and Echelon Wiring Guidelines level IV echelon wire.

J. All Ethernet cabling, routers, hubs, and switches for connecting 230900 furnished and installed control panels, servers and clients to the building owner’s Ethernet network are the responsibility of the BAS contractor.

3.07 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.

B. Mount sensors rigidly and adequately for operating environment.

C. Install room temperature sensors on concealed junction boxes properly supported by wall framing. For room sensors located exterior walls, furnish and install a ¼" thick, adhesive backed, foam insulating pad made by BAPI. Do not place room sensors in direct sunlight.

D. Air seal wires attached to sensors in their conduits in the wall to prevent sensor readings from being affected by air transmitted from other areas.

E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft 2) of coil area.

G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

H. Install outdoor air temperature sensors on north wall at designated location with sun shield.

I. Differential Air Static Pressure:
   1. Supply Duct Static Pressure: Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
   2. Return Duct Static Pressure: Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
   3. Building Static Pressure: Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
   4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
   5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
   6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.

J. Smoke detectors, freeze stats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow BAS software to monitor safety switch status.

3.08 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing: Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
   1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Division 23.
   2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
   3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
   4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
   5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
   6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
   7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
   8. Alarms and Interlocks:
      a. Check each alarm with an appropriate signal at a value that will trip the alarm.
      b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
      c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.09 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration: Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Section 3.9 (Control System Checkout and Testing). Furnish log documenting completion of startup tests.
   1. Demonstration shall follow process submitted and approved under Submittals section of this specification. Complete approved checklists and forms for each system as part of system demonstration.
   2. Demonstrate actual field operation of each sequence of operation. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Owner’s representative. Provide and operate test equipment required to prove proper system operation.
   3. Demonstrate compliance with System Performance section of this specification.
   4. Demonstrate compliance with sequences of operation through each operational mode.
   5. Demonstrate complete operation of operator interface.
   6. Demonstrate each of the following:

a. DDC loop response: Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Further tuning will be required of each loop that displays unreasonably under- or over-damped control.
b. Building fire alarm system interface.
c. Furnish trend logs for each system: Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 15 minutes. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs, or shall be furnished in graphical Quark Communications' Building Inspection format.

7. Tests that fail to demonstrate proper system operation shall be repeated after BAS Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

3.10 CLEANING

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.

B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.

C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.11 AS-BUILT DOCUMENTATION

A. Project Record Documents. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

1. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format. As-built floor plans indicating the routing of communication wiring shall be included.
2. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
3. As-built versions of submittal Product Data.
4. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
5. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
6. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

7. Engineering, installation, and maintenance manuals that explain how to:
8. Design and install new points, panels, and other hardware.
9. Perform preventive maintenance and calibration.
10. Debug hardware problems.
11. Repair or replace hardware.
12. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
13. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
14. List of recommended spare parts with part numbers and suppliers.
15. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
16. Complete original-issue copies of furnished software, including operating systems, custom programming language, BAS software, and graphics software.
17. Licenses, guarantees, and warranty documents.
18. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
19. Owner training materials.

3.12 TRAINING

A. Provide 8 hours of training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.

B. Training shall enable students to accomplish the following objectives:
1. Proficiently operate system
2. Understand control system architecture and configuration
3. Understand DDC system components
4. Understand system operation, including DDC system control and optimizing routines (algorithms)
5. Operate workstation and peripherals
6. Log on and off system
7. Access graphics, point reports, and logs
8. Adjust and change system setpoints, time schedules, and holiday schedules
9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
10. Understand system drawings and Operation and Maintenance manual

C. Provide course outline and materials according to Section 230900 (Submittals). Provide one copy of training material per student.

D. Instructors shall be factory-trained and experienced in presenting this material and shall present according to a pre-written curriculum.

E. Perform classroom training using a network of working controllers, representative of installed hardware.

F. Additionally, the system manufacture shall make classroom-based instructions available to the owner at the same level of expertise as system integrators or factory technicians.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Refrigerant pipes and fittings.
   2. Refrigerant piping valves and specialties.
   3. Refrigerants.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.
   1. Include pressure drop, based on manufacturer's test data, for the following:
      a. Thermostatic expansion valves.
      b. Solenoid valves.
      c. Hot-gas bypass valves.
      d. Filter dryers.
      e. Strainers.
      f. Pressure-regulating valves.

B. Sustainable Design Submittals:
   1. Product Data for EA Prerequisite "Fundamental Refrigerant Management": For refrigerants, indicating compliance with refrigerant management practices.

C. Shop Drawings:
   1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
   2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
   3. Show interface and spatial relationships between piping and equipment.
   4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

D. All copper refrigeration tube shall be marked with the metal or alloy designation, temper, size, and name of supplier
   1. Annealed Temper straight lengths or coils shall be identified with a tag indicating that the product was manufactured in accordance with ASTM B280
   2. Drawn-Temper straight length shall be identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
   3. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.07 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:
   1. Suction Lines for Air-Conditioning Applications: 115 psig.
   2. Suction Lines for Heat-Pump Applications: 225 psig.
   3. Hot-Gas and Liquid Lines: 225 psig.

B. Line Test Pressure for Refrigerant R-407C:
   1. Suction Lines for Air-Conditioning Applications: 230 psig.
   2. Suction Lines for Heat-Pump Applications: 380 psig.
   3. Hot-Gas and Liquid Lines: 380 psig.

C. Line Test Pressure for Refrigerant R-410A:
   1. Suction Lines for Air-Conditioning Applications: 300 psig.
   2. Suction Lines for Heat-Pump Applications: 535 psig.

3. Hot-Gas and Liquid Lines: 535 psig.

2.02 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Mechanical Fittings: ETL tested and listed to UL 207 mechanical fittings for joining copper-to-copper. Fittings shall have dielectric coating. Fittings shall be certified to a working pressure of 600 psi. Fittings shall be wrapped with fusing non-adhesive silicone tape.

E. Brazing Filler Metals: AWS A5.8/A5.8M.

F. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

G. Fitting Tape:

1. Self-fusing, silicone tape. Silicone tape must withstand temperature ranges of -60 degrees Celsius to 260 degrees Celsius. Tape must have a tensile strength equal to or greater than 700psi and must be UL listed.

H. Flexible Connectors:
1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.03 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.

C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Flanged Unions:
1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.

2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
6. Pressure Rating: Factory test at minimum 400 psig.
7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket.
2. End Connections:
   a. NPS 2 and Smaller: With threaded-end connections.
   b. NPS 2-1/2 and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.04 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
   d. Paul Mueller Company.
2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

B. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Danfoss Inc.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
   e. Paul Mueller Company.
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.

6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

C. Service Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
   d. Paul Mueller Company.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

D. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
   e. Paul Mueller Company.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 115-V ac coil.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

E. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
   d. Paul Mueller Company.
2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
3. Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Thermostatic Expansion Valves: Comply with AHRI 750.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Emerson Climate Technologies.
      c. Heldon Products; Henry Technologies.
      d. Paul Mueller Company.
   2. Body, Bonnet, and Seal Cap: Forged brass or steel.
   3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
   4. Packing and Gaskets: Non-asbestos.
   5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
   6. Suction Temperature: 40 deg F.
   7. Superheat: Adjustable.
   8. Reverse-flow option (for heat-pump applications).
   9. End Connections: Socket, flare, or threaded union.
   10. Working Pressure Rating: 700 psig.

G. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies.
      c. Parker Hannifin Corp.
   2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
   3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
   4. Packing and Gaskets: Non-asbestos.
   5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
   6. Seat: Polytetrafluoroethylene.
   7. Equalizer: External.
   8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 115-V ac coil.
   9. End Connections: Socket.
   10. Set Pressure: 5 psig.
   11. Throttling Range: Maximum 5 psig.
   12. Working Pressure Rating: 500 psig.
   13. Maximum Operating Temperature: 240 deg F.

H. Angle-Type Strainers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies.
      c. Parker Hannifin Corp.
   2. Body: Forged brass or cast bronze.
   3. Drain Plug: Brass hex plug.
   4. Screen: 100-mesh monel.
   5. End Connections: Socket or flare.
   6. Working Pressure Rating: 500 psig.
   7. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

J. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated alumina.
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Rated Flow: <Insert **tons**>.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

K. Permanent Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated alumina.
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.

9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

L. Mufflers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

M. Receivers: Comply with AHRI 495.

N.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Heldon Products; Henry Technologies.
2. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
3. Comply with UL 207; listed and labeled by an NRTL.
4. Body: Welded steel with corrosion-resistant coating.
5. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
6. End Connections: Socket or threaded.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

O. Liquid Accumulators: Comply with AHRI 495.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Emerson Climate Technologies.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

2.05 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-134a

A. Suction Lines NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, Type L annealed-temper tubing and wrought-copper fittings with soldered joints.

B. Suction Lines NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR, Type L light drawn-temper (H55) tubing and wrought-copper fittings with soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
   1. NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR annealed-temper tubing and wrought-copper fittings with soldered joints.
   2. NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR light drawn-temper (H55) tubing and wrought-copper fittings with soldered joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with soldered joints.

3.02 PIPING APPLICATIONS FOR REFRIGERANT R-407C

A. Suction Lines NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, Type L annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR light drawn-temper (H55) tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
   1. NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
   2. NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR, light drawn-temper (H55) tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.03 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 and Smaller for Air-Conditioning Applications with line sets less than 30 feet: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.

B. Suction Lines NPS 4 and Smaller for Air-Conditioning Applications with line sets greater than 30 feet and Variable Refrigerant Flow: Copper, Type ACR, light drawn-temper (H55) tubing and wrought-copper fittings with soldered joints.

C. Hot-Gas and Liquid Lines:
   1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
   2. NPS 3/4 to NPS 2: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications NPS 2-1/2 to NPS 4: Schedule 40, black-steel and wrought-steel fittings with welded joints.

E. Safety-Relief-Valve Discharge Piping:
   1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
   2. NPS 3/4 to NPS 2: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

F. Safety-Relief-Valve Discharge Piping NPS 2-1/2 to NPS 4: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.04 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.05 PIPING INSTALLATION

A. 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. 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.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 23 09 00 "Building Automation System" for, control wiring and Section 25 90 50 "Sequence of Operations for HVAC DDC", for sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid conduit in locations where exposed to damage.

O. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope of 1/8-inch per foot away from the compressor.
   2. Install horizontal suction lines with a uniform slope of 1/8-inch per foot downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

P. Install self-fusing silicone tape to completely enclose all mechanical fittings.

Q. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

R. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
   1. Shot blast the interior of piping.
   2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
   3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
   4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
   5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
   6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

U. Install sleeves for piping penetrations of walls, ceilings, and floors.

V. Install sleeve seals for piping penetrations of concrete walls and slabs.

3.06 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill and continuously purge pipe and fittings with nitrogen, during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel 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 to 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.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.07 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Utilize hangers that support the piping on the outside of the insulation with inserts, or hangers that incorporate a non-metallic insert.

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2: Maximum span, 10 feet; minimum rod, 3/8 inch.
2. NPS 2-1/2: Maximum span, 11 feet; minimum rod, 3/8 inch.
3. NPS 3: Maximum span, 12 feet; minimum rod, 3/8 inch.
4. NPS 4: Maximum span, 14 feet; minimum rod, 1/2 inch.

F. Support multifloor vertical runs at least at each floor.

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.09 SYSTEM CHARGING

A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.
5. When charging filter dryer shall be replaced after each three cylinders of refrigerant.
6. Weigh refrigerant drum before charging and record in final charging report to enable accurate record of refrigerant charge.

3.10 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   1. Open shutoff valves in condenser water circuit.
   2. Verify that compressor oil level is correct.
   3. Open compressor suction and discharge valves.
   4. Open refrigerant valves except bypass valves that are used for other purposes.
   5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13

HVAC METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Ducts and fittings.
2. Sheet metal materials.
3. Flexible Ducts.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.
8. Duct leakage testing.

B. Related Sections:
1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 07 13 “HVAC Duct Insulation”.
3. Section 23 33 00 "Air Duct Accessories" for dampers, duct silencers, duct-mounting access doors and panels, turning vanes, and flexible connections.
4. Section 23 31 19 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design:
1. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
2. Contractor may change duct sizes from those shown provided pressure drop and velocity remain constant. Duct aspect ratio shall be maximum 3:1 unless approved by owner’s representative.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
   2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
   3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Flexible ducts.
   2. Liners and adhesives.
   3. Sealants and gaskets.
   4. [[Seismic-restraint devices].]

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement details and spacing.
   8. Seam and joint construction and sealing.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, flexible connectors, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.
   5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation] for selecting hangers and supports [and seismic restraints].

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
   3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
D. REGULATORY REQUIREMENTS
   1. Construct ductwork to NFPA 90A standards.

E. FIELD CONDITIONS
   1. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
   2. Maintain temperatures within acceptable range during and after installation of duct sealants.
   3. Ductwork shall be transported to the site in enclosed vehicles or with ends capped.
   4. Do not store ductwork directly on ground or floor.
   5. Ductwork stored or stacked on site shall be capped.
   6. Installed duct shall be capped at the end of the day. Duct found uncapped after the end of the day shall be cleaned.

PART 2 - PRODUCTS

2.01 SINGLE WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
   2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide on joints or formed-on flanges fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Slide on Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

b. Formed on Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

2. Manufacturers
   a. Ductmate Industries, Inc.
   b. Lockformer.
   c. Nexus Inc.
   d. Ward Industries

C. Longitudinal Seams: Pittsburgh lock seams fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359-inch thick or less, with more than 10 sq ft of non-braced panel area unless ducts are lined.

2.02 SINGLE-WALL ROUNDDUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Duct Joints
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 60 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Ducts Larger than 60 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
   4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rub-ber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
      a. Manufacturers
         1) Ductmate Industries, Inc.
         2) Lindab Inc.

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts less than 84 inches diameter with spiral lockseam.
   2. Fabricate round ducts larger than 84 inches in diameter with butt-welded longitudinal seams.
   3. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." 90 degree T's without shoe and pulled fittings are not permitted.

G. Fabricate elbows using die-formed, gored spot welded and sealed, or pleated construction. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Round Elbows 8 Inches and Less in Diameter: 2-piece welded construction, fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate non-standard bend-angle configurations or nonstandard diameter elbows with gored construction.
   2. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees. Fabricate non-standard bend-angle configurations or nonstandard diameter elbows with gored construction.
   3. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows.

2.03 MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation (except as noted below): G60 (Z180).
   2. Galvanized Coating Designation for outside air intake ductwork, outdoor unjacketed ductwork, and as otherwise noted: G90 (Z275).
   3. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60 (Z180).
   2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface].
   3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

F. Factory- or Shop-Applied Antimicrobial Coating:
   1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
   2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

H. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

I. Duct Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during transportation and construction.
   1. Product: DynAir Duct Protection Film or equivalent.
   2. High tack water-based adhesive.
   3. Thickness: 2 mils.
   4. UV stability.
   5. VOC content: zero.
   6. Elongation before break: minimum 325 %.

2.04 DUCT LINER

A. General Requirements:
   1. No fiberglass duct liner is allowed.
   2. Service temperature: -20 deg F to 250 deg F.
   3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   4. NFPA 90A and NFPA 90B compliant.
   5. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   6. Passes ASTM C665 and C1338 for fungi resistance and mold growth.

B. Polyester Duct Liner:
   1. Manufacturers:
      a. Ductmate - PolyArmor.
      b. Or engineer-approved equivalent.
   2. K value: ASTM C518, 0.24 at 75 deg F; R-value per inch: 4.2.
   3. Minimum Noise Reduction Coefficient (NRC): 0.65 at 1 inch thickness.
   4. Maximum moisture sorption: 2% by weight.
   5. Minimum 25% recycled content.
   6. Volatile Organic Content (VOC): 0 ppm.
   7. Water-Based Liner Adhesive.

C. Polyamide Foam Duct Liner:
   1. Manufacturers:
      a. Boyd Corporation – Solcoustic.
      b. Or engineer-approved equivalent.
   2. K value: ASTM C518, 0.30 at 75 deg F; R-value per inch: 3.3.
   3. Minimum Noise Reduction Coefficient (NRC): 0.70 at 1 inch thickness.
   4. Maximum moisture sorption: 2% by weight.
   5. Mechanical Fasteners:
      a. Suitable for attachment to duct without damaging liner as recommended by manufacturer.
      b. Pin length: as required. Pin shall project no more than 1/8 inch (3 mm) into air stream.

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

2.05 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723 (ASTM E84); certified by an NRTL.
B. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on or spray on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Volatile Organic Content (VOC): Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Single-component, acid-curing, silicone, elastomeric. Comply with ASTM C 920, Type S, Grade NS, Class 25, Use O.
   1. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.

2.06 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
F. 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.
G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.07 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
   1. Basis of Design: Mason SCB.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
C. Install ducts in maximum practical lengths.
D. Install ducts with fewest possible joints.
E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
H. Install ducts with a clearance of at least 1 inch (25 mm), plus allowance for insulation thickness.
I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
M. Under no circumstances will any labels be permitted on interior surfaces of ductwork. Any materials delivered to the jobsite with interior labels shall be physically and chemically cleaned to remove all remnants of the tag and/or adhesive used to place it.
N. Where connecting flexible duct to metal duct the inner lining shall be placed a minimum of 6 inches over the metal. A zip tie shall be placed over the joint and the flexible duct collar attached with a minimum of three sheet metal screws with foil tape provided to seal the end. The duct insulation shall cover this assembly with the outer membrane covering the insulation and sealed with tape having an integral vapor barrier.
O. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
P. Duct Tape is not permitted.
Q. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
R. Aluminum ductwork shall be used to handle moisture-laden air from shower rooms, shower drying rooms. Slope duct up at minimum 1% slope away from exhaust grille for minimum of 10 feet.
S. At exterior wall louvers, seal duct to louver frame. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Insulate unused portion of outside air intake or exhaust louvers, and duct to the insulated isolation damper. Blank-out material shall be same material as duct, painted black on exterior side. Install outside air intakes to pitch (1 inch per 20 feet) toward intake louver where possible, provide a low point drain prior to equipment where intake duct must slope down from louver. Seal ducts seams to form watertight joints.

T. Install minimum 10 feet of stainless steel duct after all duct mounted humidifiers with botoom surface sloped back at 1% to humidifier.

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements. Comply with ASTM A780.

3.03 ADDITIONAL EXTERIOR DUCT INSTALLATION REQUIREMENTS

A. Exterior ductwork under negative pressure shall be so designed and constructed that rainwater on the duct surface cannot be drawn into the duct to reappear inside the building.

B. Exterior ductwork under positive pressure is to be made watertight with exterior waterproof sealant.

C. The cross section of all exterior ductwork shall be pitched at 1 percent slope such that water drains from the top of the duct to one or both sides of the duct, and does not pool on the top.

D. Paint exposed roof mounted ductwork; color to be per Architect requirements.

3.04 ADDITIONAL WELDED DUCT REQUIREMENTS

A. All welded duct may be butt-welded or joggle welded. Where joggle welds are used on fume exhaust systems, the lip formed on the interior surface shall be oriented downstream of the airflow to minimize pockets where condensed liquids may collect.
B. Welded duct sections shall be verified to be continuous and free of leakage prior to shipment from the fabrication facility. Leakage testing may be accomplished utilizing either light or pressurization.
C. Welds on exposed ductwork in occupied spaces shall be prepared as follows:
   1. Stainless Steel #2B: Standard stainless steel finish used for ductwork, exhaust stacks, within mechanical spaces, low wall returns, fume hoods, back of house systems, etc. Welds shall be brushed and painted with Chrome Aluminum paint.

2. Stainless Steel #4: Exposed aesthetic architectural finish. Only shall be used when specified on drawings or elsewhere in the specifications. Finish shall be prepared to a kitchen grade finish with welds ground smooth and brush polished to restore the #4 finish.

D. For installations serving fume exhaust.
1. All fittings shall be long radius. Round elbows shall be minimum 5 gore.
2. Slope horizontal ductwork back toward source connected equipment minimum 1% slope so that moisture and liquids may drain back toward equipment.
3. Low point “traps” in the ductwork shall be fitted with a low point drain valve, ½” welded connection, stainless steel piping and valve.

3.05 ADDITIONAL REQUIREMENTS FOR CLOTHES DRYER EXHAUST DUCT

A. Duct shall not be routed through plenum or unconditioned attic or crawlspace.

B. Flexible dryer duct shall not be concealed.

3.06 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood for horizontal runs less than 75 feet. Duct shall be sloped at 1-inch per 12 inches for horizontal runs in excess of

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of, 20 feet (6 m) where installed access doors are 20 inches x 20 inches and 12 feet (3.7 m) where access doors are less than 20 inches x 20 inches, in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
D. Install residue trap at the base of each vertical riser.

3.07 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.08 INTERNAL LINING IINSTALLATION

A. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.09 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.10 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.
   1. Space lateral supports a maximum of 40 feet on.center, and longitudinal supports a maximum of 80 feet on center.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
C. Install cables so they do not bend across edges of adjacent equipment or building structure.
D. Install cable restraints on ducts that are suspended with vibration isolators.
E. Install seismic-restraint devices using methods approved by the Office of Statewide Health Planning and Development for the State of California or an agency acceptable to authorities having jurisdiction.
F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.11 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.12 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting.".

3.13 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.
B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   4. Coils and related components.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   6. Supply-air ducts, dampers, actuators, and turning vanes.
   7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Ducts with a Pressure Class of positive 3-Inch wg or higher or negative 3-Inch wg or lower: Test 100 percent of total installed duct area for each designated pressure class.
      b. Ducts with a Pressure Class between positive 2-Inch wg and negative 2-Inch wg inclusive: Test representative duct sections, selected by Design Engineer, totaling no less than 25 percent of total installed duct area for each designated pressure class.
      c. Risers and all supply and exhaust branch ducting shall be tested to within 5 feet of a diffuser collar or the point of connection to an exhaust device, respectively.
      d. Welded Exhaust Ducts: Test 100 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

3.15 DUCT SCHEDULE

A. Fabricate ducts of galvanized steel except as otherwise indicated and as follows:

Table: Duct Schedule

Type	Material	Pressure Class	Rect. Leakage Class	Round Leakage Class	Seal Class
Supply Risers/Mains	Galvanized	+ 4" w.g.	6	3	A
Supply (after fan coil units, heat pumps)	Galvanized	+ 2" w.g.	24	12	C
Constant volume AHU Supply (Risers and Mains)	Galvanized	+ 3" w.g.	6	3	A
Return	Galvanized	- 2” w.g.	24	12	C
Transfer	Galvanized	- 1” w.g.	24	12	C
Outside Air	Galvanized	- 2” w.g.	24	12	C
General Exhaust	Galvanized	- 2" w.g.	12	6	B

Notes:

1. All supply, return, relief and exhaust duct utilized as part of a smoke exhaust, stair and elevator pressurization system pressure class shall be 1.5 times that stated above or maximum scheduled fan design pressure whichever is greater.

B. Liner:
1. Supply Air Ducts: Polyester, 1 inch (25 mm) thick.
2. Return Air Ducts: Polyester, 1 inch (25 mm) thick.
3. Exhaust Air Ducts: Polyamide, 1 inch (25 mm) thick.
4. Supply Fan Plenums: Polyamide, 2 inches (51 mm) thick.
5. Return- and Exhaust-Fan Plenums: Polyamide, 2 inches (51 mm) thick.
6. Transfer Ducts: Polyamide, 1 inch (25 mm) thick.

C. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:
   1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
   2) Mitered Type RE 4 without vanes.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
   1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
   2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
   3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
c. Velocity 1500 fpm (7.6 m/s) or Higher:
   1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
   b. Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
   c. Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
   d. Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
   e. Radius-to Diameter Ratio: 1.5.
   f. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   g. Round Elbows,14 Inches and Larger in Diameter: Standing seam.

D. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

HVAC DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Backdraft dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Pressure Independent Automatic Balancing Dampers
5. Fire dampers.
6. Smoke dampers.
7. Combination fire and smoke dampers.
8. Corridor dampers.
9. Duct silencers.
10. Turning vanes.
11. Remote damper operators.
12. Duct-mounted access doors.
13. Flexible connectors.
14. Duct security bars.
15. Duct accessory hardware.

B. Related Requirements:
1. Division 07 for Firestopping.
2. Section 23 31 13 “HVAC Metal Ducts” for flexible ducts.
3. Division 26 for wiring connections.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittals:
1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      b. Manual volume damper installations.
      c. Control-damper installations.
      d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
      e. Duct security bars.
      f. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Sound Attenuators
   1. All tests shall be conducted by a laboratory that is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) to conduct the test. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Where test data is obtained in the manufacturer's laboratory, the facility shall be available for inspection and witnessed testing by the architect, mechanical engineer and acoustical consultant in order to verify compliance with the latest edition of ASTM Standard E477 or a test standard approved by the acoustical consultant. The architect or project acoustical consultant shall be the final arbiter in determining compliance.
   2. Manufacturer’s Experience: The manufacturer shall have successful experience in duct silencer production, including no less than five years experience in fabrication and delivery of duct silencers equal in size and quantity to this work. The

Manufacturer shall be capable of supplying references and acoustical test results for up to five recently completed projects similar to this work.

3. Acoustical and Aerodynamic Performance: Duct silencer acoustical and aerodynamic performance shall be determined in accordance with the latest edition of ASTM Standard E477-90 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers or a test standard approved by the acoustical consultant. All silencer ratings shall be determined in a duct-to-reverberant room test facility that provides for airflow in both directions through the test silencer in accordance with the latest edition of ASTM E-477 test standard or a test standard approved by the acoustical consultant. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Provide duct accessories of materials suited to associated duct materials.

D. Air extractors shall not be used, except with the expressed written consent of the Design Engineer.

2.02 BACKDRAFT DAMPERS

A. General:
1. Provide manufacturer’s standard backdraft damper if available as fan or air-moving equipment accessory.
2. Provide damper material of the same material as associated ductwork.

B. Manufacturers:
1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

C. Description: Gravity balanced.
1. Maximum Air Velocity: 3000 fpm.
2. Maximum System Pressure: match associated ductwork.
3. Frame: hat shaped, minimum 20 gage galvanized steel,flanged both sides.
4. Bearings: Synthetic.
5. Blades: Multiple single-piece parallel blades, minimum 28 gage galvanized steel.
6. Blade Seals: Extruded vinyl, mechanically locked.
7. Linkage: concealed in frame
8. Blade Axles:

a. Up to 42 inch damper width: Nonmetallic or steel
b. 42 inch width and larger: steel.

9. Tie Bars and Brackets: Galvanized steel.
10. Accessories:
    a. Adjustment device to permit setting for varying differential static pressure.
    b. Counterweights and spring-assist kits for vertical airflow installations.
    c. Electric actuators.
    d. Chain pulls.
    e. Screen Mounting: Front mounted in sleeve.
        1) Sleeve Thickness: 20 gage minimum.
        2) Sleeve Length: 6 inches minimum.
    f. Screen Mounting: Rear mounted.
    g. Screen Material: Galvanized steel.
    h. Screen Type: **Bird**.
    i. 90-degree stops.

2.03 BAROMETRIC RELIEF DAMPERS

A. Description: Counterbalanced backdraft damper.
1. Sensitivity: 0.01 inch w.g. differential pressure.
2. Frame : extruded aluminum channel, front and rear flanges.
3. Blades: Single-piece, parallel, minimum 28 gage aluminum
4. Blade Seals: Extruded vinyl, mechanically locked maximum 6” width.
5. Bearings: Synthetic
6. Counterbalance: zinc plated adjustable steel weights attached to blades.
7. Accessories:
    a. Screen Mounting: Front mounted in sleeve.
        1) Sleeve Thickness: 20 gage minimum.
        2) Sleeve Length: 6 inches minimum.
    b. Screen Mounting: Rear mounted.
    c. Screen Material: Galvanized steel.
    d. Screen Type: **Bird**.

2.04 MANUAL VOLUME DAMPERS

A. General Description: Factory fabricated, with required hardware and accessories.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Damper Frame: hat-shaped, material shall match associated ductwork.

D. Flanges for attaching to walls and flangeless frames for installing in ducts.

E. Manufacturers:
1. Ruskin.
2. Louvers and Dampers.
3. Nailor Industries.

F. Standard Manual Volume Dampers (2-inch wg and below):

1. Frame: 3 inch deep, minimum 20 gauge galvanized steel.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Maximum Air Velocity: 1500 fpm.
5. Maximum System Pressure: 2 inch w.g.
6. Axles:
    a. 18” wide and below: minimum 3/8” square extended beyond frame with standoff bracket.
    b. 19” wide and above: minimum 1/2” square extended beyond frame with standoff bracket.
    c.
7. Blades:
    a. Stiffened, opposed-blade design.
    b. 18” wide and below: 22 gauge.
    c. 19” wide and above: 16 gauge.
    d. [Include locking hand quadrant to hold single-blade dampers in a fixed position without vibration.]
8. Bearings: Molded synthetic.

G. Standard Manual Volume Dampers 3-inch wg and above):
1. Frame: 5-inch deep, minimum 16 gage reinforced for corner braces.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Maximum Air Velocity: 1500 fpm.
5. Maximum System Pressure: 5 inch w.g.
6. Axles: minimum 1/2”
7. Control shaft: minimum 1/2” square extended beyond frame with standoff bracket, with outboard support bearing.
8. Blades:
    a. Opposed-blade design.
    b. Minimum 16 gage
    c. Stiffen damper blades for stability.
    d. Blade stop.
    e. [Include locking hand quadrant to hold single-blade dampers in a fixed position without vibration.]
9. Bearings: Molded synthetic.

H. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Pottorff.
    b. Ruskin Company.
    c. Trox USA Inc.
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:
    a. Hat or U shaped.
    b. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
    c. Mitered and welded corners.

d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:
   a. Multiple or single Airfoil blade.
   b. Opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized, roll-formed steel, 0.064 inch thick.
7. Blade Axles: Galvanized steel.
8. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered stainless steel.
11. Tie Bars and Brackets: Galvanized steel.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.05 FIRE AND SMOKE DAMPERS

A. Manufacturers:
1. Ruskin Company.
2. Louvers & Dampers, Inc.
3. Nailor Industries, Inc.
4. Ward Industries.

B. General Requirements:
1. Labeled according to UL 555C by an NRTL.
2. Fabricate in accordance with NFPA 90A
3. Comply with construction details for tested assemblies as indicated in UL's "Fire Resistance Directory."
4. Fire Rating: to suit wall, floor, ceiling, or corridor assembly, refer to Architectural Drawings.
5. Operational ratings: suited to meet duct pressure and velocity design airflow conditions.
6.

C. Fire Dampers:
1. Type: Dynamic.
2. Operational ratings: suited to meet design airflow conditions, and minimum 4-inch wg static pressure class and 2000-fpm velocity.
3. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel; with mitered and interlocking corners.
4. Blades: Roll-formed, interlocking, airfoil, galvanized sheet steel.
5. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
6. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
7. links.

D. Smoke Dampers:

1. Smoke Detector: . Refer to Specification section 28 31 11 “DIGITAL ADDRESSABLE FIRE ALARM”
2.]Operational ratings: suited to meet design airflow conditions, and minimum 4-inch wg static pressure class and 2000-fpm velocity.
3. Frame: hat shaped, galvanized sheet steel with mounting frame.
4. Blades: Airfoil, galvanized sheet steel.
5. Leakage: Class I.
6. Actuator: electric, out of airstream, two-position, fail closed.
7. Mounting Sleeve: Factory-installed, with breakaway connection galvanized sheet steel; length to suit wall or floor application. Gage shall be per requirements of UL 555 and not less than the attached duct gage, with factory-furnished silicone calking
   The following options are not required by code however, they do provide functionality for the mandatory cycle testing of dampers as required by NFPA. The switch package allows for remote operation and visual indication of the damper status and is typically mounted under the ceiling. Typically this would only be used in industrial applications because of the visual impact of the lights and panel. The damper test switch is typically duct mounted and performs same function to locally cycle test the damper. We should include one of these options unless building contains full smoke control with firemans control panel as all dampers can be tested through that.
8. Switch Package to allow remote indication of damper blade position.
9. Damper test switch for cycle testing.
10. [Auxilary switch for fan signaling for fan shut down where failure of damper would block greater than than 50% of fan airflow.

E. Combination Fire and Smoke Dampers:
1. Operational ratings: suited to meet design airflow conditions, and minimum 4-inch wg (1 kPa) static pressure class and 2000-fpm (10 m/s) velocity.
2. Frame: hat shaped, galvanized sheet steel.
3. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
4. Smoke Detector: **Refer to Specification section 28 31 11 “DIGITAL ADDRESSABLE FIRE ALARM”**Blades: Roll-formed, one-piece airfoil, galvanized sheet steel.
5. Actuator: electric, out of airstream, two-position, fail closed.
6. Leakage: Class I.
7. Mounting Sleeve: Factory-installed, with breakaway connection galvanized sheet steel; length to suit wall or floor application. Gage shall be per requirements of UL 555 and not less than the attached duct gage, with factory-furnished silicone calking.
8. Damper test switch for cycle testing.
9. Auxilary switch for fan signaling for fan shut down where failure of damper would block greater than than 50% of fan airflow.

F. Corridor Dampers:
1. Operational ratings: suited to meet design airflow conditions, and minimum 4-inch wg static pressure class and 2000-fpm velocity.
2. Frame: hat shaped, galvanized sheet steel.
3. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

4. Smoke Detector: **Refer to Specification section 28 31 11 "DIGITAL ADDRESSABLE FIRE ALARM"**Blades: Roll-formed, one-piece airfoil, galvanized sheet steel.
5. Mounting Sleeve: Factory-installed, with breakaway connection galvanized sheet steel; length to suit wall or floor application. Gage shall be per requirements of UL 555 and not less than the attached duct gage, with factory-furnished silicone calking.
6. Leakage: Class I.

2.06 DUCT SILENCERS

A. Manufacturers:
1. Vibro-Acoustics.
2. Ruskin.
3. Kinetics Noise Control.

B. General Requirements:
1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.

C. Shape:
1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.
6. Rectangular Packless

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275), galvanized sheet steel,
1. Sheet Metal Thickness for straight units 0.034 inch thick.
2. Sheet Metal Thickness for elbow units 0.060 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90 , galvanized sheet steel.
1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch (0.85 mm) thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.05 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 (Z275) galvanized sheet metal
1. Sheet Metal Thickness for straight units 0.018 inch thick
2. Sheet Metal Thickness for elbow units 0.030 inch thick.

3. Sheet Metal Thickness for circular units through 18 inches 0.018 inch thick
4. Sheet Metal Thickness for circular units above 18 inches 0.030 inch thick

G. Special Construction:
1. Suitable for outdoor use.
2. High transmission loss walls

H. Connection Sizes: Provide transition to and from connecting ductwork to schedule silencer size.

I. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative Film-lined type with fill material.
   a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression.
   b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
   c. Glass fiber and fiber glass will not be permitted.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Joints: Lock formed and sealed.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.

L. Source Quality Control: Test according to ASTM E 477.

2.07 TURNING VANES

A. Manufacturers:
1. Duro Dyne Inc.
2. Ductmate Industries.
3. Metalaire.
4. Ruskin.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Single Wall: 3/4 inch trailing edge and 2 inch radius.
2. Double Wall: 2 inch inside radius. Vane length not to exceed 36 inch.

3. Acoustic Turning Vanes: 4 inch double wall airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

E. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

2.08 REMOTE CABLE-DRIVEN VOLUME DAMPER OPERATORS

A. Manufacturers:
1. Pottorff.
2. Ventfabrics, Inc.
3. Ventlok.
4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.
1. Provide package for complete workable system for remote damper operation.
2. Pressure Rating: 1-inch w.g.
3. Velocity Rating: 1,500 FPM.
4. Tubing: Plastic.
5. Cable: Stainless steel, 50 feet maximum length.
6. Wall-Box Mounting:
    a. Recessed, with tamper-proof, stainless steel cover plate.

2.09 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
    a. Double wall; insulation fill and thickness as indicated for duct pressure class, minimum 1 inch.
    b. Hinges and Latches: continuous piano hinge and cam latches.
    c. Shape and material to match ductwork.
    d. Fabricate doors airtight and suitable for duct pressure class.
    e. Doors shall open against air pressure.
    f. On access doors on ducts of 4 inch w.g. pressure or greater, provide sign reading “CAUTION – DOOR CLOSES WITH AIR PRESSURE”.
2. Frame duct opening with continuous 1 inch by 1 inch angle. Provide sponge rubber or neoprene gasket at door-to-frame and frame-to-duct.

B. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall for non-insulated ducts [**Double wall with insulation fill**] for insulated ducts with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 1.0- to 5.0-inch wg.

5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, polystyrene-foam board.

2.10 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Flame Gard, Inc.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F .

F. Minimum Pressure Rating: 10-inch wg , positive or negative.

2.11 FLEXIBLE DUCTS

A. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
1. Manufacturers:
   a. Casco L-181M.
   b. Flexmaster USA 1NI.
   c. Thermaflex MC.
2. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg negative.
3. Maximum Air Velocity: 4000 fpm .
4. Temperature Range: Minus 10 to plus 160 deg F .
5. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
6. NFPA 90A and NFPA 90B compliant.

B. Acoustically Rated, Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; vapor-barrier film.
1. Manufacturers:
   a. Casco SF-181M.
   b. Flexmaster USA 1B.
   c. Thermaflex M-KE.
2. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
3. Maximum Air Velocity: 4000 fpm .
4. Temperature Range: Minus 20 to plus 175 deg F.

5. Water Vapor Permeance: maximum 0.17 perms (ASTM E 96, Procedure A).
6. Insulation R-Value: R-4.2 minimum at 70 deg F.
7. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
8. NFPA 90A and NFPA 90B compliant.
9. The sound attenuation (insertion loss) of the acoustical flexible air duct shall meet or exceed the values tabulated below

Straight Duct Insertion Loss in Decibels per Length of 10 Feet with No Airflow

Acoustical Flexible Air Duct Inner Diameter	**Octave Band Center Frequency (Hz)**						
	125	**250**	**500**	**1000**	**2000**	**4000**	**8000**
6 Inches	20	25	30	33	30	25	22
10 Inches	18	20	25	28	25	22	20
16 Inches	15	18	20	25	22	15	15

C. Flexible Duct Attachment:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches to suit duct size.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers:
1. Durodyne.
2. Ventfabrics.

B. Materials: Flame-retardant or noncombustible fabrics. NFPA 90A compliant.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd. .
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F .

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd. .
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F .

F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd. .
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd. .
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F .

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.13 DUCT SECURITY BARS

A. Description: Field- or factory-fabricated and field-installed duct security bars.

B. Configuration:
1. Sleeve: 3/16-inch , continuously welded steel frames, to be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
2. Bars: Tool-resistant, steel, 7/8 inch diameter, spaced so that no opening is larger than 5 inches .

2.14 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless integral backdraft damper is provided, and on outside air intakes

as close as possible to the exterior. Separate backdraft damper is not required where control damper is indicated, or otherwise indicated

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. Provide elevated dial or shaft extension for insulated ducts.
   1. Utilize aluminum framed and blades for volume dampers in wet air streams, utilize galvanized steel blades and frames in all other locations.
   2. Cut slot in end of volume damper rod (Quadrant End) to indicate blade position.
   3. Provide galvanized sheet metal "hat section" for volume dampers on ducts with exterior insulation so that quadrant will be exposed.
   4. Unless indicated otherwise below or on drawings volume dampers shall be standard design:
      a. Spaces with sound rating NC 30 and below: Low Leakage
      b.

D. Install cable-driven remote volume dampers for all volume dampers located in inaccessible ceilings or as indicated on Contract Drawings.
   1. Locate wall box within 10 feet in accessible location.
   2. Wall box shall be recessed-type in finished spaces.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Automatic balancing dampers installation
   1. Install dampers at locations indicated on the drawings and in accordance with manufacturer's installation instructions.
   2. Install dampers square and free from racking with blades orientation as scheduled or required.
   3. Do not compress or stretch damper frame into duct or opening.
   4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jackshaft.
   5. Control damper shall be installed in horizontal or vertical applications.
   6. Install with minimum 5 diameters straight duct upstream of damper.
   7. Where installed in horizontal applications, the set-point adjustment indicator shall be placed at the ‘6 o’clock position’, with the blade running vertically.
   8. Where installed in horizontal applications, the set-point adjustment indicator shall be placed at the ‘12 o’clock position’.

H. Install fire and smoke dampers according to UL listing.

I. Fire Damper installation is required for all ductwork penetrating fire-rated walls, floors, and ceilings. Smoke damper installation is required for all ductwork penetrating smoke-rated partitions. Coordinate location and rating of fire and smoke dampers with Architectural Drawings. Provide dampers where required even if not shown on Mechanical Drawings.

J. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

K. Locate duct silencers a minimum of two equivalent duct diameters from elbows and fittings.

L. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches (150 mm) o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch (300-by-300-mm) hinged access panel with cam lock in duct in each side of sleeve.

M. Sound Attenuators
1. Install where shown on Drawings in accordance with the manufacturer's recommendations to obtain the published acoustical and air flow performance.
2. Duct Silencer baffles should be oriented so as to be parallel to the plane of the turn if the silencer is located in a position less than 3 duct diameters in distance from the elbow. The duct diameter shall be based upon the maximum duct cross sectional dimension of the sound attenuator.
3. Do not locate rectangular sound attenuators within one duct diameter from elbows, fan suction or discharge openings, takeoffs, etc.
4. Support duct silencers independent of ductwork, **.**

N. Install turning vanes in all rectangular elbows.
1. Ductwork of pressure class +/- 2-inch w.g. or lower: single wall vanes.
2. Ductwork of pressure class +/- 3-inch w.g. and greater: double wall vanes.
3. Acoustical turning vanes are not to be used unless specifically indicated on the Contract Drawings.

O. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On upstream **and downstream** side of duct coils.
2. Upstream **and downstream** from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from control dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

P. Install access doors with swing against duct static pressure.

Q. Access Door Sizes:

1. Rectangular duct larger than 30 inches: 24 by 24 inches .
2. Rectangular duct up to 30 inches: 16 by 20 inches .
3. Rectangular duct up to 18 inches: 12 by 12 inches .
4. For ducts smaller than 18 inches: 2 inch less than duct height by 12 inch length.

R. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

S. Install duct test holes where required for testing and balancing purposes.

T. Flexible Connectors
1. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
2. Allow at least 1 inch slack in flexible connections to insure that no vibration is transmitted from fan to ductwork
3. On fans with a total static pressure of 5 inch w.g. or greater, install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

U. Flexible Duct
1. Connect diffusers or light troffer boots to low pressure ducts with maximum 84-inch lengths of flexible duct clamped or strapped in place.
2. Connect flexible ducts to metal ducts with draw bands.
3. Installation of the acoustical flexible air duct shall be in accordance with the manufacturer's instructions and recommended procedures. Bends shall not have a radius of curvature smaller than 1.5 duct diameters. Before entering the rear of any diffuser, flexible duct must be straight and perpendicular to the diffuser for a minimum of 3 duct diameters.
4. Flexible duct must not be installed directly at the inlet or discharge of any volume control device

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 33 19

DUCT SILENCERS

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. Section Includes:
   1. Duct Silencers.
B. Related Sections:
   1. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment”.

1.03 SUBMITTALS

A. Performance Data:
   1. Silencer manufacturer to provide submittal drawings detailing all duct silencer data specified in the construction documents.
   2. Submit Manufacturer's recommended installation instructions and procedures.
   3. Identify all proposed changes, differences and/or discrepancies, including verbiage, terms and definitions between Contract Documents and submittals.
   4. Submit a list of all field conditions which the manufacturer has determined will limit the specified acoustical performance requirements specified for duct silencers.
   5. Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E-477 test standard with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.
   6. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials. The laboratory must be NVLAP accredited for the ASTM E477 test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop drawings submitted without proper certifications will be rejected.
      a. Sound trap model number, dimensions and silencer designation.
      b. The manufacturer shall supply certified dynamic insertion loss data for each scheduled silencer in octave bands centered at 63 Hz through 8,000 Hz for both forward and reverse flow conditions.
      c. The manufacturer shall supply certified self-noise power level data for each scheduled silencer in same octave bands as above.
      d. Maximum pressure drop at required air volume. Submitted silencer pressure drops shall not exceed those listed in the silencer schedule.

1.04 QUALITY ASSURANCE

A. The manufacturer shall have successful experience in duct silencer production, including no less than five years’ experience in fabrication and delivery of duct silencers equal in size and quantity to this Work. The Manufacturer shall be capable of supplying references and acoustical test results for up to five recently completed projects similar to this Work.

B. Silencer performance must have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers or a test standard approved by the acoustical consultant. The test facility must provide for airflow in both directions through the test silencer. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption. The aero-acoustic laboratory must be currently NVLAP accredited for the ASTM E477 test standard.

C. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

D. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

E. The architect or project acoustical consultant shall be the final arbiter in determining compliance.

PART 2 - PRODUCTS

2.01 DUCT SILENCERS

A. Manufacturers: Price (Basis of Design), Vibro-Acoustics or Industrial Acoustics Company (IAC).
   1. Alternate manufacturers must request and obtain written approval by the Acoustic Consultant to bid the project at least 10 days prior to the bid due-date. As a condition of pre-approval, alternate manufacturers must submit to the Acoustic Consultant a minimum of five (5) different HVAC silencer test reports. Each report shall be for a silencer tested in full accordance with the ASTM E-477 silencer test standard in an aero-acoustic test facility which is NVLAP accredited for the ASTM E-477 standard. A copy of the laboratory's NVLAP accreditation certificate must be included with the submitted reports.

B. General Requirements
   1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
   2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
   3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
   4. Casings shall be lock-formed and sealed to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the job site. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
   5. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.
   6. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, sealants, and acoustical spacers, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA

255 or UL 723.
a. Airstream surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
b. Outer casings of rectangular duct silencers shall be made of 22 gauge galvanized steel in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
c. Outer casings of rectangular elbow silencers shall be made of 18 gauge galvanized steel in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed.

7. Outer casings of circular silencers shall be made of galvanized steel as listed below.
   a. Circular silencers: Up to 18-inches in diameter: 22 gauge.
   b. Circular silencers: 18-inches to 30-inches in diameter: 20-gauge.
   c. Circular silencers: 30-inches to 54-inches in diameter: 18-gauge
   d. Circular silencers: greater than 54-inches in diameter: 16-gauge
8. Inner perforated galvanized steel liners:
   a. Rectangular silencers: 26-gauge.
   b. Elbow silencers: 22 gauge.
   c. Circular silencers: Up to 18-inches in diameter: 26 gauge.
   d. Circular silencers: Greater than 18-inches in diameter: 22-gauge.
9. Sound absorbing fill material shall be inert and vermin proof fibrous material of a density sufficient to obtain the specified acoustic performance. Fiberglass shall be packed with a minimum of 15% compression during silencer assembly. Media shall be bacteria and fungus resistant. It shall be resilient such that it will not crumble or break. It shall conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel.
   a. Where indicated on the silencer schedule for dissipative silencers, fiberglass fill material shall be encapsulated in fiberglass cloth to help prevent shedding, erosion and impregnation of the fiberglass.
10. Where indicated on the silencer schedule for film lined silencers, the fiberglass fill material shall be completely wrapped with polymer bag enclosing fill to help prevent shedding, erosion and impregnation. The polymer bag shall be heat sealed before assembly. The enclosed acoustic media shall be separated from the perforated metal by a factory installed 1/2-inch thick acoustically transparent spacer. The spacer shall be flame retardant and erosion resistant. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install silencer according to manufacturer’s written installation instructions.

B. Install where shown on Drawings in accordance with the manufacturer's recommendations to obtain the published acoustical and air flow performance.

C. Sound trap baffles should be oriented so as to be parallel to the plane of the turn if the sound trap is located in a position less than 3 duct diameters in distance from the elbow. The duct diameter shall be based upon the maximum duct cross sectional dimension of the sound trap.

D. If the sound trap is located greater than 3 duct diameters away from an elbow, the orientation is

not critical.

E. Do not locate rectangular sound attenuators within one duct diameter from elbows, fan suction or discharge openings, takeoffs, etc. unless indicated on the drawings.

3.02 SCHEDULE

Tag	WxH (in)	L (in)	Vel. (FPM)	PD in w.g.	BoD Model		Dynamic Insertion Loss (dB re: 10^{-12}W) Generated Noise (dB re: 10^{-12}W)							
							63	125	250	500	1000	2000	4000	8000
DOAS EA	24x24	36	-1150	0.16	RH36/1D	DIL	6	8	14	25	30	27	20	16
						GN	52	38	34	37	44	48	49	44
DOAS SA	24x24	72	1625	0.18	RH72/6D	DIL	8	12	20	34	28	20	15	12
						GN	52	39	34	33	39	40	40	36
RTU-1 RA	24x24	36	1250	0.17	RH36/6E	DIL	6	9	17	25	22	17	15	13
						GN	51	37	32	35	42	47	48	43
RTU-1 SA	24x24	36	1250	0.17	RH36/6E	DIL	6	9	15	23	21	17	15	13
						GN	49	35	31	30	38	37	37	33
RTU-2 RA	24x24	36	1125	0.14	RH36/6E	DIL	6	9	16	25	22	17	15	13
						GN	48	34	29	31	40	44	45	40
RTU-2 SA	24x24	36	1125	0.25	RL36/6D	DIL	7	10	17	26	23	19	16	13
						GN	54	38	39	43	43	43	39	32
RTU-3.1 RA	24x24	60	991	0.08	RM60/6C	DIL	8	12	21	34	29	20	14	11
						GN	34	20	15	31	36	33	31	21
RTU-3.1 SA	24x24	72	1400	0.21	RH72/6E	DIL	9	14	25	37	35	27	19	14
						GN	52	39	35	33	40	40	40	36
RTU-3.2 RA	24x24	48	625	0.12	RH48/6G	DIL	9	14	25	34	34	26	20	17
						GN	45	30	24	28	37	42	41	37
RTU-3.2 SA	24x24	36	1000	0.11	RH36/6E	DIL	6	9	15	24	21	17	15	13
						GN	43	28	23	23	33	32	30	27

END OF SECTION

SECTION 23 34 00

EXHAUST FAN NOISE REQUIREMENTS

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. The fan manufacturer shall furnish factory supplied data showing the sound power levels for the inlet of each fan.

1.03 REFERENCES

A. All sound power level measurements and calculations shall be made in complete accordance with the latest version of AMCA Standard 300, Test Code for Sound Rating, and AMCA Standard 301, Method for Calculating Fan Sound Ratings from Laboratory Test Data. Equivalent test and calculation procedures may be substituted for the above procedures if approved in advance by the Architect.

1.04 SUBMITTALS

A. Submit octave band sound power level data at the design airflow and static pressure conditions for the inlet opening for each scheduled exhaust fan. All acoustic data shall be measured and provided in accordance with AMCA Standard 300 or a test standard approved by the project Acoustical Consultant.

PART 2 - PRODUCTS

2.01 EXHAUST FAN SOUND POWER LEVELS

A. The sound power levels of each fan coil unit INLET shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.

MAXIMUM INLET OCTAVE BAND SOUND POWER LEVELS (Lw), (dB re: 10^{-12} Watts)								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
EF-1	71	69	81	75	66	58	60	57

B. In the event the sound power level specifications is exceeded by the submitted product, it shall be the option of the contractor, if approved in advance by the Architect and

Mechanical Engineer, to provide additional sound traps or other sound attenuation devices (e.g. plenums, duct liner) to supplement the specified design in order to comply with the sound power level specification. The cost for the additional noise control shall be borne by the contractor. Calculations shall be provided by the contractor which substantiate that the sound power levels produced by the substituted equipment and any required sound attenuation devices do not exceed the specified sound power levels.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Centrifugal fans.
      a. Utility sets.
   2. Inline centrifugal fans.
   3. Ceiling mounted fans.
   4. Centrifugal roof ventilators.

B. Related Requirements:
   1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
   2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
   3. Section 23 07 13 - Duct Insulation.
   4. Section 23 33 00 - Air Duct Accessories.
   5. Section 26 27 26 – Wiring Devices.

1.02 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 2008).

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; American Bearing Manufacturers Association, Inc.; 2014

C. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2010.

D. AMCA 204 – Balance Quality and Vibration Levels for Fans.

E. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 2007 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).

F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc.; 2008.

G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 2007.

H. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.

I. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.04 ACTION SUBMITTALS

A. See Division 01 - Administrative Requirements and Section 23 05 00 “HVAC and Plumbing General Requirements”, for submittal procedures.

B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
   1. Fan operating efficiency.
   2. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   3. Material gages and finishes, including color charts.
   4. Dampers, including housings, linkages, and operators.
   5. Roof Curbs
   6. Fan Speed Controllers

C. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
   1. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
      a. Wiring Diagrams: Power, signal, and control wiring.

D. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
      a. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
      b. Design Calculations: Calculate requirements for selecting vibration isolators[and seismic restraints] and for designing vibration isolation bases.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural supports.
   2. Roof openings.

1.06 CLOSEOUT SUBMITTALS

A. Submit under provisions of General Conditions and Division 01 as applicable.

B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

C. Manufacturer’s Installation Instructions.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Fan Belts: One set for each individual fan.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

D. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

E. UL Standards: Fans shall comply with UL 705.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.10 FIELD CONDITIONS

A. Permanent fans may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

B. Lift and support units with manufacturer's designated lifting or supporting points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Motors:
   1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
   2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   3. Speed Control: Fans shall be provided with Variable-frequency Controllers (VFC) or Electronically Commutated Motors (ECM) unless noted otherwise.

C. Fabrication: Conform to AMCA 99. Fan construction class shall be sufficient to meet fan design air flow and pressure.

D. Selected fans shall be capable of accommodating static pressure and flow variations of plus or minus 15 percent of scheduled values.

E. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.02 CENTRIFUGAL FANS

A. Manufacturers:
   1. Greenheck.
   2. Loren Cook Company .
   3. Twin City.

B. Description:
   1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
   2. Wheel shall be Airfoil, Backward Inclined, or Forward Curved as scheduled.
   3. Fan shall be Single Width, Single Inlet (SWSI) or Double Width, Double Inlet (DWDI) as scheduled.

C. Construction:
   1. Utility Set Fans: Heavy gage steel, spot welded, adequately braced, designed to minimize turbulence with tapered spun inlet bell and shaped cut. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, lifting lugs, and accessories.
   2. Plenum Fans: Fabricate without fan scroll housing, with heavy-gauge reinforced steel inlet plate with removable spun inlet cone, structural steel frame, and shaft and bearings.

a. Plenum fans shall be configured so that both fan bearings are on the drive side of the wheel with the wheel over hung (Arrangement #1 for all belt drive and Arrangement #4 for all direct drive fans).

3. Fan wheel: Heavy backplate, hollow die-formed, blades continuously welded at tip flange and backplate, cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

D. Bearings and Drives:

1. Bearings: Heavy duty pillow block type, selfgreasing ball bearings with ABMA 9 L_{10} life at 80,000 hours.
2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
3. Direct Drive.
4. Belt Drives:
   a. Factory mounted, with adjustable alignment and belt tensioning.
   b. Service Factor Based on Fan Motor Size: 1.5.
   c. Motor Pulleys: Adjustable pitch for use with motors through 5 HP; fixed pitch for use with motors larger than 5 HP. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   d. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   e. Belt Guard: Fabricate to OSHA and SMACNA Duct Construction Standards; 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
   f. Motor Mount: Adjustable for belt tensioning.

E. Accessories:

1. Inlet and Outlet flange.
2. Backdraft Dampers: Gravity actuated with counterweight and interlocking blades with felt edges in steel frame installed on fan discharge.
3. Access Doors: Shaped to conform to scroll, with quick opening latches and gaskets.
4. Scroll Drain: minimum 3/4 inch steel pipe coupling welded to low point of fan scroll.
5. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
6. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing to completely cover motor and drive.
7. Disconnect Switch: Nonfusible type, with thermal-overload protection factory-mounted outside fan housing, factory wired through an internal aluminum conduit.

2.03 INLINE CENTRIFUGAL FANS

A. Manufacturers:

1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.
4. Twin City.

B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, belt- or direct-driven inline centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

C. Construction:
1. Housing: Heavy gauge galvanized steel, inlet and outlet flanges, removable access panels, lifting lugs, and support bracket adaptable to floor, side wall, or ceiling mounting.
2. Direct-Drive Units: Motor mounted in airstream factory wired to disconnect switch located on outside of fan housing.
3. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
4. Fan Wheels: Aluminum, blades welded to aluminum hub.

D. Accessories:
1. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in discharge; factory set to close when fan stops.
2. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
4. Disconnect Switch: Nonfusible type, with thermal-overload protection factory-mounted outside fan housing, factory wired through an internal aluminum conduit.

2.04 CEILING MOUNTED FANS WITH INTEGRAL GRILLE

A. Manufacturers:
1. Greenheck.
2. Panasonic.
3. Broan.

B. Description:
1. Fan shall be EnergyStar rated.
2. Fan shall be UL listed for installation in a tub/shower enclosure when used with GFCI branch circuit wiring.

C. Construction:
1. Housing: heavy-gauge galvanized steel, painted.
2. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
3. Grille Color and Style: As selected by Architect from manufacturer's standard range.
4. Electrical Requirements: Junction box for electrical connection on housing.
5. Electronically Commutated Motor (ECM).

6. Provide duct connection.

D. Controls:
1. [Multifunction switch—button wall switch for lighting control, color as selected by Architect from manufacturer's standard range.]
2. Programmable controller.

2.05 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers:
1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.

B. Housing: Removable, [spun-aluminum, dome top and outlet baffle] [extruded-aluminum, rectangular top] [galvanized steel, mushroom-domed top]; one-piece, aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains**.**

C. Fan Wheels: Aluminum hub and wheel.

D. Accessories:
1. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
2. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

E. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: [12 inches (300 mm)] or [18 inches (450 mm)] based on what have been specified in the drawings.
3. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
4. Sound Curb: Curb with sound-absorbing insulation.
5. Pitch Mounting: Manufacture curb for roof slope.
6. Metal Liner: Galvanized steel.
7. Burglar Bars: 3/4-inch thick steel bars welded in place to form 6-inch squares.
8. Mounting Pedestal: Galvanized steel with removable access panel.
9. Vented Curb: Unlined with louvered vents in vertical sides.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fans level and plumb.

C. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. snubbers to prevent tension in flexible connectors when fan is operating.

F. Install fans with resilient electrical leads; refer to Division 26.

G. Provide sheaves required for final air balance.

H. Provide safety screen where inlet or outlet is exposed.

I. Provide backdraft dampers on discharge of exhaust fans and inlet of Outside Air Fans and as indicated that shall automatically close during periods of non-use; refer to Section 23 33 00 “Air Duct Accessories”.

J. Install units with clearances for service and maintenance.

K. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Install flexible connections between fan inlet and discharge ductwork; refer to Section 23 33 00 “Air Duct Accessories”. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

B. Install piping from scroll drain connection, , to nearest floor drain with pipe sizes matching the drain connection.

C. Connect wiring according to Division 26.

D. Ground spark-resistant fans according to Division 26.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections[with the assistance of a factory-authorized service representative]:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. See Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

C. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 23 37 13.13

AIR DIFFUSERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Rectangular and square ceiling diffusers.
2. Linear bar diffusers.
3. Linear slot diffusers.
4. Ceiling-integral continuous slot diffusers.

B. Related Requirements:
1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Actual size of smallest diffuser indicated.

C. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.

D. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected. Actual size of smallest diffuser indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries
2. Titus

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel or Aluminum.

D. Finish: Baked enamel, color selected by Architect.

E. Face Size: See sizes specified on schedules in mechanical plans.

F. Face Style: Plaque.

G. Mounting: See schedules on mechanical plans.

H. Pattern: Fixed.

2.02 LINEAR BAR DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries
2. Titus

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel or Aluminum.

D. Finish: Baked enamel, color selected by Architect.

E. Narrow Core Spacing Arrangement: Refer to schedule.

F. One-Way Deflection Vanes: Extruded construction fixed louvers with removable core.

G. Frame: 3/4 inch wide.

H. Mounting: Coordinate with architect.

I. Damper Type: Remote Damper

2.03 LINEAR SLOT DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Price Industries
   2. Titus

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material - Shell: Steel or Aluminum, insulated.

D. Material - Pattern Controller and Tees: Aluminum.

E. Finish - Face and Shell: Baked enamel, black.

F. Finish - Pattern Controller: Baked enamel, black.

G. Finish - Tees: Baked enamel, color selected by Architect.

H. Slot Width: See schedules on mechanical plans.

I. Number of Slots: See schedules on mechanical plans.

J. Length: See mechanical plans.

K. Accessories: T-bar slot.

2.04 CEILING-INTEGRAL CONTINUOUS DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Price Industries
   2. Titus

B. Slot Width: See schedules on mechanical plans.

C. Section Length: See mechanical plans.

D. Straight and curved sections as required to accommodate layout.

E. Mitered tees and corners.

F. Pattern Controllers: 24 inches o.c.

G. Material: Aluminum, extruded, heavy wall.

H. Finishes:
   1. Exterior: Standard white.
   2. Interior: Standard black.

I. Throw: Standard.

J. Mounting: Ceiling.

K. Plenum: Insulated.

L. Other Features: 5
   1. Painted interior.
   2. Blank-offs as required.

2.05 AIR NOZZLE DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Price Industries
   2. Air Concepts

B. Exterior Construction: Air nozzle shall be 16 gauage cold rolled steel construction with series of concentric round diffusers.

C. Interior Construction: Inner nozzle assembly shall be manually adjustable to produce swivel range of +/- 30 degrees wtihin a fixed arc.

D. Mounting: T-bar layin or surface mount

E. Finishes: Custom to match paint sample or field finished to match architects requirements.

2.06 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.02 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 37 13.23

REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Adjustable blade face registers and grilles.
   2. Fixed face registers and grilles.
   3. Linear bar grilles.

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
   2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.

C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Smallest size register and grille indicated.

D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Smallest size register and grille indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 REGISTERS

A. Adjustable Blade Face Register
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Basis of design: Price Industries
1) Alternates by: Anemostat Products; a Mestek company, Kreuger, Titus
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting Frame: Filter.
9. Mounting: Countersunk screw.
10. Damper Type:Adjustable opposed blade
11. Accessories:
a. Rear-blade gang operator.
b. Filter.

B. Spiral Duct Adjustable Blade Face Register
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Basis of design: Price Industries
1) Alternates by: Anemostat Products; a Mestek company, Kreuger, Titus
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable Air Scoop.
10. Accessories:
a. Rear-blade gang operator.

2.02 GRILLES

A. Fixed Face Grille
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Basis of design: Price Industries
         1) Alternates by: Anemostat Products; a Mestek company, Kreuger, Titus
   2. Material: Aluminum.
   3. Finish: Baked enamel, color selected by Architect.
   4. Face Blade Arrangement: Horizontal; spaced 3/4 inch apart.
   5. Face Arrangement: Perforated core.
   6. Core Construction: Integral.
   7. Frame: 1 inch wide.
   8. Mounting Frame: Filter.
   9. Damper Type: Adjustable opposed blade
   10. Mounting: Countersunk screw.
   11. Accessores:
      a. Filter.
      b. Spiral duct frame

B. Linear Bar Grilles
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Basis of design: Price Industries
         1) Alternates by: Anemostat Products; a Mestek company, Kreuger, Titus
   2. Material: Aluminum.
   3. Finish: Baked enamel, color selected by Architect.
   4. Face Blade Arrangement: Horizontal; spaced 1/2 inch apart.
   5. Face Arrangement: Perforated core.
   6. Core Construction: Integral.
   7. Distribution plenum.
      a. Internal insulation.
      b. Inlet damper.
   8. Frame: 1 inch wide.
   9. Mounting Frame: Filter.
   10. Mounting: Countersunk screw.
   11. Damper Type: Adjustable opposed blade.

2.03 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.02 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 74 13

PACKAGED ROOFTOP AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions, And Division 1, General Requirements, apply to the Work of this section.

1.02 SUMMARY

A. Section includes packaged rooftop air handling units with associated components and accessories.

B. RELATED REQUIREMENTS
1. Division 22 – condensate drains.
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.
3. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
4. Section 23 33 00 – Air Duct Accessories: Flexible duct connections.
5. Section 23 34 00 – HVAC Fans.
6. Division 23 09 00 – Controls.
7. Division 26 –Wiring Devices: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AFBMA 9 – Load Ratings and Fatigues Life for Ball Bearings

B. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings

C. AMCA 99 – Standards Handbook

D. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes

E. AMCA 300 – Test Code for Sound Rating Air Moving Devices

F. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices

G. AMCA 500 – Test Methods for Louver, Dampers, and Shutters

H. AHRI 410 – Forced-Circulation Air-Cooling and Air-Heating Coils

I. AHRI 430 – Central Station Air Handling Units

J. AHRI 435 – Application of Central Station Air Handling Units

K. NEMA MG1 – Motors and Generators

L. NFPA 70 – National Electrical Code

M. SMACNA – HVAC Duct Construction Standards – Metal and Flexible

N. UL 900 – Test Performance of Air Filter Units

O. VFD and options shall be ULTM 508 listed.

P. NEMA 12 enclosed VFD shall be ULTM approved for mounting in conditioned air ducts and plenums.

Q. The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA, National Electric Code NEC, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, and CE96.

1.04 ACTION SUBMITTALS

A. Submit under provisions of General Conditions and Division 01 as applicable.

B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.

C. Product Data:
1. Provide literature, which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, electrical characteristics and connection requirements.
2. Provide data on filter media, filter performance data, filter assembly, and filter frames.
3. Provide fan curves with specified operating point clearly plotted.
4. Submit sound power level data for fan unit outlet, inlet and casing radiated at rated capacity and specified pressure.
5. Submit electrical requirements for power supply including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field installed wiring.
6. Submit performance and vibration test results of the fan for review prior to any air handling unit shipment to the jobsite.

D. Controls Information:
1. Contractor shall review the control diagrams, sequences of operation, and points lists and confirm manufacturer's hardware and programming will allow:

   a. Sequences of operation to be implemented without changes.
   b. System integration via hardwired, BACnet over IP for RTU-1 and DOAS, other platform communication.
   c. Read / Write points integration.
2. Contractor shall include a copy of the design control diagrams, sequences of operation, and points list as a part of their submittal and either sign off on agreeing to all aspects of the control intent or provide a letter to the same effect.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which units will be attached.
   2. Roof openings.
   3. Roof curbs and flashing.

B. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in “Performance Requirements” Article and in Section 23 05 48 “Vibration and Seismic Controls for HVAC.”
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Seismic Qualification Certificates: For units, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
   4. Restraint of internal components, including fans, coils, and refrigeration components.

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Submit under provisions of General Conditions and Division 01 as applicable.

B. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists and wiring diagrams.

C. Manufacturer’s Installation Instructions.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Extra Fan Belts: One set for each belt-driven fan.
   2. Filters: One set of filters for each unit.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience, which issues complete catalog data on total product.

1.09 COORDINATION

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

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

C. Controls Coordination: Manufacturer shall review the controls design, including control diagrams, points lists, and written sequences of operation and confirm in writing on unit manufacturer corporate letterhead that manufacturer has:
   1. Reviewed the equipment sequence of operation and confirms that the factory supply sequence of operation can perform all aspects of the noted sequence.
   2. Reviewed the equipment points list and confirm that all points called for are provided and meet the read only or programmable status noted in the points list.
   3. Reviewed the equipment control diagram and confirms that the unit is configured as per the diagram.
   4. Noted any deviations from the control sequences, diagrams or points lists.

1.10 FIELD CONDITIONS

A. Permanent fans may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

B. Fans used during construction shall have all filters replaced when the Owner takes Ownership of the building.

C. Lift and support units with manufacturer’s designated lifting or supporting points.

1.11 Warranty

A. See Division 01 – Closeout procedures, for additional warranty requirements.

B. Provide manufacturer’s warranty for period of 12 months from shipment. Warranty to include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory-authorized on –site service.
   1. Warranty Period for Compressors Parts: Manufacturer’s standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Control Boards Parts: Manufacturer’s standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Manufacturers:
   1. Basis of design by: Trane.

B. Alternate by: Carrier

C. AMCA Compliance:
   1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
   2. Damper leakage tested in accordance with AMCA 500-D.
   3. Operating Limits: Classify according to AMCA 99.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Unit shall be configured with economizer section, including associated relief/exhaust fan, outdoor, return and exhaust air dampers.

2.02 UNIT BASE
   1. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, watertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.
   2. All floor panels shall have a solid galvanized steel liner on the air stream side of the unit to protect the insulation during service and maintenance. Fans, coils and major components shall be supported with structural steel members.

2.03 UNIT HOUSING

A. General Fabrication Requirements for Housing: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Casing Construction: Provide 2” double wall construction with R-13 foam insulation on RTU-1 and DOAS. All panels shall be foam injected and be designed to withstand 5.0” static pressure. All units shall have structural members with minimum of 16 gauge with access doors and removable panels of minimum 20 gauge.

C. Exterior Casing Material: Galvanized steel with factory-painted with 1000 hour salt spray finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

D. Inside Casing: G-90-coated galvanized steel. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Drain pans shall be constructed from 304 stainless steel. The drain pan shall be insulated with insulation to prevent condensation under the drain pan. Insulation shall be protected with a water-proof liner. Drain pans must be sized such that the entire coil, including headers and return bends, are inside the drain pan. Drain pans must slope in two directions so there is no standing water in drain pan. Stainless steel condensate connection shall be provided on one side of the unit. Coils shall be supported on members to prevent immersion of the coil in condensate and allow for complete cleaning of drainpan beneath the coils.

F. After final assembly the unit exterior shall be coated with an industrial grade, high solids, and polyurethane paint. In addition, all fan bases, springs and structural steel supports shall be coated with the same finish. The paint system shall meet ASTM B117 Salt spray test for a minimum of 500 hours.

G. Provide factory rain hoods at all outdoor air inlets. Provide birdscreen.

2.04 FANS

A. Type: Forward curved centrifugal fan and Direct Drive Plenum Fan should be used for RTU-1 and DOAS. Refer to Section 23 34 00 “HVAC Fans”.

B. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

C. Bearings if applicable: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

D. The fan diameter and width shall be sized to optimize fan performance as indicated on the equipment schedule. Design point of operation should not exceed 90% of peak static pressure.

E. The fan shaft shall be sized not to exceed 75% of the first critical speed for maximum RPM of Class specified. The critical speed will refer to the top of the speed range of the fans’ AMCA class. The lateral static deflection shall not exceed 0.003 inch per foot of the length of the shaft. Fans shall be balanced to ISO standard G6.3.

2.05 MOTORS

A. Refer to Section 23 05 13 “Common Motor Requirements for HVAC Equipment”.

B. Motors shall be driven by Variable-frequency Drives (VFDs) or Electronically Commutated (ECM). Refer to Section 26 29 23 “Variable-Frequency Motors Controllers”.

2.06 COILS

A. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

B. Fabrication:

1. Type: Plate fin extended surface.
2. Tubes: 5/8 inch OD seamless copper with 0.020 inch minimum final wall thickness, expanded into the fin collars to provide a permanent mechanical bond.
3. Fins: minimum 0.008 inch thick aluminum or copper fins.
4. Return bends: 0.025 inch wall thickness individually replaceable on both sides of the coil.

C. Refrigerant Coils:
1. Headers: Seamless copper tubes with silver brazed joints.
2. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
3. Configuration: Down feed with bottom suction.
4. Expansion valve: Electronic expansion valve.

2.07 FILTERS

A. Minimum arrestance and a minimum efficiency reporting value according to ASHRAE 52.2.

B. Flat Panel Filter Housing: 2 inch , panel-type, MERV 13 air filters with holding frames.

2.08 DAMPERS

A. Dampers shall be supplied with low leak extruded galvanized airfoil blades. Blades shall be supplied with rubber edge seals and galvanized arc end seals. Rubber edge seals shall be backed by the damper blade to assure a positive seal in the closed position. Dampers shall be provided with nylon bearings within extruded openings.

B. Damper leakage shall not exceed 3 CFM/ft2 at 1.0” of static pressure. Leakage testing shall be in accordance with AMCA standard 500 figure 5.5. Test results must be from independent testing laboratory.

2.09 DX CONDENSING SECTIONS

A. The Direct Expansion (DX) Condensing Section shall be fully integrated with the air handling unit.

B. Refrigerant: R-410A.

C. Compressors:
1. Hermetic scroll type. One of the compressors shall be a digital scroll compressor providing load control on DOAS and RTU-1. Other RTU’s shall be manufactured with 2 compressors to provide 3 stages of Cooling. Reciprocating compressors are not acceptable due to their inherently excessive noise and vibration characteristics.
2. Each refrigeration circuit shall include all specialties for proper operation, including liquid line filter drier and sightglass, refrigerant distributor(s) with electronic expansion valve(s), and charging/service ports.

3. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensors shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors.
4. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability.

D. Condensing Units:
1. Air Cooled Condensing Units shall incorporate a V-style coil arrangement to minimize the footprint and height of the unit. The entire condenser section shall be supported. Provide steel wire cooling guard.
2. Condenser coils shall be constructed of seamless copper tubing mechanically expanded into aluminum fins, and incorporate an integral subcooling circuit.
3. For RTU-1 and DOAS units, condenser fans shall be controlled by VFD. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0-115F. Mechanical cooling shall be provided to 0F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of loss of phase.

2.10 OUTDOOR AIR SECTION ENERGY RECOVERY (ERV) on RTU-1 and DOAS:
1. The rotor media shall be made of aluminum, formed into a honeycomb structure to minimize pressure loss and avoid plugging. Paper, plastic or fibrous media are not acceptable. The rotor media must be coated to resist corrosion. All surfaces must be coated with a non-migrating desiccant layer to insure that adequate latent capacity is provided. The desiccant coating must be firmly bonded to the aluminum surface and will not be dislodged when challenged with high velocity air up to 5000 feet per minute. Products that loose desiccant when served with high velocity air are not acceptable. The cassette must be a slide out design for serviceability. The media shall be cleanable with low temperature steam, hot water or light detergent without degrading the latent recovery.
2. Sensible and latent recovery efficiencies must be clearly documented through a testing program conducted in accordance with ASHRAE Standard 84 and AHRI 1060. The testing must have been conducted by a qualified independent organization. The performance test reports must be provided for engineering review as part of the submittals for this project.
3. The rotor media shall be permanent, with an anticipated life of 20 years. It must be tested in accordance with ASTM Standard E-84 and provide smoke and flame spread ratings of less than 25 and 50 as required by NFPA 90A and UL 1995. A copy of the ASTM E-84 test report confirming the method of test and results shall be provided with the submittal. Heat recovery wheels incorporating “throw-away” media and tested to UL900 for Class 2 filters are not acceptable.
4. The wheel manufacturer must have been producing energy recovery wheels for a minimum of ten years.
5. The rotor shall be supplied with perimeter brush seals and face contact seals to minimize air leakage and wheel bypass.
6. The rotor media shall be supported by a structural aluminum hub and aluminum reinforcing spoke system. The rotor bearings must be greaseable and provide L10 life in excess of 20 years.
7. The cassette framework shall be made of galvanized steel to prevent corrosion.

8. The rotor must be driven by long-life polyurethane/polyester composite link belt system. The rotor/cassette shall be designed so that belt can be removed or serviced without the removal of the bearing. A 3 phase A/C gear motor shall be utilized to accommodate variable speed application.
9. Variable speed control is required for frost prevention. It must be accomplished by the use of a factory installed and wired A/C inverter. The variable speed drive system shall allow for a minimum 60:1 turndown ratio.

2.11 ELECTRICAL REQUIREMENTS

A. Provide unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

B. Provide duplex, 115 volt convenience outlet with 15 amp overcurrent protection.

C. Provide separate electrical feed for Modulating Powered Exhaust on RTU-2.

2.12 CONTROLS

A. DDC Controller:
1. Controller shall have volatile-memory backup.
2. Safety Control Operation:

   a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
   b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
   c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28.
   d. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
3. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum of **four** programmable periods per day.
4. Unoccupied Period with separate heating and cooling setbacks and override function.
5. Supply Fan Operation:

   a. Occupied Periods: Run fan continuously.
   b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:

   a. Occupied Periods: Cycle or stage compressors**,** to match compressor output to cooling load to maintain discharge temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
   b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
7. Fixed Minimum Outdoor-Air Damper Operation:

a. Occupied Periods: Open to minimum damper position as determined by TAB.
b. Unoccupied Periods: Close the outdoor-air damper.

8. Economizer Outdoor-Air Damper Operation:

a. Controller shall permit air-side economizer operation. During economizer cycle operation, lock out cooling.
b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 10 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature.

9. Carbon Dioxide Sensor Operation:

a. Occupied Periods: Engage Demand Control Ventilation sequence to maintain Carbon Dioxide setpoint.
b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

B. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet over IP compatible interface on RTU-1 and DOAS for central HVAC control workstation for the following:

a. Adjusting set points.
b. Monitoring supply fan start, stop, and operation.
c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
d. Monitoring occupied and unoccupied operations.
e. Monitoring constant and variable motor loads.
f. Monitoring variable speed controller operation.
g. Monitoring cooling load.
h. Monitoring economizer cycles.
i. Monitoring air-distribution static pressure and ventilation air volume.

2.13 ACCESSORIES

A. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

B. Factory- or field-installed demand-controlled ventilation.

C. Safeties:
1. Smoke detector.
2. Condensate overflow switch.

D. Outdoor air intake weather hood **with moisture eliminator**.

E. Service Lights and Switch: Factory installed in fan with weatherproof cover on RTU-1 and DOAS.

F. Modulating Hot Gas Reheat shall be included on DOAS and RTU-1. Minimum of 6" between the evaporator coil and the HGRH coil is required to prevent re-hydration.

G. Roof Curb:
   1. Prefabricated mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling and condensing sections.
   2. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   3. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match unit, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish. All fans must be periodically rotated during storage period per manufacturer recommendation. Unit is to be alcohol wiped before shipment.

3.02 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of units.

B. Examine roughing-in for units to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where units will be installed.

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

3.03 INSTALLATION

A. Equipment Mounting:
   1. Roof Curb: Install on roof structure or concrete base, level and secure. Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07. Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
   2. Install units level on structural **curbs steel supports**. Coordinate penetrations and flashing with construction. Secure units to structural support with anchor bolts.
   3. Install units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.
   4. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

B. Install units with clearances for service and maintenance.

C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.04 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain. Refer to Plumbing Drawings.

B. Install piping adjacent to units to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to units with flexible duct connectors specified in Section 23 33 00 “Air Duct Accessories.”
   4. Install return-air duct continuously through roof structure.

D. Power connections by Division 26.
   1. Connect convenience outlet to separate circuit as per NEC.

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. After installing units and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.06 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated, and fan has been test run under observation.

3.07 INSTALLATION AND START UP

A. Complete installation and startup checks according to manufacturer’s written instructions.

END OF SECTION

SECTION 23 74 15

AIR HANDLING UNIT NOISE REQUIREMENTS

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. The air-handling equipment manufacturer shall furnish factory supplied data showing the sound power levels for the AHU casing, supply air discharge and return air inlet openings for each air-handling unit.

1.03 REFERENCES

A. ARI Standard 260, Sound Rating of Ducted Air Moving and Conditioning Equipment or a test standard approved by the acoustical consultant. Equivalent test and calculation procedures may be substituted for the above procedures if approved in advance by the Architect. The sound power level of each air-hanlding units supply air discharge, return air inlet, and exhaust air noise shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.

1.04 SUBMITTALS

A. Submit octave band sound power level data at the design airflow and static pressure conditions for the casing, supply air discharge openings and return air openings for each scheduled air-handling unit. All acoustic data shall be measured and provided in accordance with ARI 260 – Standard Sound Rating of Ducted Air Moving and Conditioning Equipment or a test standard approved by the project Acoustical Consultant. Alternate test procedures must be substituted for review and approval by the Acoustical Consultant in advance of product submission.

PART 2 - PRODUCTS

2.01 AHU SOUND POWER LEVELS

A. The sound power levels of each air-handling unit's casing, supply air discharge and return air inlet openings shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.

OCTAVE BAND SOUND POWER LEVELS (Lw), (dB re: 10^{-12} Watts)								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
DOAS								
Supply Air	83	78	88	84	84	79	76	72

OCTAVE BAND SOUND POWER LEVELS (Lw), (dB re: 10^{-12} Watts)								
Return Air	87	80	89	86	86	82	78	75
Outdoor	82.2	92.1	90.6	89.2	87	85.8	81	75.1
RTU-1								
Supply Air	80	80	89	85	83	80	75	69
Return Air	78	78	87	83	81	78	73	67
Outdoor	81.2	96.1	97.6	95.2	91	86.8	80	74.1
RTU-2, -3.1, -3.2								
Supply Air	90	77	66	68	67	62	57	51
Return Air	88	77	70	66	64	64	65	61
Outdoor	90.5	96.5	91.5	91	88.5	82	76.5	70.5

B. Should the submitted air-handling unit sound power levels exceed the specified levels in the table above, it shall be the option of the contractor to provide supplemental noise control (in the form of silencers, plenums, duct liner, etc.) in order to bring each unit into compliance. Supplemental noise control for each air-handling unit must be reviewed and approved by the architect and mechanical engineer in advance of installation. The cost associated with all supplemental noise control shall be borne by the contractor until the noise levels of each unit comply with the specified values above.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 23 80 15

FAN COIL UNIT NOISE REQUIREMENTS

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. The fan coil unit manufacturer shall furnish factory supplied data showing the sound power levels for each fan coil unit at 1) ducted supply air discharge 2) return air opening and 3) casing radiated.

1.03 REFERENCES

A. AHRI Standard 260, Sound Rating of Ducted Air Moving and Conditioning Equipment or a test standard approved by the acoustical consultant. Equivalent test and calculation procedures may be substituted for the above procedures if approved in advance by the Architect.

1.04 SUBMITTALS

A. Submit octave band sound power level data at the design airflow and static pressure conditions for each scheduled fan coil unit. All acoustic data shall be measured and provided in accordance with AHRI 260 or a test standard approved by the project Acoustical Consultant. Alternate test procedures must be substituted for review and approval by the Acoustical Consultant in advance of product submission.

PART 2 - PRODUCTS

2.01 FCU SOUND POWER LEVELS

A. The sound power levels of each fan coil unit shall not exceed the values list in the schedule below when operating at the maximum design airflow and static pressure conditions.

MAXIMUM OCTAVE BAND SOUND POWER LEVELS (Lw), (dB re: 10^{-12} Watts)								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
FCU 108, 109, 111, 115D, 208, 209, 210, 211, 214N								
Ducted Discharge	81	75	70	65	65	61	56	52
Ducted Inlet	82	73	71	65	63	57	52	46
FCU 155B, 115C, 241B, 214L, 214M								

Ducted Discharge	73.7	68.5	65	60.9	58	54.5	49.5	47.6
Free Inlet and Casing Radiated	64.4	60.5	63.6	58.9	55.9	51.2	46.3	42.7

B.

MAXIMUM OCTAVE BAND SOUND PRESSURE LEVEL at 5 feet distance								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
FCU 108, 109, 110, 115D, 208, 209, 210, 211, 214N								
Casing Radiated	47	51	47	43	39	34	28	23
FCU 155B, 115C, 241B, 214L, 214M								
Casing Radiated	41	46	38	34	31	26	19	20
FCU 214H, 214J, 214K								
Casing Radiated	41	35	33	29	23	16	13	10
FCU 214H, 214J, 214K								
Casing Radiated	41	37	37	33	28	22	16	11
FCU 214H, 214J, 214K								
Casing Radiated	41	45	45	42	36	33	29	19

C. In the event the sound power level specifications is exceeded by the submitted product, it shall be the option of the contractor, if approved in advance by the Architect and Mechanical Engineer, to provide additional sound traps or other sound attenuation devices (e.g. plenums, duct liner) to supplement the specified design in order to comply with the sound power level specification. The cost for the additional noise control shall be borne by the contractor. Calculations shall be provided by the contractor which substantiate that the sound power levels produced by the substituted equipment and any required sound attenuation devices do not exceed the specified sound power levels.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 23 81 26

COOLING MINI-SPLIT SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:
   1. Outdoor air-cooled condensing units.
   2. Indoor evaporator units.
   3. Refrigerant piping and piping insulation.
   4. Controls.

B. Related Requirements:
   1. Division 01 – Demonstration and Training, General Commissioning Requirements, Commissioning Authority Responsibilities.
   2. Division 22 – Condensate drain piping.
   3. Division 26 – Equipment Wiring: Power connections to equipment.

1.03 REFERENCE STANDARDS

A. AHRI 210/240 – Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. AHRI 270 – Sound Rating of Outdoor Unitary Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

C. AHRI 520 – Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute; 2004.

D. ASHRAE Standard 15 – Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2013 (ANSI/ASHRAE Standard 15).

E. ASHRAE Standard 23.1 – Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.

F. NEMA MG 1 – Motors and Generators; National Electrical Manufacturers Association; 2011.

G. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

H. NFPA 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.

I. UL 207 – Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 ACTION SUBMITTALS

A. See Division 01 and Section 23 00 00 “HVAC General Requirements” for submittal procedures.

B. Design Data:
1. Provide design calculations showing that system will achieve performance specified.
2. Provide design data required by ASHRAE 90.1.

C. Product Data: Submit manufacturer’s data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
1. Outdoor/Central Units:
a. Refrigerant Type and Size of Charge.
b. Cooling Capacity: BTU/h (kW).
c. Cooling Input Power: BTU/h (kW).
d. Operating Temperature Range.
e. Fan speed control: Variable speed or number of discrete speeds (e.g. low, medium, high).
f. Air Flow: Cubic feet per minute.
g. Fan Curves.
h. External Static Pressure (ESP): inches wg (Pa).
i. Sound Pressure Level: dB(A).
j. Electrical Data:
1) Power Supply: Volts and Phase.
2) Full Load Amps (FLA).
3) Fan Motor: HP (W).
4) Maximum Circuit Amps (MCA).
5) Maximum Fuse Amps (MFA).
6) Maximum Starting Current (MSC).
7) Total Over Current Amps (TOCA).
k. Weight, Dimensions, and Center of Gravity.
l. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
m. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
n. Control Options.
2. Indoor/Evaporator Units:
a. Cooling Capacity: BTU/h (kW).
b. Cooling Input Power: BTU/h (kW).

c. Fan speed control: Variable speed or number of discrete speeds (e.g. low, medium, high).
d. Air Flow: Cubic feet per minute.
e. Fan Curves.
f. External Static Pressure (ESP): inches wg (Pa).
g. Sound Pressure level: dB(A).
h. Electrical Data:
1) Power Supply: Volts and Phase.
2) Full Load Amps (FLA).
3) Fan Motor: HP (W).
4) Maximum Circuit Amps (MCA).
5) Maximum Fuse Amps (MFA).
6) Maximum Starting Current (MSC).
7) Total Over Current Amps (TOCA).
i. Maximum Lift of Built-in Condensate Pump.
j. Weight, Dimensions, and Center of Gravity.
k. Control Options.

3. Shop Drawings: Schematic flow diagram showing fans, coils, dampers, outdoor units, indoor units, and control devices.
4. Wiring Diagrams: Power, signal, and control wiring.
5. Bill of Materials: A table, including quantities, of all equipment, controllers, and devices to be provided.
6. Controls:
a. Physical location of all user interfaces indicated on plans.
b. Physical location of all thermostats indicated on plans.
c. List of all available hardwired points, if any. Indicate where and at which device connection is made physically.
d. List of all available BACnet network points. Indicate where and at which device connection is made physically.
e. List of anticipated control zones, indicating setpoints and schedule to be programmed for each zone.
7. Refrigerant Piping:
a. For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer’s test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
b. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
c. Test Reports: Indicate results of leak test, acid test.

D. Controls Information:
1. Contractor shall review the control diagrams, sequences of operation, and points lists and confirm manufacturer's hardware and programming will allow:
a. Sequences of operation to be implemented without changes.
b. System integration via hardwired, BACnet, other platform communication.
c. Read / Write points integration.
2. Contractor shall include a copy of the design control diagrams, sequences of operation, and points list as a part of their submittal and either sign off on agreeing to all aspects of the control intent or provide a letter to the same effect.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Required working clearances and required area above and around units.
   2. Show layout and relationships between electrical components and adjacent structural and mechanical elements.
   3. Show support locations, type of support, and weight on each support.
   4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each unit, accessories, and components, from manufacturer.
   1. Certificate of compliance.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each system from manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Filter-Drier Cartridges: One of each type and size.

B. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

C. Extra Refrigerant: One container of refrigerant.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Factory authorized installed trained and certified by manufacturer.

1.09 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

B. Store equipment indoors.

C. All duct and pipe segments shall remain capped and clean until ready for installation.

1.10 WARRANTY

A. Provide manufacturer's warranty for five (5) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced by the manufacturer at no cost to Owner.

B. Motors: 1 year.

C. All other components: 1 year.

D. All warranty service work shall be performed by a factory trained service professional.

E. See Division 01 Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Mitsubishi

B. Daikin

C. Carrier Corporation

D. Substitutions: See Division 01 – Product Requirements

2.02 SYSTEM DESIGN

A. Split-System Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL Listed.
   1. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
   2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements
   1. Efficiency: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Standard 90.1 and scheduled data; seasonal efficiency to ASHRAE Standard 103 and scheduled data.
   2. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

C. Electrical Characteristics:

1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Division 26.

2.03 INDOOR UNITS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
   1. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
   2. Drain pans: galvanized steel, double sloped, with connection for drain, insulated.

B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
   1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.

C. Air Filters: 1 inch thick, in fiberboard frames.

D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

2.04 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Refrigerant: R-410A.
   2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner. Weep holes for water drainage and mounting holes in base.
   3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Standard 23.1 and UL 207.
   4. Sound Rating: maximum 58 dBA, when measured in accordance with AHRI 270.

B. Compressor: AHRI 520; hermetic, variable-speed, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.

C. Compressor shall be mounted on vibration isolation. Compressor motor shall have thermaland current-sensitive overload devices, start capacitor, relay, and contactor.

D. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
   1. Condenser Fans: Direct-drive propeller type.
   2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.

E. Coil: Air-cooled, aluminum fins bonded to copper tubes.

F. Fan: Aluminum-propeller type, directly connected to motor.

G. Motor: Permanently lubricated, with integral thermal-overload protection.

H. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.
   2. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

I. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.
   2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig (1965 kPa) and off when pressure drops below 140 psig (965 kPa) for operation to 0 deg F (-18 deg C).
   3. [Dehumidification operation mode.]

J. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches (10 cm) square; minimum of two located under cabinet feet.

2.05 ACCESSORY EQUIPMENT

A. Room Thermostat: Wall-mounted, electric solid-state microcomputer-based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
   1. System selector switch (off-cool) and fan control switch (auto-on).
   2. Preferential rate control to minimize overshoot and deviation from setpoint.
   3. Set-up for four separate temperatures per day.
   4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
   5. Short cycle protection.
   6. Programming based on weekdays, Saturday and Sunday.
   7. Selection features including deg F (deg C) display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
   8. Battery replacement without program loss.
   9. [Humidity sensor.]
   10. Thermostat display:
      a. Time of day.
      b. Actual room temperature.
      c. Programmed temperature.
      d. Programmed time.
      e. Duration of timed override.
      f. Day of week.
      g. System mode indication: heating, cooling, fan auto, off, and on, auto or on, off.

2.06 VRF Manufacturer shall provide a LonWorks LMAP04U Communication Interface that can be tied back into the BMS System

2.07 REFRIGERANT PIPING

A. Provide two-pipe refrigerant system.

B. Provide pipe of material and type corresponding to manufacturer requirements, and length as required by system design.

C. Provide hangers and supports that comply with MSS SP-58.

D. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance.

E. Refrigerant piping layout shall be designed so as to not require oil traps.

F. Flexible Connectors:
   1. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
   2. Maximum Operating Temperature: 250 deg F (121 deg C).
   3. Offset Performance for vibration: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7 inch (180 mm) long assembly.
   4. Offset Performance for seismic: as required.

G. Insulate each refrigerant line individually between the condensing and indoor units.

H. Service valve shall be provided at each refrigerant piping connection to equipment (indoor units, outdoor units (each frame), and heat recovery units) to allow for servicing for VRF system without evacuating the entire piping system.

I. Insulation:
   1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials.
   2. Refrigerant Suction and Liquid Piping:
      a. NPS 3/4 and smaller: Flexible Elastomeric: 1 inch thick.
      b. NPS 1 and larger: Flexible Elastomeric: 1 1/2 inch thick.
   3. Refrigerant Hot-Gas Piping (3 pipe systems):
   4. All Pipe Sizes: Flexible Elastomeric: 2 1/2 inch thick. (two layers required).
   5. Alternate insulation materials and thicknesses are acceptable if recommended by the VRF manufacturer and code compliant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

3.02 INSTALLATION

A. Install in accordance with manufacturer’s instructions and requirements of local authorities having jurisdiction.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch-thick , reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03. Coordinate anchor installation with concrete base.

D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

E. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 7. Anchor units to supports with removable, cadmium-plated fasteners.

F. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch . Refer to Division 23 Section "Mechanical Vibration and Seismic Controls."

G. Install in accordance with NFPA 90A and NFPA 90B.

H. Install refrigeration systems in accordance with ASHRAE Standard 15.

I. Pipe drain from humidifiers to nearest floor drain.

J. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

K. Install piping adjacent to unit to allow service and maintenance.

L. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.

3.03 FIELD QUALITY CONTROL

A. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Replace Filter Drier 30 days after acceptance.

END OF SECTION

SECTION 23 81 29

VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Variable refrigerant flow (VRF) system, consisting of:
   1. Outdoor/Condensing unit(s).
   2. Heat Recovery Units/Branch Selector Boxes.
   3. Indoor/Evaporator units.
   4. Refrigerant piping and piping insulation.
   5. Controls.

B. Related Sections:
   1. Division 01: Demonstration and Training, General Commissioning Requirements, Commissioning Authority Responsibilities.
   2. Division 22: Condensate drain piping.
   3. Section 23 08 00 - Commissioning of HVAC.
   4. Division 25: Building Automation System and Sequences of Operation.
   5. Division 26: Power connections to equipment.

1.03 DEFINITIONS

A. COP: Coefficient of performance.

B. EER: Energy efficiency ratio.

C. EEV: Electronic expansion valve.

1.04 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2016.

C. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2009.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010 (ANSI/ASHRAE Std 15).

E. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc; 2010, Including All Addenda (ANSI/ASHRAE/

F. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; American Society of Mechanical Engineers; 2010.

G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 ACTION SUBMITTALS

A. See Division 01 and Section 23 00 00 “HVAC General Requirements” for submittal procedures.

B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.

C. Design Data:
   1. Provide design calculations showing that system will achieve performance specified.
   2. Provide design data required by ASHRAE 90.1.

D. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
   1. Outdoor/Central Units:
      a. Refrigerant Type and Size of Charge.
      b. Cooling Capacity: BTU/h (kW).
      c. Heating Capacity: BTU/h (kW).
      d. Cooling Input Power: BTU/h (kW).
      e. Heating Input Power: BTU/h (kW).
      f. Operating Temperature Range, Cooling and Heating.
      g. Fan speed control: Variable speed or number of discrete speeds (e.g. low, medium, high).
      h. Air Flow: Cubic feet per minute.
      i. Fan Curves.
      j. External Static Pressure (ESP): inches wg (Pa).
      k. Sound Pressure Level: dB(A).
      l. Electrical Data:
         1) Power Supply: Volts and Phase.
         2) Full Load Amps (FLA).

3) Fan Motor: HP.
4) Maximum Circuit Amps (MCA).
5) Maximum Fuse Amps (MFA).
6) Maximum Starting Current (MSC).
7) Total Over Current Amps (TOCA).

m. Weight and Dimensions.
n. Maximum number of indoor units that can be served.
o. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
p. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
q. Control Options.

2. Branch Selector/Heat Recovery Units:
   a. Maximum Connectable Cooling Capacity: BTU/h (kW).
   b. Sound Pressure: dB(A).
   c. Number of Connectable Indoor Units:
   d. Weight and Dimensions
   e. Electrical Data:
      1) Power Supply: Volts and Phase.
      2) Full Load Amps (FLA).
      3) Maximum Circuit Amps (MCA).
      4) Maximum Fuse Amps (MFA).
   f. Weight and Dimensions.
3. Indoor/Evaporator Units:
   a. Cooling Capacity: BTU/h (kW).
   b. Heating Capacity: BTU/h (kW).
   c. Cooling Input Power: BTU/h (kW).
   d. Heating Input Power: BTU/h (kW).
   e. Fan speed control: Variable speed or number of discrete speeds (e.g. low, medium, high).
   f. Air Flow: Cubic feet per minute.
   g. Fan Curves.
   h. External Static Pressure (ESP): inches wg (Pa).
   i. Sound Pressure level: dB(A).
   j. Electrical Data:
      1) Power Supply: Volts and Phase.
      2) Full Load Amps (FLA).
      3) Fan Motor: HP (W).
      4) Maximum Circuit Amps (MCA).
      5) Maximum Fuse Amps (MFA).
      6) Maximum Starting Current (MSC).
      7) Total Over Current Amps (TOCA).
   k. Maximum Lift of Built-in Condensate Pump.
   l. Weight and Dimensions.
   m. Control Options.
4. Shop Drawings: Schematic flow diagram showing fans, coils, dampers, outdoor units, indoor units, branch selector units and control devices.
5. Wiring Diagrams: Power, signal, and control wiring.
6. Bill of Materials: A table, including quantities, of all equipment, controllers, and devices to be provided.

7. Controls:
   a. System architecture one-line diagram indicating schematic location of all controlled devices, controllers, gateways and interfaces.
   b. Physical location of all user interfaces indicated on plans.
   c. Physical location of all thermostats indicated on plans.
   d. List of all available hardwired points, if any. Indicate where and at which device connection is made physically.
   e. List of all available BACnet network points. Indicate where and at which device connection is made physically.
   f. List of anticipated control zones, indicating setpoints and schedule to be programmed for each zone.
8. Refrigerant Piping:
   a. For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
   b. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
   c. Test Reports: Indicate results of leak test, acid test.
   d. Insulation.

E. Controls Information:
   1. Contractor shall review the control diagrams, sequences of operation, and points lists and confirm manufacturer's hardware and programming will allow:
      a. Sequences of operation to be implemented without changes.
      b. System integration via hardwired, BACnet, other platform communication.
      c. Read / Write points integration.
   2. Contractor shall include a copy of the design control diagrams, sequences of operation, and points list as a part of their submittal and either sign off on agreeing to all aspects of the control intent or provide a letter to the same effect.
   3. VRF Manufacturer shall provide a LonWorks LMAP04U Communication Interface that can be tied back into the BMS System

1.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Required working clearances and required area above and around units.
   2. Show layout and relationships between electrical components and adjacent structural and mechanical elements.
   3. Show support locations, type of support, and weight on each support.
   4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each unit, accessories, and components, from manufacturer.
   1. Certificate of compliance.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each system from manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Filter-Dryer Cartridges: One of each type and size.

B. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

C. Extra Refrigerant: Provide extra refrigerant equal to the system charge or one system charge in a multiple circuit system.

1.09 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer has been producing VRF heat pump systems for at least five (5) years.
   2. Manufacturer provides system design software to installers.

B. Installer Qualifications: Factory-authorized installed trained and certified by manufacturer.

1.11 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

B. Store equipment indoors.

C. All duct and pipe segments shall remain capped and clean until ready for installation.

1.12 WARRANTY

A. Warranty requirements below are written to allow a wide range of manufacturers. Some manufacturers provide a longer warranty (e.g. Mitsubishi) and/or offer extended compressor warranty if the right paperwork is submitted. Edit to match your manufacturer’s requirements if possible.

B. The entire VRF system shall be warranted by a single manufacturer or entity.

C. Compressors
   1. Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced by the manufacturer at no cost to Owner.
   2. Installing contractor shall furnish and submit additional tests and/or registration as required by the manufacturer to obtain the maximum available compressor warranty beyond the basic warranty period. Requirements vary by manufacturer. Contractor shall review and comply with manufacturer requirements for installed system.

D. All other components: 1 year.

E. All warranty service work shall be performed by a factory trained service professional.

F. See Division 01 for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design
   1. The system design shown in Contract Drawings is based on equipment and system designed by Mitsubishi.
   2. The entire VRF system, excluding commodities such as wire and pipe, shall be provided by a single manufacturer and shall be warranted as a system.

B. Systems designed and manufactured by other manufacturers will be considered by Engineer of Record under the terms described for substitutions with the following conditions:
   1. Substitutions: See Division 01.
   2. Substitution requests will be considered only if received at least 10 days prior to the bid date. Substitutions first proposed at submittal time will not be accepted.
   3. Substitution requests will be considered only if required submittal data is complete; see article SUBMITTALS above.
   4. Contractor (not equipment supplier) shall certify that the use of the substitute system and equipment will not require changes to other work or re-design by Architect.
   5. Contractor shall be wholly responsible for coordinating, documenting and implementing any VRF system design changes necessitated by the substitution.
      a. Substitution shall not result in additional costs to the Owner.
      b. Substitution shall not result in additional design time for the Engineer of Record.
      c. Contractor shall provide shop drawings and as-built drawings in Revit or AutoCAD format.
   6. Contractor or HVAC subcontractor shall certify that the substitute system will achieve the performance specified.

7. Do not assume substitution has been accepted until formal written notice has been issued by Architect.
8. Proposed substitution heat pump system shall have published performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI Standard 1230 certified product directory.

2.02 HVAC SYSTEM DESIGN

A. General
1. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
2. See Contract Drawing mechanical schedules for performance requirements and design conditions.
3. Zone Control
   a. Provide a thermostat for every zone.
   b. Provide capability for space temperature control for each individual indoor/evaporator unit independently of all other units.
   c. Provide ability for each individual indoor/evaporator unit to select heating or cooling independently of all other units.
4. The following information is provided on Contract Drawing mechanical plans:
   a. Map of zones/conditioned spaces.
   b. Outdoor condenser unit locations.
   c. Indoor evaporator unit locations.
   d. Branch selector unit locations.
   e. Refrigerant piping location and sizes.
   f. Condensate piping (by others).
   g. VRF system shall be capable of continuous operation when one or more indoor units are being serviced or power to indoor unit is disconnected. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable or allowed.

B. Connection Ratio:
1. The ratio of nominal indoor unit capacity to nominal outdoor unit capacity shall not exceed that implied by equipment selections listed in Contract Drawings mechanical schedule.
2. Contractor is responsible for calculating the connection ratio based on scheduled
3. equipment.
4. In any case, connection ratio shall not exceed 150% without explicit permission from VRF system manufacturer.

C. Operating Temperature Ranges:
1. Simultaneous Heating and Cooling Operating Range: minus 14 °F to 60 °F dry bulb.
2. Cooling Mode Operating Range: 23 °F to 109 °F dry bulb.
3. Heating Mode Operating Range: 0 °F to 77 °F dry bulb; -4 °F to 60 °F wet bulb
4. Heating mode shall not require low ambient kit or auxiliary heat source.

D. Wiring: Per manufacturer recommendations.

E. VRF System Controls
   1. System operation shall be controlled by a factory-installed microprocessor-based system controller which is integral to the VRF system.
   2. Install with hardwired control or network connections between outdoor unit(s) and indoor unit(s) so that entire VRF system is controlled as integrated whole. All features and functions of the entire VRF system, including indoor units, shall be available from the systems control panel.
   3. System shall provide time-based occupancy schedules and control overrides of indoor and outdoor units.
   4. System controller shall automatically perform ongoing self-diagnostics and shall notify users of faults and alarms via controls panel (below).
   5. Provide the following control interfaces:
      a. For each indoor/evaporator Unit: One wall-mounted wired local controller/thermostat, with temperature sensor; locate where indicated on Contract Drawings.
      b. System controls panel, capable of controlling all indoor units and supporting all features listed in previous paragraph. Locate where indicated on Contract Drawings.
   6. Native BACnet gateway, capable of communicating with a BACnet-based BAS system using native BACnet objects and protocol. Connection and mapping of gateway to BAS shall be by DDC Contractor. See Section 23 09 00.

F. Local Controllers/Thermostats
   1. Thermostat/controller shall be wall-mounted, wired, containing temperature sensor in a ventilated cover.
   2. Provide with insulated base.
   3. There shall be three types of thermostats.
      a. Type 1 – No Display, No Controls:
         1) Blank cover
         2) No occupant controls
      b. Type 2 – With Display, No Controls:
         1) Cover shall include integral LCD display showing current temperature and active setpoint.
         2) No occupant controls.
      c. Type 3 – With Display, With Controls:
         1) Display per Type 2 thermostat.
         2) Include means for occupant to adjust setpoint (buttons, dials, or sliders).
         3) Include override pushbutton (“janitor’s button”) capable of being programmed to start system outside of scheduled occupancy.
   4. Unless otherwise called out on Contract Drawing mechanical floorplans or zone schedule, install thermostat Types based on location:
      a. Open offices: Type 2
      b. Private offices: Type 3
      c. Corridors/hallways: Type 1
      d. Conference/meeting rooms: Type 3
      e. Classrooms, labs, multi-purpose rooms: Type 3
      f. Lobbies, public spaces: Type 2
      g. Equipment rooms and other back-of-house spaces: Type 2
      h. Others not listed: Request clarification from Engineer of Record

G. Control of External Equipment by VRF System Controller
   1. VRF system controls shall control external equipment
      a. Control connection shall be via BACnet network connection.

H. Sequences of Operations
   1. VRF system control shall be by control logic residing in the VRF system controller.
   2. There shall be no connection to a separate DDC BAS.
   3. DDC BAS shall be connected to DDC BAS as shown on Contract Drawing control schematics.
   4. VRF control system shall monitor and log all alarms and faults, and display them at the control interface.
   5. VRF control system shall operate VRF outdoor and indoor units as required to maintain temperature of each space between its currently active (i.e. occupied, or unoccupied) cooling setpoint and heating setpoint.

2.03 EQUIPMENT

A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
   1. Refrigerant: R-410A.
   2. Performance Certification: AHRI Certified; www.ahrinet.org. EER and COP values shall be based on tests conducted at “full load” in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.
   3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL and bearing the certification label.
   4. Provide units capable of serving the zones indicated.
   5. Thermal Performance: Provide heating and cooling capacity as indicated.
   6. Energy Efficiency: Provide units with EER and/or COP equal or better to that listed in the Contract Drawing mechanical schedule.
   7. Outdoor Units: Units and their supports designed and installed to resist wind pressures defined in ASCE 7 for the Project location.

B. Electrical Characteristics per Contract Drawing mechanical equipment schedule.
   1. Provide factory-mounted disconnect switch.

2.04 REFRIGERANT PIPING

A. Provide two-pipe refrigerant system.

B. Provide pipe of material and type corresponding to manufacturer requirements, and length as required by system design.

C. Provide hangers and supports that comply with MSS SP-58.

D. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance.

E. Refrigerant piping layout shall be designed so as to not require oil traps.

F. Flexible Connectors:
   1. Working Pressure Rating: Factory test at minimum 600 psig.
   2. Maximum Operating Temperature: 250 deg F.
   3. Offset Performance for vibration: Capable of minimum 3/4 inch misalignment in minimum 7 inch long assembly.
   4. Offset Performance for seismic: as required.

G. Insulate each refrigerant line individually between the condensing and indoor units.

H. Service valve shall be provided at each refrigerant piping connection to equipment (indoor units, outdoor units (each frame), and heat recovery units) to allow for servicing for VRF system without evacuating the entire piping system.

I. Insulation:
   1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials.
   2. Refrigerant Suction and Liquid Piping:
      a. NPS 3/4 and smaller: Flexible Elastomeric: 1 inch thick.
      b. NPS 1 and larger: Flexible Elastomeric: 1 1/2 inch thick.
   3. Refrigerant Hot-Gas Piping (3 pipe systems):
      a. All Pipe Sizes: Flexible Elastomeric: 2 1/2 inch thick. (two layers required).
   4. Alternate insulation materials and thicknesses are acceptable if recommended by the VRF manufacturer and code compliant.

2.05 SOFTWARE

A. Any software or smartphone apps associated with or required for the installation, testing, troubleshooting, maintenance, programming, operation or expansion of the VRF system shall be provided at no cost to the owner.

B. If software is licensed on an annual basis, include the cost of at least five (5) years licensing with initial bid. In addition, clearly indicate on bid the requirement for and the cost of the annual license starting with the fifth year after installation.

2.06 OUTDOOR/CONDENSING UNITS

A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with provided indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls.
   1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
   2. Refrigerant: Factory charged.
   3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
   4. Capable of being installed with wiring to the left, right, rear or bottom.
   5. Capable of being installed with piping to the front or bottom.
   6. Modular design capable of being ganged for higher capacity.
   7. Heating:

a. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source.
b. Provide with low-ambient kit only if specified in Contract Drawing mechanical schedules.
c. Supplemental electric heat is not acceptable.

8. Defrost and oil recovery operating mode shall not produce indoor space cooling. During mode operation, temporarily disable indoor unit fan, or continue to provide heating (e.g. with split coil).
9. Sound Pressure Level Control: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 59 dB, 56 dB, and 53 dB, maximum or as shown on Contract Drawing mechanical schedule.
10. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
11. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
12. Oil Recovery Cycle: Automatic and periodic, or as needed based on oil level switch.

B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
1. Designed to allow side-by-side installation with minimum spacing

C. Fans:
1. Direct-drive propeller type fan with variable speed operation via variable frequency drive (VFD) or electronically commutated motor (ECM).
2. Fan Airflow: Per Contract Drawing mechanical schedule
3. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.

D. Condenser Coils:
1. Copper or aluminum tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

E. Compressors: Scroll type, hermetically sealed, and variable speed inverter-driven;
1. Variable Speed Control
a. Capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure.
b. Compressor capacity control by changing inverter frequency.
c. Staging of fixed speed compressors for capacity control is also acceptable, but there must be minimum one variable speed compressor to permit fine modulation of capacity.
2. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost, or every 8 hours.

3. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced system capacity manually or automatically; provide microprocessor and associated controls specifically designed to address this condition.
4. Inverter Driven Compressors: Phase-voltage monitor, inverter driven, highly efficient reluctance DC (digitally commutating), hermetically sealed scroll.
5. Rotors: Incorporating neodymium magnets for higher torque and efficiency.
6. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Provide oil separators and intelligent oil management system.
8. Compressor shall be isolated to avoid the transmission of vibration.

2.07 BRANCH SELECTOR/HEAT RECOVERY UNIT

A. Branch Selector/Heat Recovery Units: Concealed boxes rated for plenum installation, designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, subcooling heat exchanger, refrigerant control piping and electronics to facilitate communications between unit and main processor and between branch unit and indoor/evaporator units.
   1. Control direction of refrigerant flow using electronic expansion or solenoid valves.
   2. Provide one electronic expansion valve for each downstream unit served, except multiple indoor/evaporator units may be connected, provided balancing joints are used in downstream piping and total capacity is within capacity range of the branch selector.
      a. Alternative: Systems with expansion valves located at indoor units are acceptable.
   3. When branch unit is simultaneously heating and cooling, energize subcooling heat exchanger.
   4. Casing: Galvanized steel sheet with resin drain pan.
   5. Insulation: Case shall be insulated, or all refrigerant piping and components shall be insulated.
   6. Refrigerant Connections: Braze or flare type.
   7. Condensate Drainage: Refer to Division 22.
   8. The VRF manufacturer shall provide published documentation that specifically allows the installation of field provided isolation valves on all pipes connected to the Heat Recovery unit, or shall provide said valves factory installed, to allow the servicing of HR units, refrigerant circuit or the replacement of HR unit without evacuating the balance of the piping system.

2.08 INDOOR/EVAPORATOR UNITS

A. Contractor shall provide indoor units of quantity and type shown on Contract Drawings plans and schedules. Do not substitute unit types without written permission from Engineer of Record. Do not submit unit types which are not included in Project, even if listed in this Section.

B. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
3. Dehumidification/Drying Function: In conjunction with wall-mounted wired remote controller.
4. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
   a. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch.
   b. Sweat or flare connections to refrigerant piping.
   c. Provide thermistor on liquid and gas lines.
5. Fans: Direct-drive, with statically and dynamically balanced impellers; minimum two speed (high and low) or continuously variable speed unless otherwise indicated; motor thermally protected.
6. Supply Airflow Adjustment for ceiling cassette style units:
   a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
   b. Field-modifiable to 3-way and 2-way airflow.
   c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
7. Sound Pressure: No more than 32 dB(A) or as specified in mechanical schedule or noted below for specific unit types. Measured at low speed at 5 feet below unit.
8. Return Air Filter: Washable long-life net filter with mildew proof resin and antifungal treatment, unless otherwise indicated. Filter shall be accessible from room (ceiling-mounted units only).
9. Condensate Pan: Built-in mildew-proof condensate drain pan with connection. Include condensate safety shutoff and alarm.
10. Condensate Pump: If gravity drainage of condensate is not feasible, include built-in or provide with condensate pump, with lift as required by application.
11. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

C. Recessed Ceiling Units (Ductless)
1. Select one of the two paragraphs below or schedule sizes on drawings. Modify sizes for projects in SI units.
2. Provide 2 FT by 2 FT: Four-way airflow cassette with central return air grille, for installation in standard 24 by 24 inch lay-in ceiling grid.
3. Provide 3 FT by 3 FT: Four-way airflow cassette with central return air grille, for installation in fixed ceiling.
4. Cabinet Height: Maximum of 12 inches above ceiling.
5. Exposed Housing: White, impact resistant, with washable decoration panel.
6. Maintenance Access: All electrical components accessible through decoration panel.
   a. Side unit access is acceptable with lay-in ceiling installations.
7. Supply Airflow Adjustment:
   a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
   b. Field-modifiable to 3-way and 2-way airflow.

c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.

8. Condensate pump must be concealed.
9. Provide supply air branch duct connection with knock-out plug.
10. Provide fresh air intake duct connection with knock-out plug.

D. Ceiling Surface-Mounted Units (Ductless)

1. White, finished casing, with removable front grille
2. Includes sound insulation
3. Provide with mounting brackets
4. Condensate pump must be concealed.
5. Sound Pressure: No more than 36 dB(A) or as specified in mechanical schedule. Measured at low speed at 5 feet from unit.

E. Wall or Floor Surface-Mounted Units (Ductless)

1. White, finished casing, with removable front grille
2. Includes sound insulation
3. Provide with mounting brackets
4. Mildew-proof drain pan
5. Include built-in or provide with condensate pump, with lift as required by application.
6. Sound Pressure: No more than 43 dB(A) or as specified in mechanical schedule. Measured at low speed at 5 feet from unit.

F. Ducted Units

1. Ducted discharge and return; powder coated or galvanized steel cabinet.
2. Provide external static pressure switch adjustable for high efficiency filter operation
3. Mildew-proof drain pan
4. Include built-in or provide with condensate pump, with lift as required by application.
5. Where high efficiency filters are indicated on schedule, provide air filter rack.
6. High Temperature Unit:
   a. Two-stage cascade heat exchanger with refrigerant circuit to boost leaving water temperature.
   b. Hot water: Capable of providing water up to 140 °F with incoming water temperatures as low as 50 °F , or as shown on mechanical schedule.

2.09 EXTERNAL COIL CONTROL

A. Case/Enclosure

1. Powder coated sheet metal.
2. NEMA 4 for outdoor installation.
3. Hinged door or removable access panel, with weather seal.
4. Screw terminal block for control and power wiring connections.
5. Knockouts for wire and pipe routing.
6. Designed for mounting to air handler.

B. Controls

1. Provide controls and valve for modulation of refrigerant flow to an external heating/cooling coil.
2. Include the following sensors:
   a. One return air temperature thermistor, shipped loose for field mounting at mixed return air side of AHU coil.
   b. One evaporator coil pipe inlet temperature thermistor, shipped loose for field mounting between EEV kit and evaporator coil.
   c. One evaporator coil pipe outlet temperature thermistor, shipped loose for field mounting.
3. VRF control system shall modulate refrigerant coil valve to maintain [**controlled variable**] at setpoint.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.

B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.

C. Notify General Contractor/Construction Manager and Engineer of Record if conditions for installation are unsatisfactory.

3.02 INSTALLATION

A. Install equipment, controls, refrigerant piping and specialties, and insulation in accordance with equipment manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install flexible connectors at compressors.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Insulate each refrigerant line and specialties individually between the condensing and indoor units.

F. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

G. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

H. Division 26 to provide separate power connections for each unit of equipment and wire factory-mounted disconnects.

I. Coordinate with installers of systems and equipment connecting to this system.

3.03 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative to inspect installation prior to startup.

B. Pressure test system with dry nitrogen to 600 psi for 24 hours per Installation Manual. Triple evacuation test down to 500 microns for 1 hour. Test to no leakage.

3.04 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform system startup.

B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

C. Adjust equipment for proper operation within manufacturer's published tolerances.

D. Submit startup forms with Pre-Functional Test report.

3.05 CLEANING

A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 COMMISSIONING

A. See Division 01 for commissioning requirements.

B. Perform commissioning as specified in Section 23 08 00.

C. Perform Functional Tests as specified by Commissioning Authority and Commissioning Coordinator. At minimum, perform the following tests and provide Functional Test report for approval before closeout submittal.
   1. Override system clock to verify that system turns on and shuts off in accordance with programmed schedule and system clock.
   2. Override or manipulate (e.g. with hot air gun or compressed air can) zone temperature readings at each zone to verify appropriate heating or cooling response.
   3. Simultaneously override or manipulate temperatures in two zones on the same branch of the same outdoor unit so as to induce heating in one zone and cooling in the other, to verify that system can provide heating and cooling simultaneously.

3.07 CLOSEOUT ACTIVITIES

A. See Division 01 - Closeout Submittals, for closeout submittals.

B. See Division 01 - Demonstration and Training, for additional requirements.

C. Provide Owner with System Manual including approved submittal, as-built mechanical and control drawings, as-built piping drawings, Operations and Maintenance manuals, troubleshooting guides, service manuals and engineering manuals in PDF format.

D. Demonstrate proper operation of equipment to Owner's designated representative.

E. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

F. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of 16 hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

3.08 PROTECTION

A. Protect installed components from subsequent construction operations.

B. Replace exposed components broken or otherwise damaged beyond repair.

3.09 MAINTENANCE

A. See Division 01 - Execution Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 25 90 50

SEQUENCES OF OPERATION FOR HVAC DDC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes control logic sequences for DDC for HVAC systems, subsystems, and equipment.

1.02 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. All Division 25, Division 23 specifications
   2. Note: Division 25 takes precedence (if discrepancies) exist with regard to DDC controls only.

1.03 DEFINITIONS

A. Industry Standard Definitions
   1. Analog Input (AI): Proportional signal from a sensor into a DDC controller (typically 0-10 VDC or 4-20 mA) to BMS.
   2. Analog Output (AO): Proportional command signal from a DDC controller to a device (typically 0-10 VDC or 4-20 mA) from BMS.
   3. Binary Input (BI): On/off or relay type signal into a DDC controller.
   4. Binary Output (BO): On/off or relay type signal from a DDC controller.
   5. BMS: Building Management System. Equivalent to Energy Management and Control System (BMS), Building Automation System (BAS), etc.
   6. DDC: Direct digital control, the control of building equipment by a programmable computer.

B. Definitions Particular to this Specification
   1. Enabled/Disabled (for equipment): Indicates whether a piece of equipment is available to respond to a command (to run, or modulate, etc.) The statement “X is enabled” means that X is *available* to run but not necessarily running.
   2. Enabled/Disabled (for control loops): Indicates whether the control loop is actively calculating an error signal and is available to use for control. Disabled control loops are inactive; they do not accumulate error and they are not used for control.
   3. Mode: The dominant Operating Mode of an air handling unit (e.g. Occupied, Unoccupied, Warm-up, etc). Often scheduled but may be in response to building conditions.
   4. Occupied/Unoccupied: Refers to a zone (or collection of zones) that is scheduled for potential occupancy (or not). People may or may not be present.
   5. Populated/Unpopulated: Refers to a zone where people are currently present (or not), as indicated by occupancy sensor, CO_2 measurement, or other means.

PART 2 - PRODUCTS

2.01 (Not Applicable)

PART 3 - EXECUTION

3.01 Sequences Of Operations

A. General
1. Contractor Review of Sequences
a. EOR is bound by code to define the intended physical function of the equipment as it was designed for proper functionality. Not being an authorized distributor or practitioner of a DDC product, it is unfeasible for the EOR to provide written descriptions for every digital detail necessary to execute the sequence of operations down to the keystroke. Where programming provisions are provided in this document, they are done so conceptually, not to be interpreted as literal as an operations manual. It is the responsibility of the applications engineering team and professional programmers within the DDC contractor's firm to apply the concepts stated in this sequence of operations and make use of the tools, features, and digital skillset afforded them to achieve the end effect. It is well recognized that many products can achieve satisfactory and even exemplary results in unique ways. Should complications or questions arise, the RFI and Submittal process shall suffice for resolution.
b. As part of the controls submittal process, the DDC Contractor shall formally state "The sequences shall be programmed as written" or it shall describe any deviations. In particular, the contractor shall annotate any:
1) Apparent errors in the sequence logic
2) Control logic which might lead to equipment damage or violate manufacturer warranties
3) Control logic elements which cannot be implemented due to the equipment submitted on by others.
4) Limitations due to VE, phasing, or owner requirements which could conflict with the design intent on the contract documents.
2. Sequence modifications due to equipment or OEM controls limitations
a. Typically, the equipment specified is open to competition and as a result, there can be slight variations among various manufacturers that may impact the sequence of operations. It is common for there to be with limitations of OEM controls or slight discrepancies in the points provided.
b. If minor specifics of the OEM controls differ slightly but still meet the design intent, then the following applies:
1) Network architecture, where provided by the EOR takes precedence over specific points. Substations of serial network comm where ethernet is designed is not acceptable. Note: topology variations through use of routers/repeaters/servers or mftr specific network products to best suit project conditions are the means and methods of the DDC contractor.
2) Specified precision or particular attributes of OEM sensors may be relaxed or amended on limited, case by case basis to accommodate what the factory feels is best to run their equipment.

3) The absence of sensors whose function is vital to the execution of the sequence of operations is not considered acceptable. Contractor to provide additional DDC controller to supplement the OEM controls if required to execute the sequence. This is particularly applicable for:
   a) Central plant equipment, air source heat pumps, and all associated CHW & HHW pumps.
   b) AHU, ERV.
4) This must be brought the attention of the EOR during submittal process so that it can be properly approved.
5) Approved changes need to be incorporated into the as-builts as the final sequence of operations. Functional and performance tests are then to be an accurate reflection of the OEM controls sequence as implemented for this specific project.

3. Zone Groups
   a. As a default, the zone groups are defined by the mechanical ductwork. Parent equipment and associated terminal units shall all grouped together.
   b. The owner may have need to subdivide zones based on occupancy, tenants, space usage, etc. Example: a kitchen or lobby could have a collection of terminal units that need to be their own zone group.
   c. DDC Contractor shall submit zone groupings for owner approval as part of the submittal process.
   d. Each Zone Group shall be capable of having separate occupancy schedules and Operating Modes from other Zone Groups.
   e. Each zone served by a fan-coil or single-zone air handler shall be its own Zone Group.
   f. All networking closets, mechanical and electrical rooms served by the air handler shall be a single Zone Group.
   g. VRF or VRV FCU may be in groups or considered independent. Contractor to send RFI if the nature of the branch selector or CU is not clear.
   h. Operable & manual window groups or natural ventilation zones may or may not coincide with mechanical equipment. Contractor to send RFI for all instances for proper verification of priority and overlap.
4. Building Operating Modes
   a. Occupied Mode:
      1) This is set based on user adjustable schedule.
      2) A thermostat with an override input may initiate occupied mode outside of the pre-set schedule.
      3) Schedule shall accommodate user provided holidays.
   b. Morning Warm-Up Mode:
      1) The design intent is for the BMS to begin warming the building so that it can be comfortable at the start of occupied mode.
      2) 100% recirculation air (no outside air) is an acceptable method of warming the building efficiently when the building is unpopulated.
      3) The start time of warmup mode is initiated by user provided schedule.
      4) Zones where the window switch indicates that a window is open shall be ignored.
      5) During morning warm up, set all zone setpoints to initial setpoint of 76°F (adj) OR an alternative approach is to set all terminal unit dampers to full open.
      6) Enable the AHU and HHW plant to run.

7) Allow economizer(s) to provide for 100% recirculation air if OAT < RAT.

c. Morning Cool-Down Mode:
   1) The design intent is for the BMS to begin cooling the building so that it can be comfortable at the start of occupied mode.
   2) 100% recirculation air (no outside air) is an acceptable method of warming the building efficiently when the building is unpopulated.
   3) The start time of warmup mode is initiated by user provided schedule.
   4) Zones where the window switch indicates that a window is open shall be ignored.
   5) During cool down mode, set all zone setpoints to initial setpoint of 69°F (adj) OR an alternative approach is to set all terminal unit dampers to full open.
   6) Enable the AHU and CHW plant to run.
   7) Allow economizer(s) to provide for 100% recirculation air if OAT > RAT.

d. Unoccupied Mode:
   1) When the Zone Group is not in any other mode.
   2) For the purposes of this document, Unoccupied Mode assumes the building is unpopulated AND it is favorable for the maximum amount of equipment to be off.
   3) All systems off.

5. Control Loops
   a. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up.
   b. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a Neutral value.
   c. A control loop in Neutral shall correspond to a condition that applies the minimum control effect, i.e. valves/dampers closed, VFDs at minimum speed, etc.
   d. The term “control loop” or “loop” is used generically for all control loops. These will typically be PI loops. Proportional plus integral plus derivative gains are not required on all loops. Do not use the derivative term on any loops unless field tuning is not possible without it.
   e. Unless specifically indicated otherwise, the following guidelines shall be followed:
   f. To avoid abrupt changes in equipment operation, the output of every control loop shall be limited by a user adjustable maximum rate of change, with a default of 25% per minute.
   g. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
   h. All hardware points, not just inputs, should be capable of being overridden for purposes of testing and commissioning. For example, the commissioning agent should be able to command damper positions, valve positions, fan speeds, etc. directly through BMS overrides.

6. Alarms
   a. Levels of alarm in order of priority

1) Level 1: Critical/life safety
2) Level 2: Significant equipment failure
3) Level 3: Non-critical equipment failure/operation
4) Level 4: Energy conservation monitor
5) Level 5: Maintenance indication, notification

b. Note: these levels are a default starting point. Owner's may have a pre-existing protocol for annunciation and escalation. These take precedence in all instances.

c. All alarms generated by the BMS shall include at least the following information:
1) Date and time of the alarm
2) Level of the alarm
3) Description of the alarm
4) Equipment tags for the units in alarm
5) Possible causes of the alarm, if provided by the fault detection routines
6) The Source which serves the equipment in alarm

7. Outdoor Air Temperature Sensing
a. When there are multiple outdoor air temperature sensors, the system shall use the valid sensor that most accurately represents the outdoor air conditions at the equipment being controlled.
1) Outdoor air temperature sensors at air handler outdoor air intakes shall be considered valid only when the supply fan is proven on and unit is in Occupied Mode or any other Mode in which the economizer is enabled.
2) The outdoor air temperature used for graphics display, optimum start, plant lockout, and other global sequences shall be the average of all valid sensor readings. If there are four or more valid outdoor air temperature sensors, discard the highest and lowest temperature readings.
3) If the control drawings indicate a weather station is to be provided, this is to used as a global point that will be passed as a virtual point to all equipment. Note: this global point would not take the place of a hardwired OAT sensor being used to control an economizer. The weather station shall be displayed on the front end and trended on 15 min intervals. These trends to be auto-exported monthly in .csv format to the email of an admin user.

8. Equipment Staging and Rotation
a. Automatic Even Wear Rotation
1) The automatic even wear rotation presented in the following section is written using the basis of equipment run time to determine position in the queue for staging and is triggered only during a stage up or stage down event. These sequences will provide the most even run time across multiple pieces of equipment.
2) Lead/lag: Unless otherwise noted, parallel staged devices (such as pumps, towers) that are not redundant shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device.

3) For example, assuming there are three devices, if all three are off or all are on, the staging order will simply be based on run hours from lowest to highest. If two devices are on, the one with the most hours will be set to be stage 2 while the other is set to stage 1; this may be the reverse of the operating order when the devices were started. If two devices are off, the one with the most hours will be set to be stage 3 while the other is set to stage 2; this may be the reverse of the operating order when the devices were stopped.
4) Lead/standby: Unless otherwise noted, parallel devices (such as pumps, towers) that are 100% redundant shall be lead/standby alternated when more than one is off so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device.
5) For example, assuming there are three devices, if all three are off, the staging order will be based on run hours from lowest to highest. If devices run continuously, lead/standby shall switch at an operator-specified runtime; standby device shall first be started and proven on before former lead device is changed to standby and shut off.

b. Exceptions
1) Operators with appropriate access level shall be able to manually command staging order via software points overriding the Even Wear or Periodic Rotation logic above, but not overriding the In Alarm or Hand Operation logic below.
2) In Alarm: If the lead device has a fault condition or has been manually switched off, a Level 2 alarm shall be generated and the device shall be set to the last stage position in the lead/lag order until alarm is reset by operator. Staging position of remaining devices shall follow the prevailing (Even Wear or Periodic Rotation) logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm. Fault conditions include the following:
a) Variable Speed Fans and Pumps
(1) VFD critical fault is ON
(2) Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the device is commanded on, or
(3) Supervised HOA at control panel in OFF position, or
(4) Loss of power (e.g. VFD DC Bus voltage = zero)
b) Constant Speed Fans and Pumps
(1) Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the device is commanded on, or
(2) Supervised HOA at control panel in OFF position
c) ASHPs
(1) ASHP alarm contact, or
(2) ASHP is manually shut off as indicated by the status of the Local/Auto switch from ASHP gateway, or

(3) ASHP status remains off 5 minutes after command to start

3) Hand Operation: If a device is on in Hand (e.g. via an HOA switch or local control of VFD), the device shall be set to the lead device and a Level 4 alarm shall be generated. The device will remain as lead until the alarm is reset by the operator. Hand operation is determined by

a) Variable Speed Fans and Pumps

(1) Status point not matching its on/off point for 15 seconds while the device is commanded off

(2) VFD in local “hand” mode

(3) Supervised HOA at control panel in ON position

b) Constant Speed Fans and Pumps

(1) Status point not matching its on/off point for 15 seconds while the device is commanded off

(2) Supervised HOA at control panel in ON position

c) ASHPs: ASHP is manually turned on as indicated by the status of the local/auto switch from ASHP gateway.

9. Maintenance / Service Modes
   a. Applicable for all staged, and rotated equipment serving common pipes or ducts including but not limited to fans in fan wall, AHU’s with common main ducts and isolation dampers, pump headered in parallel, ASHPs in parallel, redundant fan coils in parallel, exhaust fans with common mains and isolation dampers, lab exhaust fans, and any other N+1 redundant equipment.
   b. The need for equipment service will enviably arise when a fan, pump, ASHP, etc. which is part of rotation of devices will need to be disabled for service.
   c. The DDC contractor shall provide programming to allow an operator to disable a piece of rotating equipment without interrupting the sequence of operation.
   d. Example if three pumps are staged to provide full rated flow, any one of them must be able to disabled without reprogramming or other manipulations.
   e. Note: this not intended guarantee the continuity of service, the loss of a pump or ASHP is likely to have consequences. Controls cannot provide redundancy, it must have been part of the original design. The intend is just to allow operators to safe off equipment while the remainder of the system is left in automatic control and is still attempting to execute the sequence to the best extent it can.
10. Air Economizer High Limits
   a. Economizer shall be disabled whenever the outdoor air conditions exceed the economizer high limit setpoint as specified by local code. Setpoints vary by energy standard, climate zone, and economizer high limit control device type. Setpoints listed below are for current ASHRAE and California Energy Standards.
   b. Title 24-2013:

Device Type	California Climate Zones	Required High Limit (Economizer Off When):
	1, 3, 5, 11-16	$T_{OA} > T_{RA}$

Device Type	California Climate Zones	Required High Limit (Economizer Off When):
Differential Dry Bulb	2, 4, 10	$T_{OA} > T_{RA} – 2°F$
	6, 8, 9	$T_{OA} > T_{RA} – 4°F$
	7	$T_{OA} > T_{RA} – 6°F$

11. VFD Speed Points
    a. The speed analog output sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz and 100% speed corresponds to maximum speed configured in the VFD.
    b. Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with the test and balance specifications. Controls contractor shall coordinate with balance contractor.
    c. For each piece of equipment, the minimum speed shall be stored in a single BMS software point. In case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BMS.
12. Miscellaneous
    a. The term “proven” (i.e. “proven on”/ “proven off”) shall mean that the equipment’s measured feedback point matches the state set by the equipment’s command point.
    b. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g. for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences.

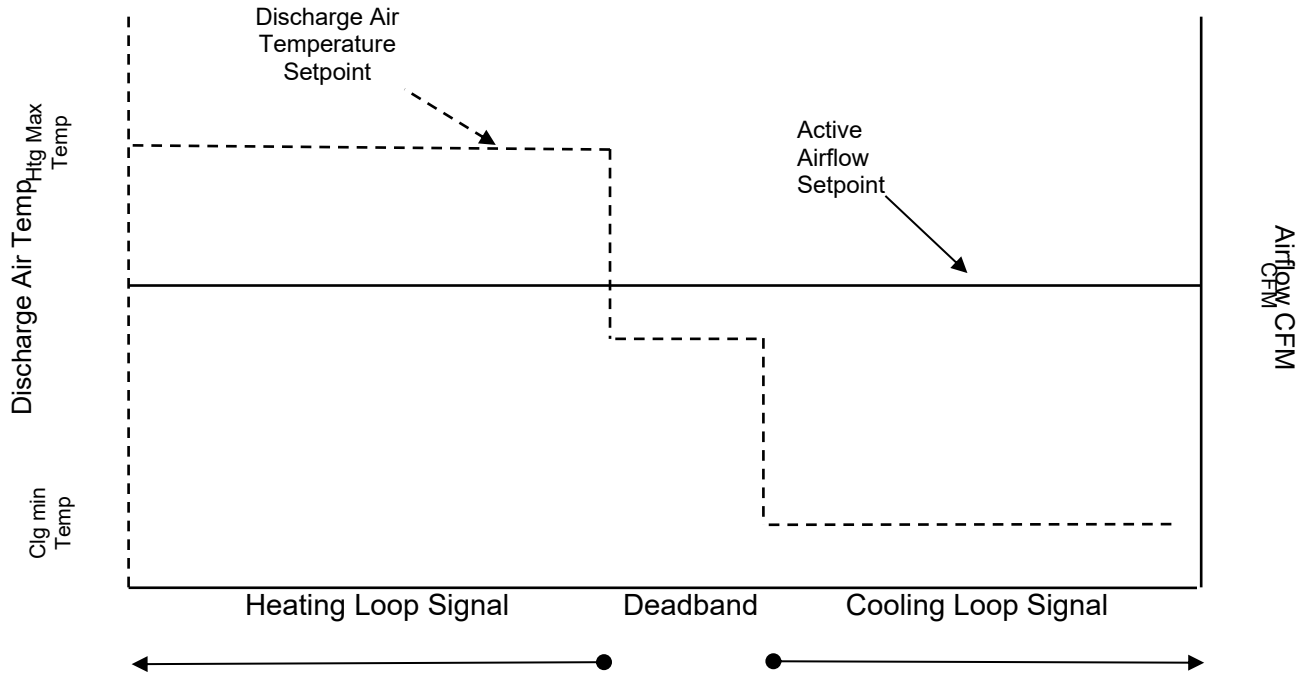
B. Generic Thermal Zones (Terminal Units)
1. Application
    a. This section applies to all single zone systems and sub-zones of air handling systems, such as VAV boxes, fan-powered boxes, etc.
2. Occupancy schedule
    a. Control contractor to obtain in written occupancy schedules from the Owner for each zone group. The Owner must approve the final schedules prior to controls completion.
    b. The default schedule shall be 8AM – 8PM.
3. Zone Temperature Setpoints
    a. Each zone shall have separate occupied and unoccupied heating and cooling setpoints.
    b. The software shall prevent:
        1) The heating setpoint from exceeding the cooling setpoint minus 1°F (i.e. the minimum difference between heating and cooling setpoints shall be 1°F).
        2) The unoccupied heating setpoint from exceeding the occupied heating setpoint.
        3) The unoccupied cooling setpoint from being less than the occupied cooling setpoint.
    c. Where the zone has a local setpoint adjustment knob/button

1) The setpoint adjustment offsets established by the occupant shall be software points that are persistent (e.g. not reset daily), but the actual offset used in control logic shall be adjusted based on limits and modes as describe below.
2) The adjustment shall be capable of being limited in software.
   a) As a default, the active occupied cooling setpoint shall be limited between 72°F and 80°F.
   b) As a default, the active occupied heating setpoint shall be limited between 65°F and 72°F.
3) The active heating and cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic described above. If zone thermostat provides only a single setpoint adjustment, then the adjustment shall move both the active heating and cooling setpoints upwards or downwards by the same amount, within the limits described above.
4) The adjustment shall only affect occupied setpoints in Occupied Mode, and shall have no impact on setpoints in all other modes.

4. Testing/Commissioning Overrides
   a. As applicable for the project commissioning needs, provide the ability to individually command all control outputs to demonstrate proper functionality.
   b. This is not intended to create one time use software or programming. Typically an simple admin login would allow for all setpoint to be over-ridden for testing. This is an acceptable method to accomplish commissioning testing.
   c. Fan Coil Unit examples:
      1) Force fan to full speed, min speed, max cool
      2) Force CHW valve full open/closed
      3) Force HHW valve full open/closed

C. FCU - VRF - Ducted
1. General
   a. The VRF FCU provides cooling and heating.
   b. Unit is controlled by OEM controls with full integration to BMS for command and monitoring.
   c. Rather than a typical configuration where the fan goes off when there is no heating or cooling, the fan will always run at the same speed during occupied modes. This allows the system to be balanced with manual dampers rather than pressure independent VAVs.
   d. In unoccupied mode the system is completely off. No heating or cooling or fans.
2. Supply fan and air temperature control - normal occupancy

a. Fan and coil controls is depicted schematically in the diagram below.
b. Figure above: there are 2 axes shown to depict the interaction of discharge



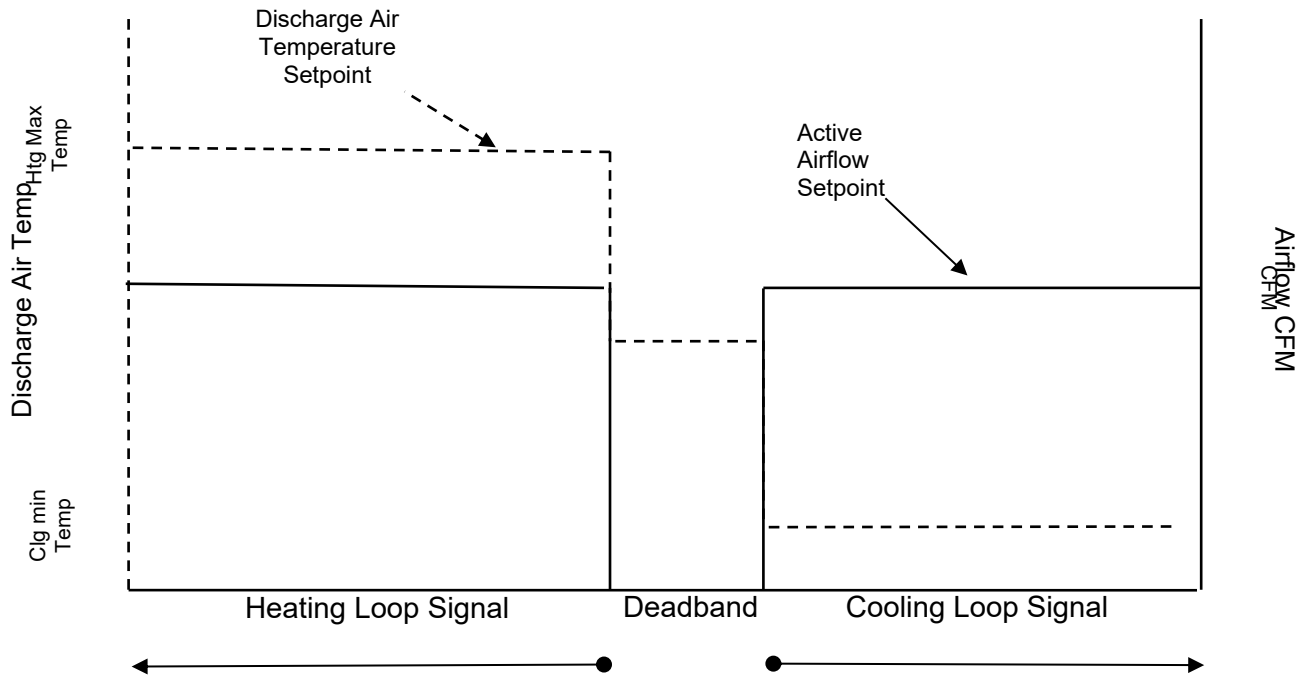
air temp and fan speed.
1) The dashed line corresponds the discharge air temp and the solid line corresponds to the fans speed.
2) Cooling and Heating Loops are mapped to the representative zone thermostat serving the space.
3) Discharge air temp is to be maintained with the OEM modulating refrigerant control valves.
4) Fan speed is constant at all times during occupied mode.
5) Occupancy Sensor – populated and unpopulated state
6) If <u>all</u> the lighting zones/scenes in an associated FCU zone are unoccupied for more than 5 min (adj), set back the thermostats to a relaxed setpoint +/- 4 deg (adj) from present value.

3. Alarms
a. Generate a maintenance alarm when fan has operated for more than 1500 hours or as recommended by the product manufacturer. Reset interval counter when alarm is acknowledged.
b. High/Low space temperature. If the thermostat is more than 2°F (adj) above/below setpoint for more than 10 minutes (adj) send an alarm.
c. If the supply fan fails to run, send an alarm.
d. Annunciate drip pan level high as a high alarm.
e. Annunciate when filter exceeds the DP threshold.
f. BMS shall annunciate all alarms available in the OEM controller through integration to VRF master controller.

D. FCU - VRF – Non-Ducted
1. General

a. The VRF FCU provides cooling and heating.
b. Unit is controlled by OEM controls with full integration to BMS for command and monitoring.
c. In unoccupied mode the system is completely off. No heating or cooling or fans.

2. Supply fan and air temperature control - normal occupancy
   a. Fan and coil controls is depicted schematically in the diagram below.
   b. Figure above: there are 2 axes shown to depict the interaction of discharge



air temp and fan speed.
   1) The dashed line corresponds the discharge air temp and the solid line corresponds to the fans speed.
   2) Cooling and Heating Loops are mapped to the representative zone thermostat serving the space.
   3) Discharge air temp is to be maintained with the OEM modulating refrigerant control valves.
   4) Fan speed is constant for heating and cooling, and off when the space is in deadband.
   5) Occupancy Sensor – populated and unpopulated state
   6) If <u>all</u> the lighting zones/scenes in an associated FCU zone are unoccupied for more than 5 min (adj), set back the thermostats to a relaxed setpoint +/- 4 deg (adj) from present value.

3. Alarms
   a. Generate a maintenance alarm when fan has operated for more than 1500 hours or as recommended by the product manufacturer. Reset interval counter when alarm is acknowledged.
   b. High/Low space temperature. If the thermostat is more than 2°F (adj) above/below setpoint for more than 10 minutes (adj) send an alarm.
   c. If the supply fan fails to run, send an alarm.

d. Annunciate drip pan level high as a high alarm.
e. Annunciate when filter exceeds the DP threshold.

4. BMS shall annunciate all alarms available in the OEM controller through integration to VRF master controller.
5. Trends
   a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
      1) Discharge air temp & setpoint
      2) Fan speed
      3) Space thermostat temp & setpoint
6. Trends
   a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
      1) Discharge air temp & setpoint
      2) Fan speed
      3) Space thermostat temp & setpoint

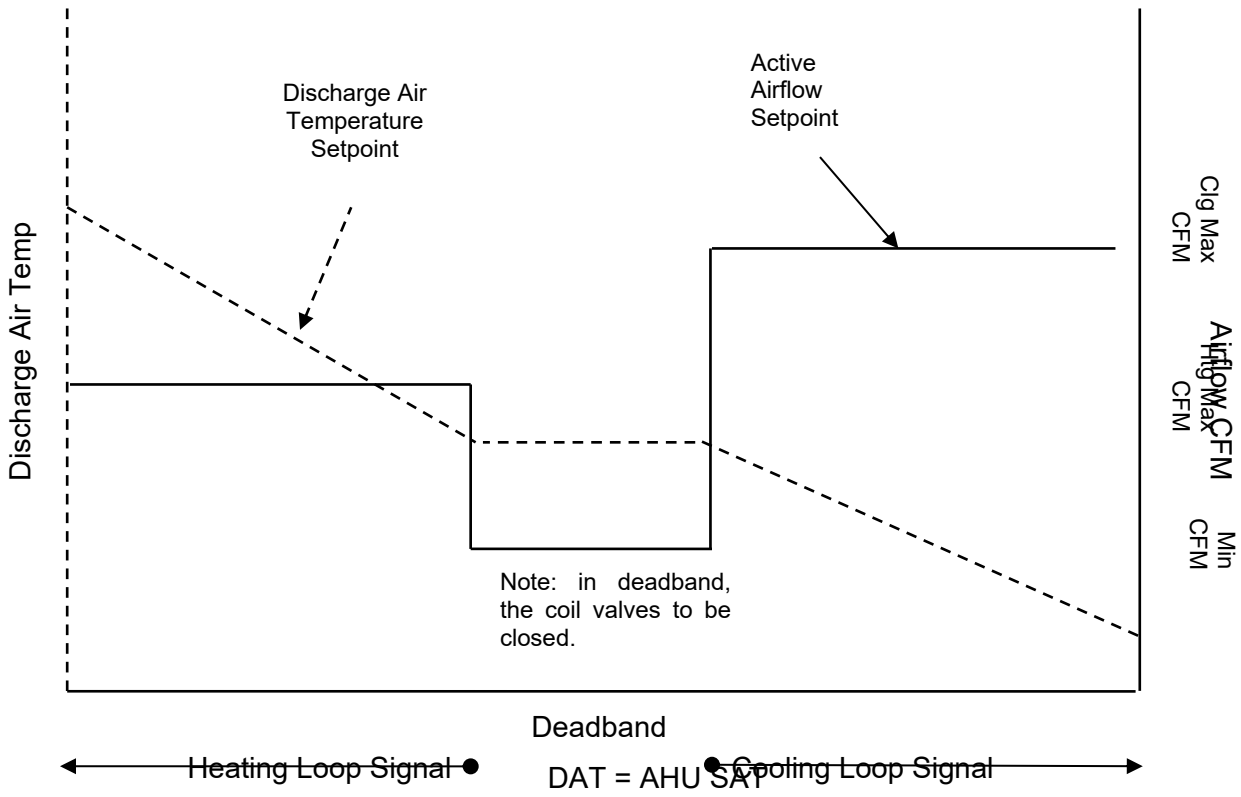
E. AHU – Heat Wheel
1. General
   a. This unit provided 100% outside air
2. Modes
   a. In unoccupied mode the AHU is to remain off, with any coil valves closed and any OA or EA dampers closed.
   b. For morning warm-up, AHU shall run with a supply air temp of 90°F (adj).
   c. For morning cool-down, AHU shall run as normal occupied mode.
   d. All other logic in this sequence pertains to occupied mode.
3. Supply Fan Control
   a. The supply fan will modulate with PI control to maintain a remote duct pressure setpoint.
   b. All fans control in unison to single output signal.
   c. Totalize current airflow rate from VAV boxes and display on AHU graphic.
   d. Display the AHU AFMS airflow rate adjacent to the sum-of-zone airflow rate.
   e. Note: high static switch is to be directly connected to emergency shut down input on supply fan(s) rather than rely on DDC logic.
4. Supply Air Temperature Control
   a. Controls to us a PI loop to control the control valve to maintain discharge air temp at setpoint across the full range of supply cfm. Controls contractor to provide tuning for stable operation.
5. Heat Wheel – Occupied Mode
   a. Heat Wheel shall be controlled with OEM controls to run when conditions for heat recovery are favorable.
   b. Favorable conditions are defined as:
      1) In heating mode, if RAT > OAT
      2) In cooling mode, if RAT < OAT
6. Exhaust Fan Control
   a. Exhaust fan is to be controlled by building DP sensor. This DP setpoint shall be set such that the barometric relief dampers are exhausting the cfm shown on the plans before starting the fan. This is a field determined setpoint, an educated starting point is .07” of w.c.
7. Alarms

a. Maintenance
   1) Interval alarm when fan has operated for more than 1,500 hours: Level 5. Reset interval counter when alarm is acknowledged.
   2) Generate a maintenance alarm when the filter DP has exceeded threshold of .2' w.c. (adj).
b. Heat Wheel
   1) If any AHU temp sensor provides erroneous data, annunciate alarm at the front end. Erroneous data defined as:
      a) Sensor reading more than 200% of reasonable range (Example: DAT of 120°F)
   2) Heat recovery when not appropriate
      a) If exchanging heat when OAT is within 5°F of the current supply air setpoint, send maintenance alarm.
      b) If not exchanging heat when OAT ≥ 90°F or ≤ 50°F, send maintenance alarm.
c. Fans
   1) If the VFD is shut down by a high/low static switch, annunciate at the highest level alarm.
   2) If fan status or feedback does not match commanded setpoint for a period of 60 seconds, send alarm.
   3) If building pressure is greater than .10", send alarm.
   4) If building pressure is less than .00" (negative), send alarm.
d. Filter
   1) If pressure drop exceeds alarm limit, send alarm.
e. Supply Air Temperature
   1) If supply air temperature exceeds 100°F or drops below 40°F, send alarm

8. Trends
   a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
      1) SAT and setpoint
      2) Refrigerant valve position
      3) RAT, OAT, Mixed Air Temp
      4) EA, OA damper positions
      5) EA damper position, building pressure, building pressure setpoint

F. AHU - SINGLE ZONE
   1. General
      a. The single zone AHU will provide heating and cooling to a single zone. Feedback is from factory thermostat.
   2. Supply Fan and Air Temperature Control
      a. Supply air temperature shall be controlled to setpoint using a control loop whose output is mapped to sequence the hot water valve and/or chilled water valve as shown in the diagram below.

b.



c. Figure above: there are two axes on the graph above. The line style of the axis corresponds to the associated line on the graph. The dashed line corresponds to the AHU DAT. The solid lines correspond to the AHU cfm.

d. The design airflow setpoints for each zone shall be scheduled on the drawings for cooling max, heating max, and design min cfm. TAB support to determine what speeds provide the appropriate cfm may be required if any kind of AFMS or flow ring is not shown on the controls diagrams.

e. The valve(s) shall be modulated with a PI loop to maintain the discharge temperature at setpoint across the range of air flow.

f. When the zone is in cooling, the cooling loop shall maintain space temperature at the heating setpoint as follows:
   1) From 0% - 100%, the cooling loop output shall reset the discharge air temperature from the current thermostat setpoint to the min discharge air temp as shown on the mech dwgs.

g. When the zone in deadband, the active airflow setpoint shall be the min airflow setpoint and all coil valves shall be closed.

h. When the zone is in heating, the heating loop shall maintain space temperature at the heating setpoint as follows:
   1) From 0% - 100%, the heating loop output shall reset the discharge air temperature from the current thermostat setpoint to the max discharge air temp as shown on the mech dwgs.

i. When lighting control system determines that the zone is unpopulated for more than 15min, thermostat setpoints shall revert to relaxed values that are +/- 4°F (adj) from prior setpoint. If the AHU or overall building mode is in cooling, then 4°F added, if the AHU or overall building mode is in heating then 4°F subtracted.

3. Economizer Control – as applicable
   a. Design intent is for OA and RA economizer dampers to modulate to allow for free cooling when conditions are favorable AND to maintain minimum outdoor air.
   b. The min OA control loop output is always to take priority over the free cooling loop.
   c. The OA cfm feedback is measured by the OA AFMS, not based on a TAB setpoint.
   d. When conditions are favorable for free cooling, the economizer shall modulate to maintain the mixed air averaging temp sensor (dry bulb only) at SAT setpoint minus 2°F (adj) but not at the expense of min OA.
   e. Mixed air temp setpoint initially set equal to DAT setpoint minus 2°F (adj).
   f. Favorable conditions are defined as:
      1) OAT ≤75°F
      2) OAT < RAT
      3) OAT > 40°F (adj)
   g. Outside Air Damper Lockout: If the outside air temperature is greater than the return air temperature, then modulate dampers to the minimum position.
4. Economizer – Other Modes – as applicable
   a. Morning warmup mode or cool down mode (as applicable)
      1) This is schedule based and is set by the building owner.
      2) The building is assumed to be completely unpopulated which allows for 100% RA and 0% OA.
      3) To expedite the warmup of the building (example: after a cold night), the OA dampers shall be fully closed for 100% recirculation so long as OAT < RAT
      4) To expedite the cool down of the building (example: after a hot weekend), the OA dampers shall be fully closed for 100% recirculation so long as OAT > RAT
5. Alarms
   a. Generate a maintenance alarm when fan has operated for more than 1500 hours or as recommended by the product manufacturer. Reset interval counter when alarm is acknowledged.
   b. High space temperature: if thermostat rises more than 5°F above setpoint for 10 minutes, send alarm.
   c. If supply fan fails to reach commanded state for more than 5 min, send alarm.
   d. Generate an alarm if drip pan sensor for fan coil units senses excessive water is in the drip pan. (as applicable, see controls diagram)
   e. Generate a maintenance alarm when the filter DP has exceeded threshold of .2’ w.c. (adj).
   f. Annunciate all available alarms from the OEM controller through integration.
6. Trends
   a. The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
      1) SAT and setpoint

2) valve positions
3) RAT, OAT
4) OA CFM (as applicable, see controls diagrams)
5) Supply Fan CFM, DP, DP setpoint (as applicable, see controls diagrams)
6) Space thermostat temp & setpoint

G. EF – DDC Schedule Controlled
1. Unless noted otherwise, all exhaust fans will have a *minimum* of schedule control through the BMS.
2. Exhaust fan shall run at Max Speed when the air handler that serves the space (directly or by transfer air) is in Occupied Mode and the air handler supply fan is proven on.
3. Janitor's closet, Copy Room, Restrooms, and Pavilion restroom and vending exhaust fans shall be connected to BMS for time schedule control. They shall initially be given independent schedule capability. The initial schedule shall be set to match building occupancy schedule.
4. Alarms
   a. Generate a Level 5 maintenance alarm when fan has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.
   b. Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.
      1) Commanded on, status off: Level 2
      2) Commanded off, status on: Level 4

H. CEILING FANS – no DDC
1. General
   a. Ceiling fan will be on manual control apart from the BMS.
   b. Note: see Fire Alarm design for requirements associated with shut down in the event of fire.

I. Interconnection to Networked Lighting Control System – OCC ONLY
1. Connect BAS to lighting control system and map across points as indicated and as required to execute control logic described below.
   a. BAS shall monitor lighting control occupancy sensors. The status of each occupancy sensor shall appear as a virtual point within the BAS.
   b. Occupancy sensors are used for zone ventilation setpoint reset.
   c. The populated/unpopulated status of each zone shall be displayed on the zone graphics.
   d. When lighting control system determines that the zone is unpopulated for more than 15min (adj), thermostat setpoints shall revert to relaxed values that are +/- 4°F (adj) from prior setpoint. If the AHU or overall building mode is in cooling, then 4°F added, if the AHU or overall building mode is in heating then 4°F subtracted. For VAV serving multiple spaces, occupancy must be off in all the associated zones.

END OF SECTION

SECTION 26 05 13

MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

1.03 DEFINITIONS

A. Jacket: A continuous nonmetallic outer covering for conductors or cables.

B. NETA ATS: Acceptance Testing Specification.

C. Sheath: A continuous metallic covering for conductors or cables.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

B. Samples: 16-inch (400-mm) lengths for each type of cable specified.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate location of each cable, splice, and termination.

B. Qualification Data: For Installer.

C. Material Certificates: For each type of cable and accessory.

D. Design Data: Cable pulling calculations, including conduit size and fill percentage, pulling tensions, cable sidewall pressure, jam probability, voltage drop, and ground wire sizing for each cable.

E. Source quality-control reports.

F. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.07 FIELD CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Construction Manager no fewer than ten days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Owner's/Architect's written permission.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.02 CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Okonite Company (The).
   2. Southwire Company.
   3. General Cable

B. Cable Type: Type MV 105.

C. Conductor Insulation: Ethylene-propylene rubber.
   1. Voltage Rating: 15 kV.
   2. Insulation Thickness: 133 percent insulation level.

D. Conductor: Copper.

E. Comply with UL 1072, AEIC CS8, ICEA S-93-639/NEMA WC 74, and ICEA S-97-682.

F. Conductor Stranding: Compact round, concentric lay, Class B.

G. Shielding: Copper tape, helically applied over semiconducting insulation shield. Minimum of 25% overlap.

H. Cable Jacket: Sunlight-resistant PVC.

2.03 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Cooper Power Systems, an Eaton business.
3. G&W Electric Company.
4. Schneider Electric

B. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.

2.04 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Cooper Power Systems, an Eaton business.
3. Raychem; TE Connectivity.
4. Schneider Electric

C. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

D. Dead-Break Cable Terminators: Elbow-type unit with 200-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.
1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.

2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.05 MEDIUM-VOLTAGE TAPES

A. Description: Electrical grade, insulating tape rated for medium voltage application.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Cooper Power Systems, an Eaton business.
3. Raychem; TE Connectivity.

C. Ethylene/propylene rubber-based, 30-mil (0.76-mm) splicing tape, rated for 130 deg C operation. Minimum 3/4 inch (20 mm) wide.

D. Silicone rubber-based, 12-mil (0.30-mm) self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inches (38 mm) wide.

2.06 ARC-PROOFING MATERIALS

A. Description: Fire retardant, providing arc flash protection.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Cooper Power Systems, an Eaton business.
3. Raychem; TE Connectivity.

C. Tape for First Course on Metal Objects: 10-mil- (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

D. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, and compatible with cable jacket.

E. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch (25 mm) wide.

2.07 FAULT INDICATORS

A. Indicators: Manually reset fault indicator with inrush restraint feature, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.

2.08 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches (1200 to 1800 mm) on the pull rope.
   1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
   2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
   2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
   3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
   4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

E. Install "buried-cable" warning tape 12 inches (305 mm) above cables.

F. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

G. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

H. Install cable splices at pull points and elsewhere as indicated; use standard kits. Use dead-front separable watertight connectors in manholes and other locations subject to water infiltration.

I. Install separable insulated-connector components as follows:
   1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
   2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
   3. Standoff Insulator: At each terminal junction, with one on each terminal.

J. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
   1. Clean cable sheath.
   2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
   3. Smooth surface contours with electrical insulation putty.
   4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
   5. Band arc-proofing tape with two layers of 1-inch- (25-mm-) wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.

K. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."

L. Install fault indicators on each phase where indicated.

M. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

N. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.02 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
   2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.

3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
4. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
5. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

C. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Photovoltaic cable, Type PV, rated 2000 V or less.
4. Mineral-insulated cable, Type MI, rated 600 V or less.
5. Fire-alarm wire and cable.
6. Connectors, splices, and terminations rated 600 V and less.

1.03 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. General Cable Technologies Corporation.
4. Okonite Company (The).
5. Southwire Company.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.

2.02 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Belden Inc.
3. General Cable Technologies Corporation.
4. Okonite Company (The).
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:
1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Bare or Insulated.

G. Conductor Insulation:
1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.03 PHOTOVOLTAIC CABLE, TYPE PV

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 2000 V.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation.
3. Service Wire Co.
4. Southwire Company.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation: Comply with UL 44 and UL 4703.

2.04 MINERAL-INSULATED CABLE, TYPE MI

A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. KME America, Inc.
2. Pentair.
3. Watlow Electric Manufacturing Company.
4. Approved equal.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 2196 for fire resistance.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper.

E. Insulation: Compressed magnesium oxide.

F. Sheath: Copper.

2.05 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Genesis Cable Products; Honeywell International, Inc.
4. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red

identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.06 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
3. ILSCO.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
2. Type: Two hole with long barrels.
3. Termination: Crimp.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

F. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

G. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

I. PV Circuits: Type USE-2 for PV source circuits rated at 600 V or less.

J. PV Circuits: Type PV for PV source circuits rated at 600 V.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.04 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
   1. Install plenum cable in environmental airspaces, including plenum ceilings.
   2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:
   1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
   2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
   3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.05 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.06 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.07 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.08 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.09 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements:

Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

   1) A low-resistance ohmmeter.
   2) Calibrated torque wrench.
   3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

E. Cables will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

      a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

         1) Test wells.
         2) Ground rods.

      b. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS or NFPA 70B.

         1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
         2) Include recommended testing intervals.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
2. Burndy; Hubbell Incorporated, Construction and Energy.
3. Galvan Industries, Inc.; Electrical Products Division, LLC.
4. nVent (ERICO).

2.03 CONDUCTORS

A. Bare Copper Conductors:
1. Stranded Conductors: ASTM B8.
2. Tinned Conductors: ASTM B33.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.04 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

K. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:
1. Mechanical type, two pieces with zinc-plated bolts.
    a. Material: Die-cast zinc alloy.
    b. Listed for direct burial.
2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.05 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
1. Bury at least 30 inches (750 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

F. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.05 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.
   1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
   2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
   3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.06 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. Use exothermic welds for all below-grade connections.
   3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
   1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
   1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

J. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.07 FIELD QUALITY CONTROL

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

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
   3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding

terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Conduit and cable support devices.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

B. Related Requirements:
1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

   a. Slotted support systems, hardware, and accessories.
   b. Clamps.
   c. Hangers.
   d. Sockets.
   e. Eye nuts.
   f. Fasteners.
   g. Anchors.
   h. Saddles.
   i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.

3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.04 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified."
2. Component Importance Factor: 1.5.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Atkore International (Allied Tube & Conduit).
    b. Atkore International (Unistrut).
    c. Eaton (B-line).
    d. Flex-Strut Inc.
    e. nVent (CADDY).

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Eaton (B-line).
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti, Inc.
4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078400 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete.

C. Anchor equipment to concrete base as follows:
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
1. Section 078400 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.02 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.03 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
   4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB (Electrification Products Division).
      b. Anamet Electrical, Inc (Anaconda Sealtite).
      c. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
      d. Electri-Flex Company.
      e. Western Tube and Conduit Corporation.
      f. Wheatland Tube Company.

   2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. GRC: Comply with ANSI C80.1 and UL 6.
   4. ARC: Comply with ANSI C80.5 and UL 6A.
   5. IMC: Comply with ANSI C80.6 and UL 1242.
   6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.
      a. Comply with NEMA RN 1.
      b. Coating Thickness: 0.040 inch (1 mm), minimum.
   7. EMT: Comply with ANSI C80.3 and UL 797.
   8. FMC: Comply with UL 1; zinc-coated steel.
   9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB (Electrification Products Division).
      b. Anamet Electrical, Inc (Anaconda Sealtite).
      c. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
      d. Western Tube and Conduit Corporation.
      e. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
   a. Material: Steel.
   b. Type: Setscrew or compression.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB (Electrification Products Division).
   b. Anamet Electrical, Inc (Anaconda Sealtite).
   c. Cantex Inc.
   d. Kraloy Fittings.
   e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:
   a. Comply with NEMA TC 14.
   b. Comply with UL 2515 for aboveground raceways.
   c. Comply with UL 2420 for belowground raceways.
4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.
7. Rigid HDPE: Comply with UL 651A.
8. Continuous HDPE: Comply with UL 651A.
9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
10. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB (Electrification Products Division).
   b. Anamet Electrical, Inc (Anaconda Sealtite).
   c. Cantex Inc.
   d. Champion Fiberglass, Inc.
   e. Electri-Flex Company.
   f. Kraloy Fittings.
   g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
   a. Fittings for LFNC: Comply with UL 514B.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB (Electrification Products Division).
2. Eaton (B-line).
3. MonoSystems, Inc.
4. Schneider Electric USA (Square D).
5. Wiegmann; Hubbell Incorporated, Commercial and Industrial.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.05 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MonoSystems, Inc.
   b. Wiremold; Legrand North America, LLC.
   c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   b. Panduit Corp.
   c. Wiremold; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
2. Brooks-Jensen.
3. Christy.
4. FSR Inc.
5. Spring City Electrical Manufacturing Company.
6. Utility Vaault Co.
7. Wiremold; Legrand North America, LLC.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:
   1. Material: sheet metal.
   2. Type: Fully adjustable.
   3. Shape: Rectangular.
   4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

M. Gangable boxes are allowed.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:
   1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.07 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brooks-Jensen.
      b. Christy.
      c. Oldcastle Precast, Inc.
      d. Quazite; Hubbell Incorporated, Power Systems.
      e. Utility Vaault Co.

   2. Standard: Comply with SCTE 77.
   3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   6. Cover Legend: Molded lettering, "ELECTRIC.".
   7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
   8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brooks-Jensen.
      b. Christy.
      c. Oldcastle Precast, Inc.
      d. Utility Vaault Co.

   2. Standard: Comply with SCTE 77.
   3. Color of Frame and Cover: Gray.
   4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   7. Cover Legend: Molded lettering, "ELECTRIC.".

8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.08 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by an independent testing agency.
   2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC or EMT.
   3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gymnasiums.

   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: GRC or IMC.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
   4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

3.02 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from ENT to GRC or IMC with PVC coating before rising above floor.

M. Stub-Ups to Above Recessed Ceilings:
   1. Use EMT, IMC, or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of

slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Surface Raceways:
1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Z. Expansion-Joint Fittings:
1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.05 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 "Penetration Firestopping."

3.06 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast concrete handholes.
6. Polymer concrete handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes.
9. High-density plastic boxes.
10. Precast manholes.
11. Utility structure accessories.

1.02 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:
1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, boxes.
4. Include underground-line warning tape.
5. Include warning planks.

B. Shop Drawings:
   1. Precast or Factory-Fabricated Underground Utility Structures:

      a. Include plans, elevations, sections, details, attachments to other work, and accessories.
      b. Include duct entry provisions, including locations and duct sizes.
      c. Include reinforcement details.
      d. Include frame and cover design and manhole chimneys.
      e. Include ladder details.
      f. Include grounding details.
      g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
      h. Include joint details.
   2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

      a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
      b. Include duct entry provisions, including locations and duct sizes.
      c. Include cover design.
      d. Include grounding details.
      e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

C. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C858.

D. Source quality-control reports.

E. Field quality-control reports.

1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1.07 FIELD CONDITIONS

A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

B. Ground Water: Assume ground-water level is 36 inches (900 mm) below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Coated Steel Conduit: PVC-coated GRC.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Anamet Electrical, Inc (Anaconda Sealtite).
   2. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
   3. Champion Fiberglass, Inc.
   4. Republic Conduit.
   5. Western Tube and Conduit Corporation.
   6. Wheatland Tube Company.

D. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.02 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. ARNCO Corp.
   2. Cantex Inc.
   3. Condux International, Inc.
   4. Electri-Flex Company.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.03 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-40 HDPE, complying with NEMA TC 7 and UL 651A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARNCO Corp.
b. Carlon; a brand of Thomas & Betts Corporation.
c. National Pipe & Plastics.
d. Premier Conduit.

2. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.04 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Atkore International (Allied Tube & Conduit).
b. Cantex Inc.
c. Carlon; a brand of Thomas & Betts Corporation.
d. Underground Devices, Inc.

B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

C. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 75 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
1. Color: Red dye added to concrete during batching.
2. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.05 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.
2. Oldcastle Precast, Inc.
3. Utility Concrete Products, LLC.
4. Utility Vault Co.

C. Comply with ASTM C858 for design and manufacturing processes.

D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

F. Cover Legend: Molded lettering, "ELECTRIC." Or as indicated for each service.

G. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

H. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
1. Extension shall provide increased depth of 12 inches (300 mm).
2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

I. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

J. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
1. Splayed location.
2. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
5. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.

K. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
1. Type and size shall match fittings to duct to be terminated.
2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.

L. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.06 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Tests of materials shall be performed by an independent testing agency.
   2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

3.02 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Cables More Than 600 V: Type EPC-40-PVC RNC, concrete-encased unless otherwise indicated.

B. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, concrete-encased unless otherwise indicated.

C. Bored Underground Duct: Type EPEC-40-HDPE unless otherwise indicated.

D. Underground Ducts Crossing Paved Paths and Walks: Type EPC-40 PVC RNC, encased in reinforced concrete.

E. Stub-ups: Concrete-encased RNC and GRC above grade.

3.03 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:
   1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.

2. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
3. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
4. Cover design load shall not exceed the design load of the handhole or box.

3.04 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area immediately after backfilling is completed.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work.

E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.05 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

B. Install duct according to NEMA TCB 2.

C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.

D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.
1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.

F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures

are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell, without reducing duct slope and without forming a trap in the line.
   2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch (19 mm).
   3. Grout end bells into structure walls from both sides to provide watertight entrances.

H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.
   1. Begin change from regular spacing to terminator spacing 10 feet (3 m) from the terminator, without reducing duct line slope and without forming a trap in the line.
   2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch (19 mm).

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

K. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.

L. Concrete-Encased Ducts and Duct Bank:
   1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
   2. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
   3. Depth: Install so top of duct envelope is at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
   4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Duct: 3 inches (75 mm) between edge of duct and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and communications ducts.
7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
8. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.

    a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

        1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and minimum 3 inches (75 mm) from conduit side to edge of slab.

    c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.

        1) Stub-ups shall be minimum 4 inches (100 mm) above finished floor and no less than 3 inches (75 mm) from conduit side to edge of slab.
9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
11. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between duct of like services, and 4 inches (100 mm) between power and communications ducts.
12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.

b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

3.06 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:
1. Finish interior surfaces with a smooth-troweled finish.
2. Knockouts for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches (38 to 50 mm) thick, arranged as indicated.
3. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.

B. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches (375 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below frost line, below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071326 "Self-Adhering Sheet Waterproofing." After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.07 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

E. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
   1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
   2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.08 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.09 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
   2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-(300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
   3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump.
   1. Sweep floor, removing dirt and debris.
   2. Remove foreign material.

END OF SECTION

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 078400 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HOLDRITE; Reliance Worldwide Company.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 05 48.16

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Restraint channel bracings.
   2. Restraint cables.
   3. Seismic-restraint accessories.
   4. Mechanical anchor bolts.
   5. Adhesive anchor bolts.

B. Related Requirements:
   1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.
   1. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
      a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   2. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
      c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:
   1. Control panels.
   2. Luminaires.
   3. Panelboards.
   4. Switchboards.

B. Welding certificates.

C. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:
   1. Building Classification Category: I.
   2. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

B. Seismic-Restraint Loading:
   1. Site Class as Defined in the CBC: A.
   2. Assigned Seismic Use Group or Building Category as Defined in the CBC: I.
      a. Component Importance Factor: 1.0.
      b. Component Response Modification Factor: 1.5.
      c. Component Amplification Factor: 1.0.

2.02 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (B-line).
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.03 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (B-line).
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receiveseismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.02 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:
   1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of

the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Color and legend requirements for raceways, conductors, and warning labels and signs.
   2. Labels.
   3. Bands and tubes.
   4. Tapes and stencils.
   5. Tags.
   6. Signs.
   7. Cable ties.
   8. Paint for identification.
   9. Fasteners for labels and signs.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
   1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit].
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
   3. Color for Neutral: White.
   4. Color for Equipment Grounds: Green.
   5. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

E. Equipment Identification Labels:
   1. Black letters on a white field.

2.03 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brother International Corporation.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products; a Brady Corporation company.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brother International Corporation.
   c. Ideal Industries, Inc.
   d. Marking Services, Inc.
   e. Panduit Corp.
2. Minimum Nominal Size:
   a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
   b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
   c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Panduit Corp.

2.05 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlton Industries, LP.
   b. Ideal Industries, Inc.
   c. Marking Services, Inc.
   d. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.

C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. HellermannTyton.
   b. LEM Products Inc.
   c. Seton Identification Products; a Brady Corporation company.

D. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Ideal Industries, Inc.

2. Tape:
   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.
   c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
   a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

2.06 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. Seton Identification Products; a Brady Corporation company.

2.07 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlton Industries, LP.
   b. Champion America.

2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Champion America.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.

2. Engraved legend.
3. Thickness:
   a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
   b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
   c. Engraved legend with black letters on white face.
   d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

L. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:
   1. Place in a location with high visibility and accessibility.
   2. Secure using general-purpose and plenum-rated cable ties.

X. Baked-Enamel Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

Y. Metal-Backed Butyrate Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

Z. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

AA. Cable Ties: General purpose, for attaching tags, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl tape applied in bands.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

F. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

H. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

I. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

K. Arc Flash Warning Labeling: Self-adhesive labels.

L. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

M. Equipment Identification Labels:
   1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchboards.
      e. Emergency system boxes and enclosures.
      f. Enclosed switches.

g. Enclosed circuit breakers.
h. Enclosed controllers.
i. Variable-speed controllers.
j. Push-button stations.
k. Remote-controlled switches, dimmer modules, and control devices.
l. Battery-inverter units.
m. Battery racks.
n. Monitoring and control equipment.
o. UPS equipment.

END OF SECTION

SECTION 26 05 72

OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.01 DEFINITIONS

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

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.02 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Short-circuit study input data, including completed computer program input data sheets.
   2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
      b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.04 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ESA Inc.
2. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
1. Protective device designations and ampere ratings.

2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:
      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Obtain all data necessary for the conduct of the study.
   1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
   2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
   7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   9. Motor horsepower and NEMA MG 1 code letter designation.
   10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.02 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
   1. Electric utility's supply termination point.
   2. Low-voltage switchgear.
   3. Control panels.
   4. Branch circuit panelboards.
   5. Disconnect switches.

3.03 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.04 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
   1. Study results shall be used to determine coordination of series-rated devices.

1.02 DEFINITIONS

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

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.03 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and equipment evaluation reports.
   3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. The following parts from the Protective Device Coordination Study Report:
         1) One-line diagram.
         2) Protective device coordination study.
         3) Time-current coordination curves.
      b. Power system data.

1.06 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. ESA Inc.
      b. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report

device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:
   a. Arcing faults.
   b. Simultaneous faults.
   c. Explicit negative sequence.
   d. Mutual coupling in zero sequence.

2.02 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
   a. Power utility's overcurrent protective device.
   b. Medium-voltage equipment overcurrent relays.
   c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
   d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
   e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
   f. Cables and conductors damage curves.
   g. Ground-fault protective devices.
   h. Motor-starting characteristics and motor damage points.
   i. Generator short-circuit decrement curve and generator damage point.
   j. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
   1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:
   1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
   2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
   1. Electric utility's supply termination point.
   2. Switchgear.

3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

M. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.03 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.04 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and, and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

3.05 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.
1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment

designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.

k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.06 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.07 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:
   1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
   2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
   3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION

SECTION 26 05 74

OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.02 DEFINITIONS

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

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.03 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
      a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.06 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. ESA Inc.
      b. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Working distance.
   6. Incident energy.
   7. Hazard risk category.
   8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.03 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Location designation.
   2. Nominal voltage.
   3. Flash protection boundary.
   4. Hazard risk category.
   5. Incident energy.
   6. Working distance.
   7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.02 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:
   1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
   2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.
   1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
   2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond three to five cycles.
   2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
   1. When the circuit breaker is in a separate enclosure.
   2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.03 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
   1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.
   2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.04 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
   1. Motor-control center.
   2. Low-voltage switchboard.
   3. Switchgear.
   4. Medium-voltage switch.
   5. Control panel.

3.05 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.06 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.
7. Emergency shunt relays.

B. Related Requirements:
1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Show installation details for the following:
   a. Occupancy sensors.
   b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
2. Structural members to which equipment will be attached.
3. Items penetrating finished ceiling, including the following:
   a. Luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Control modules.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.05 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of lighting control software.
      b. Faulty operation of lighting control devices.
   2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Cooper Industries, Inc.
   2. Intermatic, Inc.
   3. Leviton Manufacturing Co., Inc.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
   1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
   2. Contact Configuration: SPST.
   3. Contact Rating: 30-A inductive or resistive, 240-V ac.
   4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
   5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
   6. Astronomic Time: All channels.
   7. Automatic daylight savings time changeover.
   8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.02 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. nLight.
2. Cooper Greengate.
3. Wattstopper DLM.
4. Leviton Manufacturing Co., Inc.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

2.03 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Hubbell Control Solutions; Hubbell Incorporated, Lighting.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. WattStopper; Legrand North America, LLC.

B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
   a. When no daylight is present (target level).
   b. When significant daylight is present.
2. System programming is done with two hand-held, remote-control tools.
   a. Initial setup tool.
   b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with integrated power pack, to detect changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

E. Power Pack: Digital controller capable of accepting 3 RJ45 inputs with two outputs rated for 20-A incandescent or LED load at 120- and 277-V ac, for 13-A LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.
1. With integral current monitoring
   a. Compatible with digital addressable lighting interface.

      1) Plenum rated.

2.04 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. RAB Lighting.
4. Schneider Electric USA (Square D).
5. Sensor Switch, Inc.
6. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors:
1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch; and BAS and lighting control system.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

10. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 48 inches (1200 mm) above finished floor.

2.05 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. nLight.
2. Cooper Greengate.
3. Wattstopper DLM.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: per architect.
11. Faceplate: Color matched to switch.

D. Wall-Switch Sensor Tag WS2:
1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: PIR.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: per Architect.
11. Faceplate: Color matched to switch.

2.06 OUTDOOR MOTION SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. NSi Industries LLC.
3. Sensor Switch, Inc.
4. WattStopper; Legrand North America, LLC.

B. Description: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.

2. PIR type, weatherproof. Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
3. Switch Rating:
   a. Luminaire-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent/LED.
4. Switch Type: SP, manual "on," automatic "off." With bypass switch to override the "on" function in case of sensor failure.
5. Voltage: Match the circuit voltage type.
6. Detector Coverage:
   a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
   b. Long Range: 180-degree field of view and 110-foot (34-m) detection range.
7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

2.07 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Lighting Control and Design.
   2. WattStopper; Legrand North America, LLC.

B. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
   1. Coil Rating: Match fixture voltage.

2.08 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 No. 16 No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected and wiring terminations suitable including proper identification and labeling.

3.02 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.03 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.04 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.05 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports and provide to the Owner’s representative for review and approval.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
   1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
   2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
   3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.08 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of

Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.23 "Relay-Based Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 09 43.23

RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Lighting control panels using mechanically held relays for switching.

B. Section Includes: Networked lighting control panels using control-voltage relays for switching and that are interoperable with HVAC DDC system.

1.2 DEFINITIONS

A. BAS: Building automation system.

B. DDC: Direct digital control.

C. IP: Internet protocol.

D. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   3. Sound data including results of operational tests of central dimming controls.
   4. Operational documentation for software and firmware.

B. Shop Drawings: For each relay panel and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail wiring partition configuration, current, and voltage ratings.
   4. Short-circuit current rating of relays.
   5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
   6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.

7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
   1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
   2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.

B. Qualification Data: For testing agency.

C. Field quality-control reports.

D. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

E. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On USB drive.
   3. Device address list.
   4. Printout of software application and graphic screens.
   5. Testing and adjusting of panic and emergency power features.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lighting Control Relays: Equal to 10 percent of amount installed for each size indicated, but no fewer than 5.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation according to NECA 407.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of standalone multipreset modular dimming controls that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Damage from transient voltage surges.
   2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
   3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.

B. Interface with HVAC BAS System: Hardware and software shall interface with HVAC BAS system to monitor, control, display, and record data for use in processing reports. Comply with requirements in Section 230900 "Building Automation (BAS) System."
   1. Hardwired Points:
      a. Monitoring: On-off status.
      b. Control: On-off operation.
   2. Communication Interface: Comply with ASHRAE 135. The communication interface shall enable the HVAC BAS system operator to remotely control and monitor lighting from a HVAC BAS system operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the HVAC BAS system. Comply with requirements in Section 230900 " Building Automation (BAS) System."

C. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.

F. Comply with UL 916.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Lighting control panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. Component Importance Factor: 1.0.

2.3 LIGHTING CONTROL RELAY PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Leviton Manufacturing Co., Inc.
   2. Lithonia Lighting; Acuity Brands Lighting, Inc.
   3. Siemens Industry, Inc., Energy Management Division.
   4. WattStopper; Legrand North America, LLC.

B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.

C. Lighting Control Panel:
   1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
   2. A vertical barrier separating branch circuits from control wiring.

D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
   1. Timing Unit:
      a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
      b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
      c. Four independent schedules, each having 24 time periods.
      d. Schedule periods settable to the minute.
      e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
      f. 10 special date periods.
   2. Sequencing Control with Override:
      a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
      b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
      c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
      d. Override control "blink warning" shall warn occupants approximately five minutes before actuating the off sequence.

3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.

E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating shall be not less than 14 kA. Control shall be three-wire, 24-V ac.

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:
1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

2.4 NETWORKED LIGHTING CONTROL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wattstopper.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.

C. Lighting Control Panels:
1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

D. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
1. Ethernet Communications: Comply with TCP/IP protocol. The main control unit shall provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
2. Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.
3. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
   a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.

b. Panel summary showing the master and slave panels connected to the controller.
c. Controller diagnostic information.
d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens shall also allow direct breaker control and zone overrides.

4. Timing Unit:
   a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
   b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
   c. Four independent schedules, each having 24 time periods.
   d. Schedule periods settable to the minute.
   e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
   f. 16 special date periods.
5. Time Synchronization: The timing unit shall be updated not less than every 24 hour(s) with the network time server.
6. Sequencing Control with Override:
   a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
   b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
   c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
   d. Override control "blinking warning" shall warn occupants approximately five minutes before actuating the off sequence.
   e. Activity log, storing previous relay operation, including the time and cause of the change of status.
   f. Download firmware to the latest version offered by manufacturer.

E. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.
1. Electronic control for operating and monitoring individual relays, and display relay on-time.
2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
3. Integral keypad and digital-display front panel for local setup, including the following:
   a. Blink notice, time adjustable from software.
   b. Ability to log and display relay on-time.
   c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.

F. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit

current rating shall be not less than 14 kA. Control shall be three-wire, 24-V ac digital control network.

G. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.

H. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device shall remain the property of Owner.

I. Software:
   1. Menu-driven data entry.
   2. Online and offline programming and editing.
   3. Provide for entry of the room or space designation for the load side of each relay.
   4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
   5. Size the software appropriate to the system.

2.5 MANUAL SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
   1. Match color and style specified in Section 262726 "Wiring Devices."
   2. Integral green LED pilot light to indicate when circuit is on.
   3. Internal white LED locator light to illuminate when circuit is off.

B. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."

C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.6 FIELD-MOUNTED SIGNAL SOURCES

A. Daylight Harvesting Switching Controls: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

B. Indoor Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Twisted-Pair Data Cable: Category 6. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panels according to NECA 407.

B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceway except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental airspaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 PANEL INSTALLATION

A. Comply with NECA 1.

B. Install panels and accessories according to NECA 407.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panel cabinet plumb and rigid without distortion of box.

F. Install filler plates in unused spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers described below. Certify compliance with manufacturer's test parameters.
      a. Circuit-Breaker Tests:
         1) Compare nameplate with Drawings and Specifications.
         2) Inspect physical and mechanical conditions.

3) Inspect anchorage and alignment.
4) Verify that the units are clean.
5) Operate the circuit breaker to ensure smooth operation.
6) Inspect bolted electrical connections for high resistance using one or more of the following methods:
   a) A low-resistance ohmmeter.
   b) Verify tightness of bolted electrical connections by calibrated torque wrench.
   c) Thermographic survey.
7) Inspect operating mechanism, contacts, and arc chutes in unsealed units.
8) Perform adjustments for final protective device settings according to the overcurrent protective device coordination study. Comply with requirements in Section 260573 "Coordination Studies."
9) Perform insulation resistance tests for one minute on each pole, phase-to-phase, and phase-to-ground with the circuit breaker closed and across each pole using manufacturer's published data.
10) Perform a contact/pole-resistance test.
11) Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be for one minute. Follow manufacturer's written instructions for solid-state units.
12) Determine long-time pickup and delay by primary current injection.
13) Determine short-time pickup and delay by primary current injection.
14) Determine ground-fault pickup and time delay by primary current injection.
15) Determine instantaneous pickup by primary current injection.
16) Test functions of the trip unit by means of secondary injection.
17) Perform minimum pickup voltage tests on shunt trip and close coils according to manufacturer's published data.
18) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset trip logs and indicators.
19) Verify operation of charging mechanism.

b. Surge Arrestor Tests:
   1) Compare nameplate with the Contract Documents.
   2) Inspect physical and mechanical conditions.
   3) Inspect anchorage, alignment, grounding, and clearances.
   4) Verify that the units are clean.
   5) Inspect bolted electrical connections for high resistance using one or more of the following methods:
      a) Low-resistance ohmmeter.
      b) Verify tightness of bolted electrical connections by calibrated torque wrench.
   6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

7) Perform an insulation-resistance test on each arrestor, phase terminal-to-ground using voltage according to manufacturer written instructions.
8) Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding tests.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

F. Lighting control panel will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.
3. Provide startup plan method of procedure (MOP) for review and approval by Owner’s Rep.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Service and distribution switchboards rated 600 V and less.
   2. Surge protection devices.
   3. Disconnecting and overcurrent protective devices.
   4. Identification.

B. Related Requirements
   1. Section 260574 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.02 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
   1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
   5. Detail utility company's metering provisions with indication of approval by utility company.
   6. Include evidence of NRTL listing for series rating of installed devices.
   7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards in PDF Format.
   9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

D. Delegated Design Submittal:
   1. For arc-flash hazard analysis.
   2. For arc-flash labels.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Routine maintenance requirements for switchboards and all installed components.
      b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
      c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
   2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
   6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards.

C. Handle and prepare switchboards for installation according to NECA 400.

1.08 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:
   1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
      b. Altitude: Not exceeding 6600 feet (2000 m).

C. Unusual Service Conditions: NEMA PB 2, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet (2000 m).

1.09 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
   2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.02 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Eaton.
   2. Schneider Electric USA (Square D).
   3. Siemens Industry, Inc., Energy Management Division.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Nominal System Voltage: 208Y/120 V.

J. Main-Bus Continuous: 2000 A.

K. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

L. Indoor Enclosures: Steel, NEMA 250, Type 1.

M. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

N. Barriers: Between adjacent switchboard sections.

O. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

P. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

Q. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

R. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

S. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

T. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
4. Copper feeder circuit-breaker line connections.
5. Tin-plated aluminum feeder circuit-breaker line connections.
6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
7. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
8. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
9. Disconnect Links:
   a. Isolate neutral bus from incoming neutral conductors.
   b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
10. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
11. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

U. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

V. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

W. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.03 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Protection Technologies Inc. (APT).
2. Curreht Technology.
3. Eaton.
4. Schneider Electric USA (Square D).
5. Siemens Industry, Inc., Energy Management Division.

B. SPDs: Comply with UL 1449, Type 1 or Type 2.

C. Features and Accessories:

1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
2. Indicator light display for protection status.
3. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
4. Surge counter.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 250kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

F. SCCR: Equal or exceed 200 kA.

G. Nominal Rating: 20 kA.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long and short time adjustments.
   d. Ground-fault pickup level, time delay, and I squared t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
e. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
f. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.05 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
d. Megawatts: Plus or minus 1 percent.
e. Megavars: Plus or minus 1 percent.
f. Power Factor: Plus or minus 1 percent.
g. Frequency: Plus or minus 0.1 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.06 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

2.07 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400.
   1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
   2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
   3. Protect from moisture, dust, dirt, and debris during storage and installation.
   4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

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

3.02 INSTALLATION

A. Install switchboards and accessories according to NECA 400.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
   1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches (50-mm) above concrete base after switchboard is anchored in place.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to switchboards.
   6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, surge protection devices, and instrumentation.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.03 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

C. Support and secure conductors within the switchboard according to NFPA 70.

D. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:
   1. Acceptance Testing:
      a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
      b. Test continuity of each circuit.
   2. Test ground-fault protection of equipment for service equipment per NFPA 70.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   5. Perform the following infrared scan tests and inspections, and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
   7. Provide startup plan method of procedure (MOP) for review and approval by Owner’s Rep.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.07 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.02 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of NRTL listing for series rating of installed devices.
   7. Include evidence of NRTL listing for SPD as installed in panelboard.
   8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   9. Include wiring diagrams for power, signal, and control wiring.

10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; See "Testing and Inspecting" Article in the Evaluations for guidance on which option to select in paragraph below.

B. Handle and prepare panelboards for installation according to NECA 407.

1.09 FIELD CONDITIONS

A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature

and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet (2000 m).

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
   1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Height: 84 inches (2.13 m) maximum.
   3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Same finish as panels and trim.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:
1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.03 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Schneider Electric USA (Square D).
3. Siemens Industry, Inc., Energy Management Division.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

G. Branch Overcurrent Protective Devices: Fused switches.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Schneider Electric USA (Square D).
3. Siemens Industry, Inc., Energy Management Division.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Schneider Electric USA (Square D).
3. Siemens Industry, Inc., Energy Management Division.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:

      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Subfeed Circuit Breakers: Vertically mounted.
6. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
   h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
   i. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
   j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
   k. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   l. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
   m. Multipole units enclosed in a single housing with a single handle factory assembled to operate as a single unit.
   n. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

o. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:
a. Standard ampere ratings and number of poles.
b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
c. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.06 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.02 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:
   1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
   2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
   3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.
   2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

P. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:

         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   4. Provide startup plan method of procedure (MOP) for review and approval by Owner's Rep.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
   1. Measure loads during period of normal facility operations.
   2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
   4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.06 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 27 13

ELECTRICITY METERING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes electricity metering.

1.02 DEFINITIONS

A. KY or KYZ Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity (kWh) that is based on a relay opening and closing in response to the rotation of the disk in the meter. Electronic meters generate pulses electronically.

1.03 ACTION SUBMITTALS

A. Product Data:
   1. For metering infrastructure components.

B. Shop Drawings: For electricity-metering equipment.
   1. Include elevation views of front panels of control and indicating devices and control stations.
   2. Include diagrams for power, signal, and control wiring.
   3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
   4. Include series-combination rating data for modular meter centers with main disconnect device.
   5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Application and operating software documentation.
   2. Software licenses.
   3. Software service agreement.
   4. Device address list.
   5. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy Submittal.
   6. Meter data sheet for each meter, listing nameplate data and serial number, accuracy certification, and test results.
   7. Meter installation and billing software startup report.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Damage from transient voltage surges.
   2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
   3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.08 COORDINATION

A. Electrical Service Connections:
   1. Coordinate with utility companies and utility-furnished components.
      a. Comply with requirements of utility providing electrical power services.
      b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 916.

2.02 UTILITY METERING INFRASTRUCTURE

A. Install metering accessories furnished by the utility company, complying with its requirements.

B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.
   1. Data Transmission: Transmit pulse data over control-circuit conductors, classified as Class 1 per NFPA 70, Article 725. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

D. Meter Sockets:
   1. Comply with requirements of electrical-power utility company.
   2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

E. Arc-Flash Warning Labels;
   1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 260574 "Arc-Flash Studies." Apply a 3-1/2-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.
   2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a 3-1/2-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
      a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
         1) Location designation.
         2) Nominal voltage.
         3) Flash protection boundary.
         4) Hazard risk category.
         5) Incident energy.
         6) Working distance.
         7) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install arc-flash labels as required by NFPA 70.

D. Wiring Method:
   1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 271500 "Communications Copper Horizontal Cabling."
   3. Minimum conduit size shall be 3/4 inch (19 mm).

3.02 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Equipment Identification Labels: Self-adhesive labels with clear protective overlay.

3.03 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:
   1. Equipment and Software Setup:
      a. Set meter date and time clock.
      b. Test, calibrate, and connect pulse metering system.
      c. Set and verify billing demand interval for demand meters.
      d. Report settings and calibration results.
      e. Set up reporting and billing software, insert billing location names and initial constant values and variable needed for billing computations.
   2. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
   3. Turn off circuits supplied by metered feeder and secure them in off condition.
   4. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
   5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
   6. Generate test report and billing for each tenant or activity from the meter reading tests.

F. Electricity metering will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Provide startup plan method of procedure (MOP) for review and approval by Owner's Rep.

3.04 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.05 DEMONSTRATION

A. Train Owner's clerical and maintenance personnel to use, adjust, operate, and maintain the electronic metering and billing software.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. Isolated Ground Receptacles. 125V, 20A.
5. Toggle switches, 120/277 V, 20 A.
6. Decorator-style devices, 20 A.
7. Occupancy sensors.
8. Digital timer light switches.
9. Wall-box dimmers.
10. Wall plates.
11. Floor service fittings.
12. Poke-through assemblies.
13. Prefabricated multioutlet assemblies.

1.02 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
   2. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
   3. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:
   1. Receptacles: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
   2. SPD Devices: Blue.
   3. Isolated-Ground Receptacles: Orange (if required).

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Isolated-Ground Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

D. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

E. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.03 USB RECEPTACLES

A. USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

3. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.04 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Pass & Seymour; Legrand North America, LLC.
   b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.05 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Comply with UL 20 and FS W-S-896.

C. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Description: Illuminated when switch is on.
3. Standards: Comply with UL 20 and FS W-S-896.

D. Lighted Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.

2. Description: Handle illuminated when switch is off.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

E. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Factory-supplied key in lieu of switch handle.
3. Standards: Comply with UL 20 and FS W-S-896.

2.06 DECORATOR-STYLE DEVICES, 20 A

A. Decorator Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.

B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Decorator, Tamper- and Weather-Resistant, Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

D. Decorator Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Comply with UL 20.

E. Decorator Single-Pole Lighted Switches,120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Wiring Devices - Arrow Hart).
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour; Legrand North America, LLC.
    d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Square face illuminated when circuit is switched off.
3. Standards: Comply with UL 20.

2.07 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Wiring Devices - Arrow Hart).
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour; Legrand North America, LLC.
    d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Adjustable time delay of 20 minutes.
6. Able to be locked to Automatic-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).
8. Connections: Provisions for connection to BAS.
9. Connections: RJ-45 communications outlet.
10. Connections: Integral wireless networking.

2.08 DIMMERS

A. Wall-Box Dimmers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Wiring Devices - Arrow Hart).
    b. Leviton Manufacturing Co., Inc.
    c. Lutron Electronics Co., Inc.
    d. Pass & Seymour; Legrand North America, LLC.
    e. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

3. Control: Continuously adjustable slider; with single-pole or three-way switching.
4. Standards: Comply with UL 1472.
5. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   a. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."
6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.09 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
5. Surface mounted boxes: Metal, Plastic cover plates are not acceptable.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Flush-Type Floor Service Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Wiring Devices - Arrow Hart).
   b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   c. Wiremold; Legrand North America, LLC.

2. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Service Plate and Cover: Rectangular, die-cast aluminum with satin finish.
5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
6. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271500 "Communications Copper Horizontal Cabling."

B. Flap-Type Service Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
c. Pass and Seymour.
d. Leviton.

2. Description: Type: Modular, flap-type, dual-service units suitable for wiring method used, with flaps flush with finished floor.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Flaps: Rectangular, die-cast aluminum with satin finish.
5. Service Plate: Same finish as flaps.
6. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
7. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271500 "Communications Copper Horizontal Cabling."

C. Above-Floor Service Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Wiring Devices - Arrow Hart).
b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
c. Wiremold; Legrand North America, LLC.

2. Description: Type: Modular, above-floor, dual-service units suitable for wiring method used.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Service Plate: Rectangular, solid brass with satin finish.
5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
6. Data Communication Outlet: Blank cover with bushed cable opening.

2.11 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell.
2. Pass & Seymour; Legrand North America, LLC.
3. Wiremold; Legrand North America, LLC.
4. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Standards: Comply with scrub water exclusion requirements in UL 514.

D. Service-Outlet Assembly: Pedestal type with services indicated Flush type with two simplex receptacles and space for two RJ-45 jacks or Flush type with four simplex receptacles and space for four RJ-45 jacks, complying with requirements in Section 271500 "Communications Copper Horizontal Cabling."

E. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.

F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

G. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire rating of floor.

H. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271500 "Communications Copper Horizontal Cabling."

2.12 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Leviton.
2. Pass and Seymour.
3. Wiremold; Legrand North America, LLC.
4. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: Metal, with manufacturer's standard finish.

E. Multioutlet Harness:
1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 18 inches (460 mm).
3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan-speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use Brother P-Touch labeling system with ½” tape with yellow on black on device plates, or equal by Panduit and durable wire markers or tags inside outlet boxes. Handwritten labels are unacceptable.

C. Key operated switches, switches with pilot lights, and switches for the control of motors, heaters and ventilators. Engraving shall be black and occur on the exposed side of the plate indicating the motor, heater, or ventilator controlled.

3.04 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

F. Wiring device will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600 V ac and less for use in the following:
      a. Control circuits.
      b. Enclosed controllers.
      c. Enclosed switches.
   2. Spare-fuse cabinets.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   3. Current-limitation curves for fuses with current-limiting characteristics.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
   4. Coordination charts and tables and related data.

1.04 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.05 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Bussmann; Eaton, Electrical Sector.
   2. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
   1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
   2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
   3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
   4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
   5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
   6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.03 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.
   3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
   4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Motor Branch Circuits: Class RK1, time delay.
   2. Large Motor Branch (601-4000 A): Class L, time delay.
   3. Other Branch Circuits: Class RK1, time delay.
   4. Control Transformer Circuits: Class CC, time delay, control transformer duty.
   5. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.04 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information

inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.02 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.
1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
      b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2010 m).

1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.02 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.03 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. ABB (Electrification Products Division).
   2. Eaton.
   3. Schneider Electric USA (Square D).
   4. Approved Equal.

B. Type HD, Heavy Duty:
   1. Single or Double throw.
   2. Three pole.
   3. 600-V ac.
   4. 200 A and smaller.
   5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
   6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.04 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB (Electrification Products Division).
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Approved Equal.

B. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.05 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (Bussmann & Edison).
2. Littelfuse, Inc.
3. Approved equal.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30, 60, 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, 30, 60, 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated,

lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

E. Control Circuit: 120-V ac.

F. Accessories:
1. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
2. Form C alarm contacts that change state when switch is tripped.
3. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24-V dc.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.06 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Schneider Electric USA (Square D).
3. Siemens Industry, Inc., Energy Management Division.
4. Approved equal..

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 167 deg F (75 deg C) rated wire.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

H. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

2.07 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1) or directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

3.03 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.04 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.05 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:

         1) Use a low-resistance ohmmeter.

            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.

i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuse holder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Coordination Studies."

END OF SECTION

SECTION 26 29 23

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.2 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.
   1. Include dimensions and finishes for VFCs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.
   1. Include mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Required working clearances and required area above and around VFCs.
   2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
   3. Show support locations, type of support, and weight on each support.
   4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.
   1. Certificate of compliance.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
      b. Manufacturer's written instructions for setting field-adjustable overload relays.
      c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
      d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
      e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
      f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch

settings for motor-running overload protection suit actual motors to be protected.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   2. Indicating Lights: Two of each type and color installed.
   3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
   4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB Low Voltage HVAC Drives.
   2. Eaton.
   3. Schneider Electric USA, Inc.
   4. Siemens Industry, Inc., Energy Management Division.
   5. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:
   1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: Constant torque and variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
   1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
   2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
   3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:
   1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
   2. Input AC Voltage Unbalance: Not exceeding 3 percent.
   3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
   4. Minimum Efficiency: 97 percent at 60 Hz, full load.
   5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
   6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
   7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
   8. Humidity Rating: Less than 95 percent (noncondensing).
   9. Altitude Rating: Not exceeding 3300 feet (1000 m).
   10. Vibration Withstand: Comply with NEMA ICS 61800-2.
   11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
   12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
   13. Speed Regulation: Plus or minus 5 percent.
   14. Output Carrier Frequency: Selectable; 0.5 to 12 kHz.

15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
   1. Signal: Electrical.

I. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 0.1 to 999.9 seconds.
   4. Deceleration: 0.1 to 999.9 seconds.
   5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:
   1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
   2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
   3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
   4. Under- and overvoltage trips.
   5. Inverter overcurrent trips.
   6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
   7. Critical frequency rejection, with three selectable, adjustable deadbands.
   8. Instantaneous line-to-line and line-to-ground overcurrent trips.
   9. Loss-of-phase protection.
   10. Reverse-phase protection.
   11. Short-circuit protection.
   12. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

O. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.
   1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
   2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
   3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
   4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
   5. NO alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:
   1. Power on.
   2. Run.
   3. Overvoltage.
   4. Line fault.
   5. Overcurrent.
   6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
   2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
      a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:
   1. Real-time clock with current time and date.
   2. Running log of total power versus time.
   3. Total run time.
   4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Motor torque (percent).
   6. Fault or alarming status (code).
   7. PID feedback signal (percent).
   8. DC-link voltage (V dc).
   9. Set point frequency (Hz).
   10. Motor output voltage (V ac).

E. Control Signal Interfaces:
   1. Electric Input Signal Interface:
      a. A minimum of two programmable analog inputs: 0- to 10-V dc.
      b. A minimum of six multifunction programmable digital inputs.
   2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
      a. 0- to 10-V dc.
      b. 4- to 20-mA dc.
      c. Potentiometer using up/down digital inputs.
      d. Fixed frequencies using digital inputs.
   3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:
      a. Output frequency (Hz).
      b. Output current (load).
      c. DC-link voltage (V dc).
      d. Motor torque (percent).
      e. Motor speed (rpm).
      f. Set point frequency (Hz).
   4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
      a. Motor running.
      b. Set point speed reached.
      c. Fault and warning indication (overtemperature or overcurrent).
      d. PID high- or low-speed limits reached.

F. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
   1. Hardwired Points:
      a. Monitoring: On-off status.
      b. Control: On-off operation.
   2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.6 OPTIONAL FEATURES

A. Damper control circuit with end-of-travel feedback capability.

B. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

C. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

D. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

E. Remote digital operator kit.

F. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer.

2.7 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.
   2. Outdoor Locations: Type 3R.
   3. Other Wet or Damp Indoor Locations: Type 4.
   4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.8 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
   1. Push Buttons: Covered Shielded.
   2. Pilot Lights: Push to test.
   3. Selector Switches: Rotary type.
   4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. Reversible NC/NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
   1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:
   1. Elapsed-time meter.
   2. Kilowatt meter.
   3. Kilowatt-hour meter.

F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

H. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

J. Spare control-wiring terminal blocks; unwired.

2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
   1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
   2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

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

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
   1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
   2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

C. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
   2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each VFC with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Provide startup plan method of procedure (MOP) for review and approval by Owner’s Rep.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust

settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 26 33 23.11

CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

PART 1 - GENERAL

1.01 DEFINITIONS

A. DDC: Direct digital control.

B. CBC: California Building Code.

C. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time can be "slow" (up to approximately 1 second) or "fast" (2-4 ms or 40-50 ms, depending on manufacturer).

D. LED: Light-emitting diode.

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

F. NiCd: Nickel cadmium.

G. OCPD: Overcurrent protective device.

H. PC: Personal computer.

I. PWM: Pulse-width modulated.

J. TDD: Total demand (harmonic current) distortion (also listed as "THD" in catalog data by manufacturers).

K. THD(V): Total harmonic voltage demand.

L. Uninterruptible: As used in the Section Text, an on-line, double-conversion (rectifier/inverter) unit, with no interruption of power to the load on interruption and restoration of the "normal" source.

M. UPS: Uninterruptible power supply.

N. VRLA: Valve-regulated lead acid.

1.02 ACTION SUBMITTALS

A. Product Data: For each type and rating of central battery equipment unit.

1. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, shipping splits, and furnished options, specialties, and accessories.

B. Shop Drawings: For each type and rating of central battery equipment unit.
1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
4. Include elevation, details, and legends of control and indication displays.
5. Include -circuit current (withstand) rating of unit.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around central battery equipment. Show central battery equipment layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

B. Qualification Data: For Installer.

C. Seismic Qualification Data: For central battery equipment, accessories, and components, from manufacturer.
1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of central battery equipment.

E. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze designated operating scenarios, including recommendations for input filtering of central battery equipment to limit TDD and THD(V) to specified levels.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For central battery equipment to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   a. Manufacturer's written instructions for testing central battery equipment.
   b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   c. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
   1. Fuses: One for every 10 of each type and rating, but no fewer than 2 of each type.
   2. Output Circuit Breakers: One for every 10 of each type and rating, but no fewer than 2 of each type.
   3. Output Circuit Breaker Open/Tripped Alarm Contacts: One for every 10 supplied, but no fewer than 2 of each type.
   4. Cabinet Ventilation Filters: One complete set.
   5. Circuit Board: One spare circuit board for each critical circuit.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles.

B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
   2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
   3. Humidity: More than 95 percent (condensing).
   4. Altitude: Exceeding 3300 feet (1000 m).

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.
   1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
      a. Central Battery Equipment (excluding Batteries): One year(s).
      b. Standard VRLA Batteries:

         1) Full Warranty: One year(s).
         2) Pro Rata: Nine years.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Central battery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated central battery equipment shall be tested and certified by an NRTL as meeting ICC-ES AC 156 test procedure requirements.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.02 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Chloride Systems.
   2. Crucial Power Products.
   3. Dual-Lite.
   4. Emergi-Lite; a Thomas & Betts brand.
   5. Myers Power Products, Inc.

B. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924.
   3. Comply with the IBC, NFPA 70, and NFPA 101.

4. Comply with NEMA PE 1.

C. Performance Requirements:
1. Fast-Transfer Central Battery Equipment: Passive standby (off-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 2-4 ms or less from normal supply to battery-inverter supply.
2. Automatic Operation:
   a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.
   b. Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
   c. If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
   d. If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.
   e. When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
   f. If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.
   g. If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.
   h. If battery is disconnected, and normal ac power is available, central battery equipment continues to supply power to the load with no degradation of its regulation of voltage and frequency of output bus.

D. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of central battery equipment input voltage rating.
2. Input Frequency Tolerance: Plus or minus 3 percent of central battery equipment frequency rating.
3. Synchronizing Slew Rate: 1 Hz per second, maximum.
4. Minimum Off-Line Efficiency: 99 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or operating condition.
6. Ambient Temperature Rating (Other Than Batteries): Not less than 68 deg F (20 deg C) and not exceeding 86 deg F (30 deg C).
7. Ambient Storage Temperature Rating (Other Than Batteries): Not less than minus 4 deg F (minus 20 deg C) and not exceeding 158 deg F ((70 deg C).)

8. Ambient Temperature Rating (Batteries): Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
9. Ambient Storage Temperature Rating (Batteries): Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F ((40 deg C).)
10. Humidity Rating: Less than 95 percent (noncondensing).
11. Altitude Rating: Not exceeding 3300 feet (1005 m).
12. Off-Line Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

E. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.

F. Controls and Indication:
1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:
   a. Normal power available.
   b. Status of system.
   c. Battery charging status.
   d. On battery power.
   e. System fault.
   f. External fault.
2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   a. Keypad: In addition to required programming and control keys, include the following:

      1) Keys for METER, CONTROL, PROGRAM, and CLEAR modes.
      2) Security Access: Provide electronic security access to controls through identification and password with at least two levels of access: View only; and view, operate, and service.
      3) Control Authority: Supports at least three conditions: Off, local manual control at unit and local automatic control at unit.
   b. Digital Display: Plain-English language messages on a digital display; provide the following historical logging information and displays:

      1) Real-time clock with current time and date.
      2) Tests and Events Logs: Record and store up to 25 tests and events.

         a) Dates.
         b) Times.
         c) Durations.
         d) Output voltage and currents.

      3) Alarm Logs: Record and store up to 25 alarms.

         a) Dates.
         b) Times.
         c) Alarm type.

4) Metering Functions: Display central battery equipment metering parameters including, but not limited to, the following:

a) Input and output voltage (V ac) and output current (A ac).
b) Battery voltage (V dc) and current (A ac).
c) Fault or alarming status (code).
d) Power output (VA).
e) Inverter load (W).
f) Ambient temperature (deg F).
g) System run time (cumulative days).
h) Inverter run time (cumulative minutes).

5) Alarm Functions: Digital display mounted flush in unit door and connected to display central battery equipment parameters including, but not limited to, the following:

a) High/low battery charge voltage.
b) High/low input voltage.
c) Battery nearing low-voltage condition.
d) Battery low voltage.
e) High ambient temperature.
f) Inverter fault.
g) Output fault.
h) Output overload.

3. Remote Signal Interfaces:
   a. Remote Indication Interface: A minimum of one programmable (Form C) dry-circuit relay output(s) (120-V ac, 2 A) for remote indication of the following:

      1) Fault or status indication.
      2) On bypass.
      3) Low battery.

   b. Communications Interface: Factory-installed hardware and software to enable a remote PC to program central battery equipment and monitor and display status and alarms.

      1) Communications Ports: RS-485.
      2) Network Communications Ports: Ethernet.
      3) Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.

G. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors to provide protection against damage from supply voltage surges as defined in IEEE C62.45, Category B and C.
   2. Integral, programmable, self-diagnostic and self-test circuitry; with alarms and logging.
   3. Battery deep-discharge and self-discharge protection; with alarms.
   4. Battery self-test circuitry; with alarms and logging.

H. Integral Input Disconnecting Means and OCPD: Thermal-magnetic circuit breaker, complying with UL 489.
   1. Integrated Equipment Minimum Short-Circuit Current (Withstand) Rating: 10 kA.

I. Inverter:
   1. Description: Solid-state, high-frequency, PWM type, with the following operational features:
      a. Automatically regulate output voltage to within plus or minus 3 percent, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 5 percent for 100 percent step-load changes.
      b. Automatically regulate output frequency to within plus or minus 1 Hz, from no load to full load, at unity power factor, over the operating range of battery voltage.
      c. Output Voltage Waveform: Sine wave with maximum 3 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
      d. Inverter Overload Capability: 115 percent for 10 minutes; 150 percent surge for 10 seconds.
      e. Load Power Factor: 0.5 lead to 0.5 lag.
      f. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.

J. Rectifier/Battery Charger:
   1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.
   2. Maximum Battery Recharge Time from Fully Discharged State: 24 hours.
   3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.

K. Batteries:
   1. Description: Standard VRLA batteries.
      a. Capable of sustaining full-capacity output of inverter unit for minimum of 90 minutes.
   2. Battery Disconnect and OCPD: Manufacturer's standard.

L. Integral Output Disconnecting Means and OCPD:
   1. Single-Output OCPD: Thermal-magnetic circuit breaker, complying with UL 489; manufacturer's standard ratings based on unit output ratings.
   2. Multiple-Output OCPDs: Thermal-magnetic circuit breakers, complying with UL 489; voltage rating matching unit output voltage rating; 20 A, single pole.
      a. Normally Closed: 2; with trip alarm.
      b. Normally Open: 2; with trip alarm.

2.03 ENCLOSURES

A. Central Battery Equipment Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.
   2. Finish: [Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment] <Insert finish>.

2.04 OPTIONAL AND ACCESSORY FEATURES

A. Factory-Installed Options and Accessories:
   1. Auto-dialer.
   2. Audible alarm with silencer switch.
   3. Remote Summary Alarm Panel: Labeled LEDs on panel faceplate shall indicate five basic status conditions. Audible signal indicates alarm conditions; silencing switch in face of panel silences signal without altering visual indication.
      a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.
      b. Maximum Distance from Main Unit: 1000 feet (304 m).
   4. Remote Meter Panel: Match equipment requirements of remote monitoring, controlling, and programming of central battery equipment.
      a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.
      b. Maximum Distance from Main Unit: 150 feet (46 m).

2.05 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate central battery equipment fabricator's quality-control and testing methods.

B. Testing: Test and inspect central battery equipment according to UL 924.

C. Factory Tests: Test and inspect assembled central battery equipment according to UL 924. Affix standards organization's label. Include the following:
   1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
   2. Full-load test.
   3. Transient-load response test.
   4. Overload test.
   5. Power failure test.

D. Central battery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store central battery equipment according to NECA 411.

B. Examine areas, surfaces, and substrates to receive central battery equipment, with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.

C. Examine equipment before installation. Reject equipment that is wet, moisture damaged, or mold damaged.

D. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.02 INSTALLATION

A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install central battery equipment and accessories according to NECA 411.

C. Wall-Mounted Central Battery Equipment: Install central battery equipment on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For units not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

D. Suspended-Mounted Central Battery Equipment: Suspend central battery equipment from structural ceiling components using hangers, clamps, and associated fittings, designed for types and sizes of units to be supported. Provide support devices complying with Section 260529 "Hangers and Supports for Electrical Systems."

E. Floor-Mounted Central Battery Equipment: Install central battery equipment on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

H. Comply with NECA 1.

I. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

J. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

K. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.03 CONNECTIONS

A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
   1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.04 CONTROL WIRING INSTALLATION

A. Install wiring between central battery equipment and remote devices.

B. Bundle, train, and support wiring in enclosures.

3.05 IDENTIFICATION

A. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label central battery equipment with engraved nameplates.
   3. Label each separate cabinet, for multicabinet units.
   4. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for central battery equipment, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of central battery equipment units.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Acceptance Testing Preparation:
   1. Inspect and Test Each Component:
      a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
      b. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
      c. Test continuity of each circuit.

E. Tests and Inspections:
   1. Inspect central battery equipment, wiring, components, connections, and equipment installation.
   2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
   3. Test continuity of each circuit.
   4. Verify that input voltages and frequencies at central battery equipment locations are within voltage and frequency limits specified in Part 2. If outside this range, notify Architect before closing input OCPDs.
   5. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries, battery chargers, and UPS, regardless of the type of central battery equipment provided. Certify compliance with test parameters.
   6. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.
   7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of central battery equipment. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of central battery equipment 11 months after date of Substantial Completion.
      c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
10. Provide test plan method of procedure (MOP) for review and approval by Owner's Rep.

F. Central battery equipment will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.07 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.08 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, and other adjustable parts.

C. Adjust the trip settings of thermal-magnetic circuit breakers with adjustable, instantaneous-trip elements; install fuses if not factory installed.

D. Set the automatic system test parameters.

E. Set field-adjustable, circuit-breaker trip ranges

3.09 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace central battery equipment whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Protection Technologies Inc. (APT).
   2. Current Systems.
   3. Eaton.
   4. Liebert; a brand of Vertiv.
   5. Schneider Electric USA, Inc.

B. SPDs: Comply with UL 1449, Type 1 and/or Type 2.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1 and/or Type 2
   1. SPDs with the following features and accessories:
      a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
      b. Indicator light display for protection status.
      c. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
      d. Surge counter.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 700 V for 208Y/120 V.
   2. Line to Ground: 1200 V for 208Y/120 V.
   3. Line to Line: 1000 V for 208Y/120 V.

F. SCCR: Equal or exceed 200 kA.

G. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Protection Technologies Inc. (APT).
   2. Current Systems.
   3. Eaton.
   4. Liebert; a brand of Vertiv.
   5. Schneider Electric USA, Inc.

B. SPDs: Comply with UL 1449, Type 1 and/or Type 2.
   1. Include LED indicator lights for power and protection status.
   2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 700 V for 208Y/120 V.
   2. Line to Ground: 700 V for 208Y/120 V.
   3. Neutral to Ground: 700 V for 208Y/120 V.
   4. Line to Line: 200 V for 208Y/120 V
   5.

E. SCCR: Equal or exceed 200 kA.

F. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:
   1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
   1. Compare equipment nameplate data for compliance with Drawings and Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
   4. Provide test plan method of procedure (MOP) for review and approval by Owner’s Rep.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 27 00 00

GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct, racks, cabinets, termination components, ancillary equipment, testing, and labeling and documentation of cables and connectors, for a complete end-to-end solution.

B. Refer to the contract documents for locations of Telecom Rooms (TRs), Equipment Room (ER), and telecommunication outlets (TOs). Note that the port and cable count at each TO may vary by location.

C. Complete installation shall comply with the Chaffey College Design Standards.

D. It shall be the responsibility of the contractor, to work with the Owner and provide the necessary assistance to make any connections from the owners' outside plant, service provider to establish services which shall ride on the new cabling system. These activities include, but are not limited to patch cords, cross connects, general wiring, documentation, and cable pair identification.

1.2. RELATED DOCUMENTS

A. General and Supplementary Conditions

B. Chaffey College Design Standards

1.3. RELATED SECTIONS

A. Division 01 – General Conditions

B. Division 07 – Penetration Firestopping

C. Division 26 - Grounding and Bonding

D. Division 26 - Raceway and Boxes

E. Division 26 - Wiring Devices

F. Division 27 - Communications

1.4. ACRONYMS AND DEFINITIONS

A. BICSI: Building Industry Consulting Service International

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection

C. EMI: Electromagnetic interference

D. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect

E. IDC: Insulation displacement connector

F. LAN: Local area network

G. NRTL: Nationally Recognized Testing Laboratory, an independent agency, with the experience and capability to conduct the testing indicated, as defined by OSHA in 29 CFR 1910.7

H. RCDD: Registered Communications Distribution Designer, a BICSI-certification

I. RMC: Rigid metallic conduit

J. TR: Telecom Room

K. UTP: Unshielded twisted pair

L. Cat. 6A: Augmented Category 6 UTP, as defined by TIA standards

1.5. CONTRACTOR QUALIFICATIONS

A. The contractor shall be a company specializing in the installation of communication cable and accessories with a minimum of five years documented experience on similar systems.

B. Must be a current certified partner of the solutions being furnished and installed in order to meet the requirements for the extended warranty and service programs.

C. Must hold a current communications cabling license within the State the project is taking place and must be verifiable for good standing.

D. Contractor must have a current affiliation with BICSI.

E. Within the project's onsite team, 15% of installers shall hold a BICSI Installer 1 certification, 15% of installers shall also hold a BICSI Installer 2 certification (Both Optical Fiber and Copper). 10% of the team shall hold a BICSI ITS Technician certification and a minimum of (1) team member shall hold a current and valid BICSI RCDD certification.

F. All BICSI certified field installers shall take on roles of Foreman or Team Lead to ensure installations are deemed compliant per codes and standards.

G. Contractor must have satisfactorily completed (3) projects within the past 5 years of similar scope and amount within the same state.

H. The selected Contractor shall provide a Project Manager to act a single point of contact for all activities performed under this section. The Project Manager shall be a Registered Communications Distribution Designer (RCDD). The RCDD shall have a minimum of 3 years experiences in design and installation. The designer must have sufficient experience in this type project(s) as to be able to lend adequate technical support to the field forces during installation, during the warranty period and during any extended warranty periods or maintenance contracts. The Contractor must attach a resume of the responsible designer to the Contractor's submittal for evaluation.

I. The Project Manager, or designee thereof, shall be required to attend project meetings as required until project closeout/signoff.

J. Should the Project Manager assigned to this project change during the installation, the new Project Manager assigned must meet all qualifications stated in this section, and must also submit a resume for review by the Consultant.

K. If, in the opinion of the Consultant, the Project Manager does not possess adequate qualifications to support the project, the Consultant reserves the right to require the Contractor to assign a designer whom, in the Owner’s opinion, possesses the necessary skills and experience required of this project.

1.6. REGULATORY REFERENCES

A. ANSI/NFPA 70

B. City of Chino Building Code.

C. ANSI/IEEE C2 - National Electrical Safety Code (NESC)

D. NFPA 70-2011 - National Electrical Code (NEC)

E. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises, published February 2009 and all latest addenda derived from ANSI/TIA 568-B

F. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard, published February 2009 and all latest addenda derived from ANSI/568-B

G. ANSI/TIA-568-C.2 – Balanced Twisted Pair Telecommunication Cabling and Components Standard, published August 2009 and all latest addenda derived from ANSI/TIA 568-B

H. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard, published June 2008 and all latest addenda derived from ANSI/TIA 568-B

I. ANSI/TIA/EIA 569-B - Commercial Building Standard for Telecommunications Pathways and Spaces

J. ANSI/TIA-606-B – Administration Standard for Telecommunications Infrastructure, published June 2012 including all latest addenda derived from TIA-606-A

K. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

L. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard

M. IEEE 142 “Green Book”- Recommended Practice for Grounding of Industrial and Commercial Power Systems

N. UL 444 - Standard for Communications Cable

O. Rural Electrification Administration (REA) PE-89 - specification for filled telephone cables with expanded insulation

P. Rural Electrification Administration (REA) PE-39 - specification for filled telephone cables

Q. CEC Article 18-27-300.22©(1)

R. NEC Article 250 for System Grounding

S. NEC Articles 770 and 800 for Cable Listing Requirements

T. Work performed should additionally comply with and follow guidelines established in the latest edition/revision, as of the date of the Contract Documents, of the following publications:
   1. BICSI Telecommunications Distribution Methods Manual (TDMM)
   2. BICSI Outside Plant Design Reference Manual (OSPDRM)
   3. National Electrical Contractors Association (NECA)/BICSI ANSI/NECA/BICSI-568-2006 Standard for Installing Commercial Building Telecommunications Cabling

U. All materials shall be new and listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

V. Notify Consultant of all material believed to be inadequate, unsuitable, in violation of law, ordinances, rules or regulations of authorities having jurisdiction.

1.7. CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or

quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Consultant for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Consultant for a decision before proceeding.

1.8. SUBMITTALS

A. Submittals shall include complete documentation of the system, products and accessories in a single submittal. Incomplete submittals will be returned unreviewed.

B. Prior to the start of work the Contractor shall submit shop drawings in an electronic form. Plans shall be fresh designs by the contractor; they cannot be overlays of the Consultant's package which are indicative as the contract documents. Shop drawings shall contain:

1. Full size floor plans showing proposed cable routing, wire basket routes, labeling of all outlets, locations of pullboxes.
2. Full size floor plans and elevations of all telecommunication room racks and cabinets; also include all walls with equipment.
3. Floor plans must include all outlet locations including identifiers as numbered and/or lettered characters per jack as determined by the contractor. These identifiers must match the corresponding jack within each patch panel within the TR.
4. List of identifier numbers or letters for outlet jacks and corresponding TR patch panel jack shall be included as part of the complete run-list on the floor plan sheets or on separate dedicated run-list sheet(s). This run-list shall be used as a placeholder for final outlet & jack labeling.
5. The run-list must be accurate and shall be printable for submitting to the owner for final patch cord planning and management.
6. Elevations shall indicate part numbers and quantities for all equipment.
7. Elevations of all type of outlet faceplates which shall include the configuration for jacks, blanks and the intended outlet labeling schemes.
8. Floor plans shall include all ladder rack or overhead cable distribution hardware within the telecommunications rooms to be installed per manufacturer's instructions.
9. Outside plant manhole and handhole designs coordinated with electrical as well as the site environment.
10. Outside plant conduit arrangement details within ductbank and within the manholes and handholes as necessary.
11. Outside plant conduit ductbank overall routing coordinated with electrical as well as the site environment.
12. All seismic bracing and support details shall be provided in coordination with the general contractor as needed.

C. Submittals shall include faceplates mockups sent to the Consultant for final review. Mockups shall have the manufacturer's cable markings clearly visible. The following are standard items that are to be submitted.
   1. Wall mounted outlet complete with faceplate, terminated jacks, blanks, and labeling for all types of outlets in project. Outlet should also contain 24" minimum of the cable proposed for the project.
   2. Wireless outlet complete with jacks, blanks, and labeling.
   3. Wall phone (stainless steel) outlet.
   4. Modular furniture outlet complete with faceplate, jacks, blanks and labeling.
   5. Raceway outlet complete with faceplate, bezel, jacks, blanks and labeling.
   6. Floorbox outlet complete with faceplate, mounting plate, jacks and labeling.

D. Where applicable, dimensions should be marked in units to match those specified.

E. Work shall not proceed without the consultant's "no exception taken" of the submitted items.

F. Floor plans will be provided to the Contractor in electronic (AutoCAD, ".dwg") formats to be utilized by the contractor in creating complete submittals and as-built documentation. These modified documents shall be provided to the Owner as part of the Record Documents.

G. All submittal documentation shall bear the stamp of a currently verifiable BICSI RCDD.

H. Plans shall be fresh designs by the Contractor; they cannot be overlays of the Consultant's package which is indicative as contract documents.

I. Contractor must submit documentation to support all Contractor Qualifications and Requirements under Section 1.5 which is to include but not limited to the following:
   1. End to end solution and partner documentation indicating contractor's staff has gone through proper channels and training support a minimum 25 year warranty and service program by the manufacturers.
   2. BICSI affiliations by contractor.
   3. BICSI cabling team's RCDD, Installer 1, Installer 2 (Optical Fiber and Copper) and ITS Technician certifications.
   4. Current copy of the State contractor's license for Communications Cabling.
   5. Documentation of (3) similar projects within the past 5 years in the same State.

J. Contractor shall include data sheets and literature of test equipment to be used for fiber and copper cabling and components.

1.9. MANUFACTURER CERTIFIED WARRANTY

A. The manufacturer shall be a company specializing in communication cable and/or accessories with a minimum of five years documented experience in producing cable and/or accessories similar to those specified below.

B. The system shall be comprised of components from a single manufacturer or a combination of manufacturers entering into a partnering agreement that allows for a warranty of the system.

C. System warranty program documents must be from that of the cabling and component manufacturer and associated partners. Cabling and component warranty programs offered by the contractor alone are not acceptable.

D. The warranty period shall be for not less than 25 years and warranty the cabling system and components will perform to the stated specifications for the warranty period.

1.10. QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

B. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

C. Requirement for specialists shall not supersede building codes and regulations governing the Work.

D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material and design.

1.11. QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work.

D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1.12. OWNER STANDARDS

A. Work performed should additionally comply with Chaffey College Design Standards.

PART 2 - PRODUCTS

2.1. NOT USED

PART 3 - EXECUTION

3.1. GENERAL

A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

B. Contractor shall be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, pathways or other hardware must be repaired by the Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced to match color, size, style and texture.

C. The installation shall be supervised on site by a BICSI certified installer.

D. The contractor shall have on staff a BICSI certified RCDD. RCDD certification shall be current and each submittal shall bear the stamp of the RCDD.

E. Outlets shall be mounted flush on a wall-mounted box, on Surface Raceway and in Modular Furniture. Information Outlet locations are identified on Project Drawings.

F. Avoid abrasion and other damage to cables during installation. Any cable damaged during installation shall be removed and a new cable installed.

G. Cables shall be a continuous run. No in-line splices are permitted except were explicitly indicated on the drawings.

3.2. DELIVERY AND STORAGE

A. Receive, handle, and store telecommunications system items and materials at the project site. Materials and items shall be so placed that they are protected from damage and deterioration.

3.3. INSTALLATION

A. The drawings for work under Division 27 Sections related to communication systems are diagrammatic and are intended to convey the scope of work and indicate the general arrangement of conduit, boxes, equipment, termination hardware, fixtures and other work included in the Contract.

B. The Contractor shall verify all dimensions and clearances before procuring any equipment.

C. Location of items required by the drawings or specifications not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to the approval of the Architect/Telecom Design Engineer.

D. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.
   1. Where space conditions appear inadequate, the Architect/Telecom Design Engineer shall be notified before proceeding with installation.
   2. Minor conduit and cable tray rerouting and changes shall be made at no additional cost to the Owner.
   3. As necessary, adjust elevations of rack-mounted termination hardware and horizontal wire management panels so as to compensate for rack unit sizes of actual hardware used, as compared to hardware rack unit sizes depicted in Contract Drawings.

E. Perform all work with skilled mechanics of the particular trade involved in a neat and workmanlike manner.

F. Perform all work in cooperation and coordination with other trades and schedule.

G. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, routes for conduit and cable tray raceway, and also furnish information and shop drawings necessary to permit trades affected to install their work properly and without delay.

H. Where there is evidence that work of one trade will interfere with the work of other trades, all trades shall assist in working out space allocations to make satisfactory adjustments and shall be prepared to submit and revise coordinated shop drawings.

I. With the approval of the Architect/Consultant and without additional cost to the Owner, make minor modifications in the work as required by structural interferences, by interferences with work of other trades or for proper execution of the work.

J. Work installed before coordinating with other trades so as to cause interference with the work of such other trades shall be changed to correct such condition without additional cost to the Owner and as directed by the Architect.

K. Minor changes in the locations of outlets, fixtures and equipment shall be made prior to rough in at the direction of the Architect/Consultant and at no additional cost to the Owner.

L. Contractor shall cooperate with other trades and coordinate work so that conflicts with other work are eliminated.

M. Equipment shall be installed with adequate space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. Contractor shall verify measurements. Discrepancies shall be brought to the Architect/Telecom Design Engineer's attention for interpretation.

N. Determine temporary openings in the buildings that will be required for the admission of apparatus furnished under this Division, and notify the Architect/Consultant accordingly.

In the event of failure to give sufficient notice in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

O. Location of telecommunication outlets and raceway pathways are approximate and exact locations shall be determined on site.

P. Contractor shall refer to contract documents for details, reflected ceiling plans, and large scale drawings.

3.4. COORDINATION

A. The Contractor shall be responsible for the coordination of telecommunications work with the work of all other trades and shall, in preparing the drawings, check the work of other trades in order to avoid possible installation conflicts arising therefrom. It shall be understood that the work shown on the shop drawings has been so coordinated. In the event of conflicts or interference that cannot be resolved in the field, the Contractor shall request a written clarification from the Architect/Consultant.

B. Coordinate service entrance arrangement with local exchange carrier(s).
   1. Meet jointly with local exchange carrier representatives and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute to other participants.
   3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

C. Where work covered by this Section connects to equipment furnished under other Sections, verify telecommunications work involved in the field and make proper connection to such equipment.

END OF SECTION 27 00 00

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes grounding and bonding of all passive and active equipment supplied by contractor and owner.

B. This Section includes grounding of communications systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

1.3. RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4. RELATED SECTIONS

A. Division 26 - Grounding and Bonding

B. Division 26 - Raceway and Boxes

C. Division 26 - Wiring Devices

D. Division 27 - Communications

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, “Grounding and Bonding for Electrical Systems.”

2.2. GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section “Conductors and Cables.”

B. Communications Copper Bonding Conductors: As follows:
   1. Telecommunications Bonding Conductor (TBC) and Telecommunications Bonding Backbones (TBB): No. 3/0, stranded copper conductor, insulated.
   2. Telecommunications Equipment Bonding Conductor (TEBC): No. 6 AWG, stranded copper conductor, insulated.

2.3. CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.4. TELECOMMUNICATIONS GROUNDING BUSBAR

A. Comply with ANSI/TIA-607-B.

B. Telecommunications Main Grounding Busbar (TMGB): Electro-tin plated copper, minimum 1/4 inch thick by 4 inches wide by minimum 20” long, with holes sized, spaced and in minimum quantities as follows:
   1. 5/16” holes at 5/8” spacing, minimum quantity of 27
   2. 7/16” holes at 1” spacing, minimum quantity of 3
   3. Provide longer TMGB as necessary to accommodate quantity of actual bonding connections required in field.

C. Telecom Grounding Busbar (TGB): Electro-tin plated copper, minimum 1/4 inch thick by 2 inches wide by minimum 12” long, with holes sized, spaced and in minimum quantities as follows:
   1. 5/16” holes at 5/8” spacing, minimum quantity of 6
   2. 7/16” holes at 1” spacing, minimum quantity of 3
   3. Provide longer TGB as necessary to accommodate quantity of actual bonding connections required in field, per communications room.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bond metallic raceways used for routing of communications bonding conductors, to the communications bonding conductor at each end.

3.2. CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor Terminations: Use pressure-type grounding lugs.

C. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

D. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.3. TELECOMMUNICATIONS GROUNDING AND BONDING

A. Comply with NEC, ANSI/TIA-607-B and UL 467.

B. Comply with telecommunications ground details and riser diagrams in Contract Drawings.

C. Telecommunications Grounding Busbars: TMGB and TMB within facility to provide for telecommunications grounding system.
1. Locate grounding terminals in each telecommunications room.
2. Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.

D. Bonding Conductors:
1. Extend a TBC from TMGB to electrical entrance facility and connect to grounding electrode system.
2. Extend a TBB from TMGB to each TGB.
3. Extend a TEBC from TGB to ground terminals at communication relay racks, wall-mount communication racks and cabinets, primary protection blocks, overhead ladder rack runway systems and cable basket tray systems.

E. Special Requirements:
1. Bonding conductors shall be insulated copper, sized as noted in Contract Drawings.
2. Bonding conductors shall be installed without splices unless as noted in telecommunications grounding riser diagram, or as approved by Architect because of special circumstances. Where splices are necessary, they shall be

accessible. Splices shall be by irreversible compression connectors or by exothermic welding.

F. Primary Protectors
   1. Primary protectors shall be installed on each cable end, in the appropriate building entrance protector.
   2. Primary protector enclosure shall be bonded to the building grounding system utilizing a minimum #6 AWG ground wire.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

END OF SECTION 27 05 26

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes pathways for distribution and protection of cabling and components.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467.

C. General Requirements: Comply with ANSI/TIA-569-B.

D. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.
   4. Bridle rings not permissible unless furnished with cable saddles.

1.3. RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4. RELATED SECTIONS

A. Division 26 - Grounding and Bonding

B. Division 26 - Raceway and Boxes

C. Division 26 - Wiring Devices

D. Division 27 – Communications

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, “Grounding and Bonding for Electrical Systems.”

2.2. CONDUIT AND ELECTRICAL BOXES

A. Comply with requirements in Division 26 Section “Raceways and Boxes.” Flexible metal conduit shall not be used, except as indicated in Contract Drawings. Coordinate with layout and sizing details and requirements as indicated in Contract Drawings.
   1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 2-1/8 inches deep.
   2. Minimum conduit to telecom outlet locations: Trade Size 1, unless otherwise noted in Contract Drawings

2.3. WIRE BASKET CABLE TRAY

A. Wire basket cable tray shall have the following characteristics:
   1. Welding mesh type.
   2. Minimum 12” wide and 4” deep.
   3. Steel.
   4. Standard galvanized finish.
   5. Provide cable tray divider within all cable tray runs to separate Audiovisual and Communications Cables.
   6. Any tray installed in open ceiling shall be painted. Coordinate color with architect in open ceiling areas before ordering.
   7. For any cable tray installed in open ceiling, provide bottom and sides liner to hide view of cables from below and sides.

B. Acceptable Manufacturers:
   1. GS Metals Flextray
   2. B-Line
   3. Or equal subject to review

2.4. LADDER RACK

A. Cable runway shall be ladder type and designed for use in telecommunications rooms.

B. Cable runway shall be aluminum construction, minimum 12” wide and 1.5” side rails.

C. Provide all parts and pieces to create a continuous pathway for cables within telecommunication rooms. Provide parts to support cable continuously from the sleeves entering the TR to the equipment racks and backboards.

D. Finish should be powder coated, black.

E. Acceptable Manufacturers:
   1. CPI Chatsworth
   2. Homaco

3. Square D

2.5. J-HOOK

A. J-Hook shall have a flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.

B. J-Hook shall have 90 degree radius edges to prevent damage while installing cables.

C. J-Hook shall be designed so the mounting hardware is recessed to prevent cable damage.

D. J-Hook shall have a stainless steel cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.

E. J-Hook shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.

F. Factory assembled multi-tiered j-hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

2.6. FLEXIBLE NON-METALLIC INNERDUCT

A. Innerduct shall be corrugated plastic.

B. Nominal duct size shall be minimum 1-inch.

C. Innerduct shall be riser, plenum, or OSP rated as required by the installation environment.

2.7. CABLE TIES

A. Bundle and support all cables and to provide a neat and orderly cabling installation.

B. Velcro tie wraps shall be used in the telecom room. Zip ties and wraps that cannot be adjusted once installed are not acceptable.

C. Velcro tie wraps shall be used for bundling all horizontal cabling which shall be supported by J-hooks.

D. Velcro tie wraps shall be provided at 3 ft. intervals minimum. On completion of installation, all cable bundles shall be neatly run and re-tied.

E. Provide a minimum of 30% overlap of wrap for each tie.

F. Wraps shall be Black in color.

G. Velcro wraps shall be plenum rated in all areas outside the telecom rooms.

2.8. DISTRIBUTION RINGS (D-RINGS).

A. Must be used to support and dress out cables on plywood backboards vertically and horizontally. Cables shall not be supported by cable ties alone on backboard.

B. Individual D-rings shall be sized to allow a minimum of 50% spare capacity for future cable installation.

PART 3 - EXECUTION

3.1. GENERAL

A. Cable shall be neatly dressed out in telecom rooms.

B. Secure cabling with Velcro type cable wraps only.

C. Install distribution rings on plywood backboards to support cables.

3.2. CABLE TRAY

A. Install cable trays level, straight, and parallel to walls.

B. Support cable trays minimum every 5 feet.

C. Install cable tray system with 12 inches clearance measured from top most surface of tray. Access from both sides shall be 12 inches minimum. Install with 12 inches clearance measured from bottom of tray.

D. Remove burrs and sharp edges from cable trays.

E. Cut cable tray wires in accordance with manufacturer's instructions.

F. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.

G. Provide conduit to tray fitting at each conduit entrance to tray.

H. Ground cable trays according to manufacturer's written instructions.

I. Cable trays shall not pass through any firewall or fire-rated soffits without appropriate firestop pillows per applicable codes.

J. Provide necessary supports and accessories for cable trays as required to make a complete job.

3.3. LADDER RACK

A. Provide dropouts at all equipment rack and backboard locations.

B. Install straight, level and perpendicular to walls and ceiling.

C. Install 3” to 6” above racks.

D. Cables shall be secured to the runway using reusable cable ties to arrange cable in logical bundles.

E. Ground cable runway according to manufacturer’s written instructions.

3.4. J-HOOKS

A. Provide J-hooks to support communications cables at locations where cable tray and/or conduit is not provided.

B. Provide J-hooks assemblies on 4-foot intervals to support all outlet cables. Install J-hooks approximately 12 inches above lay-in ceiling. Use J-hooks to support not more than 50 cables per hook. Provide additional hooks in rows as required to support more than 50 cables.

C. Individual J-hooks shall be arranged to allow a minimum of 50% spare capacity for future cable installation.

D. Secure J-hooks to concrete slab using threaded expansion anchor bolts. Drill slab and install expansion bolt.

E. Coordinate location with HVAC duct and lights. Do not install above fluorescent lighting fixtures.

3.5. FLEXIBLE NON-METALLIC INNERDUCT

A. Innerduct segments shall be spliced using couplings designed for that purpose.

B. All vacant innerduct shall be equipped with a pull cord and capped at both ends.

C. Innerduct shall extend to the ladder rack above the termination enclosure.

D. All exposed innerduct shall be labeled at 50-foot intervals with tags indicating the cable type it contains.

3.6. CABLE WRAP AROUND SLEEVING (ALL OPEN OFFICE AREAS)

A. Provide braided sleeving over bundles of cables entering the workstation islands from the walkerduct, poke-thru, floorbox & raised floor grommet provisions.

B. Product must be a braided polyethylene material.

C. Sleeving must be sized to accommodate the diameter of cable bundles as needed.

D. Product must be flexible and expandable to accommodate the routing of cable and expansion for 15% of future cabling capacity.

E. Color options must be submitted for review by the design team.

F. Provide Techflex FlexoPet product or equal subject to review.

END OF SECTION 27 05 28

SECTION 27 08 00

COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a testing, documenting, and commissioning of an operable end to end structured cabling system.

B. Complete installation shall comply with the campus or owner's latest telecommunication and IT standards documents.

1.2. RELATED SECTIONS

A. Division 27

1.3. PROJECT AS-BUILT AND CLOSEOUT DOCUMENTS

A. Accurately record exact sizes, locations, heights and quantities of cables and Information Outlets.

B. As-built drawings shall indicate all final cable routes and final outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

C. As-built drawings must include all final labeling information at every outlet derived from initial run-list produced within shop drawings as described per all items under Section 27 00 00-1.8-B.

D. Final labeling must include labeling on the patch panels within the TRs & ER.

E. Drawings shall indicate final TR & ER locations along with their final build

F. Drawings shall indicate final TR & ER locations along with their final build out conditions at end of the project.

G. Submit bound folders of product used in the project for record.

H. Submit cable tester calibration reports.

I. Submit all copper and fiber optic test results as indicated in Part 3 of this specification. This should include every cable channel installed in the project.

J. Plans shall be provided in full size PDF, AutoCAD or REVIT format within a CD or DVD along with hard copies.

PART 2 - PRODUCTS

2.1. NOT USED

PART 3 - EXECUTION

3.1. GENERAL

A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

3.2. IDENTIFICATION AND LABELING

A. All backbone and station cables, faceplates and termination components shall be clearly labeled in accordance with EIA/TIA 606-B.

B. The Contractor shall obtain the labeling scheme from the Owner.

C. Labels strips shall be covered with a protective plastic coating. Labels shall be machine printed. No handwritten label shall be accepted. Stick-on labels are not acceptable.

D. Components
   1. The labeling made for each component should be:
      a. Unique, to prevent confusion with similar components.
      b. Legible and permanent enough to last the lifecycle of the component.
      c. The following infrastructure components should be labeled:
         1) Telecommunications spaces
         2) Telecommunications pathways
         3) Telecommunications cables
         4) Zone boxes
         5) Connecting hardware
         6) Grounding (earthing) system

E. Telecommunications Spaces
   1. Telecommunications spaces include:
      a. Equipment rooms (ERs)
      b. Telecommunication rooms (TRs)
      c. Telecommunication enclosures (TEs)
      d. Work areas
   2. Spaces should be labeled at their entrances, as follows:
      a. In small, single-story buildings, a simple sign on the door is sufficient.
      b. In larger buildings, the labeling should provide a unique identifier, since there may be a number of telecommunications spaces.

F. Telecommunications pathways
   1. Labeling of pathways helps prevent inadvertent installation of cables from systems that may interfere with each other.

2. When labeling pathways, the following guidelines should be met:
    a. Labeling should be affixed at the ends of each pathway.
    b. Pathways should be labeled at regular intervals and wherever they are accessible.
    c. In a basic system, the conduits should be marked from the main ER by painting or using a permanent-colored tape-wrap made for this purpose.
    d. In systems utilizing zone boxes for consolidation or distribution of low-voltage systems, each box label should include the information about the room of origin and system usage.
    e. In complex systems or large buildings:
        1) A striped tape should wrap pathways with the base color identifying them as telecommunications pathways and tracer color identifying the individual uses.
        2) Each pathway should be assigned a unique alphanumeric identifier.
        3) All wall or floor penetrations should be labeled.
3. Telecommunications cables
    a. When labeling telecommunications cables:
        1) Cables should be identified at each end with a permanent label or physical/electronic tag. The same alphanumeric identifiers should be used at both ends of the cable.
        2) Cable should be identified at regular intervals throughout its length with its alphanumeric identifier when cables are rearranged, rerouted, or removed in spite of the added cost.
    b. In systems that are:
        1) Basic, the labeling scheme can be a simple number sequence.
        2) Complex, the labeling may indicate the type, function, and terminating position.

G. Connecting hardware
1. Connecting hardware items (e.g., cross-connect fields and telecommunications outlet/connectors) require a unique, alphanumeric identification such as the following three-level scheme:
    a. First level – Termination field or patch panel. Color-coding or other labeling should be used to uniquely identify each termination field on a common mechanical assembly.
    b. Second level – Terminal block within a given field or patch panel, which could be a row of insulation displacement connectors (IDCs), optical fiber connectors, or modular jacks.
    c. Third level – Defines the individual position within a given terminal block or patch panel.

H. Grounding (Earthing)
1. Grounding system components (e.g., ground bars and grounding conductors) require special labeling for safety and noise control purposes and for simplifying and expediting ground system audits.
2. All equipment grounding conductors should be labeled to indicate the:

a. Grounded rack, cabinet, or shelf.
b. Ground bar to which the grounding conductors are connected.

3. Each grounding conductor in a building should be labeled, including those connecting building steel, grounding electrodes, water pipes, radio towers, and telecommunications structural components.

3.3. TESTING AND COMPLIANCE

A. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Testing shall be executed by technicians holding proof of successful installation certification from the system manufacturer.

B. Cable testers are to be calibrated within four (4) months of use.

C. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type including equipment to use, set-up, test frequencies or wavelengths, results format, etc.

D. 100% of the installed cabling links must be tested in accordance with ANSI/TIA/EIA-568-B standard and must pass the requirements described under the heading for each cable type. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

E. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.

F. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner. Representatives of the Owner shall be invited to be in attendance to witness the test procedures. The contractor shall provide a minimum of one (1) week advance notice to the Engineer as to allow for such participation. The notification shall include a written description of the proposed conduct of the tests including copies of blank test result sheets to be used.

G. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences. A representative of the Owner reserves the right to select a random sample of up to 5% of the installed links for retesting. The Contractor shall re-test these randomly selected links and the results are to be stored in the tester. The results obtained shall be compared to the original test data provided by the Contractor. If more than 2% of the sample pass/fail results differ from the original test data, the installation contractor under supervision of the Owner's representative shall repeat 100% testing and the cost shall be borne by the Contractor.

3.4. CABLING ADMINISTRATION DRAWINGS

A. Prepare Cabling Administration Drawings showing building floor plans with cable administration-point identification labeling. Depict all telecommunications outlets and their associated label, provide callouts indicating locations of telecom rooms and spaces and, where applicable, indicate zone line demarcations denoting areas served by each respective telecom room. Coordinate drawing features with shop drawing requirements outlined in Section 270000.

B. Prepare Drawings for use as part of cabling installation work. Periodically update Drawings to reflect constructed conditions, including any moves, changes or additions to the communications infrastructure. At completion, Cabling Administration Drawings shall reflect as-built conditions.

C. Interim Submission: Issue two (2) half-size printed copies of in-progress draft Cabling Administration Drawings to Owner no later than five (5) weeks prior to Substantial Completion, for Owner's use in preparation of patch schedules and to support other internal move-in planning processes. Coordinate exact timing with Owner's IT personnel.

3.5. TEST RESULTS DOCUMENTATION

A. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The test result records saved by the tester shall be transferred into a spreadsheet or database that allows for the maintenance, inspection and archiving of these test records. Provide the database for the completed job on CD-ROM. If the results cannot be viewed by Microsoft Excel or Microsoft Access, the Contractor shall provide one licensed copy of a software package suitable to view and print reports of the test results.

B. Upon completion of the installation, the contractor shall provide three (3) full electronic documentation sets to the Consultant for approval.

C. Documentation shall be submitted within ten (10) working days of the completion of the testing phase. This includes draft as-built drawings. Draft drawings may include annotations done by hand.

D. Machine generated final copies of all drawings shall be submitted within 30 working days of the completion of the testing phase. Final copies shall have all annotations in CAD format.

E. All documentation, including hard copy and electronic forms shall become the property of the Owner.

F. A paper copy of the test results shall be provided that lists all the links that have been tested along with the following summary information:
   1. The identification of the customer site as specified by the end-user.
   2. The identification of the link in accordance with the naming convention defined in the overall system documentation.
   3. The overall Pass/Fail evaluation of the link-under-test.

4. The date and time the test results were saved in the memory of the tester.

G. The following information shall be provided in the electronic database of the test results information for each link:
1. The identification of the customer site as specified by the end-user.
2. The identification of the link and/or fiber in accordance with the naming convention defined in the overall system documentation.
3. The overall Pass/Fail evaluation of the link-under-test.
4. The date and time the test results were saved in the memory of the tester.
5. The name of the standard selected to execute the stored test results.
6. The cable type and the value of NVP or index of refraction used for length calculations.
7. The brand name, model and serial number of the tester.
8. The identification of the tester interface.
9. For fiber tests, the identification of each link/fiber in accordance with the naming convention defined in the overall system documentation
10. For fiber tests, the insertion loss (attenuation) measured at each wavelength, and the test limit calculated for the corresponding wavelength.
11. For fiber tests, the link length shall be reported for each optical fiber for which the test limit was calculated based on the formulas above.
12. The revision of the tester software and the revision of the test standards database in the tester.

H. The test results information must contain information on each of the required test parameters in accordance with the descriptions above. For each of the frequency-dependent test parameters, the value measured at every frequency during the test shall be reported.

3.6. CATEGORY 6 CABLING

A. The test parameters for cat 6 are defined in TIA Cat 6 standard, which refers to the ANSI/TIA-568-C.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

B. The test equipment (tester) for cat 6 cabling shall comply with the accuracy requirements for the proposed level III field testers as defined in the TIA Cat 6 Document. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration are specified in Table B.2 of Annex B of the TIA Cat 6 Standard.

C. The following parameters shall be tested for each cable:
1. Length – The length of the cable shall be defined as the length of the pair with the shortest electrical length.
2. Wire Map – The wire map shall indicate continuity to the remote end for all conductors; identify any shorts between conductors; and identify transposed, reversed or split pairs. Any incorrect parameters shall be corrected.

3. Insertion Loss – Insertion loss shall be measured in decibels (dB) and tested in a maximum step size of 1 MHz. All of the test points shall be provided in the test results.
4. Near End Crosstalk (NEXT) – NEXT shall be measured on each wire pair combination from each end of the link for a total of 12 pair combinations. The maximum step size shall not exceed the parameters in Table 1.
5. Power Sum NEXT (PSNEXT) – PSNEXT shall be measured on each wire pair from each end of the link for a total of 8 measurements. The maximum step size shall not exceed the parameters in Table 1.
6. Equal Level Far End Crosstalk (ELFEXT) – ELFEXT shall be measured on each wire pair combination from each end of the link for a total of 24 pair combinations. The maximum step size shall not exceed the parameters in Table 1.
7. Power Sum ELFEXT (PSELFEXT) – PSELFEXT shall be measured on each wire pair from each end of the link for a total of 8 measurements. The maximum step size shall not exceed the parameters in Table 1.
8. Return Loss – Return loss shall be measured on each wire pair from each end of the link for a total of 8 measurements. The maximum step size shall not exceed the parameters in Table 1.
9. Propagation Delay – Propagation delay shall be measured on each wire pair for a total of 4 measurements.
10. Delay Skew – Delay skew shall be defined as the difference between the fastest and slowest pairs in a cable.

Table 1

Frequency Range (MHz)	Maximum Step size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250 (Cat 6 only)	0.50

3.7. CATEGORY 6A CABLING

A. Each category 6A cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA-568-C.2 “Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard”

B. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 500 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

C. The test equipment (tester) shall comply with the accuracy requirements for level IIIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152.

D. The following parameters shall be tested for each cable:

1. Wire Map – Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.
2. Length – The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
3. Insertion Loss (Attenuation) – Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 500 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.
4. NEXT Loss – Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 500 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
5. PS NEXT Loss – Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 500 MHz and the step size may not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS NEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
6. ACR-F, pair-to-pair – Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the

disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured from 1 through 500 MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR-F. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

7. PS ACR-F Loss – Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
8. Return Loss – Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured form 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
9. Propagation Delay – Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.
10. Delay Skew – This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.
11. PS ANEXT – Pair-to-pair Alien NEXT (ANEXT) contributions is measured by applying the stimulus signal at the near end to one wire pair of a disturbing link and measuring the coupled signal at the near end of a wire pair in a disturbed link. This process is repeated for every wire pair in a disturbing link. The PS ANEXT for each wire pair in a disturbed link is obtained by the power sum addition of all the pair-to-pair ANEXT results to that wire pair from all wire pairs in disturbing links. All the links that are bundles with the disturbed link need to be

included as disturbing links. In addition, links that are terminated in adjacent positions in a patch panel or interconnect panel should also be included as disturbing links in this test. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS ANEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

12. PS AACR-F – The pair-to-pair Alien Far End crosstalk (AFEXT) contributions is measured by applying the signal at the near end to one wire pair of a disturbing channel or permanent link and measuring the coupled signal at the far end of a wire pair in a disturbed channel or permanent link. This process is repeated for every wire pair in a disturbing link and for all links in close proximity. A normalization, which is dependent on the relative length of disturbing and disturbed link, is applied to each pair-to-pair alien FEXT measurement. Then the PS Alien Attenuation-to-Crosstalk Ratio from the Far end (PS AACR-F) for each wire pair in a disturbed channel or permanent link is obtained by the power sum addition of all the normalized pair-to-pair far end alien crosstalk results to that wire pair from all wire pairs in disturbing links in close proximity. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS AACR-F. if the link or channel connects two patch panels (data center), these wire pairs must be identified for the tests performed from both ends. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

requency Range (MHz)	aximum Step size (MHz)
– 31.25	15
1.26 – 100	25
00 – 250	50
50 – 500	00

E. In addition to testing the “In-link” performance parameters detailed in D above, Alien Crosstalk testing or “Between-link’ testing shall be carried out in accordance with Section 4.7 of ANSI/TIA-1152. Alien crosstalk testing includes the PS ANEXT and PS AACR-F (Power sum alien attenuation-to-crosstalk ratio from the far end) performance parameters. The standards refer to the link-under-test for Alien Crosstalk as the disturbed link.

F. PS ANEXT and PS AACR-F shall meet or exceed the limits defined in Section 6 of the TIA Cat 6A Standard.

G. Selection of disturbed links: 1 % of the links in the cabling installation or 5 links, whichever is more. Chose short, medium and long links equally.

H. Selection of disturber links. Select all of the links that are in the same cable bundle and the most consistently positioned relative to the disturbed link as disturbing links.

I. If the margin of PS ANEXT and PS AACR-F exceeds 5 db for the first three short, medium and long links (nine in total), further alien crosstalk testing can be discontinued.

3.8. BACKBONE COPPER CABLE TESTING

A. Backbone Voice cables shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity and conductor position on the termination blocks. Any incorrectly positioned pairs must be identified and corrected. The percentage of “bad” pairs shall not exceed 3% in any backbone cable based on total pair count. All bad pairs must be identified and documented.

B. The Contractor shall be responsible to test the entire system from each voice outlet to the building Main Crossconnect (MC). If more than a 1% failure on the cross-connects occur the contractor will be required to provide mapping of the system.

3.9. FIBER OPTIC CABLE TESTING

A. Every fiber optic cabling link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.

B. ANSI/TIA/EIA-568-B, defines the passive cabling network, to include cable, connectors, and splices, between two optical fiber patch panels. A typical horizontal link segment is from the telecommunications outlet/connector to the horizontal cross-connect. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.

C. 100% of the installed cabling links shall be tested. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

D. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by the manufacturer of the fiber optic cable and/or the fiber optic connectors or the manufacturer of the test equipment used for the field certification.

E. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap with a Category 1 light source.

F. Field test instruments for single mode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7.

G. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

H. The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.

I. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.

J. ANSI/TIA/EIA standard 568-B prescribes that the single performance parameter for field testing of fiber optic links is insertion loss. The insertion loss shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B:
   1. Link Attenuation = Cable_Attn + Connector_Attn + Splice_Attn
   2. Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
   3. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation Coefficient (dB/km)
Multimode 50/125 µm	850	3.0
	1300	1.0
Single-mode (Inside plant)	1310	0.5
	1383	0.5
	1550	0.5
Single-mode (Outside plant)	1310	0.5
	1383	0.5
	1550	0.5

   4. Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)
   5. Maximum allowable individual connector_loss = 0.75 dB
   6. Splice_Attn (dB) = number of splices (S) * splice_loss (dB)
   7. Maximum allowable splice_loss = 0.3 dB

K. Additional 40GB/100GB requirements for multimode fiber:
   1. Maximum MPO and individual connector loss = .35 dB
   2. Maximum total connector loss per 150 meters = 1 dB
   3. Maximum total channel insertion loss per 150 meters = 1.5 dB

L. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

M. Link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1

N. The acceptable link attenuation for a multimode horizontal optical fiber cabling system is based on the maximum 90 m (295 ft) distance. The horizontal link should be tested at

850 nm or 1300 nm in one direction in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper. The horizontal link shall be tested using a fixed upper limit for attenuation of 2.0 dB.

O. Multimode backbone links shall be tested in one direction at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A. The link attenuation equation above shall be used to determine limit values.

P. Single mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper. All single mode links shall be certified with test tools using a Category 2 laser light sources at 1310 nm and 1550 nm.

3.10. WARRANTY

A. The Contractor shall guarantee all materials, equipment, etc., for one year from date of substantial completion of this work. This guarantee shall include all labor, material and travel time. This warranty is in addition to the cabling system manufacturer's warranty.

END OF SECTION 27 08 00

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. Including equipment for the Telecom Rooms.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3. RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4. RELATED SECTIONS

A. Division 26 - Grounding and Bonding

B. Division 27 - Communications

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable equipment rack, cabinet and cable management and accessory manufacturers:
   1. Chatsworth Products Inc.
   2. Rittal
   3. Southwest Data Networks
   4. Homaco

2.2. EQUIPMENT RACK

A. Standard 2-post floor-mounted 19” Rack: Aluminum or steel construction, freestanding, modular, with top and bottom angles.

B. Rack shall be 84" high and accommodate industry standard 19” wide mounting brackets.

C. Rack shall incorporate a universal 5/8"-5/8"-1/2"alternating hole pattern.

D. Rack rails shall be threaded and tapped to accept industry standard #12-24 mounting screws.

E. Rack should be supplied with a ground bar and #6 AWG Ground lug.

F. Equipment Rack shall be equipped with cable management hardware to provide for orderly and secure routing of cabling. Provide cable management as described in the specifications and drawings.

2.3. HORIZONTAL CABLE MANAGEMENT

A. Horizontal cable manager shall be slotted duct with removable cover. Manager shall be a minimum of 2 rack units high and suitable for mounting in a standard 19” wide rack.

B. Provide strain relief and cable management at the rear of each manager unit for clean routing of all cables.

C. Management shall be Black in color.

2.4. VERTICAL CABLE MANAGEMENT

A. Vertical cable manager shall be slotted duct with removable cover. Wires should be held in place after cover is removed. Finger spacing for front side shall be on 1U centers. Manager shall have integral cable pass thru holes for ease of front to back cabling. Management shall be provided for front and back of rack.

B. Management shall be side mounted on both sides of each equipment rack as shown on the drawings.

C. The back side of management shall include adjustable rear cable rings with spin-open latches. Spacing between rings from top to bottom should not impede in bundling and passing of cable groups.

D. The front side of the management shall feature a minimum of 7.5 in. depth or 37 sq. in. of usable area. The rear side of the management shall feature a minimum of 6.8 in. depth or 39.4 sq. in. of usable area.

E. Height of management shall match overall height of rack and have a minimum 6 in. width.

F. Contractor shall review and confirm the vertical management capacity with the amount of cables being terminated prior to product submission.

G. Management shall be Black in color.

2.5. TELECOMMUNICATIONS PLYWOOD BACKBOARD

A. Backboards shall be 4’W x 8’H x ¾”D.

B. Finished grade of A-C or better. A-side shall face the interior of the room.

C. All sides of each backboard should be finished with (2) coats of white paint prior to installation. Plywood grade and fire rating stamps on plywood shall remain exposed and not painted over.

D. If the walls where plywood backboard will hang are fire rated or there's a requirement for fire rating per codes, the plywood backboard and finish paint must meet the same fire rated requirements.

E. A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

2.6. POWER DISTRIBUTION UNIT (PDU)

A. PDU inlet cord shall include the appropriate plug deemed necessary (e.g. 5-20P/5-30P/L6-30P) per the electrical drawings. Refer to the electrical drawings for more information on plug type for dedicated power receptacles above the equipment racks and cabinets or elsewhere in the room.

B. Horizontally mounted PDUs shall include a minimum of (8) NEMA 5-15R/5-20R power sockets on the back side for equipment connections. PDUs shall be horizontally mounted with no more than 1 rack unit in height.

C. Vertically mounted PDUs for equipment cabinets or 4-post racks should include a minimum of (21) C13 and (3) C19 power sockets for equipment connections. PDUs shall be mounted vertically at the back of the rack.

D. Inlet cord on PDU shall be a minimum 12 feet in length.

E. PDUs shall be switched and functionality to be metered by individual outlet.

F. Each outlet on PDU shall support power-on, power-off and reboot on a real-time programmable basis.

G. Unit shall allow reporting of voltage, frequency & load level, and current via Ethernet interface. Notifications of conditions are to be reported by email, secure web, SNMP, Telnet or SSH interface.

H. PDU shall provide Transient suppression to avoid overloads per the wattage rated by the PDU overall and by the individual power outlets.

I. UL-1449, UL 1283 and UL-497A compliant.

J. Power strip shall meet or exceed IEEE 587 Category A & B specifications.

K. Provide (1) horizontally mounted PDU shall be furnished and installed within each 2-post rack and equipment cabinet or 4-post rack.

L. Provide (1) vertically mounted PDU shall be furnished and installed within each equipment cabinet or 4-post rack.

PART 3 - EXECUTION

3.1. EQUIPMENT RACK

A. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. Rack shall also be stabilized by extending a brace to the wall. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

B. Provide minimum clearances as shown on Drawings. Locations where these guidelines cannot be followed should be brought to the attention of the Consultant prior to installation.

C. Install with a minimum of 36 inches clear access behind and in front of rack unless otherwise directed by drawings.

D. Install racks straight and perpendicular to walls.

E. All hardware and equipment shall be mounted above 18" and below 79" A.F.F.

F. The rack shall be grounded to the telecommunications ground bar (TGB) using a minimum #6 AWG insulated stranded copper conductor. Conductor jacket shall be green.

3.2. WIRE MANAGEMENT

A. Rack shall be equipped with vertical and horizontal wire management hardware.

B. Provide horizontal cable management hardware below each patch panel.

C. Provide vertical cable management hardware on front and rear of each rack. Where multiple racks are installed, troughs shall be mounted between the uprights of adjacent racks per manufacturer recommendations.

3.3. BACKBOARDS:

A. Install backboards 6” above the finished floor to 8’6” AFF. Mounting shall be sufficient enough to support the equipment.

B. Shall be mounted with a minimum of 3/8” toggle bolts and 2” fender washer on each corner and 4’ on center as required.

END OF SECTION 27 11 00

SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end backbone structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, testing, labeling and documentation of cables and connectors.

B. Complete product procurement and installation shall comply with the campus or owner's latest telecommunication and Information Technology standards documents.

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable backbone voice copper & component (interbuilding and intrabuilding) manufacturers:
   1. General Cable Belden
   2. Superior-Esses
   3. Or equal subject to review.

B. Acceptable fiber optic cabling & component (interbuilding and intrabuilding) manufacturers:
   1. Sumitomo Electric FutureFlex fiber bundles
   2. Or equal subject to review.

2.2. BASIC ENVIRONMENTAL REQUIREMENTS

A. Cabling shall be suitable for environment in which they are to be installed.

B. Cabling shall be plenum-rated within interior premise installations.

C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

2.3. INTRABUILDING COPPER CABLING (VOICE)

A. Backbone Cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

B. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.

C. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

D. The cables shall contain an overall corrugated, coated aluminum shield that is electrically continuous over its entire length.

E. Provide one full 500-foot spool of 24-AWG two-pair jumper wire on a spool holder for additional cross connects by owner.

2.4. INTERBUILDING COPPER CABLING (VOICE)

A. Cables shall incorporate 24 AWG solid, annealed, bare copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene.

B. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

C. Cables shall be designated RUS/REA PE-89 suitable for duct or direct burial applications. Cables shall be Aluminum Steel with Polyethylene (ASP) filled core cables.

D. Conductors shall be insulated with a thermoplastic skin. Maximum diameter of the insulated conductor shall be 0.048 in (1.22 mm). Insulated conductors shall be stranded into pairs of varying lengths in order to minimize cross-talk.

E. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.

F. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

G. Cable shall meet the physical and electrical requirements of 100 Ohm twisted pair cable as defined by standards. Cable shall conform to Category 3 performance specifications or better.

H. A flooding compound shall be applied over the core and to all surfaces of the shield/armor to resist moisture entry and to inhibit corrosion.

I. The cable core shall be filled with a waterproofing compound and wrapped with a non-hydroscopic core tape.

J. The cables shall contain an overall corrugated, coated aluminum shield, which is electrically continuous over its entire length.

K. The cable shall be finished with a polyethylene jacket, which is sequentially printed with a footage marker at regular intervals.

2.5. VOICE TERMINATION FIELD

A. Voice terminations shall utilize 110 style termination block hardware with 25 pairs per row.

B. The mechanical termination shall be capable of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.

C. 4-pair connecting blocks shall be utilized to make electrical connection between terminated cables and cross connect wires. The blocks shall be designed to maintain the cable pair twists as closely as possible to the point of mechanical termination.

D. Base shall employ standoff legs to allow cable routing behind base.

E. Base shall have integral label holder to identify location of cable.

F. Horizontal management shall be via jumper troughs furnished with standoff legs.

G. Provide a punchdown tower kit system for mounting the 110 block units. System shall include jumper troughs and provide horizontal cable management.

H. Vertical cable management shall be via multi pair vertical cable managers designed for use with the tower system.

2.6. AIR BLOWN FIBER CABLE (INTERBUILDING AND RISER)

A. Use for interbuilding fiber cables between buildings and intrabuilding fiber riser cable between BDF and IDFs if applicable.

B. Multi-mode optical fibers in each cable shall meet the following specifications:
1. Transmission Windows 850nm and 1300nm
2. Core Diameter 50.0 ± 3μm
3. Maximum Attenuation 3.0 dB/km @ 850nm; 1.0 dB/km @ 1300nm
4. Minimum Bandwidth 500 MHz/km @ 850nm
500 MHz/km @ 1300nm
5. 0.275 numerical aperture

C. Single-mode optical fibers in each cable shall meet the following specifications:
1. Transmission Windows 1310nm and 1550nm
2. Core Diameter 8.3μm
3. Maximum Attenuation 0.4 dB/km @ 1310nm
0.3 dB/km @ 1550nm
4. Zero dispersion slope (1300-1322 nm): - 0.095/(nm2/km)

D. Fiber bundle sizes shall be as indicated on telecommunication drawings. The sizes are 2-, 4-, 6-, 12- and 18- fiber bundles.

E. Fiber bundles shall not be spliced or patched at transition points from indoor to outdoor environments.

2.7. TUBE CABLE – OUTSIDE PLANT

A. All tube cable sheath opening that are created for connecting tube cable cells in underground manholes or pull boxes shall be encased in an outside plant splice case designed for copper cables.

B. The water-proof splice enclosure must be approved by the manufacturer for connecting tube cables.

C. All tube cables shall be properly secured to the backboards, equipment racks, or ladder racks.

D. Tube cable sizes shall be 19-, 7-, 4- or 2-cell depending on the design on the drawings. The standard tube in conduit shall be Sumitomo TOX. For aerial use Sumitomo MSO shall be used. For direct buried, use Sumitomo AOX.

E. Clear single cell tube cable.

F. Acceptable manufacturers:
1. Sumitomo Electric FutureFlex fiber tube cables.
2. Or equal subject to review.

2.8. TUBE DISTRIBUTION UNITS (TDU'S) – OUTDOOR

A. The outdoor TDU shall be an outdoor NEMA-type enclosure suitable for the site environmental conditions. The Contractor is responsible for selecting the enclosure hardware to meet the site conditions.

B. TDU's shall be for tube distribution, routing and termination.

C. Size of the TDU will depend on the number of tubes to enter the unit. For up to 42 tube – 16"x16"x4"; for up to 84 types – 24"x20"x7"; and for up to 168 tubes – 36"x30"x9".

2.9. FIBER OPTIC TERMINATION UNITS (FTU'S)

A. FTU's shall provide for strain relief of incoming type cables as well as providing connector panels and connector couplings adequate to accommodate the number of fibers to be terminated.

B. All FTU's shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturer's recommended minimums or 1.2", whichever is larger.

C. Couplers shall be mounted on a panel that, in turn, snaps into the housing assembly.

D. FTU's shall have a common key lock that opens all FTU's installed for this project.

E. The Contractor shall be responsible for selecting the FTU hardware to meet site conditions.

F. FTU's shall be rack-mounted, unless specified otherwise in the drawings. Sizes are 18-fiber, 36-fiber, 48-fiber or 72-fiber.

G. Connector type shall be LC.

2.10. FIBER OPTIC TERMINATION PANELS

A. All fibers shall be terminated on Duplex-LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that snaps into the enclosure.

B. The enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.

C. The panel enclosure shall be sized to accommodate the total quantity of fiber strands as described in the specifications and drawings.

D. Termination panels shall be enclosed assemblies. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

E. The patch panel enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturers recommended minimums.

F. Access to the inside of the patch panel enclosure during installation shall be from the front and rear.

G. The patch panel enclosure shall be configured to require only front access when patching. The enclosure shall provide a physical barrier to access of backbone cables.

H. The enclosure shall incorporate a storage cassette, tray, or other mechanism designed to allow identification, access and termination of individual fibers.

I. The fiber optic patch panel shall be rated to match or exceed the ANSI/TIA/EIA rated wiring terminated on the panel.

2.11. FIBER OPTIC CONNECTOR

A. The Optical Connector shall be Duplex-LC type modular jack. Completed cable assembly shall interface with fiber optic terminal bulkhead feed-through receptacle on Fiber Optic Patch Panel. Supply and install dust caps for terminated fibers.

B. The connector ferrule shall be ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive [or mechanical connection].

2.12. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cables shall match the core size and type of fiber being patched. The fiber optic patch cables shall utilize tight buffer construction.

B. Fiber Optic jumpers shall incorporate connectors that match the terminations of the fiber being patched. Connector body shall be of materials similar to that used in the proposed couplings.

C. Provide patch cords with connectors compatible with equipment being patched. Verify connector type of active electronic equipment with owner.

D. Provide one optical fiber patch cord per optical fiber strand installed.

E. For the TR patch cords, 80% shall be 3 meters, 10% shall be 4 meters and 10% shall be 7 meters in length from the total number.

PART 3 - EXECUTION

3.1. INTRABUILDING COPPER CABLING (VOICE)

A. Follow cable manufacturer's cable pulling recommendations. Recommended pulling tensions and pulling bending radii shall not be exceeded. Any cable bent beyond minimum bending radius shall not be installed.

B. All cable shall be free of tension at both ends. A ten foot service loop shall be provided with each backbone cable.

C. Avoid abrasion and other damage to cables during installation.

D. Pulling Lubricant shall be used to ease pulling tensions. Lubricant shall not damage or degrade cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

E. Termination of Backbone Voice cabling shall be accomplished by using five-pair clips.

F. Cables shall be installed in conduit, cable tray, or on J-hooks as shown on the Drawings.

3.2. INTERBUILDING COPPER CABLING (VOICE)

A. All conductors shall be continuous and splice free.

B. Bridge taps shall not be allowed.

3.3. VOICE TERMINATION FIELD

A. Horizontal wiring troughs shall be positioned at the top of each column of termination blocks and between each 100-pair wiring block.

B. Vertical cable managers incorporating metal distributing rings shall be provided for vertical routing of jumper and/or cross-connect wire.

C. Utilize multiple 300 or 900 pair tower systems and corresponding vertical cable managers to create termination fields.

D. Blocks shall identify each pair position by a different color designation. Integral label holders shall allow for easy identification of each location.

E. The Contractor shall be responsible for the cross connect between the station and backbone cabling.

F. Cross connect the center two pair of each station cable to the backbone cable. Use single or two pair cross connect wire for this purpose.

G. Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall be neatly laced, dressed and supported. Retainer shall be used on each 110-type block to secure jumper wires on the wiring block(s).

H. Termination blocks shall have a minimum capacity of 20% spare pairs after all horizontal cabling is terminated.

3.4. FIBER OPTIC CABLE

A. Cable shall be continuous and free of splices except in specified splice trays in TR or ER locations. Factory optical fiber splices are not allowed.

B. The fiber manufacturer shall subject all fibers to a minimum tensile proof test equivalent to 100-kpsi. All fibers in each cable shall be guaranteed to meet the stated specifications.

C. Backbone intra-building fiber optic cabling shall be installed via conduit and/or in innerduct in cable tray as illustrated on the drawings.

D. Provide 15 feet of slack in each backbone fiber optic cable. The cable slack shall be coiled and stored in a location to protect it from damage in the TR or ER in the case of inter-building cables. The slack shall be stored in a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

E. Maintain bending radius of twenty times the outside diameter of the cable during installation and ten times the outside diameter with no load.

F. Backbone Fiber Optic Cable shall be installed in protective innerduct where cable is susceptible to damage. This includes areas cable tray and transitions between pathways. The innerduct should extend into the termination and/or storage enclosure(s) at system endpoints.

3.5. FIBER OPTIC CONNECTOR

A. The fiber optic connector shall be installed per manufacturer’s written instructions.

3.6. FIBER OPTIC PATCH PANEL

A. Fiber optic patch panels shall be rack mounted.

B. Install fiber optic patch panels in topmost rack position.

C. Transition outdoor to indoor cables either by splicing factory-terminated pigtails or by the use of a "fan-out" kit. Secure individual fibers in an aramid reinforced tube.

D. Termination hardware shall incorporate a mechanism to secure cable and sub-assemblies and prevent damage.

E. Splicing shall be by the “fusion” method.

F. Direct termination of 250 µm coated fibers shall not be permitted.

3.7. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cords shall be installed per manufacturer’s written instructions.

B. Contractor must coordinate with the owner for installing all patch cords within the TR.

C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

END OF SECTION 27 13 00

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end horizontal structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, testing, labeling and documentation of cables and connectors.

B. Complete product procurement and installation shall comply with the campus or owner's latest telecommunication and Information Technology standards documents.

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable indoor/premise end to end solutions for horizontal Category 6 copper and components:
   1. Commscope

B. Acceptable indoor/outdoor end to end solutions for horizontal copper and components:
   1. Commscope

2.2. BASIC ENVIRONMENTAL REQUIREMENTS

A. Cabling shall be suitable for environment in which they are to be installed.

B. Cabling shall be plenum rated within interior premise installations.

C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

2.3. HORIZONTAL STATION CABLE

A. Cable shall consist of 4 pair #24 AWG insulated solid copper conductors. Each pair shall be unshielded and twisted.

B. Transmission characteristics of the cables shall exceed Category 6 performance as defined by industry standards.

C. The jacket color for communication cables shall be **Blue**.

2.4. HORIZONTAL STATION INDOOR/OUTDOOR CABLE

A. Cable shall be provided wherever it shall run within a wet environment or where it would be exposed to an outdoor condition.

B. Transmission characteristics of the cables shall meet full Category 6 performance as defined by industry standards.

C. Cable shall be suitable for installation both indoors and outdoors.

D. Cable shall be suitable for both direct burial and underground conduit installations.

E. Cable shall retain an CMP plenum rating to meet the listing requirements per NFPA for use within building premises.

F. Cable shall be constructed with a dry or gel-filled type water blocking material.

2.5. INDOOR JACKS

A. Jacks shall be non-keyed 8-pin 8 conductor (8P8C) modular jacks.

B. Data termination hardware shall meet full Category 6 performance specifications as defined by industry standards.

C. Jacks shall be UL verified and listed.

D. Color of the communication data jack shall be **Yellow**.

E. Color of the communication voice jack shall be **White**.

2.6. OUTDOOR JACKS

A. In outdoor conditions as indicated on drawings provide IP67 rated jacks.

B. Jacks shall be terminated and installed within appropriate outdoor rated stainless steel faceplate as indicated by manufacturer instructions.

C. Provide weather seals on outlets as needed to equal that of outdoor rated products in the project and per manufacturer's recommendations.

D. Provide IP67 rated screw on covers produced by the same jack manufacturer for every outdoor jack installed.

E. Data termination hardware shall meet full Category 6 performance specifications as defined by industry standards.

F. Jacks shall be UL verified and listed.

2.7. TELECOM OUTLET - STANDARD INDOOR

A. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).

B. Connector assemblies shall utilize modular jacks as specified in Paragraph 2.5.

C. Outlet faceplates shall incorporate recessed designation strips for identifying labels. Designation strips shall be fitted with clear plastic covers.

D. The faceplate of the IO shall be constructed of high impact plastic (except where noted otherwise).

E. Single-gang faceplates shall be 2.75 x 4.5 inches.

F. Faceplates shall be UL listed.

G. Color of the wall plate shall be Ivory or White depending on electrical outlet color to match.

2.8. TELECOM OUTLET - STANDARD OUTDOOR

A. Faceplates shall be IP67 rated faceplate.

B. Faceplate shall be stainless steel and tamper resistant.

C. Provide weather seals on faceplate as needed to equal that of outdoor rated products in the project and per manufacturer's recommendations.

D. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).

E. Connector assemblies shall utilize modular jacks as specified in Paragraph 2.6.

F. Outlet faceplates shall include area for integrating waterproof labels. Designation strips shall be fitted with clear waterproof covers.

G. Single-gang faceplates shall be 2.75 x 4.5 inches.

H. Faceplates shall be UL listed.

2.9. TELECOM OUTLET - WALL PHONE

A. Faceplate shall be stainless steel flush to utilize a single modular jack.

B. Faceplate shall have standard mounting stubs on top and bottom suitable for wall mounting a standard phone directly over it.

C. Outlet shall be placed at a location providing 12" x 12" clearance at all sides to accommodate the phone.

2.10. TELECOM OUTLET - MODULAR FURNITURE

A. Outlet module shall be formulated to fit all jacks in row for use within furniture cabling provision or raceway. Contractor must confirm compatibility of outlet with the raceway manufacturer prior to ordering.

B. Outlet module shall allow jacks to retain the configuration of the standard information outlets shall accommodate easy to read labels configured horizontally.

C. Color of the outlet module should be Ivory or White depending on electrical outlet color to match.

2.11. TELECOM OUTLET - FLOORBOX/POKE-THRU

A. Faceplate shall include mounting slots for accommodating required jacks within the floorbox/poke-thru. Contractor must confirm compatibility of faceplate with the floorbox/poke-thru

B. Faceplate shall be able to fit within standard NEMA provision as well as low voltage floorbox and poke-thru provisions.

C. Color of the faceplate shall be Ivory or White depending on electrical outlet color to match.

2.12. TELECOM OUTLET - RACEWAY

A. Outlet module shall be formulated to fit all jacks for use within the raceway's provisions. Contractor must confirm compatibility of outlet with the raceway manufacturer.

B. Outlet module shall allow jacks to retain the configuration of the standard information outlets shall accommodate easy to read labels configured horizontally.

C. Color of the outlet module should be Ivory or White depending on electrical outlet color to match.

2.13. HORIZONTAL STATION CABLE PATCH PANEL

A. The data patch panel shall utilize modular jacks as described in Paragraph 2.3.

B. Patch panels shall be 19" wide and rack mounted.

C. Individual patch panels shall contain a maximum of 48 ports.

D. The data patch panel as a system shall be rated to match or exceed the ANSI/TIA/EIA rated wiring terminated on the panel.

E. Patch panel shall be complete with rear strain relief mechanism for the incoming cables.

F. The patch panel shall have integral designation strips to identify each port on the front and rear of the panel.

G. Patch panels shall have a minimum of 20% spare ports.

2.14. COMMUNICATIONS INDOOR OUTLET PATCH CORDS

A. Patch cords shall be factory manufactured by the same manufacturer providing the horizontal cabling and meet the requirements of Category 6 cabling.

B. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.

C. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

D. Furnish one patch cord per installed jack at workstation and TR room.

E. Patch cord lengths must not exceed the maximum allowed for proper operation per Manufacturer's requirement or specifications.

F. Install the quantity of patch cords in coordination with network deployment with owner.

G. All workstation patch cords shall be 14 feet in length.

H. For the TR patch cords, 80% shall be 7 feet, and 20% shall be 14 feet in length from the total number.

2.15. COMMUNICATIONS OUTDOOR OUTLET PATCH CORDS

A. In outdoor conditions as indicated on drawings provide IP67 rated patch cords.

B. Patch cords shall be from the same manufacturer as the outdoor rated jacks submitted for installation.

C. Patch cords shall be factory manufactured by the same manufacturer providing the horizontal cabling and meet the requirements of Category 6 cabling.

D. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.

E. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

F. Provide patch cord for all outdoor drops.

G. Each patch cord shall be 5 feet in length.

PART 3 - EXECUTION

3.1. HORIZONTAL DATA STATION CABLE AND TERMINATIONS

A. All horizontal Data Station Cables shall terminate on modular patch panels in their respective Telecommunications Rooms (TR) or Equipment Room (ER) as specified on the drawings.

B. The maximum station cable drop length shall not exceed 90-meters. This length shall be measured from the patch panel in the wiring closet to the outlet in the work area. The Contractor is responsible for installing station cabling in a fashion to avoid runs that exceed this distance. Any areas that violate the above constraints shall be identified and reported to the Consultant prior to installation.

C. All cables shall be continuous and splice-free.

D. During pulling operation provide adequate resources to observe cable at all points of duct entry and exit.

E. Avoid abrasion and other damage to cables during installation.

F. All cable shall be installed free of tension at both ends. In cases where the cable must bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

G. Cables shall be supported according to applicable codes. J-hooks used for cable support shall be manufactured solely for the purpose of supporting communication cables.

H. Supports should be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 12-inches, another support shall be used.

I. Cable shall never be supported by the ceiling grid.

J. Cables shall not be attached to existing cabling, plumbing or steam piping, ductwork, ceiling supports or the outside of existing electrical or communications conduit.

K. Manufacturer’s minimum bend radius specifications shall be observed at all times. Cable ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.

L. Cable sheaths shall be protected from damage by sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable. Bushings shall be used at both ends of all EMT and rigid steel conduit.

M. Maintain the following minimum separation distances between power and data cables.

Condition	Minimum Separation Distance		
	< 2kVA	2-5 kVA	>5kVA

Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	5”	12”	24”
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	2.5”	6”	12”
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway		3”	6”
Electrical motors and transformers			48”

N. Maintain the following minimum separation distances between data cables and specific electromagnetic interference sources:

Source of Disturbance	Minimum Separation
Fluorescent lamps	5”
Neon lamps	5”
Mercury vapour lamps	5”
High-intensity discharge lamps	5”
Arc welders	31”
Frequency induction heating	39”

O. Cables shall be routed through channel in modular furniture. Communication cabling shall not run in channel with power wiring.

P. Information Outlets shall be flush mounted on wall-mounted boxes, in floor-mounted boxes, and in modular furniture as shown on Drawings.

Q. All data and voice cables shall be positioned on termination hardware in sequence of the Outlet I.D. starting with the lowest number.

R. Termination hardware (Blocks and Patch Panels) positioning and layout must be reviewed by the Consultant prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.

S. Patch panels shall be installed to allow for future cables to be added without disrupting existing installation.

T. Cables shall have a 12” service loop in outlet box or supported properly above ceiling.

3.2. JACKS

A. Jacks shall be wired per TIA-568B pin outs.

3.3. INFORMATION OUTLET

A. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

B. Outlet boxes shall be secured to building with minimum of two mechanical fasteners per box. Adhesive fasteners are not allowed.

C. All extra openings to be filled with blank inserts.

3.4. COMMUNICATIONS PATCH PANEL

A. Panels shall be fully populated with jacks.

B. Install copper patch panels below fiber optic patch panels in telecommunications rack.

3.5. HORIZONTAL DATA STATION CABLE PATCH CORDS

A. The patch cords shall be installed per manufacturer’s written instructions.

B. Contractor must coordinate with the owner for installing all patch cords within the TR.

C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

END OF SECTION 27 15 00

SECTION 27 51 26

ASSISTIVE LISTENING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fixed Assistive Listening Systems (ALS) as part of the building project.
   2. Portable Assistive Listening Systems as part of the building project.

1.02 SCOPE OF WORK

A. The work shall consist of the design, provision, termination, testing, and documentation of a complete and fully functional ALS. The instructions in this section are specific to the ALS installations and should be read in conjunction with other contract documents as applicable.

1.03 REGULATORY REFERENCES

A. ALS equipment provided per this Section shall be in full compliance with the requirements of the Americans with Disabilities Act and as needed for the facility to meet full compliance.

B. ALS System shall be provided in accordance with CBC Section 11B-219 and shall comply with CBC Section 11B-706.

C. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two. 25% minimum of the receivers provided, but no less than two, shall be hearing aid compatible in accordance with CBC Section 11B-706.3.

D. If the system provided is limited to specific areas or seats, then such areas or seats shall be within a 50-foot viewing distance of, and have a complete view of, the stage or playing area. CBC Section 11B-219.4

1.04 PRE-INSTALLATION MEETINGS

A. Pre-installation conference: Not applicable.

1.05 SUBMITTALS

A. Submit under provisions defined in Division 01 General Requirements

B. Prior to ordering materials or commencing any construction activities, the contractor shall provide the Owner with a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work.

C. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations
2. Storage and handling requirements and recommendations.
3. Manufacturer's installation, operation, maintenance, and cleaning instructions.

D. Shop Drawings: Indicate fabrication and installation details, electric wiring diagrams, product list including manufacturers, models, and quantities.

E. Submit proof of qualifications specified in the “Quality Assurance” paragraph.

1.06 Quality Assurance

A. Manufacturer Qualifications
1. Manufacturer with 10 years minimum successful experience manufacturing Assistive Listening Systems.
2. Manufacturer whose product offerings include all components and accessories needed to execute fully functional ALS systems that satisfy CBC and ADA requirements for each space

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, per Applicable Code Requirements

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits

1.09 WARRANTY

A. Warranty
1. Warranty Period: One (1) year from date of Substantial Completion or the manufacturer’s stated product warranty, whichever is greater

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Listen Technologies

B. Or equal

2.02 PRODUCT REQUIREMENTS

A. Basis of Design: Listen Technologies
1. Items specified are to establish a standard of quality for design, function, materials, and appearance.
2. Equivalent products by listed manufacturers are acceptable.

B. Type A – Fixed System
   1. The full complement of equipment provided shall constitute a complete system of compatible components as produced by a single manufacturer. A mix of components by multiple manufacturers shall be unacceptable.
   2. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The ALS system shall have 80dB SNR or greater, end-to-end. Receivers shall be frequency agile and frequency set with a "seek" button. The receiver will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally. The portable receivers and transmitters shall incorporate automatic battery charging circuitry for recharging of Ni-MH batteries.
   3. Equipment for (1) system for Multipurpose Room (MPR) 101:
      a. Listen Technologies LT-800-72-01 57-Channel base station (Qty: 1), or equal
      b. Listen Technologies LR-4200-072 Portable Display receiver (Qty: 2), or equal
      c. Listen Technologies LA-123 ALS Antenna (Qty: 1), or equal
      d. Listen Technologies LA-404 Ear Speaker (Qty: 2), or equal
      e. Listen Technologies LA-430 Neck Loop (Qty: 2), or equal
      f. Listen Technologies LA-365 NiMH rechargeable batteries. (Qty: 2), or equal
      g. Listen Technologies LA-381-01 12-Unit Charging/Carrying Case (Qty: 1), or equal
      h. Cabling to support proper coverage for each system.

C. Type B – Portable System
   1. Portable System – Provide (2) complete systems total, (1) system per floor.
   2. The full complement of equipment provided shall constitute a complete system of compatible components as produced by a single manufacturer. A mix of components by multiple manufacturers shall be unacceptable.
   3. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The ALS system shall have 80dB SNR or greater, end-to-end. Receivers shall be frequency agile and frequency set with a "seek" button. The receiver will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally. The portable receivers and transmitters shall incorporate automatic battery charging circuitry for recharging of Ni-MH batteries.
   4. Equipment for one (1) complete system:
      a. Listen Technologies LT-800-216 Portable Transmitter (Qty: 1) and compatible transmitter antennas (Qty: 1), or equal
      b. Shure MX153B Microflex Headset Microphone (Qty: 1), or equal
      c. Shure QLXD1 Bodypack Transmitter (Qty: 1), or equal
      d. Shure QLXD4 Receiver (Qty: 1) and compatible antennas (Qty: 1), or equal
      e. Shure SB900A lithium-ion rechargeable batteries (Qty: 1 pair) and charger, or equal
      f. Shure SBC10-100-US battery charger for SB900 rechargeable batteries (Qty: 1), or equal.
      g. Listen Technologies LR-5200-216 Portable receiver (Qty: 3), or equal
      h. Listen Technologies LA-430 Neck Loop (Qty: 3), or equal
      i. Listen Technologies LA-401 Ear Speaker (Qty: 3), or equal
      j. Listen Technologies LA-365 Li-Ion rechargeable Batteries (Qty: 4 pair), or equal

k. Listen Technologies LA-380 12-Unit Portable RF Intelligent Product Charging/Carrying Case (Qty: 1 total to be shared by all portable ALS systems), or equal.
l. Listen Technologies LA-304 ALS Notification Signage Kit (Qty: 1 per portable system)
m. SKB 4U Roto Shallow Rack Case with Steel Rails, 4-RU (Qty: 1), or equal
n. Middle Atlantic D2 drawer (Qty: 1), or equal
o. Custom 2-RU black connector plate and connectors to be mounted in rear of Rack Case. Provide custom text engraving on plate and back-fill engraved text with white paint. See Sketch “ALS1” in Appendix A for receptacle and engraved-text information.
p. Custom 3’ balanced audio adapter cable from the installed AV system’s master program audio output to the XLR input on the Custom 2-RU connector plate. Cable may need to be terminated with a 3.5mm on one end and have an XLR-M connector on the other. AVC shall field verify. (Qty: 1), or equal
q. All required cabling, connectors, and terminations. See wiring diagram “ALS2” in Appendix A.
r. 12’ power cable with standard 5-15 plug on one end and a L5-20R twist-lock plug on the other. (Qty: 1), or equal.

PART 3 - EXECUTION

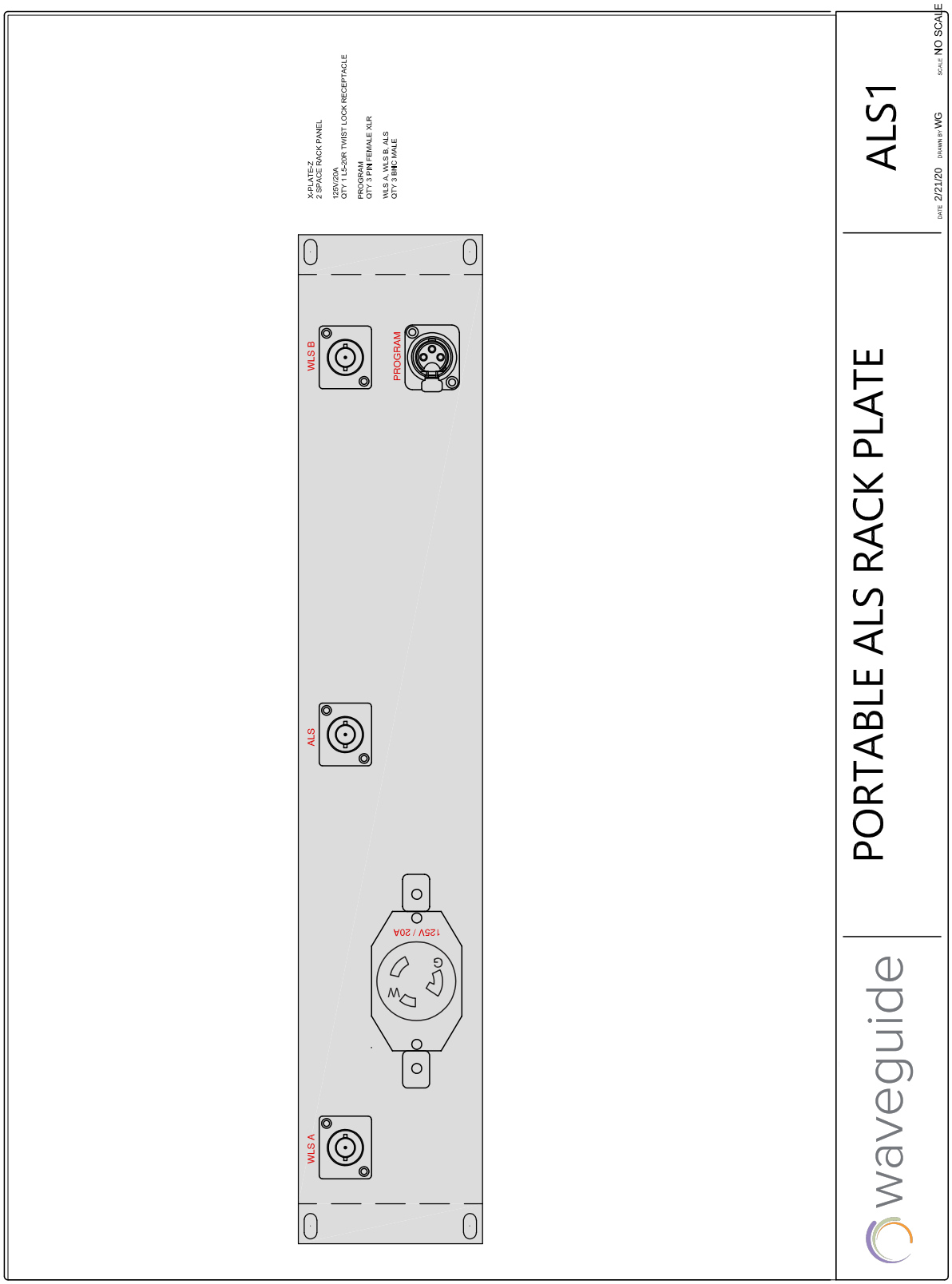
3.01 EQUIPMENT INSTALLATION

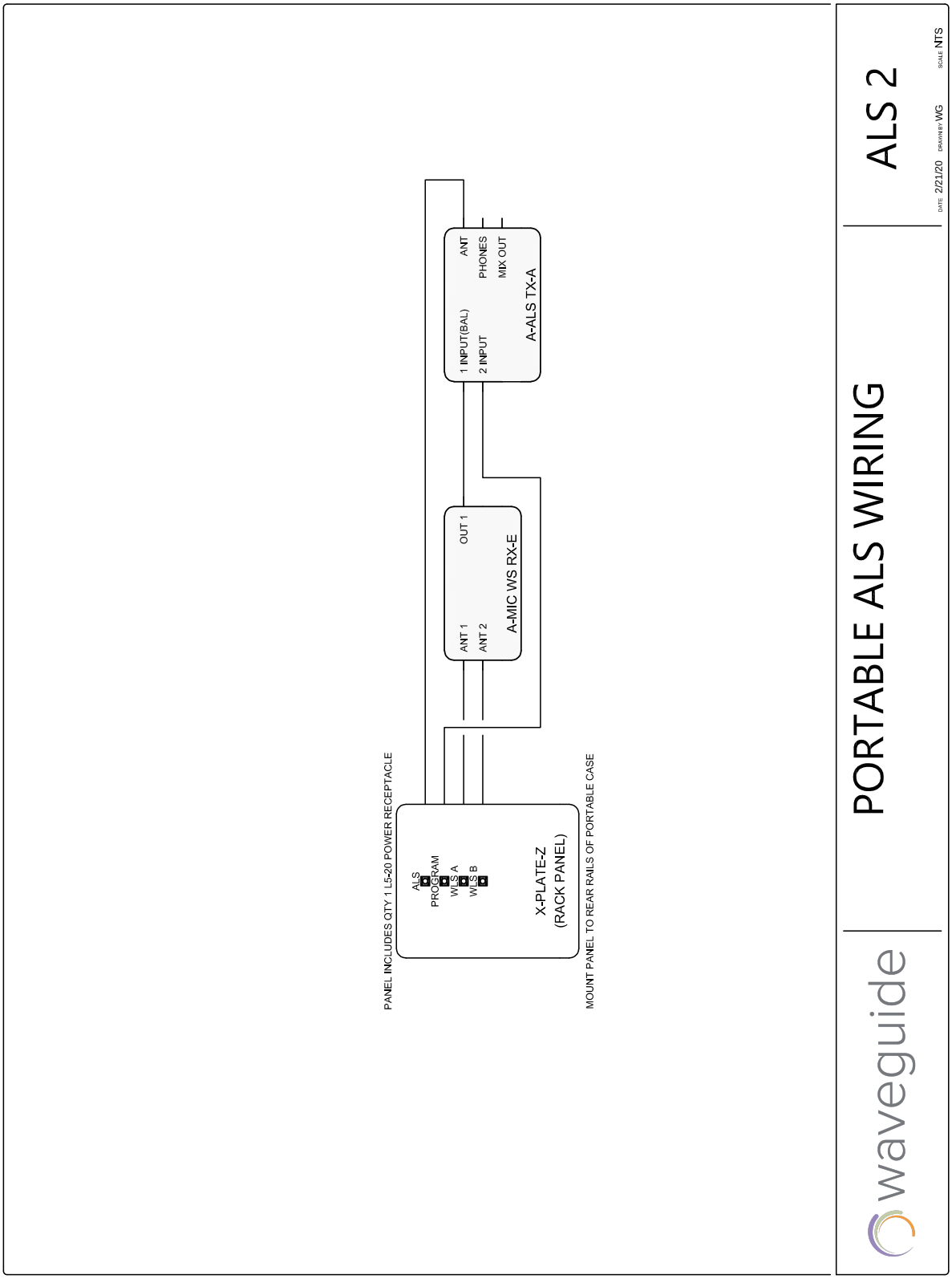
A. All specified portable ALS equipment shall be delivered to the Owner’s Representative unopened in original packaging for installation and/or deployment by others.

B. All specified fixed ALS system shall be installed in accordance with the Audio Visual systems requirements by the AV integrator

APPENDIX A – SYSTEM SKETCHES

See below for the ALS system wiring sketches and custom plate requirements.




PANEL INCLUDES QTY 1 L5-20 POWER RECEPTACLE
ALS
PROGRAM
WS A
WS B
X-PLATE-Z
(RACK PANEL)
MOUNT PANEL TO REAR RAILS OF PORTABLE CASE
ANT 1
ANT 2
OUT 1
A-MIC WS RX-E
1 INPUT(BAL)
2 INPUT
ANT
PHONES
MIX OUT
A-ALS TX-A
waveguide
PORTABLE ALS WIRING
ALS 2
DATE 2/21/20
DRAWN BY WG
SCALE NTS

END OF SECTION

SECTION 28 10 00

Access Control

Chapter 1 - System Description

1.01 General product description

A. The Integrated Access Control System's (ACS) primary function shall be to regulate access through specific doors, gates or barriers to secured areas of the facility. It shall also have the provision of capturing cardholder images and producing access cards used to provide this access.

B. The system shall use a single seamlessly integrated database for both its access control and badging functionality. This integration shall be provided under one operating environment.

C. The system shall provide a multi-tasking environment that allows the user to run several applications simultaneously. The ACS shall be able to run in conjunction with other Windows applications such as MS Word and Excel while concurrently annunciating on-line access and security alarms and monitoring information.

D. All system application modules, features, and functions shall be generated from a single source code set. In addition, the source code must be designed using object-oriented software development techniques and compiled into native 32-bit and managed code applications. There shall not be separate source code bases for access control and ID badging. All system features and functionality listed in the proceeding pages shall ship with each system. Features and functionality available to the "Owner" shall be determined through licensing and shall be controlled by a software license key. The "Security Contractor" shall work with the Owner to develop and configure the system.

E. The access control software shall offer a high-security solution, based on digital certification.

1. The authentication between the client and server shall be done through certificates using the x.509 standard with authorization through user logon credentials.

2. A Certification Authority (CA) signs the certificates for the server and remote clients, and allows authentication during installation and all operations to ensure there is no manipulation of the data during transmission.

3. It shall also be possible to use Self-signed Certificate for easier installation, or a Machine Certificate for more advanced and robust installation.

F. Manufacturer: Siemens Industry: To match existing SiPass Integrated ACS already installed throughout.

Chapter 2 - Glossary of Terms & Abbreviations

A. ACS: Access Control System - The ACS incorporates the entire access control and security network, including the Server, Workstations and Intelligent field or system controllers.

B. ISC: Intelligent System Controller - The hardware components of the system to which the physical components (input devices, entry devices, and output devices) of the access control system connect. The ISC communicates with the ASC Server.

C. MMI: Man Machine Interface - Also known as the Graphical User Interface (GUI)

D. NIC: Network Interface Card

E. DRIM: Dual Reader Interface Module

F. SRIM: Single Reader Interface Module

G. GEM: Graphics Editing Module

Chapter 3- Compliance & Standards

A. The “Tenderer” shall be regularly engaged in the manufacturing, installation and maintenance of ACS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of ACS systems similar in size and complexity to this project. The tenderer shall also be a maintained service organization consisting of at least ten (10) competent service people for a period of not less than ten years and be able provide a list of five projects, similar in size and scope to this project, completed within the last five years.

B. The Intelligent System Controllers (ISC's) shall comply with at least two standards from the following compliance regulations:

1. CE
2. C-Tick
3. UL

C. The purpose of these regulations is to maximize the operational usability of the product and to ensure minimum standards within the access control system development have been maintained. These standards will also ensure electromagnetic interference between electronic products are minimized as these may diminish the performance of electrical products or disrupt essential communications.

Chapter 4- Installation

A. The ACS shall be designed, installed, commissioned and serviced by manufacturer employed, factory trained personnel.

B. All materials supplied by the Security Contractor shall be new and shall comply with the latest published specifications and recommendations of the manufacturer in all respects unless otherwise indicated. The Security Contractor shall supply the latest model available for all equipment items. Unless otherwise indicated in the specification, all electronic equipment shall be a standard, unmodified production model.

C. Equivalent products may not be substituted for previously approved products unless the Architect has approved a written request from the Security Contractor. All requests for

substitute equipment must reflect a complete description of the proposed substitute equipment, including manufacturer's technical descriptions, drawings and technical performance.

D. The Security Contractor shall be responsible for providing complete and operational subsystems, including but not limited to all hardware, software, wire, cable, conduit and boxes, power circuit connections, terminal blocks, labor, management, engineering, training, testing, relocation adjusting and connection to NIC work and devices.

E. Required Manufacturer: Siemens Industry, to match existing ACS, SiPass Integrated Access Control

Chapter 5 - System Requirements

5.01 System Architecture

A. The system shall be of a Server / Client architecture with the option to configure the Server and client ACS software on different PCs residing on the same computer network. Full network functionality shall be available over remote links between the Server and any workstation, using the following protocols:

1. NetBEUI
2. IPX/SPX
3. TCP/IP

B. Dial-in capability from remote workstation to the Server using a remote access service shall also be available.

C. Encryption between the Server and each Client is configurable and safeguarded using IPSec, to ensure the integrity and security of the data transferred.

D. Manufacturer: Siemens Industry to match existing ACS, SiPass Integrated Access Control no substitutions will be accepted.

5.02 Server

A. The ACS Server shall be capable of operating on an IBM compatible computer with the following minimum system requirements:

1. Operating System - Windows 8.1 / Windows Server 2012 R2 (64-bit) / Windows Server 2008 R2 (SP2) (64-bit) / Windows 7 (Professional, Enterprise) SP1 (32-bit & 64-bit) / Windows 2003 Server (SP2) (32-bit only)
2. ODBC - Microsoft SQL 2012 (SP1) (32/64-bit) / SQL 2008 R2 (32/64-bit) / SQL 2008 R2 Express (32/64-bit) / SQL 2005 (SP3 or later) (32-bit) / SQL 2014
3. RAM - 4 GB
4. Hard Drive - 160 GB

5. Ports - At least one network connection (as outlined above)

6. Standard mouse, keyboard, and color monitor

5.03 Workstation

A. Workstations shall be capable of operating on an IBM compatible computer with the following minimum system requirements:

1. Operating System - Windows 8.1 / Windows Server 2012 R2 (64-bit) / Windows Server

   2008 R2 (SP2) (64-bit) / Windows 7 (Professional, Enterprise) SP1 (32-bit & 64-bit) / Windows 2003 Server (SP2) (32-bit only)

2. RAM - 1024 MB

3. Hard Drive - 80 GB

4. Monitor - VGA or better

5. Ports - At least one network connection port to the Server PC.

6. Standard mouse, keyboard, video card and color monitor

Chapter 6 - IT Security

6.01 Latest Security Standards

A. The ACS shall be capable of meeting current market standards of IT security to preemptively counter threats in order to provide customers with a highly secured solution having

Intellectual Property (IP) and Cyber Security threat protection, data protection and encrypted data transmission throughout the network.

B. The system shall include the following

1. Card Reader (128 bit AES encryption with DESFire)

2. Reader Controller (AES up to 256 Bit)

3. Server Controller (AES 128 Bit)

4. OSDP encryption between controller-reader

5. DesFire EV1 encryption for access cards

6. RESTful Servers

7. HTML 5

8. Mutual Authentication between Server and Clients

9. Verifies the message has not been changed during transmission

10. Clients with no direct database connection

11. Permission checks when a client establishes a connection to server

C. The ACS manufacturer must make updates to the ACS to mitigate potential vulnerabilities that should be identified through continual threat and risk analysis process including penetration testing.

6.02 Mutual Authentication through Digital Certificates

A. The ACS shall be able to authenticate Server and Clients by using digital certificates. These digital certificates must allow the server to authenticate the connecting clients and verify that any subsequent messages from client to server can be verified to ensure there was no manipulation of the data during transmission.

B. The ACS shall offer easy to use certificate management process that allows for either customer based certificates to be used or for creation of self-signed certificates. The certification management utility must be able to update certificates or block specific clients, if required.

Chapter 7 - Intelligent System Controllers

A. The system shall be configured with the ACS software connected via an Ethernet link to any configurable number of Intelligent System Controllers.

7.01 IP Connected Door Controller

A. The ACS shall support IP connected door controller to help in reduction of overall cost for installation and maintenance; and enable strong autonomous operations of field equipment through peer to peer communications.

B. The controller shall be capable of controlling up to two doors, supporting FLN devices and hosting of units such as the 8IO, OPM and IPM, while enabling standard features like distributed intelligence, IP addressing of doors, state-of-the art technology and modern design.

7.02 Distributed intelligence

A. The system shall employ a distributed architecture so that all access decisions are made locally at the Intelligent System Controller (ISC). All decisions to grant access shall be made by the local ISC.

B. An Intelligent System Controller (ISC) shall link the ACS software to all other field hardware. It shall provide full distributed processing for access control and alarm monitoring operations. Access levels, hardware configurations and programmed alarm outputs assigned at the administrative workstation shall be downloaded immediately to the ACS software. All access granted/denied decisions shall be made at the ISC to provide fast responses to card reader transactions.

C. The ISC shall be required to operate in a stand-alone and peer-to-peer mode in the event it loses communication with system software. It shall continue to make access granted/denied decisions and maintain a log of events. Events shall be stored in local memory, and then uploaded automatically to the system when communications are restored.

Furthermore, an individual ISC shall be able to communicate with another ISC to distribute cardholder locations and to perform scheduled and alarm events.

7.03 Ethernet Communications

A. The ISC shall communicate with the ACS via any standard WAN / LAN communications link. The ISC shall provide integrated onboard port for direct Ethernet connection. This connection

shall not be an RS-485 communications channel that has simply been converted into an Ethernet connection using a “Terminal Server” or similar conversion device.

B. The ISC shall be IP addressable and support standard TCP/IP transmission.

7.04 Dial-up capabilities

A. The system shall be capable of communicating with remotely located ISCs using dial-up modem connectivity. The system shall provide the capability to download database changes to such a controller incrementally.

B. The ISCs shall also provide the additional functionality of dialing into the ACS Server to communicate alarm events, and other events deemed severe enough for this activity. All other transactions that occur at the remote ISC shall be stored in its internal buffer until that buffer reaches 80% capacity or the server requests the buffer contents, at which point the ISC will upload the entire contents of its transaction buffer.

7.05 Redundant Communications

A. In the case of main communications line failure with the host system, the ISC shall be able to activate an alternative communications method. This alternative method will be activated automatically and ensure that all critical events and alarm messages are forwarded to the host.

7.06 Internal Memory

A. The ISCs will be supplied complete with internal non-volatile memory. This memory will allow all program, access permissions, time schedules and the current date and time data stored in

the ISC memory to be retained during periods of power failure. The purpose is to ensure the ISC returns to full operation after the event of absolute power failure. In addition, the ISC memory will not require the connection of a battery to permanently store system information.

7.07 Expandable Memory

A. The ISCs will support the installation of an expandable memory card. This memory card will be used to increase the overall capacity of the ISC and allow the backup of programmed and transaction data locally for recovery immediately following a power failure.

7.08 Local Alarm Input and Output

A. The ISC shall support the onboard direct connection of a tamper input. This input connection shall be reserved for connecting a tamper switch of the equipment cabinet in which the ISC has been installed.

B. Upon the Tamper input being triggered the ISC shall also provide a local output that is capable of connecting an output device that can be triggered as a result of cabinet tempering.

7.09 LED diagnostics

A. As a minimum the ISC shall provide at LEDs that can be easily viewed for diagnostic purposes. These LEDs shall indicate the state of power and communications at any given time.

7.010 Dual Reader Interface Module

A. A Dual Reader Interface Module (DRIM) shall be available for each controlled door and provide the ability to connect up to two card readers or entry devices. This DRIM shall:

1. Monitor the door position (door contact)
2. Allow the connection of a Request-to-Exit (REX) switch for exit
3. Control an electric door lock or strike
4. Provide the facility for up to 3 auxiliary input devices to be connected
5. Allow the connection of an alarm buzzer that can be triggered in the case of an alarm event, or more specifically locally trigger a buzzer for a door held event before this alarm is registered at the host.

B. All events that occur at the door must be reported from the DRIM to the ISC.

C. To allow for situations where an entry and exit reader may be required at the one door a DRIM will allow two readers to be connected. However, in circumstances where a door shall only require one reader the DRIM can be configured to operate in a two door mode, whereby a reader, door lock and door monitoring device can be connected for each door.

D. In addition, the DRIM shall also provide connection for single advanced reader that connects via an RS-485 or Wiegand / Clock/Data connections.

E. Finally, the DRIM shall also provide the ability to work offline in cases where communications with ISC has have been lost and still continue to accept a set of specified cards as being valid to the door(s) which it controls.

7.011 Single Reader Interface Module

A. A Single Reader Interface Module (SRIM) shall be available for each controlled door and provide the ability to connect a single card reader or entry device. This SRIM shall:

1. Monitor the door position (door contact)

2. Allow the connection of a Request-to-Exit (REX) switch for exit

3. Control an electric door lock or strike

4. Provide the facility for up to 3 auxiliary input devices to be connected

5. Allow the connection of an alarm buzzer that can be triggered in the case of an alarm event, or more specifically locally trigger a buzzer for a door held event before this alarm is registered at the host.

B. All events that occur at the door must be reported from the RIM to the ISC. In addition, the SRIM shall also provide the ability to work offline in cases where communications with ISC has have been lost and still continue to accept a set of specified cards as being valid to the door(s) which it controls.

7.012 Eight Reader Interface Module

A. An Eight Reader Interface Module (ERIM) shall be available for each controlled door and provide the ability to connect up to eight separate card readers or entry devices. This ERIM shall:

1. Monitor the door position (door contact) for each door

2. Allow the connection of a Request-to-Exit (REX) switch for each exit

3. Control an electric door lock or strike for each door

4. Provide the facility for up to 16 auxiliary input devices to be connected

5. Allow the connection of an alarm buzzer that can be triggered in the case of an alarm event, or more specifically locally trigger a buzzer for a door held event before this alarm is registered at the host.

B. All events that occur at any door must be reported from the ERIM to the ISC.

C. To allow for situations where an entry and exit readers may be required at a door the ERIM will allow two readers to be used for single door control and provide the possibility to uses the following combinations of door control:

1. Eight single reader doors

2. Six single reader doors and one dual reader door

3. Four single reader doors and two dual reader doors

4. Two single reader doors and three dual reader doors

5. Four dual reader doors

D. The ERIM shall also provide connection for up to eight advanced readers that connect via an RS-485 or Wiegand / clock/data connection.

E. The ERIM shall also provide emergency override that supports wire supervision, to ensure that false fire override conditions are not triggered.

7.013 Input Control Module

A. A hardware module shall be available to independently monitor up to 32 alarm input devices and report line fault conditions, alarm conditions, power failure and wire supervision. When an alarm input is activated, the condition shall be reported to the ISC and subsequently to the ACS host. The same module shall also provide the ability to connect up to four control devices and support emergency override capabilities.

B. The emergency override shall additionally support wire supervision, to ensure that false fire override conditions are not triggered.

7.014 Elevator control module

A. A hardware module shall be available to monitor up to 16 independent input devices and reports line fault conditions, alarm conditions, and power failure. When an alarm input is activated, the condition shall be reported to the ISC and subsequently to the ACS workstation. The same module shall also allow the control of up to 16 output devices that can be controlled via the change in state of an input (monitor point) or a command received from the ACS Server. These outputs shall support fire override operation.

B. The emergency override shall additionally support wire supervision, to ensure that false fire override conditions are not triggered.

7.015 Input / Output control module

A. A hardware module shall be available to monitor up to 8 independent input devices and reports line fault conditions, alarm conditions, power failure, and wire supervision. When an alarm input is activated, the condition shall be reported to the ISC and subsequently to the ACS workstation. The same module shall also allow the control of up to 8 output devices that can be controlled via the change in state of an input (monitor point) or a command received from the ACS Server. These outputs shall support fire override operation.

7.016 Diagnostics

A. Each ISC and hardware module shall provide a series of visible Light Emitting Diodes (LEDs) that display the status of the controller or module, and can be used as visual diagnostic indicators. As a minimum, the following diagnostic LEDs should be available:

1. Communications
2. Monitor point (input) status
3. Control point (output) status
4. Power

7.017 Housings & equipment tamper switches

A. All access control hardware components shall be housed in a lockable metal cabinet that is fitted with equipment tamper switches and meets the appropriate environmental requirements. The ISC shall allow the connection of equipment tamper switches to detect access to security equipment and shall consist of a spring loaded switch assembly. Any movement of the cabinet door shall cause the switch contacts to transfer. Tamper switches

shall incorporate SPDT contacts and be mounted within each cabinet containing security equipment such that the switch cannot be disconnected or disabled from the cabinet exterior.

7.018 Firmware Download

A. All access control hardware components shall be supported by a built in firmware download and configuration utility from the ACS. This utility shall be included within the MMI and not via an external dedicated tool only.

Chapter 8 - Communications

A. The system shall use TCP/IP communications techniques over Ethernet, whilst employing proprietary communications protocols. The encryption between the ACS host and each ISC shall use implementation of the Advanced Encryption Standard (AES) to encrypt all messages and ensure data security.

8.01 ACS communications

A. The connection between the ACS Server and each MMI workstation shall use standard Ethernet communications.

B. The communications protocol to transfer messages to or from the ACS Server to any MMI workstation in the system shall be of a proprietary nature to the manufacturer providing the highest level of security.

C. In addition, the communications protocol shall allow an encryption mechanism to be configured, that ensures the transfer of data cannot be interpreted.

8.02 ACS / ISC communications

A. The connection between the ACS Host and the ISCs shall use standard Ethernet communications. All communications between the ISCs and sub-devices shall be based upon the standard RS485 transmission techniques using a proprietary protocol.

B. The communications protocol to transfer messages to or from the ACS Host to any ISC in the system shall be of a proprietary nature to the manufacturer providing the highest level of security.

C. In addition, the communications protocol shall incorporate an error checking routine that checks the integrity of the messages that are transferred on this line.

8.03 ISC communications

A. The connection between an ISC and a series of entry devices using Reader Interface Modules (RIMs), or system extension boards shall use standard RS485 communications techniques. The communications protocol to transfer messages to or from the ISC to any connected device shall be of a proprietary nature to the manufacturer providing the highest level of security possible.

B. In addition, the communications protocol shall incorporate an error checking routine that checks the integrity of the messages that are transferred on this line.

C. Each ISC shall be capable of communicating with at least 96 of these devices at any one time, using four separate channels to co-ordinate the communications process and share the load across different channels.

Chapter 9 - System Operators

A. The system will only permit authorized operators, who have been given permissions to log on to the ACS at a workstation, to administer aspects of the system. The functionality available to these operators shall be fully configurable via the comprehensive partitioning architecture.

9.01 Authentication

A. The system shall request an operator's user name and password before entry to the MMI is granted. The password must be fully encrypted on-screen to prevent it from being easily copied. The MMI will not be displayed until the identification of the operator has been verified and access to the ACS is granted. Authentication may be based on a pre-defined time schedule for certain groups of operators.

1. Authentication Rules: It shall be possible for the following configurable logon rules to apply to each account:

    a. Password age

    b. Password Length

    c. Logon retries

    d. Complexity

B. Finally, it may be possible for the operator to change their own password or for authentication to be performed using the standard Windows logon identification. Therefore the currently logged in Windows User's details can be used to verify their permission to log into the ACS.

9.02 Partitioning

A. Operator specific password access protection shall be provided to allow the user/manager to limit workstation control, display and database manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (an unlimited number of operator accounts shall be supported).

B. The System shall employ an application partitioning design so that applications are broken into separate distinct programs capable of running independently to other System applications. Applications shall include, but not be limited to, alarm monitoring, system administration & configuration, cardholder management, graphics, ID card printing, and cardholder forms designing modules. Each client workstation shall have the ability to be installed with any combination of the above listed modular applications.

C. The system shall allow partitioning to be assigned on the basis of the following conditions:

1. Cardholders

2. System Functions (minimum of 70 feature levels)

3. Holidays

4. ISCs

5. Field Devices

6. Custom Pages

7. Time Schedules

8. Site Plans

9. Reports

D. The system shall prevent the currently logged in operator from viewing the details, regarding any alarms triggered by a system component to which they have not been assigned privileges, including:

1. Audit trail alarm entries

2. Audit trail reports, which include alarm details

3. Audible and visual alarm annunciation

4. The alarm information associated with any system component to which an operator has been assigned privileges will be displayed.

E. The system shall allow partitioning to be assigned on the basis of audit trail reports. The currently logged on operator shall only be able to create or run those reports to which they have been assigned privileges.

1. The system shall also prevent the currently logged in operator from printing reports that include those system components to which they have not been provided privileges.

9.03 Privilege levels

A. When assigning a function to an operator, the system shall allow the level of assignment to be specified. These levels include:

1. Read only: This type of privilege level does not allow the operator to create or modify components in the specified area of the system. However, they are allowed to view those records.

2. Modify: This type of privilege level does not allow the operator to create components in the specified area of the system. However, they are allowed to view and make modifications to existing records.

3. Full: This type of privilege level allows the operator to create, modify and view components in the specified area of the system.

9.04 Operator profiles

A. The ACS shall support multiple operator profiles such that preferences are retained for individual operators, irrespective of the workstation that they log onto. The display colors and data layout shall be configurable (and be saved) per operator.

9.05 Operator journal

A. A system operator journal shall be available to log important daily events. The operator is required to select a journal subject from a pre-defined list. The ACS shall allow an administrator to set the names to comprise this list of subjects. The system shall also allow

all journal entries relating to a particular subject to be recalled and viewed on-screen, printed or both.

9.06 Workstation auto-lock

A. All ACS workstations shall automatically lock if left idle for a configurable period of time - requiring the operator to identify him or herself by re-entering their password. The operator shall also have the capability of manually locking a workstation at any time. Any system initiated or manual workstation locks shall be logged in the ACS audit trail.

9.07 Default Accounts

A. At installation the ISC shall be automatically configured with default operator accounts. These accounts shall be defined in such a way that they reflect the standard duties of different operators that can be expected to use the system.

Chapter 10 - Cardholders

A. The system shall include a cardholder management component that is integrated with the access control system. The system must support at least 500,000 cards – all of which are downloaded and retained in the memory of each ISC. This cardholder management functionality must allow the enrolment of cardholders into the database, capturing of images and import/export of employee data. This functionality shall also allow a system operator to assign or modify the access rights of any cardholder.

10.01 Cardholder data

A. As a minimum, the ACS shall allow configurable fields to be customized by the system administrator to suit the needs of the facility owner. The system shall provide a Graphics Editing Module (GEM) that gives operators the ability to modify any standard field to customize the cardholder screens as desired. Once these fields have been defined, the ACS shall not permit these (database) fields to be changed.

B. In addition it shall be possible to add cardholders to the database without assigning a card to that cardholder.

10.02 Searching

A. The system shall allow the search of all programmed cardholders, based on the criteria supplied by an operator. Operators shall only be able to search and retrieve cardholder records to which they have assigned privileges. **B.** As a minimum, the search criteria shall include:

1. Card number
2. Name (first and / or last)
3. Work Group

4. Title
5. Address
6. Contact Numbers (phone, mobile, and pager)
7. Payroll Number
8. Vehicle Details (registration, color, model)

C. Searching shall not only be limited to entire word matches. An operator may also search for cardholders by entering data that appears in the beginning of a word or string.

D. If more than one cardholder in the system meets the specified criteria, the operator shall be displayed a list of all matching records, from which they can select a particular record.

E. When search results are returned, the operator shall be able to dynamically re-sort the information displayed so that appears in a useful order (for example, by last name). When selecting an individual record to expand, it shall be possible to keep the search dialog active so that other cardholder records can be opened at a later time if required.

10.03 Cardholder images

A. The ACS shall support the capturing of a high quality image of a cardholder from any workstation. The system operator shall have the option of capturing images in real-time or alternatively by importing an existing image.

B. If capturing images in real-time, the operator shall be able to use an appropriate capture card or use a USB digital video camera. If cardholder images already exist, the operator shall be able to import images of all standard formats including jpg, bmp, gif, and tif.

1. Once an image has been captured or imported, the operator shall be able to preview in full color, the cardholder image complete with the card, as it will appear when printed. The Operator shall have the ability to crop and resize the image and adjust the brightness and contrast.

C. The cardholder image shall be able to be recalled at any time from any workstation to verify the identity of any cardholder on the facility.

10.04 Cardholder Fingerprints

A. The ACS shall support the capturing of high quality finger prints and encoding the finger print into the card during enrolment process that is native of ACS.

B. Also the ACS shall allow operators to capture and store the fingerprint to the ACS database. The fingerprints shall be captured using a biometric reader and an enrolment reader shall be used for fingerprint encoding.

10.05 Cardholder Signatures

A. The ACS shall support the capturing of cardholder signatures from any workstation. The system operator shall have the option of capturing signatures in real-time or alternatively by importing an existing signature.

B. If capturing signature in real-time, the operator shall be able to use a USB signature capture pad. If cardholder signature already exists, the operator shall be able to import images of all standard formats including jpg, bmp, gif, and tif.

10.06 Card Trace

A. The ACS shall record the last visited access point (with date and time) for every cardholder. A special trace function shall be available for operators to track activity of specific cardholders. When the trace has been applied, all card activity relating to that cardholder will

be highlighted in the audit trail. A report may also be generated that details the locations visited by the traced cardholder.

10.07 Grouping cardholders

A. The ACS shall allow the grouping of cardholders into specific configurable entities. This shall facilitate voiding of a large number of cards with a single action and also assist with operator partitioning.

10.08 Cardholder violations

A. The system shall monitor every card presented at each reader in the system and prevent access at the reader (door) if any of the following access violation conditions exist:

1. The card has not been assigned access permission at the current time.
2. The card has not been assigned permission at the reader.
3. The cardholder has been voided in the system.
4. The cardholder belongs to a group of cardholders that has been voided.
5. Entry to or exit from an area governed by anti-pass back control has been violated.
6. A card belongs to a group of cards that has been disabled.
7. A card was presented at a reader that has been disabled or taken out of service.
8. The card has been presented before its allocated start date, or after the card's designated end date.
9. The card presented does not belong to the site, which includes an invalid card number, an invalid site number or a card containing an invalid facility code.

B. In addition, a message will be logged in the audit trail indicating the card use violation, and if configured, a visual and audible alarm will also be displayed.

10.09 Cardholder Data Import / Export

A. The system shall provide an external software tool that can be used to import or export cardholder data from another application via text file.

B. This manipulation of data shall be governed by the same login rules applied to a standard operator of the system and shall also be capable of synchronizing data over a period of time.

C. The system shall also provide an automatic synchronization tool that allows changes to be automatically bought in the ACS. .

10.010 Cardholder Changes

A. It shall be possible to display all changes made to a cardholder record within a specified date range so that record can be reversed to a previous status from any point in time.

10.011 Multiple Cards per Cardholder

A. It shall be possible to define up to 5 cards for each cardholder in the system and have an independent void or active status for each card and the overall cardholder.

B. In addition, it shall be possible for each card assigned to the same cardholder to be of a different card technology and for each card to have separate access permissions.

10.012 Inactive Cardholders

A. It shall be possible to effectively park cardholders by removing a card from their current identity profile. Whilst this data will still remain in the ACS the cardholder will still be considered inactive and not count toward any overall licensing structure or otherwise.

10.013 Custom Cardholder Information

A. The ACS shall provide an integrated tool for creating custom cardholder information. This shall provide the ability to add the following information types to a cardholder custom page:

1. Textbox
2. Dropdown List Box
3. Date Calendar
4. Group Box
5. Dialog Labels
6. Custom Button
7. Attachments Box

B. In addition, design of custom pages shall be simple drag and drop functionality with automatic page guides for aligning already placed components and the ability to individually change the parameters of each component selected.

C. Finally, it shall be possible to import or export custom pages using an xml format.

10.014 Cardholder Watch lists

A. The ACS shall provide the ability to import information regarding any cardholder on a watch list from a government agency or otherwise

B. When an operator attempts to enroll a cardholder into the ACS that matches the information already contained in a watch list, the ACS shall generate an alarm that alerts the operator that a match has been recognized and further action may be required.

C. This match shall include general cardholder information or may even include custom cardholder information

Chapter 11 - Assignment of access

A. The system shall allow an infinite number of combinations of access permissions to be assigned to any cardholder programmed in the system. The system shall allow access permissions to be assigned to access points, areas, elevator floors, groups and venues.

B. In addition, the system shall provide the ability to schedule the times during which cardholder access to each separately allocated resource is permitted.

C. Access shall also be extended to output points, whereby a cardholder presenting their access badge not only unlocks a door, but can also easily change the state of any output in the system.

D. Upon changing or assigning access to any cardholder, the details shall be immediately propagated to all on-line ISCs.

1. Access privileges shall be assignable on the following basis:
2. Access based upon access group privileges
3. Access based upon personalized privileges
4. Access based upon a venue booking privileges
5. Access based upon offline doors
6. Any combination of the above

Chapter 12 - Time Schedules & Holidays

A. The ACS shall allow up to 65,000 configurable time schedules to be defined. Each time schedule can consist of up to 20 independent time periods including up to 8 holidays. For ease of configuration, the operator shall be able to select from week days, weekends, or specify a particular day or time. The ACS shall have the intelligence to check whether the time periods are valid and not conflicting with existing credentials.

B. A time schedule can be configured to include or exclude holidays. Upon changing a time schedule record, the ACS shall immediately propagate the appropriate changes to all affected ISCs.

Chapter 13 - Card Readers and Cards

A. Card Readers shall read encoded data from the access card and transmit that data back to the

ISC. The card reader or entry device should give an audible and visual indication of each read.

13.01 Supported cards and technologies

A. The system shall be compatible with all major card and access entry technologies, including (but not limited to):

1. Proximity cards and readers
2. Biometric readers
3. Bar code cards and readers
4. Magstripe cards and readers
5. Wiegand cards and readers
6. Smart cards and readers
7. Optical cards and readers
8. Transmitter and infra-red cards and readers
9. Keypads and PIN pads

B. In addition, the ACS manufacturer shall be able to provide a number of different encoded card technologies, which use sophisticated algorithms. These algorithms shall be proprietary in nature to the manufacturer, and should be sophisticated enough that they increase the security of the installation. The support for these formats will be in addition to any format perceived to be an industry standard. These shall include at least one proprietary format in each of the following:

1. Bar code
2. Magstripe
3. Wiegand (output protocol)
4. Smart Card
5. RS-485
6. Clock & Data

13.02 Ability to produce cards with bar codes, magnetic stripes, smart cards

A. The system shall be able to create and print either magstripe, bar code, or smart cards using an integrated printing function.

B. When creating bar code cards the user must have the option to choose the type of barcode that suits their facility. The user should be able to specify the bar code ratios, character length and position on the card.

13.03 Ability to support multiple cards

A. As a minimum, the ACS system shall support the use of at different card technologies. As such, each tenant within an allotted environment may bring their own card technologies with them.

13.04 Ability to support MIFARE smart cards

A. The ACS system shall support the use of MIFARE smart card technology. As such the system shall provide the ability to encode smart cards including the ability to program the following:

1. Specify a custom format including length, facility, company, card number and parity.
2. Program each sector / block on a MIFARE (1K and 4K byte) smart card for access control and non-access control applications
3. Specify sector keys and the way in which these keys interact with the sector for the reading and writing of information
4. Specify the output type and data type of the information stored on the card
5. Program database information for each block / sector

B. The ACS system shall also support the ability to read an entire smart (1Kb and 4Kb) card based upon a pre-configured profile. This card reading shall provide a dedicated viewing screen from which the currents contents of all blocks and sectors can be viewed on-screen.

13.05 Ability to support DESFire and DESFire EV1 smart cards

A. The ACS system shall support the use of DESFire smart card encoding technology. This option shall support a wide range of smart cards. The ACS shall provide the ability to encode DESFire smart cards including the ability to program the following:

1. Specify a custom format including length, facility, company, card number and parity.
2. Program each Application / File on a DESFire (2K, 4K and 8K) smart card for access control and non-access control applications
3. Encryption Key for the smart card
4. Length of data written on the card, Output format, Access Control, and the Data Type to be encoded on to the smart card.

13.06 Ability to support Custom Wiegand cards

A. The ACS system shall support the use of proximity card technology with a custom wiegand format including the ability to program the following:

B. Specify a custom format including;

1. Length
2. Facility Code

3. Company Code
4. Card number
5. Revision
6. Parity
7. Provide a graphical means of specifying the format details

13.07 Enrollment

A. It shall be possible to connect standard card readers to the ISC workstation directly using a free USB port for the purpose of automatically capturing the card details during the cardholder enrollment process.

13.08 Ability to support iClass cards and readers

A. The ACS system shall support the use of iClass technology natively (e.g.; not just via a wiegand connection) including the ability to perform the following:

1. Support for HADP iCLass readers
2. Support for access control via CSN or iClass ID
3. Ability to display appropriate status messages on those readers with an LCD screen

Chapter 14 - Host Event Processing

A. The ACS shall be capable of processing events in the system as they occur, and distributing this information throughout the entire access control and security network.

14.01 Immediate propagation

A. Changes made using the ACS software shall be automatically recorded to the ODBC compliant database and downloaded to the correct ISC(s) using the appropriate communications channel. In addition, the ACS software shall also provide the tools to manually download all appropriate database information, allowing the full initialization of each ISC.

B. All database changes shall be performed while the workstation is on-line without disrupting other system operations.

C. Changes made at the ISC equipment shall be automatically uploaded to the ACS server, to ensure system continuity. Each ISC shall be capable of reporting all changes in status, system events, and actions performed, to the ACS in real-time. These messages shall be displayed immediately in the ACS audit trail. The effect of each message must be reflected throughout the system as they occur, such as, the immediate changing of the color of a symbol located on a site plan to indicate a change in point status.

14.02 Local event buffer

A. The ISCs shall maintain a buffer of all events that occur locally. This buffer shall store all messages until they are uploaded to the ACS server. If the communications between the ISC

and the ACS server are lost, the buffer will be retained until communications is restored, at which point all logged events shall be uploaded to the ACS server.

14.03 Database accessibility

A. All System data must reside on a single database on the network and must be accessible in real-time to every / any system workstation. This shall allow for automatic change propagation to all workstations on the system as well as a common database to consolidate all information and allow for better disaster recovery.

Chapter 15 - Real time Audit Trail

A. The system shall log all events that occur to both an on-screen audit trail window and a retrievable database record. These events must be logged on-screen as they occur (in realtime). All system changes, alarm events, entry / exit conditions, point state changes, exception messages, miscellaneous system messages, or any information relating to the access control system in general shall be logged to this audit trail.

15.01 Partitioned display data

A. The system shall be capable of filtering all displayed audit trail messages based upon the currently ‘logged in’ operator’s assigned privileges. Only those events to which the operator has been assigned privileges will appear on-screen or any audit trail report printed whilst that operator is logged on.

15.02 Operator audit trail profile

A. The system shall allow the operator to select which information columns are displayed and which information columns are not displayed on-screen in the audit trail window. The system shall also allow the operator to change the width of any displayed audit trail column by simply using the mouse to drag the column wider.

B. The system shall allow the operator to select the colors in which certain events are displayed in the on-screen audit trail window. The operator shall also be able to select the background colors displayed behind these entries. As a minimum, the system shall allow the following audit trail component colors to be configured:

1. Alarm message text color
2. Normal message text colors
3. Alarm message background color
4. Normal message background color

C. In addition, it shall be possible to display each alarm with an individual alarm color; this will allow alarms of a similar to type to be instantly recognized.

15.03 History View

A. The system shall provide the ability to switch to an audit trail history mode that allows history events to be easily searched. This view shall allow events to be searched based upon any text contained in the audit trail messages that have been recorded.

15.04 Event short-cuts

A. The system shall facilitate a quick link (short-cut) from any event appearing in the audit trail. As a minimum, there shall be a link to the cardholders and the point location relating to the audit trail event. This will enable easy access to the respective record, allowing the operator to change the details of that record, if necessary.

15.05 Dual window

A. The ACS shall allow any operator to scroll through past events without losing the ability to monitor new events. This shall be easily achieved via a split-pane audit trail window. Both viewers shall display all events as they occur. The upper viewer shall allow the operator to scroll-back and view previous events that have occurred at the facility, but have scrolled off screen as other events are logged. The lower viewer shall display the latest logged events at all times.

B. The two viewers shall be separated by a movable partition that allows the operator to change the viewable area by simply using the PC mouse. In addition, the system shall allow the operator to select the number of entries that are retained in each on-screen viewer at any time.

C. Any older events that cause the viewer to exceed the configured entry limit will be removed and must be logged to a permanently stored log-file that can be recovered by creating an audit trail report.

D. The currently logged in operator shall also be allowed to determine the order in which events are displayed (i.e.: latest event appearing at the top or the bottom of the audit trail).

15.06 Real-time audit trail printing

A. The ACS shall allow the system administrator to configure the type of events to print to a dedicated printer in real-time. The administrator shall have the option of selecting to print all events or only alarm events. This can be in addition to displaying the events on-screen.

15.07 Filtering and Search

A. The MMI workstation shall allow the audit trail messages displayed on-screen (in history mode) to be searched using a full text search field. In addition, should be possible to filter the displayed records. The filter options will include, but will not be limited to:

1. Date and Time
2. Type and Category of event
3. Point Information
4. Group

5. Name

6. Employee ID

15.08 Change Tracking

A. The Audit Trail shall detail each database change made within the system, including the data that was changed and a record of the operator who made that change.

15.09 Custom Audit Trails Views

A. The ACS shall provide the ability for an operator to create a custom Audit Trail view that includes the following features:

1. The customized view should update in real time as transactions occur in the system

2. Multiple custom views shall be permitted at any point in time

3. Ability to filter information displayed (for example may only display messages from a select group of doors)

4. An operator shall be permitted to share views (configuration of) with other ACS operators

5. Ability to configure a view with special trace conditions such that any important event in the system is displayed with identifying colors. For example, whenever a specific door is unlocked a message should appear in green

6. Any view shall support the configuration of multiple trace conditions at any time

7. It shall be possible to print the custom view at any system printer

Chapter 16 - Advanced Alarm Management

A. The ACS shall provide an advanced alarm management system. This system shall allow the visual and audible annunciation of alarm events as they occur, in real-time. The annunciation of an alarm shall take priority over all other system functionality to ensure the alarm is registered immediately upon occurring.

16.01 Alarm annunciation

A. The system shall provide an audible and visual annunciation of all appropriate alarm situations as they occur. Each alarm annunciation shall be configurable, so that it requires positive action to be taken by the System Operator when acknowledging it, and always appears in the foreground of the MMI.

B. Immediately following the visual and audible annunciation of an alarm, a field shall become available where the system operator can enter comments regarding the alarm situation, and shall prevent the alarm from being cleared until an entry in this field has been made. Once entered the System Operator shall be allowed to acknowledge the alarm.

C. In addition, pre-defined alarm responses shall be available. These responses are specific to the facility and can be selected from a drop-down list to ensure quick and efficient acknowledgement of an alarm situation, in lieu of typing a message.

D. After an alarm has been announced, the system shall allow the operator to silence the alarm for a selected period of time. After this time period has elapsed the alarm annunciation will be regenerated.

E. Upon an alarm being announced, the System Operator shall be provided with the facility to view an alarm queue before taking further action. Alarms with the highest priority shall be placed at the head of the queue. As a minimum the alarm queue will display the following alarm attributes:

1. Priority of the alarm
2. Date and Time at which the alarm occurred
3. Name of the system component that caused or initiated the alarm
4. Current status of the system component that caused or initiated the alarm

F. The system shall provide the ability to outline unique emergency instructions to be specified for each type of alarm. These instructions should be displayed on request before the alarm is actioned, in order to help the Operator understand the requirements and necessary routines for clearing the alarm. These alarm instructions should be able to contain any combination text or graphics and if appropriate contain a windows video (*.avi) that can be played on request of the system operator.

G. In addition, these instructions should appear in a dialog that allows the system operator to enter a log in relation to the alarm and acknowledge the alarm, whilst simultaneously viewing the instructions.

16.02 Visual alarm graphics

A. The system shall be configured so that the activation of any alarm provides text and audio instructions outlining the procedures to follow in responding to the alarm, at the Alarm Monitoring Workstation and automatically calls up associated maps upon grabbing the alarm.

B. The alarm-handling portion of the system shall provide dynamic color alarm graphic maps. These maps shall allow the operator to respond to and clear alarms from the alarms graphics screen.

C. The system shall allow the creation of color graphic floor plan displays and system schematics for each piece of equipment, including card readers, inputs (monitor points), and outputs (control points) to optimize system performance, analysis and speed alarm recognition.

D. The MMI shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.

E. The system shall allow the equipment state to be changed by clicking on the point block or graphic symbol and selecting the new state. In addition symbol colors shall be used to indicate status and change as the status of the equipment changes.

F. Real-time, dynamic graphical maps will mean that the map screen will not have to re-paint or refresh each time a new alarm or event condition occurs.

16.03 Multimedia alarming

A. The system shall extensively integrate and use multimedia throughout the ACS. The system shall provide owner customizable voice alarm annunciation and a flashing colored system icon for each alarm in the System. In addition, the System shall provide customizable voice instructions so that each alarm or event in the System can have both sets of text instructions and/or pre-recorded audio voice instructions.

16.04 Alarm re-activation

A. The ACS shall allow each alarm to be configured with an internal timer that re-activates the alarm annunciation if the change in status that initially caused the alarm to be announced has not been rectified. This timer shall only accompany those alarms where the status of the system component can be restored to a normal state.

16.05 Alarm Queue

A. The ACS shall place each outstanding alarm in a queue with the highest priority alarm at the top of the queue. The alarm queue shall be able display different alarms with unique colors to allow for easy and quick identification of any outstanding alarm.

B. In addition, each entry in the queue as a minimum, will display the alarm location, its current status, and the date and time at which the alarm first occurred. The alarm queue will also provide the ability to clear alarms when necessary.

16.06 Alarm configuration

A. The ACS shall allow each alarm to be fully configurable. As a minimum the System Operator shall be able to configure alarms in response to changes in state or messages received from the following system components:

1. Access Points
2. Areas or zones
3. Communications
4. Elevator floors
5. Input points
6. Output points
7. Intelligent System Controller (ISC)
8. Interlocked Door Groups

9. External System Points

B. As a minimum, each alarm created shall allow the operator to define the following attributes:

1. Whether or not the alarm is required to be acknowledged when announced
2. Alarm priority, with up to 7 priority alarm levels
3. The color of each alarm priority level
4. Instructions to be associated with the alarm
5. Sound to be played when the alarm is visually announced
6. Alarm re-activation time
7. State change or event that will trigger the alarm or return the system component to normal
8. Description of each status
9. Symbols to represent the alarm and normal status of the component on a graphical map

C. The system shall also allow alarms to be forwarded to an alternative alarm handling solution. The methods in which alarms can be forwarded include:

1. To a mobile phone using SMS
2. To a pager
3. Via email
4. From one ACS server to another (in the same security network and communications structure)
5. To an OPC (Alarm and Events) compliant system

Chapter 17 - Printers

A. All printers can reside on the same network as the access control and security system.

17.01 Dedicate printers by function

A. The system shall be capable of configuring dedicated printers for each specific task that requires the use of printed results. As a minimum the system shall allow the following printer types to be specified:

1. Audit Trail printing
2. Card printing
3. Plan printing

4. Report printing

17.02 Reports

A. The system shall be capable of configuring a dedicated printer specifically for the task of printing audit trail, database, or operator journal reports. This facility shall provide the selection of a default printer for this task and the ability to change the printer characteristics to suit the printing requirements.

17.03 Real time printing

A. The system shall be capable of printing all audit trail entries as they occur, using a dedicated printer specifically for this task. This facility shall allow the filtering of audit trail messages that are printed, including alarm messages only or all messages. In addition, the system shall allow the printer type used to be selected, be it 132 column, 80 column, or other printer types.

17.04 ID card printing

A. The system shall support any card printer with industry standard Windows drivers. It shall support double-sided full color printing, edge to edge printing with the additional ability to encode magnetic stripes or bar codes on cards.

17.05 Plan printing

A. The system shall be capable of configuring a dedicated printer specifically for the task of printing graphical site plans. This facility shall provide the selection of a default printer for this task including the ability to select the following type of printers:

1. pen plotters
2. inkjet printers
3. bubble jet printers
4. laser printers
5. electrostatic printers

B. The ability to change the printer characteristics to suit the operator's requirements shall also be available.

Chapter 18 - Archiving System

A. The system shall be capable of archiving the programmed database information, the logged audit trail data, operator journal entries, graphics, alarm sound files, alarm instructions and custom designed reports. Once archived, the system shall provide the tools required to restore this data at a later time if necessary.

18.01 Archiving medium

A. The system shall provide the ability to select the location of the archived data, be it using a local hard drive, another hard drive located on a machine in the same computer network, a floppy drive or any other mass storage device as deemed acceptable.

18.02 User-definable archiving parameters

A. The archiving facility shall allow the operator to select what information is to be stored. When archiving database information, the operator should be able to independently or collectively select the following information for storage:

1. All programmed database records
2. All system graphics, including site plans, symbols, alarm instructions and drawings
3. System parameters
4. Operator profiles
5. Cardholder images
6. Reports

B. Upon restoring the archived data, the system operator shall have the same flexibility in choosing which components are to be restored if more than one component was part of the archived file.

C. When archiving audit trail information, the operator should be able to independently or collectively select specific dates for storage. Upon restoring the archived data, the system operator shall have the same flexibility in choosing the dates for which audit trail entries are to be restored.

D. In addition, the operator shall be able to choose whether to encrypt the backed audit trail data.

18.03 Automatic Archive

A. The system shall provide the mechanisms to create an automated backup. This will allow a backup schedule to be implemented for the ACS data and will include scheduling for one off date and time, day of the week, or monthly. In addition it shall be possible to specify the type of data to be automatically archived

Chapter 19 - Reporting

A. The system shall be capable of providing detailed reports through a specialized application within the main GUI. This application provides reports regarding the information contained in the database, audit trail, or operator journals, without the need for programming skills.

B. The system shall provide the capability for the configuration and set-up of a specific system printer for printing reports, and allow the use of network printers. The system shall also

exclude those records from any report to which the currently logged in System Operator has not been assigned privileges to view.

19.01 Available Reports

A. The list of reports shall be available in a tree view sorted by functional area of the system, whereby individual report views can be easily selected and displayed within the MMI. As a minimum the system shall supply at least 50 pre-defined reports in the following functional areas:

1. Alarm Information
2. Hardware Components
3. Time Schedules
4. Groups (hardware / cardholders)
5. Access Definitions
6. Site Plans
7. Cardholders
8. Audit Trail Messages
9. Event Routines
10. External Devices (e.g.: CCTV)
11. Holidays
12. Elevators
13. Operators
14. Mustering
15. General

B. The report view MMI shall be displayed within an independent window to the ACS main operation window so that the reporting function never takes away focus from the audit trail view or other important access control information being displayed on screen,

C. In addition, it shall be possible to hide the tree view navigation pane to maximize the area on screen in which to view the data associated with the report selected.

19.02 Report sort and filtering

A. Once displayed, each report can be filtered and information ordered as required. The main functions that shall be available to customize the current view of a displayed report shall include as a minimum:

1. Customized column view (order columns, add new columns, remove columns)
2. Column order (alphabetical sort order – ascending / descending)
3. Information Grouping (Group information based upon data in a column, including hierarchical grouping)
4. Key word filter (filter any information in a column based on a key word including wild card characters etc.)
5. Automatically size columns for the information displayed

19.03 Design custom report views

A. The system shall provide the tools necessary for the operator to create custom reports regarding information in either the audit trail or database. This customization shall allow the following selection criteria as a minimum:

1. Customized report creation wizard
2. Custom report name
3. Report type selection (for example: cardholders)
4. Selection of column information to be displayed (for example: first name, last name)
5. Filtered criteria (for example: first name = John) with more than 15 different filter types (equal to, greater than, etc.)
6. Ability to add additional filtered criteria including logical operators (and / or / and not / or not)
7. Addition of the new custom report to the tree view for easy and permanent selection

19.04 Print to reports printer

A. The system shall provide the functionality to configure and setup individual printers for each different system task that may require printed results. This includes the ability to configure a printer specifically for the purpose of creating printed reports. In addition, the printer configuration shall allow for the setup of local or network printers for these tasks.

19.05 Print reports automatically

A. The system shall provide the tools to automatically generate reports, based upon a defined schedule without operator intervention. These automatically generated reports shall be saved to disk and can be viewed at any later time while still saved.

19.06 Print Preview

A. It shall be possible to provide a print preview on screen with the option to change the printer settings so that the view can be customized by the operator before printing.

19.07 Report Export

A. It shall be possible to export the data contained within a report to the following data formats:

1. Microsoft Excel (.xls)
2. XML (.xml)
3. Tab delimited (.txt)
4. Comma delimited (.csv)

19.08 Report Layout

A. Finally, where applicable it shall be possible to dynamically change the report layout on screen by selecting an appropriate current view. For example, when creating a report based upon cardholders it shall be possible to view layouts based upon a list, by card status, alphabetical order, grouping, or with photograph. Once selected, the screen will reflect the layout chosen.

19.09 Interactive Reporting

A. The ACS shall provide a report with an interactive functionality. As a minimum, interactive reports shall permit the following:

1. Ability to create a complex report based on any information contained within the ACS
2. Alternatively, it will be possible to import reports from an external source
3. Each interactive report will provide the facility for a set of conditions to configured for the report information (e.g.: date > mm/dd/yyyy)
4. Perform functions on any information that meets the criteria selected. These functions shall include voiding a cardholder.
5. Functions shall be activated manually by right clicking or automatically upon report analysis by the ACS.

19.010 Unused Cards

A. The ACS shall provide a mechanism to remove unused cards from an active state in the system.

B. The length of time which defines an unused card shall be configurable.

C. The ACS shall allow a report to be generated that lists all cards that at the time the report was generated the cards listed were considered unused.

It shall be possible to directly from right clicking on entries in the report to void any or all unused cards as seen applicable by the operator who produced the report.

D. The ACS shall also provide the ability for unused cards to be automatically voided in the system at a regular interval (for example, on a weekly basis), without the need for operator intervention.

Chapter 20 - Scheduling

A. The system must provide the capability for an operator to define specific times, during which certain events and system control will occur. The system must be capable of handling at least 65,000 distinct time schedules. These schedules must be operator customizable, so that, they can schedule events across an entire week, with up to twenty distinct time periods during that week. Primarily, the time schedules must be able to handle holidays, provide access at certain times, and schedule or permit events during the specified times.

20.01 Holidays

A. The system must be capable of defining over 100 holidays in advance of them occurring. A defined holiday will override the normal timed schedules where configured and allow other system functions to behave as normal.

20.02 Public floor access

A. The system must be capable of scheduling specific times when access to floors in an elevator system are taken 'off' security and are accessible to the general public. At all other times the system shall secure those floors and provide access only to valid cardholders.

20.03 Access per door

A. The system must be capable of scheduling specific times when a cardholder is permitted to access a specified door, barrier or gate. At all other times the cardholder will be prevented from gaining access at that door.

20.04 By specific date & time

A. The system shall be capable of scheduling certain programmable events to occur on specific dates or during specific times of the day.

20.05 By certain event

A. The system shall be capable of scheduling certain programmable events to occur in response to the activation of another event or system status change. The event or status changes that trigger this response shall be fully configurable.

Chapter 21 - Anti-passback

A. The system shall be capable of providing anti-passback control, whereby, a cardholder that uses their card at an entry reader must not be able to re-enter until they have first exited using the specified exit reader. The system must also be capable of operating in either a soft or hard antipassback mode

B. The anti-passback control should also be flexible so that cardholder's that have violated antipassback rules or have lost their access card can be forgiven by a system operator.

21.01 Soft Anti-passback

A. The system shall provide the selection of a soft anti-passback mode, which permits entry at a door or barrier (to a valid cardholder) when the anti-passback rules have breached. However, the system will still generate an alarm in response to this anti-passback violation.

21.02 Hard Anti-passback

A. The system shall provide the selection of a hard anti-passback mode, which does not permit entry at a door or barrier (to a valid cardholder) when anti-passback rules have been breached. In addition this type of breach will also generate an alarm.

21.03 Peer-to-Peer Anti-passback

A. The system shall provide full anti-passback capabilities across multiple ISCs without the need to consult the ACS host. This will allows full anti-passback capability even when communications with the host has been lost.

B. In addition, peer-to-peer anti-passback operation shall provide a fail-safe mode, whereby entry or exit to a secure area will be permitted when communications between controllers has been lost.

21.04 Mustering Area

A. The system shall provide the facility via the anti-passback functionality to designate specific mustering areas. These areas shall allow reports to be generated that display all those cardholders currently logged into that area.

21.05 Area Limits

A. The system shall allow each area to be defined with a maximum cardholder count. Once this limit has been reached the area will be considered as being “Full”. Once the full capacity has been reached, the system shall allow:

1. The prevention of further cardholders from entering the area

2. The triggering of an output device, for example a “Parking Lot Full” sign

21.06 Cascading Anti-passback

A. The system shall allow single reader doors to be created within an area. These doors will not fall under normal anti-passback control, however, entry will not permitted unless the anti-passback conditions assigned to the surrounding area have been previously observed.

21.07 Four Eyes Access

A. The system shall allow an area to be nominated as a “Four Eyes” location. An alarm in a four eyes location shall be raised when a single cardholder has entered that location and resided within the location for a specified amount of time without a second or subsequent cardholder entering. A four eyes area will also allow an alarm to be raised when no cardholders reside within the location.

21.08 Timed Re-entry

A. The system shall allow an entry point(s) to be nominated as a timed re-entry point. Once a cardholder has used their card at a timed re-entry access point, that cardholder will not be permitted to re-use their card again to gain access to that location within a specified time period.

21.09 Door Interlocking

A. The system shall allow the configuration of a set of interlocked doors, such that opening any single door within the defined set prevents any other door from being opened at the same time, even if a valid cardholder attempts to gain entry at that door.

B. In addition, it shall be possible define a time period once the first door has been closed, before another door in the set can be opened.

21.010 Dual Custody

A. The system shall allow the configuration of a door such that it can only be opened if two valid cardholders present their access badge at the door within a defined time period. This mode shall also allow for supervisory access (e.g.: visitor escort) and an override function based upon cardholder so that cardholders of an authorized level do not require a subsequent cardholder before entry is permitted.

21.011 Clustering

A. Finally, the system shall allow the configuration of a set of controllers in a single group for the purpose of anti-passback configuration. Whilst both local anti-passback and global anti-passback operation shall be available, this subset allows a group of controllers to monitor anti-passback within their own cluster.

B. This type of clustering shall also allow cardholders to maintain a current count in separate antipassback locations. For example, when a cardholder leaves their car in the carpark the increased count because of that card remains raised, even if the cardholder enters another antipassback area that is managed across multiple controllers.

Chapter 22 - Parking Lot Management

A. The system shall allow a parking lot or similar location to be configured, whereby; entry to that location is governed by access privileges set in the system.

B. The system shall count the number of entries and exits from that location and when the specified limit has been reached, will raise a visual and audible alarm and prevent any further cardholders from accessing the parking lot. The system should also be capable of triggering an event when the car park limit has been reached, allowing a sign or other visual indicator to be turned on.

C. The system will allow entry into the carpark based upon groups of cardholders. Each group of cardholders can be configured with a capacity that applies only to that group. In addition, the system shall be capable of raising alarms when the group has violated the anti-passback limit assigned to them.

D. A dynamic screen shall be available that lists all cardholders who have entered the carpark and the date and time during which they entered. In addition, this screen will also show count for each group of cardholders that have been set a limit for the area.

E. The system must also be capable of producing a report that provides the details of all cardholders with a vehicle currently parked within the parking lot.

Chapter 23 - Security Programming

A. The ISC or the system controller shall have a Programmable logic engine allowing security programming and control.

B. The security control shall be presented to the operator through a user-friendly graphical designer. The programmable security control shall operate like a programming logic engine running in a controller. This feature shall give the ACS operators an ability to construct logical activities using the graphical designer. The logical activities shall then be executed by the controller

C. The programmable security control shall allow the operator to visually design activity programs in the system and download them to the controller. The operators shall be able to customize activities for multiple triggers, and resulting effects via the graphical designers.

D. As a minimum, the ACS's security programming shall make the following features available:

1. Enabling users to create and design customized, site-specific activity programs for their site, without having to contact vendors for related firmware modifications
2. A Single ISC or controller shall execute multiple programmable activities simultaneously. A single programmed activity shall be executed from multiple ISC's.
3. The programmable activities shall be controlled and executed by Time Schedules
4. A variety of entities like Access, Input and Output point, Access Events, Intrusion Areas, AntiPassback areas, Workgroups, and Floors shall be supported.
5. Virtual Components like flags, timers, counters shall be incorporated as triggers and effects.

Chapter 23 - Control and Monitor Points

A. The system shall provide a mechanism to define both control and monitor points. These points will allow the system to link input devices with output devices, trigger event generated tasks, and be used to override general system operation through the use of the MMI.

23.01 Monitor Point Parameters

A. As a minimum, when programming a monitor point in the ACS, the System Operator shall be able to:

1. Enter a unique name for each point. This name will be used in Audit Trail messages regarding the status of the monitor point.
2. Select the mode of operation for each point from the MMI, based on the desired reporting and general alarm activation for that point.
3. Define the specific conditions that cause the point to go into alarm and the type of annunciation parameters associated with that alarm.
4. Select the specific delay times for each monitor point programmed in the system.

5. Select the time schedule that will be applied to the monitor point.

23.02 Control Point Parameters

A. As a minimum, when programming a control point in the ACS, the System Operator shall be able to:

1. Enter a unique name for each point. This name will be used in Audit Trail messages regarding the status of the control point.
2. Select the time schedule that will be applied to the control point.
3. Define the specific conditions that cause the point to go into alarm and the type of annunciation parameters associated with that alarm.
4. Select the specific delay time for each control point programmed in the system.

Chapter 24 - Event Routines

A. The system shall allow an Operator to create their own event driven routines based on any required system operation. These event routines shall run automatically without the need for human intervention or the workstation MMI being operational.

B. The ACS shall be able to trigger event routines from the ACS host or from an individual ISC. Routines initiated by an ICS shall be able to trigger outcomes affecting other ISCs without the need for ACS host intervention. This scenario will allow peer-to-peer routines to run even when communications with the host are lost.

24.01 Event Triggers

A. As a minimum, the Operator shall be able to configure event routines that can include any of the following individual event triggers:

1. System Components, including access points, input devices, and output devices
2. Specific time
3. Communications channels (lost / resumed)
4. Date

24.02 Event Actions

A. As a minimum, the Operator shall be able to configure event routines that can include any of the following system actions in response to an individual trigger:

1. Change the state of any of the following system components; access points, input devices, output devices, and areas.
2. Send commands to the CCTV equipment that manipulate the movement of cameras or images displayed on a monitor.
3. Start DVR recording processes.
4. Send specific commands to a system ISC.

5. Automatic program execution. Which includes any executable program on the host PC or that is accessible on the network on which the host PC resides. This should also allow for the inclusion of additional parameters to start that program, if required.

6. The control of external third party systems, such as lighting control etc.

7. Send messages to mobile phones, pagers or via an email system.

24.03 Host Events

A. The ACS shall be capable of imitating host based event routines. These routines shall be able to target physical devices, but also extend to communication with third party products such as Windows Applications, CCTV systems, DVR systems etc. The triggering of the majority of these events will rely upon communications of the ACS with the field hardware devices for status information. **24.04 ISC Events**

A. Each ISC shall be capable of imitating event routines. These routines shall be able to target physical devices in the access system. In addition, these event routines shall be able to operate in a peertopeer mode. This means that a single ISC can control the operation of a device on another ISC as a direct result of the routine.

B. The system shall allow an Operator to define a message that will appear in the audit trail when the event is initiated. This message will indicate that the event task has been activated.

24.05 Events via GSM

A. The ACS shall support the ability to send messages as a result of events triggered in the system via SMS using a GSM modem connected to the system.

Chapter 25 - (Point) Grouping

A. The system shall be able to collectively group components of the same type for the purposes of controlling those components as a single entity. As a minimum, the components that can be grouped shall include:

1. Access points - card readers and other entry devices

2. Input devices (monitor points) – detection and monitoring devices

3. Output devices (control points)

4. ISCs – field controllers

5. CCTV monitors

6. CCTV cameras

7. DVRs

8. Elevator floors

9. External third party system points

B. The system shall allow the visual and audible annunciation of a group alarm. This alarm shall be triggered when a pre-defined number of group members have individually initiated alarms within a configurable time period.

Chapter 26 - System Status

A. The system shall provide a status bar that indicates the current status of system components. As a minimum the system shall be capable of displaying the status of the following components in that status bar:

1. System messages: All text messages that indicate relevant information to the process currently being performed.
2. Alarm count: Indicates the number of outstanding system alarms that are waiting to be either acknowledged by an Operator or returned to a normal state.
3. ISC communications: Indicates the number of ISCs that are currently on-line and communicating with the ACS server.
4. Workstation status: Indicates the status of communications between the workstation being used by the logged in Operator and the ACS server.
5. Locked workstation: Indicates when the workstation has been locked, indicating that an authenticity check is required before the workstation can be used again.
6. Zoom: Indicates the zoom ratio of any graphic that is opened and displayed on-screen.
7. Date and time: Indicates the current date and time.

B. In addition, the status bar shall provide short tool tips when the mouse pointer is placed directly over the icons contained in this bar.

C. A full system status screen shall also be available that provides a summary of points defined in the system. This screen shall be able to provide a summary at a glance providing full system counts. It shall also be able to provide the status of both physical and logical points currently in alarm, including:

1. Complete system summary
2. Physical points in alarm
3. Logical points in alarm
4. Door status

Chapter 27 - System Overview

A. The system shall be able to display a full architecture of the access control and security network in a Windows Explorer type view. By simply clicking on any component in the system, the operator shall be able to display the full details regarding that component.

B. Furthermore, by right clicking on a component the operator shall be able to open its property dialog, from which, its basic properties can be changed.

Chapter 28 - Multiple Facility Linking

A. The system shall be capable of connecting multiple independent facilities to build a complex access control and security network and provide a complete enterprise solution. This network should allow a single cardholder to be programmed at any facility within that network. This link should distribute cardholder information including images.

B. The system should be capable of reconciling all cardholder information, so that each facility is updated with the most current data. The system should provide a mechanism by which the reconciliation process can be performed using either a manual or automatic routine, but should also be able to perform this task in real-time.

C. The communications between facilities should be compliant with a wide variety of networking protocols, and as a minimum include:

1. Remote Access Server (RAS)
2. Local Area Network (LAN)
3. Wide Area Network (WAN)

D. As a minimum, the ACS shall be capable of linking independent sites across:

1. campus
2. large single facility
3. cities
4. states
5. nationally
6. internationally

Chapter 29 - Third party integration

29.01 Cardholder Application Programming Interface

A. The system shall support information sharing both to and from third party applications via the use of an Application Programming Interface (API). This API must be DCOM compatible and execute the same logon routine as if logging on from a standard ACS workstation.

B. This sharing of information shall still be governed by the standard authentication used by the ACS, and prevent those System Operators logging into the third party package from accessing information to which they have not been assigned appropriate privileges.

C. As a minimum, the system shall allow the transfer of the following cardholder data to and from the third party application:

1. Card number
2. Name (first and last) 3. Employee ID
4. Start and End Dates

5. Vehicle Details (registration, color, model)

D. In addition to sharing cardholder data, the API shall also allow the ability to set cardholder access control privileges from a third party application, again governed by standard ACS authentication techniques.

E. All activity carried out via the API shall be logged to the ACS audit trail in real-time. Reports may also be generated at a later stage detailing all the events that occurred from the third party application.

F. In addition, the API shall not simply be a disguised SQL interface that may allow invalid changes to database information. Rather, it must be a full application programming interface that enforces all the standard business rules of the ACS.

29.02 Building Management System (BMS)

A. The system shall support the integration of the ACS with a Building Management System (BMS), using the same workstation to control both systems from the MMI. The two systems should provide hardware connectivity so that points programmed in one system, can be used to trigger actions and change the state of points contained in the other system.

29.03 Alarm Monitoring Systems (AMS)

A. The system shall be capable of sending alarm messages to an alarm monitoring company, via the use of a dedicated alarm monitoring protocol. The alarms shall be configurable and the scheduling of these alarm messages should also abide by the standard system scheduling rules.

29.04 Danger Management Station (DMS)

A. The system shall be capable of integrating with a danger management station. This integrating shall allow the ACS alarms to be handled from the same interface used to respond to critical nature alarms such as fire etc. In addition, the ACS shall be able to connect with multiple MDS simultaneously, and enforce the same authentication rules that apply to the ACS natively.

Chapter 30 - Server Redundancy

A. The system shall be capable of duplicating all database information on a backup Server. When the primary server fails, the system shall be capable of continuing operation using the backup server without loss of data. In instances when the backup server is required, the system should fail-over automatically.

B. During fail-over, workstations shall automatically be locked out from the database preventing further database changes from taking place. Once the secondary server is on-line workstations should only allow manual logon to gain entry back into the system to ensure correct authentication has taken place.

C. Data mirroring shall be provided across a dedicated link between the primary and secondary servers. This will prevent an increased traffic load on the WAN/LAN due to data mirroring.

D. The system shall be configured so that it is possible to remove the primary or backup server for maintenance or repair without interrupting the operation of the access control and security network. As a minimum, the system will fail-over in the event of:

1. Hard disk drive failure

2. Power supply failure 3. Mother board failure

4. As a minimum, the Server Redundancy solution shall incorporate the following functionality:

5. Bi-directional failover

6. Hardware independence

7. Operates at the device driver level

8. Use of TCP / IP protocols and industry standard network cards for mirroring traffic 9. RAID compatible

Chapter 31 - Pharmaceutical Site Ready

A. The system shall be capable of fulfilling the FDA's 21 CFR Part 11 code. This ensures that electronic records and signatures must be proven to be as trustworthy and reliable as handwritten ones.

31.01 Security

A. The system shall restrict system access to only those users who have the appropriate access rights. A report shall be available detailing each operator account. The system shall also record all successful and unsuccessful attempts at logging on including complete date and time stamping for these actions.

31.02 User Identity

A. The system shall provide multiple operator access levels and can identify each user via a unique electronic user name and password. The ACS shall provide basic default operator accounts at the time of installation.

31.03 Electronic records

A. The system shall be able to provide accurate and complete copies of electronic records in human readable form. It shall be possible to provide a printed report of any data or activity in the system based upon reproducible and known criteria.

31.04 Data Retention

A. The system shall permanently store historical data and this data can be accessed if the ACS completely fails.

31.05 Data Protection

A. The ACS or systems employed by the ACS shall protect records from accidental or intentional modification, moving or deletion while on the system. It shall be possible to determine if records have been organically modified.

Chapter 32 - Documentation

A. A comprehensive documentation portfolio shall support the system.

32.01 Software Documentation

A. The ACS manufacturer shall be able to supply a full range of software documentation, including:

1. An Installation Guide
2. User's Guides for the core software module and any additional optional modules
3. Product Sheets that outline the system requirements and specifications

B. The software shall include a comprehensive help system that provides information regarding all aspects of the ACS. This help system shall include written procedures that guide the System Operator through the use of the ACS.

32.02 Hardware Documentation

A. The ACS manufacturer shall be able to supply a full range of ISC documentation, including:

1. User's Guides
2. Installation Sheets
3. Product Sheets that outline the system requirements and specifications.

32.03 Other Documentation

A. The ACS manufacturer shall also be able to supply a guide that outlines the Third Party Application Protocol Interface (API) and instructions regarding the programming of third party software to communicate with the ACS system.

B. Software installed on the system such as operating system, database application and others shall be supported by the documentation provided by the manufacturers of those applications.

Feature Description - Visitor Management

A. The system shall include a visitor management component that is integrated with the access control system. The system must support at least 100,000 visitor cards. This visitor management functionality must allow the enrolment of visitors into the database, capturing of images and import/export of visitor data.

33.01 Visitor data

A. As a minimum, the ACS shall allow up to 196 configurable visitor fields to be customized by the system administrator to suit the needs of the facility owner. The system shall provide a Graphics Editing Module (GEM) that gives operators the ability to modify any standard field to customize the cardholder screens as desired. Once these fields have been defined, the ACS shall not permit these (database) fields to be changed.

B. The visitor module shall also enable additional fields not used with other system cardholders including:

1. Visited Cardholder – selected from a list of existing cardholders in the system.
2. Card Status – card issued to or returned by visitor

3. Card issue time and date
4. Card return time and date
5. Visitor profile
6. Visitor's Company
7. Reason for visit
8. Visitor's driver's license
9. Visitor's email address

33.02 Searching

A. The system shall allow the search of all programmed cardholders, based on the criteria supplied by an operator. Operators shall only be able to search and retrieve visitor records to which they have assigned privileges.

B. As a minimum, the search criteria shall include:

1. Card number
2. Name (first and / or last)
3. Profile
4. Reason for visit
5. Driver's License
6. Email Address

C. Searching shall not only be limited to entire word matches. An operator may also search for cardholders by entering data that appears in the beginning of a word or string.

D. If more than one visitor in the system meets the specified criteria, the operator shall be displayed a list of all matching records, from which they can select a particular record.

33.03 Visitor images

A. The ACS shall support the capturing of a high quality image of a visitor from any workstation. The system operator shall have the option of capturing images in real-time or alternatively by importing an existing image.

B. If capturing images in real-time, the operator shall be able to use an appropriate capture card or use a USB digital video camera. If visitor images already exist, the operator shall be able to import images of all standard formats including jpg, bmp, gif, and tif.

C. Once an image has been captured or imported, the operator shall be able to preview in full color, the visitor image complete with the card, as it will appear when printed. The Operator shall have the ability to crop and resize the image and adjust the brightness and contrast.

D. The visitor image shall be able to be recalled at any time from any workstation to verify the identity of any visitor on the facility.

33.04 Visitor violations

A. The system shall monitor every card presented at each reader in the system and prevent access at the reader (door) if any of the following access violation conditions exist:

1. The card has not been assigned access permission at the current time.
2. The card has not been assigned permission at the reader.
3. The visitor has been voided in the system.
4. The visitor's card has not been issued.
5. The visitor belongs to a group of visitors that has been voided.
6. Entry to or exit from an area governed by anti-passback control has been violated.
7. A card belongs to a group of cards that has been disabled.
8. A card was presented at a reader that has been disabled or taken out of service.
9. The card has been presented before its allocated start date, or after the card's designated end date.
10. The card presented does not belong to the site, which includes an invalid card number, an invalid site number or a card containing an invalid facility code.

B. In addition, a message will be logged in the audit trail indicating the card use violation, and if configured, a visual and audible alarm will also be displayed.

33.05 Restricted Visitors

A. The system shall provide the ability to restrict specified visitors and visitors that belong to a specified company from being issued a visitor card. When an operator attempts to add a visitor from a restricted company a warning will be displayed.

33.06 Visitor Card Issue and Return

A. The system shall provide the ability to log the issue and return of visitor cards. This functionality will include:

1. Enabling of the card once it has been issued in the ACS.
2. Automatic voiding of the card once it has been returned in the ACS.
3. Full date and time recording of card issue and return

33.07 Expected Visitors List

A. The system shall provide the ability to maintain a list of expected visitors that displays the name of the visitor, their company and their expected time of arrival and departure. This list shall also be able to display visitors that are currently on site with the same information as expected visitors.

Feature Description - Guard Tour

A. The system shall be able to provide guard tour functionality. The guard tour functionality shall be an integrated component of the ACS. It shall take advantage of existing card readers or inputs, to allow a guard to conduct specific tours around the facility using these devices to register their attendance at pre-defined stops and monitor their progress as they conduct their tour.

B. The system shall be capable of registering alarms to indicate breaches in a tour or notify the System Operator of potential safety conflicts. The guard tour functionality shall allow the user total flexibility over the configuration and programming of guard tours using any combination of access points or input devices that have already been programmed in the system.

1. As a minimum the guard tour operation shall include the following:

    a. The Operator must also be able to start tours independently and if required abort a tour already in operation.

    b. Once a tour is operational, the system must be able to initiate alarms when a guard arrives early, arrives late or fails to arrive at a designated checkpoint.

    c. An Operator shall be able to print a report that details all the checkpoints to be visited by the guard and the order in which these checkpoints should be visited

    d. The system shall provide a window from which the movements of guards and the tour, which they are currently conducting, are displayed.

    e. The system shall allow tour recovery after power failure has occurred.

2. In addition, the guard tour specifications must meet or exceed the following:

    a. Allow a minimum of 100 tours to be defined in the system.

    b. Allow each tour to contain up to 30 independent stop points.

    c. Allow up to 20 tours to run simultaneously.

    d. Allow at least 500 guards to be programmed in the system.

Feature Description - Intrusion System Integration

A. The ACS shall allow the integration of an intrusion system. After integration the ACS shall be used to view the status of areas in the intrusion system and also send a variety of manual commands to the intrusion system. In addition it shall be possible to configure cardholder rights to arm/disarm intrusion system areas.

B. The ACS shall also support the input points connected to the intrusion system and shall integrate them into alarms, graphic maps, manual commands and event tasks. **C.** Arming and Disarming of intrusion areas can be performed by:

1. Manual control of intrusion areas

2. Creating graphic maps

3. Intrusion Terminal Control

D. The Manual Commands available for the intrusion system shall be as a minimum:

1. Arm
2. Disarm
3. Part Arm
4. Clear Intrusion Alarms
5. Clear All Bells

35.01 Intrusion Detection

A. The system shall have the ability to provide intrusion detection. When the system has been armed, any detection point that is breached will automatically raise a visual and audible alarm.

1. **Intrusion Capabilities:** The intrusion detection system shall provide as a minimum the following capabilities:

   a. Automatic zonal arming and disarming based on a pre-defined schedule.

   b. Independent arming and disarming of discrete zones within the facility.

   c. The last cardholder to leave the facility shall be able to automatically arm the entire facility when they arm their specific zone.

   d. The system shall allow zones to be graphically depicted on a site plan that indicates their current status in real-time.

   e. Configurable entry and exit timers, that allow passage prior to alarm activation.

   f. Cardholder specific override privileges on alarm points (sectors) that cannot be secured because that point is in an alarm state at the time of activation.

   g. The system shall intelligently handle zones, so that any locations within that zone, which are also common to other system zones, are not armed till all the associated zones have already been armed. This intelligence shall allow the securing of the entire facility and intruder alarm detection system.

2. **Sectors:** The intrusion detection shall be capable of including many sectors (detection devices) in multiple zones. Each of these zones should be able to be independently or collectively controlled by the assigned cardholders.

3. **Grace Period:** The system shall be capable of sounding an audible alarm during the entry or exit period, to alert the user that they can now enter or exit the detection zone without generating a nuisance alarm. This entry or exit time shall be customizable.

4. **Arming:** The system shall provide entry and exit devices that allow users to arm or disarm a zone (group of detection devices) as they exit or leave a facility. This entry / exit device, shall display provide the necessary tools for the cardholder to make the appropriate selections and carry out the task of arming or disarming.

5. **Part Arming:** The system shall provide the ability to arm part of an intrusion area, such that the perimeter points become armed, but the internal intrusion points to that area remain unarmed.

35.02 Intrusion Panel Interface

A. The system shall integrate with a dedicated intrusion panel, using an ISC to communicate directly with that panel.

B. As a minimum the system shall support the following intrusion panel integration features:

1. Automatic zonal arming and disarming based on a pre-defined schedule.
2. Manual (via card badge within the access system) arming and disarming of discrete zones within the facility.
3. The system shall allow zones to be graphically depicted on a site plan that indicates their current status in real-time.
4. Permit operators to send manual commands to the intrusion panel
5. Display audit trail messages from the intrusion panel
6. Ability to arm an entire zone or just part of the zone (perimeter) based upon the chosen arming option.

C. **Auto Discovery Mode:** There shall be an auto discovery feature to provide efficient location and programming of intrusion zones and inputs that have already been programmed within the intrusion panel.

35.03 Duress

A. The system shall allow cardholders to indicate whether they are requesting access under a forced or duress situation and thus communicate a potential emergency to the ACS. When such a duress action has been registered, the cardholder will be permitted access and a duress alarm will be announced on the system, without arousing suspicion.

B. In addition, the system shall allow the configuration of a duress button, which, when triggered shall raise a visual and audible alarm at each ACS workstation.

Feature Description - DVR Integration

36.01 Digital Video Recorder (DVR) Management

A. The ACS shall be able to provide an interface to multiple DVR units via an Ethernet link. This management of DVRs will allow for the remote surveillance of the facility using the ACS to monitor and control the operation of DVR components.

B. The DVR functionality shall be available only to those operators who have been granted the appropriate permissions to either configure DVR functions or operate the DVR equipment. The DVR interface shall be an integrated component of the ACS and shall not be a separate application.

1. **High Level Interface:** The DVR system shall be facilitated via a high level Ethernet interface to a range of DVR unit types. As a minimum, the DVR HLI shall support DVRs from the following corporations:

    a. Siemens SISTORE

b. Nexus

c. DVTel

d. Bosch

e. Genetec Security Centre

f. Siveillance VMS

g. Seetec

2. **Cameras:** The Security Operator shall have full control of all camera functions directly from any ACS workstation. As a minimum, the operator shall have pan/tilt/zoom control, iris control, focus, pan/tilt speed, heater and wiper controls. Camera control shall be via mouse, keyboard or a combination of both and be integrated into the ACS MMI.

3. **Live video:** The system shall allow the operator to view live video input from within the ACS and be able to manually control the appropriate cameras from this view. This shall be achievable via either mouse or keyboard control.

4. **Multiple Video Matrix Display:** It shall be possible for live video to be displayed inside a window that can handle and display multiple live video streams simultaneously in a matrix view.

   The layout of this matrix shall be configurable so that the operator can select the optimum display setup for streaming live images. In addition the live video matrix display shall support the drag and drop of cameras images. This means that from a list of available cameras, the operator shall be able to drag the camera name from that list to a video display square in the matrix and the live video from that camera shall appear.

5. **DVR Configurations:** As a minimum, the ACS shall allow the configuration of the following DVR functions directly from the MMI:

   a. **Presets:** A defined, recallable position for a camera. A preset allows a PTZ camera to be automatically moved to a pre-defined co-ordinate position.

   b. **Patterns:** A defined, moveable camera routine. A pattern allows a PTZ camera to continuously move in a pre-defined manner using pan, tilt and zoom functions.

   c. In the case of communications being lost, the ACS shall be able to restore all DVR functions to normal activity when communications are restored.

6. **Switching in response to certain events**: The ACS shall be able to do any of the following DVR actions in response to a specific event:

   a. switch a camera to a specific monitor:

   b. run a pattern

   c. run a sequence

   d. begin recording

7. The ACS shall provide an intuitive easy-to-use operator MMI. This MMI shall be an integrated component of the ACS interface and allow the configuration and operation of the DVR system

directly. When controlling the DVR equipment the System Operator shall be able view live images on-screen in real time. This on-screen display shall allow the System Operator to easily control both PTZ and fixed cameras using the PC mouse. As a minimum, the following DVR control functions should be available using the mouse pointer or left click of the mouse button:

a. image display (including specific monitor and camera selection)

b. camera movement

c. zoom-in and zoom-out

d. open-iris and close-iris

e. focus-near and focus-far

f. pan / tilt speed

g. heater control

h. wiper control

8. **DVR Playback:** The ACS operator shall be able to playback any recorded event stored on any connected DVR unit by simply selecting the appropriate unit and camera and then entering the date and time at which the event occurred. Once these options have been specified it shall be possible to playback the recorded image within the MMI.

9. **DVR Playback from Event Log and Reports:** The ACS operator shall be able to playback any ACS triggered recording event by simply selecting the appropriate message in either the ACS live event log or any historical report that includes such events. Once selected the ACS shall playback the recorded image within the MMI.

10. **Video Verification:** In conjunction with the DVR unit the ACS shall be able to display a live video signal together with the stored cardholder photograph upon a valid card badge. Using these two images the system operator shall be permitted to allow or deny access to the cardholder attempting to gain entry at the door.

11. **DVR Alarms:** The ACS shall also be able to receive and display within the MMI DVR specific alarms. As a minimum Motion Detection alarms and Video Loss alarms shall be communicated and displayed within the MMI.

12. **IP Camera Support:** The ACS shall support the connection of IP based cameras. It shall support the connection of these cameras via two methods:

    a. Directly to the ACS without the need for a DVR for video display purposes

    b. Via a DVR for recording and control purposes

13. **Support for Input / Output Points:** The ACS shall also support the physical output and inputs connected to the DVR system, as a minimum allowing input state changes to be notified, alarms to be registered and the ability to send commands directly to output devices. The ACS shall support the ability to upload the following configuration from the connected DVR a. Cameras

    b. IP Camera

c. Input Points

d. Output Points

e. Monitors

f. Sensor Points (like motion detection in EDS)

36.02 DVR System Interface

A. The system shall support the ability to manage any generic DVR system via the use of an Application Programming Interface (API). This API must be DCOM compatible and execute the same logon routine as if logging on from a standard ACS workstation.

B. The integration of DVR units using this interface shall still be governed by the standard authentication used by the ACS, and prevent those System Operators from accessing information to which they have not been assigned appropriate privileges.

C. As a minimum, the DVR API shall provide the following management of DVR units:

1. Viewing of live camera images
2. Ability to configure multiple DVR units and cameras
3. Full PTZ functional control of cameras
4. Configuration of alarms that trigger DVR recording events
5. Configuration of routines that manage DVR functions
6. Audit trail log playback of recorded images
7. Display of messages in the audit trail log

D. The API shall provide the flexibility to communicate with multiple DVR units of different manufacturers.

1. **Interface integration:** The system shall display video images and provide controls within the ACS MMI itself. Whilst it shall be possible to use the image player software provided with the DVR unit, the ACS shall, via the API, provide all the tools necessary to integrate live video, and DVR unit control from its own MMI.
2. **Tools and Documentation:** The system shall come with a complete API guide to assist in creating the required components to manage a DVR unit from the ACS. Sample code shall also be provided with examples of how to most efficiently integrate the ACS with a DVR unit.

Feature Description - CCTV High Level Interface (HLI)

A. The ACS shall be able to provide a CCTV High Level Interface (HLI). This HLI will allow for the remote surveillance of the facility using the ACS to monitor and control the operation of CCTV components.

B. CCTV functionality shall be available only to those operators who have been granted the appropriate permissions to either configure CCTV functions or operate the CCTV equipment. The CCTV interface shall be an integrated component of the ACS and shall not be a separate application.

37.01 High Level Interface

A. The CCTV system shall be facilitated via a high level interface (HLI) to a range of matrix switchers. As a minimum, the CCTV HLI shall support one of the following matrix switchers:

1. Siemens SIMATRIX
2. Pelco 9760/9740
3. Pelco CM6800
4. Pelco CM6700 **37.02 Cameras**

A. The Security Operator shall have full control of all camera functions directly from any ACS workstation. As a minimum, the operator shall have pan/tilt/zoom control, iris control, focus, pan/tilt speed. Camera control shall be via mouse, keyboard or a combination of both. **37.03 Live video**

A. The system shall allow the operator to view live video input from within the ACS and be able to manually control the appropriate cameras from this view. This shall be achievable via either mouse or keyboard control.

37.04 CCTV Configurations

A. As a minimum, the ACS shall allow the configuration of the following CCTV functions directly from the MMI:

1. **Presets:** A defined, recallable position for a camera. A preset allows a PTZ camera to be automatically moved to a pre-defined co-ordinate position.
2. **Patterns:** A defined, moveable camera routine. A pattern allows a PTZ camera to continuously move in a pre-defined manner using pan, tilt and zoom functions.
3. **Sequences**: A defined series or presets, patterns and stop or pause times (dwells).

B. In the case of communications being lost, the ACS shall be able to restore all CCTV functions to normal activity when communications are restored.

37.05 Switching in response to certain events

A. The ACS shall be able to do any of the following CCTV actions in response to a specific event:

1. switch a camera to a specific monitor
2. run a pattern
3. run a sequence

37.06 CCTV MMI

A. The ACS shall provide an intuitive easy-to-use operator MMI. This MMI shall be an integrated component of the ACS interface and allow the configuration and operation of the CCTV system directly.

B. When controlling the CCTV equipment the System Operator shall be able to view CCTV images onscreen in real time. This on-screen display shall allow the System Operator to easily control both PTZ and fixed CCTV cameras using the PC mouse. As a minimum, the following CCTV control functions should be available using the mouse pointer or left click of the button: mouse

1. image display (including specific monitor and camera selection)
2. camera movement
3. zoom-in and zoom-out
4. open-iris and close-iris
5. focus-near and focus-far
6. pan / tilt speed
7. image / screen size

37.07 CCTV Macros

The ACS shall also provide the ability to run macros hosted by the CCTV processor in response to conditions within the access control system. This will also include the ability for the CCTV system to send alarms to the ACS, include alarms for the detection of video signal loss at any camera configured within the system.

37.08 CCTV Command Mapping

A. The ACS shall support the DVR inputs and outputs as native inputs / outputs to the system with the ability to integrate them in graphical maps and alarm handling. In addition, the ACS shall also support the camera preset positions.

37.09 Video Loss

A. The CCTV system shall be able to report a loss of video signal from any camera hosted in the system and raise this as an alarm within the ACS.

37.010 Video Verification

A. In conjunction with the CCTV system the ACS shall be able to display a live video signal together with the stored cardholder photograph upon a valid card badge. Using these two images the system operator shall be permitted to allow or deny access to the cardholder attempting to gain entry at the door.

Feature Description - Photo ID and Image Verification

38.01 Video Imaging / Badging & Card Printing

A. The ACS shall include a state-of the-art, 32-bit, ID badge creation and production system that is integrated with the cardholder management system. This shall allow for the creation of different badge types based on a database field and the linking of that field to a badge type to automate the process of credential production.

B. In addition, the use of security colors, graphic images, photos or signatures shall be supported to allow security officers to quickly identify personnel access authority by the badge design.

C. The ACS shall incorporate into a single, seamless integrated system, imaging technology and personnel management, which is written from the same source code as the access control and alarm-monitoring functionality. The system shall generate and store personnel records as well as monitor badge use throughout the facility.

D. The system shall allow badges to be fabricated at any system Workstation, based on data and images that are input and captured at the time of enrolment.

E. Images are to be digitized using industry standard JPEG image compression, and printed using a direct card printing process. A record for each cardholder shall be created in the badging module of the system by entering the required data. Once all fields have been entered, the system shall store the cardholder's record in the system database.

38.02 Card Design

A. The System shall provide a badge layout creation and editing facility to allow for the creation of custom badge designs. The System shall support credit card, government, and custom ID card sizes in either a Landscape or portrait format.

The ACS shall also allow for the incorporation of bar codes or magnetic stripes onto the card template. This shall be visible at run-time from the respective cardholder record.

38.03 Image capture from Live Video Source

A. The system shall allow live image capture using a Windows compatible video source including support for USB type image capture devices (using either live video or still digital picture). If required, the image capture shall be able to be performed on any Windows Workstation connected to the ACS.

B. These captured images shall then be saved to the cardholder's record in the ACS database with the ability to be recalled at any later time. The system shall also provide the necessary tools to import existing images into each cardholder's record.

C. Once an image has been captured or imported to the ACS, the Operator shall be able to crop the image or select the appropriate image aspect to be printed on a card using a simple click and drag graphical mask.

D. The System Operator shall be able to preview in full color, the badge, as it will appear when printed. As a minimum, the System Operator shall have the ability to:

1. crop images
2. adjust the image intensity
3. adjust the image contrast
4. adjust the image saturation
5. adjust the image sharpness

38.04 Cardholder Verification

A. The system shall allow a cardholder's record to be recalled from the audit trail window. The System Operator must be able to display a cardholder record with the stored cardholder's image. This feature shall be provided at the MMI, to assist the System Operator in determining access rights of an employee who may have lost their badge.

Feature Description - Graphics

A. The system shall support a graphics module that allows the design, import and construction of site plans, drawings, dynamic symbols, alarm instructions and card templates. This graphics module

shall support the standard ACS partitioning, to prevent those System Operators without the appropriately assigned privileges from accessing graphical objects.

39.01 Graphical Maps

A. The system shall allow the design, import, and construction of site plans, which can be used to visually handle alarms, control access, and generally monitor the facility. Each site plan shall be updated dynamically as the status of system components change. The symbol representing each component will automatically update in color, alerting the operator of its change in status.

B. The system shall provide a pre-defined library of symbols that represent the most common access control and security components. In addition, the system shall allow the operator to create their own library of symbols that represent the devices installed at the facility.

The system shall provide a built-in suite of graphics tools that can be used to create or modify a site plan. As a minimum, these tools shall include:

1. Import of existing site plans, including AutoCAD, bmp, jpg, wmf, tif, and most other raster type images.
2. Common Windows text tools, such as alignment, font, and style.
3. Color tools to change the fill and border color of components in a plan.
4. Drawing tools, so that lines, boxes, circles, arcs, and free-hand lines can be drawn.
5. Alignment tools, to align separate components in a site plan.
6. Shortcuts that add a button to a site plan that, when clicked automatically open a new site plan or trigger a system action, such as opening a door.
7. Grid or crosshairs that aid in the alignment and scale when creating a site plan.

D. Each site plan shall have the ability to unlock a door to allow entry, control points at the click of a button, retrieve point information at the click of a button, and create shortcut buttons to other plans in the system or frequently used system commands.

E. In addition, the ACS shall allow partitioning for each graphical map. This partitioning shall allow only those System Operators that have been assigned the appropriate privileges to the graphical map, to view it and control points located on that map.

39.02 Symbols and Drawings

A. The system shall provide a clipart library of access control components and symbols including doors, car park boom gates, and PIRs. The user shall have the ability to add custom symbols or design new symbols for this library. Once created, these symbols shall be able to dynamically change color in response to a change in status of the component which they represent.

B. The system shall also allow the importing or creation of drawings that can be used in other parts of the system. The graphical editor will provide the tools necessary to import and add features to these drawings.

Feature Description - Elevator Management

A. The system shall be capable of providing access control and security for both high-level and lowlevel elevator systems.

40.01 Low-Level

A. The low-level elevator management shall provide floor access control, with the ability to provide security during nominated times (after hours) and general access during busier times of the day.

B. The system shall also provide the mechanism, whereby, a fire emergency or override system can be turned on either automatically via a trigger from another system or manually using the MMI.

C. In addition, the system shall provide the option of configuring remote access buttons that allow visitors to be granted entry to both the facility and selected floor from a remote location.

D. The system shall also provide the option of configuring fail-safe or fail-secure operation after powerloss or system reset has occurred.

E. The system shall only allow one valid floor selection (to a secured floor) each time a card reader is presented at the elevator.

F. The system shall provide a “Wizard” like configuration for elevator components. This will ensure the quickest possible method for adding elevator floors to the ACS.

40.02 High-Level Interface

A. The High-Level elevator management shall provide the ability to connect the access control and security system to an Elevator Management System (EMS) using a high-level interface.

B. This interface shall provide the ability to allow security during nominated times (after hours) and general access during busier times of the day. The system shall also provide the mechanism whereby a fire emergency or override message can be sent to the EMS.

C. Connection to the Elevator EMS shall be via an RS-485, RS-232, or RS-422 wired connection.

D. The system shall be flexible enough to allow communication to any Elevator EMS, with a small amount of interface programming required. This programming will be independent to the ISC firmware and its operation. This shall also allow the ISC to communicate and control access to an elevator system, even in those situations where a custom elevator implantation has been commissioned.

40.03 High-Level interface to thyssenkrupp Destination Control System

A. The ACS shall be able to interface to a IP based elevator control system and not require any customization by the customer. This support shall be such that the user Interface (UI) is adaptable, as much as is possible, to multiple lift systems (not concurrent in a single Central Controller instance). It shall also be capable of running on Linux based Operating System and for this initial release, the hardware nominated is the Central Controller.

B. The UI shall be able to show the configuration options within the elevator system and allow upload, download and editing if the lift system allows it.

C. Assignment of floor access privileges should be consistent with the existing elevator programming. Customization for further lift protocols shall be implemented in the ACS software and firmware.

Feature Description - Time and Attendance Recording

A. The system shall be capable of recording the entry and exit of cardholders at designated card readers or groups of card readers.

B. Once recorded the system shall allow for the export of the time and attendance information to a third party T&A or HR application. This export shall be available in a “.CSV” or “tab delimited” format to a pre-defined file location and file name.

C. In addition, the exact information contained within the export file shall be selectable and extend to at least the following required information:

1. First Name
2. Last Name

3. Date of record

4. Time of record

5. Location that the record was logged

Feature Description - Web Availability

A. The ACS shall be compatible with a complete web interface allowing the MMI to be made available via the internet.

B. It shall be possible to run more than one such web client instance simultaneously as if it were simply a native application client connecting to the ACS.

42.01 Web Available features

A. In addition to applying to full logon rules administered by the ACS, the following features shall be able to be used over an internet connection, as a minimum:

1. Cardholder configuration and access assignment

2. Visitor configuration and access assignment

3. Access level configuration

4. Access group configuration

5. Venue and booking

B. Simply a native application client connecting to the ACS.

42.02 Web Client User Interface

A. The web based client shall have a user-centric design with simple and self-explanatory menu structures and buttons. It shall be built on the latest Web technology and use high security communication for data transfer. The user shall able to create a customizable dashboard with widget capabilities, linking and pinning. The web client shall also be based on responsive design model so that it can support multiple resolutions on multiple monitors. Browser support shall include Chrome, Firefox and IE.

Feature Description - APOGEE Interface

43.01 Siemens APOGEE Building Management System Integration

A. The system shall integrate with the Siemens APOGEE Building Management System (BMS), using the ACS workstation to send security data to the system. The two systems should provide hardware connectivity so that points programmed in one system, can be used to trigger actions and change the state of points contained in the other system.

B. As a minimum the system shall be capable of allowing the BMS operator to:

1. Query the status of the ACS Input and Output Points

2. Secure/Unlock individual doors

3. Schedule through the BMS system

4. Bi-directional alarm acknowledgement

5. Control HVAC and lighting zones (Notification Zones) based on cardholder entry

6. BMS should know cardholder identity

C. The interface shall support the Siemens APOGEE system without the need for custom software:

1. **Auto Discovery Mode:** There shall be an auto discovery feature to provide efficient start-up and commissioning. When communication is established between the BMS and the ACS, the BMS must auto discover the devices and points from the ACS database and automatically build security points in the BMS system.

Feature Description - OPC A&E Server Interface

44.01 Open Communications

A. OPC

1. The system shall support message sharing both to and from third party applications via the use of an OPC interface. This OPC implementation must be compatible with the “Alarms & Events” section of the OPC protocol.

2. This sharing of information shall still be governed by the standard authentication used by the ACS.

3. As a minimum, the system shall allow the following communications with other OPC compliant applications:

   a. Receive events from third party applications

   b. Send events to third party applications

   c. Receive alarms from third party applications

   d. Send alarms to third party applications

   e. Group points into logical collections

   f. Alarm acknowledgement

4. In addition all activity carried out through the OPC interface shall be logged to the ACS audit trail in real-time. Reports may also be generated at a later stage detailing all the events that occurred from the third party application.

B. OPC Based Routines

1. The system shall support the triggering of event routines based upon messages received from third party OPC compliant applications.

Feature Description - Management Station API

45.01 Management Application Programming Interface

A. The ACS shall provide a management interface that allows data to be accessed and maintained using a RESTful API Web Service.

B. As a minimum, the system shall allow the transfer of the following data to the third party management application:

1. Audit trail logging (all transactions)
2. Ability to send commands from the management station to the ACS
3. Point monitoring
4. View alarms
5. Acknowledge alarms

C. The API shall provide the flexibility to customize the logged audit trail messages, so that only those messages that are required are sent to the management station by the ACS.

45.02 Tools and Documentation

A. The system shall come with a complete API guide to assist in creating the required components within the management station application. Sample code shall also be provided with examples of how to most efficiently integrate the ACS with the management station.

Feature Description - SALTO (Offline Door) Integration

A. The ACS shall support the integration of offline doors, so that remote doors and doors without wiring can be managed through a single MMI. As a minimum the system shall support the following offline door features:

1. Assignment of Doors and Lockers in the ACS.
2. Offline door messages appear in the event log (e.g.: low battery)
3. Management of card access to online and offline doors in a single system
4. Ability to void cards at offline doors
5. Support for SPACE Protocol
6. Support for Cerpass Protocol
7. PIN Function
8. ADA - Disability assistance (latch time extension)

46.01 Access Assignment

A. It shall be possible to assign offline doors in the standard manner via the ACS for any cardholder in the system. The ACS shall provide support for simultaneously adding access to both offline doors and online doors at exactly the same time.

46.02 Offline Door Alarms

A. It shall be possible to display alarms received from the offline doors in the same MMI as all online doors without the need for the operator to change applications.

46.03 Offline Behavior

A. As a minimum the offline doors shall exhibit the following characteristics

1. Access cards shall carry all events (logs) over a period of time with a minimum of 50 events in history
2. The same card shall be used for both online and offline doors
3. It shall be possible to “activate” the card every day for offline doors only

Feature Description - Man Machine (MM8000) Interface (MMI)

A. As a minimum the ACS shall provide the ability to connect up to 140 workstations to the server. Each workstation shall have the capability of displaying an easy to use MMI, from which all system operation, including programming, control and operation can be accomplished. The MMI shall employ a standard Windows look and feel and provide both an intuitive menu and button driven navigation system.

47.01 On-line help

A. The MMI shall provide a comprehensive on-line help system, which shall be available at any time and from any screen. The help system shall describe the use of all system functions and provide a comprehensive glossary of terms. In addition, the help system shall provide the standard windows help contents listing, index listing and key word or phrase search functionality.

47.02 Navigation

A. The MMI shall use standard Windows controls, including:

1. Mouse control
2. Menu functionality
3. Button navigation
4. Keyboard equivalent mouse shortcuts

47.03 Toolbar Customization

A. The MMI shall use allow for the customization of an operator specific toolbar. This shall provide the ability to create a custom toolbar that only includes those buttons (links to parts of the ACS) that are most commonly used or required for the operation of the system.

B. In addition, the operator shall be able to display the look and feel of the toolbar buttons that allow them to perform tasks quickly and efficiently including the text size and placement and size and position of icons displayed. **47.04 Windows look and feel**

A. The MMI shall support a user friendly, Windows Graphical User Interface (GUI) that shall be intuitive. All messages and interface text shall be in English prose unless another language has been specified and installed. All functions shall be either keyboard or mouse driven to allow the System Operators to choose the method of navigating through the screens. In the alarm-monitoring module of the system software, all major functions (opening a door, acknowledging alarms, etc.) shall be accomplished using a minimum number of mouse clicks.

B. The operator workstation interface software shall minimize operator training through the use of language prompting, on-line help, and industry standard PC application software. **47.05 Languages**

A. The system shall support the installation of multiple language versions.

B. In addition, the manufacturer shall be able to provide the tools to translate the ACS into other languages as may be required.

47.06 Installation

A. The MMI and ACS shall use standard Windows installation processes and employ a software installation that is similar in look and feel to other Windows applications.

B. The installation licensing shall allow for the selection of software installations that cater for the size and functionality of the facility at which the system is being installed. As a minimum the following package types should be available as default:

1. Basic
2. Intermediate
3. Advanced

Additional Feature

A. Messenger

Additional Feature

B. Data Synchronizer

Additional Feature

C. Smart Card Encoding (Y/N)

Additional Feature

D. Global Implementation in other Languages

Upgradeability / Expandability

A. The system shall be fully upgradeable, with the possibility of upgrading software and hardware components at minimum cost.

B. The system should also be fully expandable to easily permit the increase in control points, monitor points, access points and cardholders.

C. Each ISC shall be designed so that they can be easily added to an expanding facility and communicate with the ACS using the same communications channels as any existing ISC. In addition, the operation of any new ISC shall not affect or cause the re-programming of any already installed ISC.

Upgradeability / Expandability

A. Number of Work stations > 100

Upgradeability / Expandability

A. HR Interface Clients > 10

Upgradeability / Expandability

A. Buses > 500

Upgradeability / Expandability

A. Cards for Expansion > 500

Upgradeability / Expandability

A. Doors for Expansion > 500

SECTION 28 31 11

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Work under this section consists of all engineering, installation labor, materials, equipment, programming, services, permits, fees and transportation necessary for, and/or reasonably incidental to, the construction and completion in working order of the work specified herein.

B. Work includes, but is not limited to the following:
1. Complete system design, engineering, testing and final acceptance by Owner and Authority having jurisdiction.
2. Life safety fire alarm detection and signaling system.
3. Plan check approval.
4. Furnishing and installation of equipment and devices.
5. Wiring in Conduit and connections.
6. Interface with elevator controls.
7. Programming, testing per NFPA 72, cleaning, adjusting of completed work.
8. Wiring diagrams, shop drawings, equipment data.
9. Complete warranty for five years. Proposal for subsequent maintenance contract including service, testing and repair or replacement.
10. All work and material for complete and operable systems as indicated or specified.
11. As constructed record drawings.
12. Permits, inspections, fees.
13. Identification and instruction in writing.
14. Coordination with existing conditions and work of other trades.
15. Furnishing of special back boxes for installation under electrical section.
16. Extending 120 or 240 volt power from electrical panelboard, coordinating and updating load schedules with Owner.

C. Section Includes:
1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

10. Network communications.
11. System printer.

D. Related Requirements:
1. Section 26 05 19 “Low-Voltage Power Conductors and Cables” for cables and conductors for fire-alarm systems.
2. Section 26 05 44 “Sleeves and Sleeve Seals”.

1.03 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Product Samples: For each device provide product sample for color and product review.

C. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the “Documentation” section of the “Fundamentals” chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.

12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
15. Extend 120 volt power from electrical panelboard, coordinating and updating load schedules with Owner.

D. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

E. For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Include in the Fire Alarm System submittal all the following information submitted as a complete package for review by the inspection agency. The contractor may submit to Architect concurrently if prior written approval for concurrent submission is obtained from the Architect. Approval by the authority having jurisdiction does not constitute acceptance by the Architect for device locations. Submit within 30 working days of award of contract. Incremental submittals at 50%, 90% and 100% completion are acceptable if proposed scope and schedule for each submittal is accepted by the Architect. Proposed scope must be submitted within 10 working days of award of contract.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

4. Prepare complete plans, risers, wiring diagrams, and installation drawings, coordinated with the work of other trades, for the fire alarm system stamped by a registered engineer where required by the inspecting agencies.
5. Plans shall be prepared under the supervision of a qualified technician who is experienced with the type of work specified herein and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum level III certification.
6. Obtain governing agency approval for fire alarm system after submitting shop drawings and before installing any portion of the system.
7. Obtain and incorporate Architectural and Owners review comments and submit modifications to authority having jurisdiction for final approval, bring any conflicts to the Architects and Owners attention. Install system per reviewed shop drawings.

F. Administrative
1. Permit application
2. Pay all plan review and inspection fees
3. Include the following installing contractor's information:
   a. Installing contractors name, address phone number.
   b. Contractor's license number.
   c. Local business license number.
   d. Include a copy of workers compensation insurance certificate.
   e. Evidence of Contractor personnel NICET Certification.
   f. List of contractor's personnel who will be working on the installation.
4. Include the following Project information:
   a. Site address.
   b. Basis for installation / Building code occupancy classification.

G. Fire alarm equipment
1. Include manufacturers specification sheets for all components
2. Identify equipment application per listing and approvals
3. Include CSFM listing sheets for all required systems and components numbers

H. General information
1. Indicate appropriate codes and standards, including reference edition.
2. Indicate type of system or service involved.
3. Include written sequence of operation or matrix table.
4. Indicate HVAC equipment locations and CFM.
5. Indicate any special system features or operations.
6. Indicate all required identification and labeling. Include locations for each item and proposed nomenclature.

I. Plans and details
1. Include the following information:
   a. Scaled reflected ceiling and floor plans, including north reference.
   b. Completed title block indicating project site address and installing contractors address.
   c. Identify each room and its proposed use.
   d. Locate all devices, cabinets and components including end of line devices.

e. Accurate legend of symbols for all fire alarm devices being installed, conforming with construction documents.
f. Identify circuit styles, designations and methods.
g. Include building cross sections, include attic, soffit or ceiling details.
h. Indicate location of sprinkler system test valve.
i. Include voltage drop calculations.
j. Include description of zone assignments / device addresses.
k. Indicate through penetration fire stopping details and specifications.
l. Include reflected ceiling plans showing duct diffusers, lighting fixtures, sprinklers, ceiling types and changes in elevations. Locate all fire alarm ceiling mounted devices in relation to work of other trades and other ceiling components.
m. Elevation detail of manual pull station installation and visual alarm signaling devices. Note that existing device mounting heights and locations may not comply with current codes.
n. Indicate device mounting heights coordinated with architectural elevations for wall mounted initiation and notification devices.
o. Include power supply source and details.

J. Riser diagram
1. Indicate conductor information:
a. Size.
b. Stranding.
c. Insulation type.
2. Identification of wire quantities and conduit or raceway sizes.
3. Include conduit fill calculations.
4. Indicate locations for end of line devices

K. Additional requirements
1. Point-to-point wiring diagrams for overall system and components, including 120-volt power distribution and interface with the HVAC and fire protection systems.
2. Typical device wiring diagrams.
3. Battery calculations to meet AHJ minimum hour requirements.
4. Details for support and anchorage of all fire alarm equipment weighing over 20 pounds.
5. Include physical and electrical characteristics of equipment to indicate conformance with the specifications.
6. Annunciator configuration and designations.
7. Revised panel schedules showing 120-volt circuit loads.
8. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
9. Device Address List: Coordinate with final system programming.
10. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

11. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
12. Audible/visual/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.06 SAMPLE WARRANTY: FOR SPECIAL WARRANTY.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
g. Record copy of site-specific software.
h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.

4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.
j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.09 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL listed alarm company.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
   1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
   2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Automatic sensitivity control of certain smoke detectors.

B. All components provided shall be listed for use with the selected system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices. Retain only those devices and systems in subparagraphs below applicable to Project. Coordinate with requirements in other Sections that specify listed devices and systems.
   1. Manual stations.
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Carbon monoxide detectors.
   6. Automatic sprinkler system water flow.
   7. Fire-extinguishing system operation.
   8. Fire standpipe system.
   9. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances including voice evacuation notices.
   2. Identify alarm and specific initiating device at fire-alarm control panel**,** connected network control panels, off-premises network control panels, and remote annunciators.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Activate voice/alarm communication system.
   5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   7. Recall elevators to primary or alternate recall floors.
   8. Activate elevator power shunt trip.
   9. Activate emergency lighting control.

C. or more of the following devices and actions:
   1. Valve supervisory switch.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
   4. Loss of primary power at fire-alarm control unit.
   5. Ground or a single break in internal circuits of fire-alarm control unit.
   6. Abnormal ac voltage at fire-alarm control unit.
   7. Break in standby battery circuitry.
   8. Failure of battery charging.
   9. Abnormal position of any switch at fire-alarm control unit or annunciator.
   10. Voice signal amplifier failure.

E. System Supervisory Signal Actions:
   1. Initiate notification appliances.
   2. Identify specific device initiating the event at fire-alarm control unit**,** connected network control panels, off-premises network control panels, and remote annunciators.
   3. Record the event on system printer.
   4. After a time-delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
   5. Display system status on graphic annunciator.

2.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.”

2.04 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, system shall be the following:
   1. Siemens XLSV

B. General Requirements for Fire-Alarm Control Unit:
   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
      a. System software and programs shall be held in non-volatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
      b. Include a real-time clock for time annotation of events on the event recorder and printer.

c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide non-volatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, two line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
a. One dedicated RS 485 port for remote station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.
d. One RS 232 port for voice evacuation interface.

E. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
a. Elevator lobby detectors except the lobby detector on the designated floor.

b. Smoke detector in elevator machine room.
c. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

A. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center.
   1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
      a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
      b. Programmable tone and message sequence selection.
      c. Standard digitally recorded messages for “Evacuation” and “All Clear.”
      d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control panel.
   2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters’ two-way telephone communication zones.
   3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

I. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters and alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium.

L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.05 MANUAL FIRE-ALARM BOXES

A. Manufacturers:
1. Siemens

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.06 SYSTEM SMOKE DETECTORS

A. Manufacturers:
1. Siemens

B. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

D. Ionization Smoke Detector:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

E. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.07 HEAT DETECTORS

A. Manufacturers:
1. Siemens

B. General Requirements for Heat Detectors: Comply with UL 521.
1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F
1. Mounting: Adapter plate for outlet box mounting] [Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.08 NOTIFICATION APPLIANCES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Siemens
2. System Sensor.
3. Wheelock; a brand of Eaton.

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

E. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

F. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

G. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word “FIRE” is engraved in minimum 1 inch (25mm) high letters on the lens.
1. Rated Light Output:
   a. 153075110] [177] cd.
   b. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.

6. Mounting Faceplate: Factory finished, red

B. Voice/Tone Notification Appliances:
1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the “Notification Appliances” and “Emergency Communications Systems” chapters in NFPA 72.
3. High-Range Units: Rated 2 to 15 W.
4. Low-Range Units: Rated 1 to 2 W.
5. Mounting: Flush
6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

H. Exit Marking Audible Notification Appliance:
1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.09 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:
1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.
1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a pre-set number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. Primary line shall be cellular communication, and secondary line is telephone (POTS) line. If service is lost on cellular signal or telephone line, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   4. Manual test report function and manual transmission clear indication.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble-initiating device.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.
   8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer’s written requirements.

B. Provide network communications pathway per manufacturer’s written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet Modbus for connection to building automation system.

2.13 SYSTEM PRINTER

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.14 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.02 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Equipment Mounting: Install fire-alarm control unit on concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 00 "Miscellaneous Cast-in-Place Concrete."
   1. Install seismic bracing. Comply with requirements in Section 27 05 48.16 "Seismic Controls for Communications Systems."
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (460-mm) centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use 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.

C. Equipment Mounting: Install fire-alarm control unit on finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48.16 “Seismic Controls for Electrical Systems.”

D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48.16 “Seismic Controls for Electrical Systems.”

E. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
   2. Mount manual fire-alarm box on a background of a contrasting color.
   3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
   4. Pull Station can be either single or dual action.

F. Smoke- or Heat-Detector Spacing:
   1. Comply with the “Smoke-Sensing Fire Detectors” section in the “Initiating Devices” chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with the “Heat-Sensing Fire Detectors” section in the “Initiating Devices” chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet (9 m)
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches (910 mm), 60 inches (1520 mm) from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

G. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

I. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

J. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

K. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

L. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

M. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

N. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.03 PATHWAYS

A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

D. Riser cabling shall be in 2 hour rated enclosure and must be FPLR cable type.

E. Where allowable by AHJ, per CBC riser cabling not installed in 2 hour rated enclosure shall be “Class A” (redundant) style wiring.

3.04 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters’ smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems.
   4. Alarm-initiating connection to elevator recall system and components.
   5. Alarm-initiating connection to activate emergency lighting control.
   6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   7. Supervisory connections at valve supervisory switches.
   8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

9. Supervisory connections at elevator shunt-trip breaker.
10. Data communication circuits for connection to building management system.
11. Data communication circuits for connection to mass notification system.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems.”

B. Install framed instructions in a location visible from fire-alarm control unit.

3.06 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.07 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction

B. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed record Drawings and system documentation that is required by the “Completion Documents, Preparation” table in the “Documentation” section of the “Fundamentals” chapter in NFPA 72.
      b. Comply with the “Visual Inspection Frequencies” table in the “Inspection” section of the “Inspection, Testing and Maintenance” chapter in NFPA 72; retain the “Initial/Reacceptance” column and list only the installed components.
   2. System Testing: Comply with the “Test Methods” table in the “Testing” section of the “Inspection, Testing and Maintenance” chapter in NFPA 72.
   3. Test audible appliances for the public operating mode according to manufacturer’s written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
   4. Test audible appliances for the private operating mode according to manufacturer’s written instructions.
   5. Test visible appliances for the public operating mode according to manufacturer’s written instructions.
   6. Factory-authorized service representative shall prepare the “Fire Alarm System Record of Completion” in the “Documentation” section of the “Fundamentals”

chapter in NFPA 72 and the “Inspection and Testing Form” in the “Records” section of the “Inspection, Testing and Maintenance” chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semi-annual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.08 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include12Insert number months’ full maintenance by skilled employees of manufacturer’s designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer’s authorized replacement parts and supplies.
   1. Include visual inspections according to the “Visual Inspection Frequencies” table in the “Testing” paragraph of the “Inspection, Testing and Maintenance” chapter in NFPA 72.
   2. Perform tests in the “Test Methods” table in the “Testing” paragraph of the “Inspection, Testing and Maintenance” chapter in NFPA 72.
   3. Perform tests per the “Testing Frequencies” table in the “Testing” paragraph of the “Inspection, Testing and Maintenance” chapter in NFPA 72.

3.09 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

SECTION 31 12 00

EXISTING FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for connection to and abandonment of existing facilities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. All related work specified elsewhere, or in other codes or standards, will be as last revised, unless a specific date of issuance is called out in opposition to later revision date(s).

B. Other sections of the technical specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
   1. Trenching, Backfilling, and Compaction: 312333

1.03 CONDITION OF EXISTING FACILITIES

A. The Owner does not warranty the condition, size, material, and location of existing facilities.

1.04 LOCATION

A. The contractor shall be responsible for potholing and verifying in advance the location of all existing utilities/pipelines as shown on the plans. Discrepancies shall be reported to the project engineer, prior to the fabrication of, or purchase of material affected by the discrepancy.

1.05 PROTECTION OF EXISTING UTILITIES AND FACILITIES

A. The contractor shall be responsible for the care and protection of all existing sewer pipe, water pipe, gas mains, culverts, power or communications lines, sidewalks, curbs, pavement, or other facilities and structures that may be encountered in or near the area of the work.

B. Contractor shall be responsible for locating existing underground utilities prior to beginning trenching or excavation activities and notify CPM.

C. In the event of damage to any existing facilities during the progress of the work and of the failure of the contractor to exercise the proper precautions, the contractor will pay for the cost of all repairs and protection to said facilities. The contractor's work may be stopped until repair operations are complete.

1.06 PROTECTION OF LANDSCAPING

A. The contractor shall be responsible for the protection of all the tress, shrubs, irrigation systems, fences, and other landscape items adjacent to or within the work area, unless they are directed to do otherwise on the plans.

B. In the event of damage to landscape items, the contractor shall replace the damaged items in a manner satisfactory to the College Project Manager.

C. When the proposed pipeline is to be within planted or other improved areas, the contractor shall restore such areas to the original condition after completion of the work. This restoration shall include grading, a placement of 5 inches of good topsoil, resoding, and replacement of all landscape items indicated.

PART 2 - MATERIALS

2.01 ALL MATERIALS USED IN MAKING THE CONNECTION OR REMOVING THE FACILITY FROM SERVICE SHALL CONFORM TO THE APPLICABLE SECTIONS OF THESE SPECIFICATIONS.

2.02 GROUT

A. Grout shall consist of Portland cement and water or of Portland cement, sand, and water; and all grout mixtures shall contain 2% of bentonite by weight of the cement. Grout shall be a pump mix with a minimum of six sacks cement (56 lbs) per cubic yard.

B. Portland cement, water and sand shall conform to the applicable requirements of the concrete section except that sand to be used shall be of such fineness that 100% will pass a standard 8-mesh sieve and at least 45%, by weight, will pass a standard 40-mesh sieve.

2.03 CONCRETE

A. Concrete used for the replacement of damaged or removed facilities shall be in accordance with Section 321613 and shall match the mix design of the existing facility and per the requirement of the jurisdictional agency.

PART 3 - EXECUTION

3.01 CONNECTION TO EXISTING FACILITIES

A. All connections shall be made by the contractor unless shown otherwise on the plans or specified herein.

B. The contractor shall notify the College Project Manager a minimum of two weeks before the time of any proposed shutdown of existing mains or services. The College Project Manager may postpone or reschedule any shutdown operation if for any reason the College Project Manager feels that the contractor is improperly prepared with competent personnel, equipment, or materials to proceed with the connection work.

C. Connections shall be made only in the presence of the College Project Manager, and no connection work shall proceed until the College Project Manager has given notice to proceed.

D. The contractor shall furnish all pipe and materials including furnishing all labor and equipment necessary to make the connections, all required excavation, backfill, pavement replacement, lights, and barricades, and may be required to include a water truck, high line hose, and fittings as part of this equipment for making the connections. In addition, the contractor shall assist the College Project Manager in alleviating any hardship incurred during the shutdown for connections.

E. The contractor will de-water existing mains, as required, in the presence of the College Project Manager.

F. The existing water line is a transite line where connection is to be made for the proposed fire hydrant and irrigation system. Contractor shall follow applicable procedures to connect the new water lines to the existing transite line.

G. Connections shall be made with as little change as possible in the grade of the new main. If the grade of the existing pipe is below that of the new pipeline, a sufficient length of the new line shall be deepened so as to prevent the creation of any high spot or abrupt changes in grade of the new line. Where the grade of the existing pipe is above that of the new pipeline, the new line shall be laid at specified depth, except for the first joint adjacent to the connection, which shall be deflected as necessary to meet the grade of the existing pipe. If sufficient change in direction cannot be obtained by the limited deflection of the first joint, a fitting of the proper angle shall be obtained by the limited deflection of the first joint, a fitting of the proper angle shall be installed. Where the connection creates a high or low spot in the line, a standard air release or blow off assemble shall be installed as directed by the College Project Manager.

H. Where connections are made to existing valves, the contractor shall furnish and install all temporary blocking, steel clamps, shackles, and anchors as required by the College Project Manager, and he shall replace the valve riser box and cover and adjust the valve cover to the proper grade in accordance with these specifications. The District will operate all existing valves. All valves, existing or newly installed, shall be readily accessible at all times to the College Project Manager for emergency operation.

I. New pipelines shall not be connected to existing facilities until the new pipelines have been successfully tested, disinfected and accepted by the College Project Manager.

3.02 REMOVAL FROM SERVICE OF EXISTING MAINS AND APPURTENANCES

A. Existing mains and appurtenances shall be removed from service at the locations shown on the plans or as directed by the College Project Manager.

B. Abandoned pipe shall be filled with grout.

C. Existing pipe and appurtenances removed from the ground will require backfill and repair of surface in accordance with Section 312333

D. The contractor shall remove and dispose of all removed pipe at his own expense.

E. Before excavating for installing mains that are to replace existing pipes and/or services, the contractor shall make proper provisions for the maintenance and continuation of service as directed by the College Project Manager unless otherwise specified.

3.03 CUTTING AND RESTORING STREET SURFACING.

A. In cutting or breaking up street surfacing, the contractor shall not use equipment that will damage adjacent pavement.

B. All asphalt and/or Portland cement concrete surfaces shall be scored with sawing equipment of a type meting the approval of the District; providing however, that any cement concrete base under an asphaltic mix surface will not be required to be scored by sawing. Existing paving surfaces shall be saw cut back beyond the edges of the trenches to form neat square cuts before repaving is commenced.

C. Pavement, sidewalks, curbs, or gutters removed or destroyed in connection with performance of the work shall be saw cut to the nearest score marks, if any, and shall be replaced with pavement sidewalks, curbs, or gutters of the same kind, or better by the contractor in accordance with the latest specifications, rules, and regulations and subject to the inspection of the agency having jurisdiction over the street of highway.

D. Aggregate base shall be placed beneath the restored pavement to the thickness required by the agency having jurisdiction.

END OF SECTION

SECTION 31 23 00

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes (but Is Not Necessarily Limited to):
   1. Rough grading earthwork.
   2. Excavating, trenching, and backfill.

1.02 UNIT PRICES

A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
   1. 24 inches outside of concrete forms other than at footings.
   2. 12 inches outside of concrete forms at footings.
   3. 6 inches outside of minimum required dimensions of concrete cast against grade.
   4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   5. 6 inches beneath bottom of concrete slabs on grade.
   6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

B. Unit prices for rock excavation include replacement with approved materials.

1.03 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe or conduit in a trench, including haunches to support sides of pipe or conduit.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subbase course and asphalt paving

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Engineered Fill: Fill material placed at the direction of the soils engineer.

G. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by College Project Manager. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by College Project Manager. Unauthorized excavation, as well as remedial work directed by College Project Manager, shall be without additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Rock (project definition): Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. 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 or ripping, when permitted:
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbf breakout force; measured according to SAE J-732.

J. Rock (ASTM definition): Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm).

K. 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.

L. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

M. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

N. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. General Provisions Section – Testing and Inspection

B. Section 31 23 33 – Trenching, Backfilling and Compaction.

C. Section 33 05 00 - Installation of Buried Pipe.

D. Section 33 41 00 – Subdrainage.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Drainage fabric.
   2. Separation fabric.

B. Samples: For the following:
   1. 10-lb. samples, sealed in airtight containers, of each proposed soil material from on-site or off-site borrow sources. This does not include District stockpile.
   2. 12-by-12-inch sample of drainage fabric.
   3. 12-by-12-inch sample of separation fabric.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with the following requirements:
   1. Classification according to ASTM D 2487 of each on-site or off-site borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 for each on-site or off-site borrow soil material proposed for fill and backfill.
   3. Laboratory compaction curve according to ASTM D 1557 for each on-site or off-site borrow soil material proposed for fill and backfill.

D. Blasting will not be permitted.

1.06 REFERENCES

A. Standard Specifications for Public Works Construction ("Greenbook"), most current edition.

1.07 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.08 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving existing facilities unless permitted in writing by College Project Manager and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify College Project Manager not less than two weeks in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without College Project Manager's written permission.
   3. Contact utility-locator service for area where Project is located before excavating.

B. Cooperate with District and utility companies in maintaining respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

C. Demolish and completely remove from site existing underground utilities to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations on District's stockpile.

B. Satisfactory Soils: Refer to Standard Specifications for Public Works Construction (SSPWC) "Greenbook" for recommendations.

C. Unsatisfactory Soils: Refer to Standard Specifications for Public Works Construction (SSPWC) "Greenbook" for recommendations. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 90 percent passing a 1-1/2- inch sieve and not more than 12 percent passing a No. 200 sieve. Must meet Caltrans standards.

F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve for Class II Base.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve. Must meet Caltrans standards.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

I. Drainage Fill: Washed, 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 0 to 5 percent passing a No. 8 sieve.

J. 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 0 to 5 percent passing a No. 4 sieve.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 DRAINAGE FABRIC

A. Non-woven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods.
   1. Grab Tensile Strength: 120 lbf; ASTM D 4632.
   2. Tear Strength: 40 lbf; ASTM D 4533.
   3. Puncture Resistance: 50 lbf; ASTM D 4833.
   4. Water Flow Rate: 150 gpm per sq. ft.; ASTM D 4491.
   5. Apparent Opening Size: No. 50; ASTM D 4751.

2.03 SEPARATION FABRIC

A. Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods.
   1. Grab Tensile Strength: 200 lbf; ASTM D 4632.
   2. Tear Strength: 75 lbf; ASTM D 4533.
   3. Puncture Resistance: 90 lbf; ASTM D 4833.
   4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D 4491.
   5. Apparent Opening Size: No. 30; ASTM D 4751.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 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.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Classified Excavation: Excavation to subgrade elevations classified as earth and rock.
   1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with 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.
      a. Do not excavate rock until it has been classified and cross-sectioned by College Project Manager.

3.05 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavation for Mechanical or Electrical Utility Structures: Excavate to required elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to required cross sections, elevations, and grades.

B. Excavations shall be in accordance with the Standard Specifications for Public Works Construction (SSPWC) “Greenbook” prepared for this Project.

3.07 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to required gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of pipe a minimum of 36” below finished grade to top of pipe.

B. Excavate trenches to uniform widths to provide a working 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 required to meet minimum cover.

1. Clearance: unless otherwise shown on the drawings, 12 inches on each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
   3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Depth: Excavate trenches 6 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.08 APPROVAL OF SUBGRADE

A. Notify College Project Manager when excavations have reached required subgrade.

B. If College Project Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
   1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by College Project Manager.

3.09 UNAUTHORIZED EXCAVATION

A. Intentionally left blank.

B. Fill unauthorized excavations under other construction or utility pipe as directed by College Project Manager.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile 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 a minimum distance equal to the depth of excavation. 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, damp proofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Inspecting and testing underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

A. 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.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. 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.

D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final subgrade.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. 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 satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill material on surfaces that are muddy, 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 BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Unless otherwise specified on the drawings or in the soils report, compact soil 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 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 90 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from 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.
   3. Stripping. When fills are to be constructed over cultivated or fallowed land, the entire area upon which the fill is to be constructed shall first be cleared of vegetation and then smoothed with a blade grader. When fills are to be constructed over sodded surfaces, the sod shall be stripped to a depth of 2 inches. These smoothed or stripped surfaces shall then be rolled to the specified density

required for fill prior to the fill material placement. Dispose of stripped material as waste and completely remove from the Project site.

4. Conservation of Topsoil. Deposit topsoil in storage piles convenient to the areas which are subsequently to receive application of topsoil. Stockpile topsoil free of roots, stones and other undesirable material as specified in Paragraph 2.1 B above. Keep topsoil, when stored, separate from other excavated materials. Cover storage piles as required to prevent wind blown dust.
5. Fills. Construct fills at the locations and to the lines and grades indicated on the Drawings. Insure that the completed fill corresponds to the shape of the typical sections shown on the Drawings or meets the requirements of that particular case. Use all approved material removed form the excavation in forming the necessary fill. All fill material shall be free from logs, stumps, sod, weeds, trash or other perishable material, and from all stones having a maximum dimension greater than 6 inches. No stones shall be permitted in the top 12 inches of fills. Place the material in successive horizontal layers not exceeding 8 inches in loose depth. Use a blade grader to keep fill material spread uniformly. Remove any soft sections, holes or depressions to required grades and refill with material as approved, and shape the entire area to line, grade, and cross section and thoroughly compact as specified. Contractor is responsible for adjustment of the moisture content of the fill material so that the specified compaction can be obtained. The rough grade for the entire Project site or portion thereof shall be approved by College Project Manager before placement of any topsoil.
   a. Subgrade Preparation. Subgrades for all drives, parking areas, sidewalks and other structures shall be shaped, dressed, moistened and compacted as specified Test the subgrade for crown, elevation and density in advance of placing pavement.
   b. Spreading of Topsoil:. Upon completion of rough grading, spread the stockpiled topsoil for a uniform depth of 6 inches, after settlement, over all areas graded not receiving other surfacing, just prior to the sodding or landscaping operation. Before spreading the topsoil, scarify the graded areas for a depth of 3 inches and repair all settlements and washes.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
   3. Pavements: Plus or minus 1/2 inch.

C. Finished Grading. Accomplish uniformly smooth grading of all areas covered within the limits of the work, including excavated and filled sections and adjacent transition areas so that the finished surface is smooth, compacted and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations except as otherwise specified. Finish all swales so as to drain readily.
   1. Backfill material shall be the same as specified for fill and shall be placed and compacted as specified for fill unless otherwise noted.

D. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in a minimum of 12 inches of filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.
   1. Compact each course of filter material to 90 percent of maximum dry unit weight according to ASTM D 1557.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 6 inches.
   1. Compact each course of filter material to 90 percent of maximum dry density according to ASTM D 1557.
   2. Place and compact impervious fill material over drainage backfill to final subgrade.

3.18 BASE COURSES

A. Under pavements and walks, place base course on prepared subgrade and as follows:
   1. Place base course material over subgrade.
   2. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 90 percent of maximum dry unit weight according to ASTM D 1557.
   3. Shape base to required crown elevations and cross-slope grades.
   4. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
   5. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 8 inches thick loose material or less than 4 inches thick when compacted.

3.19 DRAINAGE COURSE

A. Under slabs-on-grade, install drainage fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

B. Under slabs-on-grade, place drainage course on prepared subgrade and as follows, unless otherwise specified by the Geotechnical Engineer:
   1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
   2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
   3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: District will furnish a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design-bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by College Project Manager.

D. Testing agency will test compaction of soils in place according to ASTM D 1556 and ASTM D 2922 as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

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 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 College Project Manager; 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 the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated area(s) on District's property. Stockpile or spread soil as directed by College Project Manager.

B. All disposal as directed by the Owner’s construction manager.

END OF SECTION

SECTION 31 23 33

TRENCHING, BACKFILLING AND COMPACTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall comply with the requirement of this section which includes materials, testing and performance of trench excavation, backfilling and compacting, complete.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 330500 – Installation of Buried Pipe.

B. Section 312300 – Earthwork.

1.03 REFERENCES

A. Standard Specifications for Public Works Construction (SSPWC) “Greenbook” most current edition.

1.04 SUBMITTALS

A. Submit drawings showing excavation and shoring, bracing, or sloping for worker protection in accordance with the Special Provisions Section if required.

B. Submit six (6) copies of a report from a testing laboratory verifying that material conforms to the specified gradations or characteristics for granular material or imported sand.

1.05 MEASUREMENT AND PAYMENT

A. Payment for the work in this section will be included as part of the Contractor's unit price per linear foot for the various types of pipe as stated in the bid documents.

PART 2 - MATERIALS

2.01 PAVEMENT ZONES

A. The pavement zone includes the asphaltic concrete and aggregate base pavement section placed over the trench backfill.

2.02 TRENCH ZONE

A. The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.

2.03 PIPE ZONE

A. The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as specified below. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipes to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be 12 inches.

2.04 PIPE BASE

A. The pipe base shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be four inches (4") below the lowest point of the pipe or bell.

2.05 SAND-CEMENT SLURRY BACKFILL

A. Sand-Cement slurry shall consist of one (1) sack of Portland cement per cubic yard of sand and sufficient moisture for workability.

2.06 BACKFILL-PIPE ZONE AND PIPE BASE

A. For ductile iron and PVC pipe the pipe base and pipe zone backfill material shall be imported sand as specified herein.

2.07 IMPORTED OR NATIVE SAND--PIPE ZONE AND PIPE BASE

A. Imported sand shall have a minimum sand equivalent of 30 per State of California, Division of Highways Test "California 217" with 100% passing a 3/8" sieve and not more than 20% passing a 200-mesh sieve.

B. Imported sand used in the pipe zone or for the pipe base shall have the following gradation:

Sieve Size	Percent passing by Weight
3/8 inch	100
No. 4	75 - 100
No. 30	12 - 50
No. 100	5 - 20
No. 200	0 - 15

2.08 SAND-CEMENT SLURRY REFILL MATERIAL FOR FOUNDATION STABILIZATION IN PIPE ZONE

A. Sand-Cement slurry fill in the pipe zone shall not be used unless approved by the College Project Manager.

B. Sand-Cement slurry shall consist of one (1) sack of Portland cement per cubic yard of sand and sufficient moisture for workability.

2.09 WATER FOR COMPACTION

A. Water used in compaction shall have a maximum chloride concentration of 500 mg/l, a maximum sulfate concentration of 500 mg/l, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali or organic materials injurious to the pipe coatings.

PART 3 - EXECUTION

3.01 TESTING FOR COMPACTION

A. Unless otherwise directed by the College Project Manager or the District, the Contractor will test for compaction as described below.

B. Determine the density of soil in place by the sand cone method, ASTM D 1556.

C. Determine the laboratory moisture-density relations of soils per ASTM D 1557.

D. Determine the relative density of cohesionless soils by ASTM D 2049.

E. Sample backfill materials by ASTM D 75.

F. Express "relative compaction" as the ratio, expressed as a percentage; of the in place dry density to the laboratory maximum dry density.

G. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction. The Contractor shall pay all associated costs of any re-testing of work not conforming to the specifications.

3.02 COMPACTION REQUIREMENTS

A. Unless otherwise shown on the Drawings or specified in the soils report relative compaction in pipe zone shall be 95 percent.

3.03 MATERIAL REPLACEMENT

A. Remove and replace any trenching and backfilling material, which does not meet the specifications, at the Contractor's expense.

3.04 SHEETING, SHORING AND BRACING OF TRENCHES (IF REQUIRED)

A. GENERAL
1. Trenches shall have sheeting, shoring and bracing conforming to CAL/OSHA requirements and General Provisions. Lateral pressures for design of trench sheeting, shoring and bracing shall be based on type of soil exposed in the trench, groundwater conditions, surcharge loads adjacent to the trench and type of shoring that will be used in the trench.
2. The banks of trenches, where required to control trench width and protect adjacent structures, shall be sheeted and braced at no additional expense to the Owner. Where shoring, sheeting, bracing or steel strutted trench boxes are necessary, they shall be furnished, placed, maintained and, except as shown or specified otherwise, removed. Where damage is liable to result from the removal of the

sheeting, then the sheeting will be required to be left in place and cut off if required or directed.

3. The design, planning, installation and removal, if required, of steel strutted trench boxes or sheeting, shoring, lagging, and bracing shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
4. The use of horizontal strutting below the barrel of the pipe or the use of the pipe as support for trench bracing will not be permitted. Sheet piling and timbers in trench excavations shall be withdrawn in a manner so as to prevent subsequent settlement of the pipe or additional backfill loading which might overload the pipe.
5. Following removal of shoring, bracing or steel strutted trench boxes, the space left due to such removal shall be backfilled immediately and the backfill compacted.

3.05 TRENCH EXCAVATION

A. GENERAL

1. Excavation of every description and of whatever substance encountered shall be performed, to the depths required. It may be necessary to increase or decrease the quantity of excavation because of unknown factors. The Engineer reserves the right to change the trench alignment from that indicated by 10 feet horizontally without additional expense to the Owner.

B. TRENCH WIDTHS

1. Maximum trench width in the pipe zone shall be as indicated on the plans. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 18 inches between the top edge of the trench and the structure or footing.

C. GRADE

1. Excavate the trench to the depth required with allowance for pipe thickness and for pipe base or special bedding. If the trench is inadvertently excavated below the required grade, refill with imported sand any part of the trench excavated below the grade at no additional cost to the Owner. Place the refilling material over the full width of trench in compacted layers not exceeding six inches (6") to the established grade with allowance for the pipe base or special bedding.

D. EXCAVATION

1. Unless otherwise indicated, excavation shall be open cut. During excavation, material shall be stockpiled in an orderly manner, a distance back from the edges of the excavations specified by the governing safety agency before being wasted as specified. Caution shall be exercised in operating heavy equipment over pipelines. Leaks or breaks caused by the Contractor's operations shall immediately be repaired at no additional expense to the Owner and in a manner acceptable to the Engineer. The banks of excavated areas shall be controlled as is necessary to prevent movement of soil in areas supporting existing foundations, slabs, pole lines, underground power or telephone cables, trees, pipelines or other structures. If, as a result of the excavation or through fault or neglect of the Contractor, the earth or ground under or around such foundations, slabs, pole lines, underground power or telephone cables, trees, pipelines or other structures,

slips or is otherwise disturbed, corrective measures shall be taken as directed at no additional expense to the Owner.

2. In the event the maximum allowable trench width is exceeded, the Contractor may be required, depending on the depth of trench, to improve the pipe bedding by utilizing concrete or other bedding materials as necessary to assure that the type of pipe installed can withstand the loads imposed by the backfill due to the depth of the trench.
3. The bottom of the trench shall be excavated to the depth required with proper allowance for pipe thickness, and for foundation stabilization and special bedding when required. Material containing rocks or cobbles larger than 2 inches in maximum dimension shall not be permitted within 6 inches of the pipe. Material of this type shall be removed from the bottom of the trench and replaced with backfill material. Parts of the trench excavated below grade shall be corrected with backfill as specified. The depth of trenches shall be as indicated.

3.06 DEWATERING

A. Provide and maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe-laying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply during 24 hours per day, seven days a week. Dispose of the water in a manner to prevent damage to adjacent property. Do not drain trench water through the pipeline under construction. Do not allow groundwater to rise around the pipe until jointing compound has set hard.

B. Contractor shall notify the College Project Manager 48 hours prior to commencement of dewatering.

3.07 LOCATION OF EXCAVATED MATERIAL

A. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Conform to federal, state and local regulations governing the safe loading of trenches with excavated material.

3.08 TRENCH BACKFILLING

A. Backfill per the detailed piping specification for the pipe and per the following.

B. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipe-laying to provide firm, uniform support along the full length of pipe.

C. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

D. No mechanical compaction of material placed within 12 inches of the outer surface of the pipe will be allowed.

E. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least two feet (2') of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

3.09 BACKFILL COMPACTION

A. Compact per the detailed specification.

B. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Consolidation by jetting or flooding will be permitted at the Geotechnical Engineer's discretion. Maximum backfill lifts shall not exceed eight inches (8").

3.10 IMPORT OR EXPORT OF BACKFILL MATERIAL

A. Excess excavation soil material shall be removed and disposed of by the Contractor off the project site at the Contract's expense. Excess soil material shall be disposed of in accordance with local regulations.

B. Contractor shall be responsible, at no additional cost to the Owner, to import any required additional backfill material necessary to return all grades to the grade encountered at the beginning of construction or as shown on the contract Drawings.

END OF SECTION

SECTION 32 01 00

LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide equipment, materials, services, and do all work necessary to perform landscape maintenance to limits of work indicated on Drawings.

1.2 SUBMITTALS

A. Submit a maintenance schedule, description of methods, equipment to be used and frequencies.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. Tree Care Industry Association" (TCIA) www.tcia.org

1.4 SITE FAMILIARIZATION

A. Carefully and closely inspect the entire area to be maintained to become familiar with site conditions at the beginning of contracted maintenance.

B. Meet and walk site at the initiation of the maintenance program to determine the condition at the time of all paved areas, planting areas, and irrigation system included within the Limit of Work.

1.5 QUALITY ASSURANCE

A. Trees, shrubs and ground covers:

1. All materials shall be maintained in a healthy, vigorous, and robust condition at all times. Tree crowns shall exhibit a full head of foliage, leaves shall show no desiccation, and the color shall be consistent with the species. Trunks, bark, and outer skin shall have no "unhealed breaks" or scars, decay cavities, no indications of borer tunneling, or evidence of soft wood.

2. Materials shall not exhibit symptoms of attack by any manner of plant pest or fungus, either in the leaf structure, the bark of outer skin, at the base of the trunk, or in the root system.

3. Shrubs, hedges, and ground covers shall have a neat, healthy appearance, and shall be trimmed in a manner to preserve the natural character of the plants. Beds shall be free of weeds.

4. Hedges shall be trimmed as directed by Owner for height and width, generally wider at the bottom than the top.

B. Grasses: Grasses shall exhibit a vigorous, healthy, uniformly green appearance, relatively free from insects, grubs, chinch bugs or other pests, free from an excessive accumulation of thatch

C. Irrigation system:

1. Irrigation system shall be supplemented by hose as required. Contractor shall visit site, inspect the system, and confer with Owner regarding the system's capabilities.

2. Grass and shrubs shall not interfere with operation of the irrigation heads.

3. System shall operate automatically on the normal watering schedule as approved by Owner.

4. System shall operate without breaks or interruptions in service. Malfunctions shall be promptly reported and repaired.

D. Pavement:

1. Hardscape paving shall be free from clippings, edgings, or vegetative trimmings caused by maintenance operations.

2. Vehicles shall be equipped with drip pans. Contractor shall be responsible for all damage to paved surfaces caused by dripping from vehicles.

E. General cleanliness:

1. The entire area shall be maintained in a neat and clean condition at all times. There shall be no accumulation of debris or litter along roadways, shrubs, beds, building corners, steps, and other structures.

2. During leaf drop, there shall be no accumulation creating hazards or hardships for vehicular or pedestrian traffic.

1.6 MAINTENANCE TASK SCHEDULES

A. Submit a report semi-monthly, including photographs, to Owner which will cover observations and conclusions made during the site walk. The report shall include

maintenance task schedules adjusted by Contractor to cover all special conditions or problems at that time. The final acceptable schedules will be as approved by Owner.

B. Notify Owner of the intended work schedule sufficiently in advance to allow Owner time to serve as field observer during the maintenance period.

C. If it becomes necessary to revise maintenance task schedules based on changing conditions or problems which arise, include revised schedules in the summary report.

1.7 MAINTENANCE INSTRUCTIONS

A. Prior to start of contract maintenance, provide a notebook to Owner of written maintenance instructions for all turf areas, planting areas, and irrigation systems within the project area. All necessary information needed to maintain areas and systems shall be provided, including man-hours required per task and cost per task to accomplish the work including total area sq. ft. for all areas to be maintained. Submit a copy of instructions to Owner for approval. Owner may require resubmittals of maintenance instructions if it is determined that the information provided is not sufficient or adequate to allow for proper maintenance.

1.8 QUALIFICATIONS OF CONTRACTOR

A. Demonstrate experience by principals in landscape maintenance as proprietor, partnership, or corporation. In addition, provide the name of the school or organization from which their training and experience was obtained, and the address and period of time by dates from start to finish of training. Give names of companies, addresses, and written references. Maintenance Contractor shall be bondable and show evidence of financial stability satisfactory to Owner that it is in good financial position to carry on the work. Contractor shall be able to take on the maintenance and welfare of the Contract areas throughout the specified period. Such care and maintenance of the Contract area shall be supervised by Contractor.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Furnish and utilize adequately maintained equipment in sufficient quantity to properly carry out the work specified herein. Unless specific arrangements are made in advance with Owner, Contractor’s maintenance equipment shall not be stored on-site.

2.2 PLANTS

A. Replace plants, trees, shrubs, grasses, and vines that are dying or in poor condition in accord with Owner’s approved Contract Directive or deficiency notice. Submit to Owner a list of replacement materials, indicating botanical name, common name, size, and unit

cost installed complete and in place. Obtain Owner's approval and written authorization prior to all replacements

2.3 MULCH

A. At all times, maintain mulch to a minimum depth of 3", per California Department of Water Resources Model Water Efficient Landscape Ordinance (MWELO).

PART 3 - EXECUTION

3.1 PROCEDURES - GENERAL

A. The following procedures may be adjusted as required by monitor's observations and recommendations.

3.2 TRASH AND LITTER PICK-UP

A. Complete trash and litter cleanup of all pavement, lawn, and planting areas within the limit of work shall be carried out a minimum of once daily and additionally as necessary to maintain the site in a clean, neat, and orderly condition.

B. Complete trash and litter cleanup of all pavement, lawn, and planting areas and emptying of trash receptacles shall be carried out each week for duration of Contract.

C. Trash receptacles shall be emptied once per week minimum.

D. Trash shall be legally disposed of off-site.

3.3 PAVEMENT AREA CLEANING/SWEEPING

A. Pavement areas within the Limit of Work shall be swept clean of all dirt, litter, and other debris a minimum of once weekly and additionally as necessary to maintain a clean condition. Pavement areas shall be either mechanically broom swept or power vacuumed as approved by Owner.

1. Pavement areas shall be swept clean of all dirt, litter, and other debris during regular maintenance visit.

2. Wash paved areas away from landscape areas to avoid contaminating landscape areas with cleaners and to avoid excessive water on the perimeter of the landscape area.

3.4 PAVED AREA WASHING

A. Pavement areas within the Limit of Work shall be washed clean with water using hose or other means only when necessary and approved by Owner.

3.5 DAMAGE INSPECTION

A. Regularly inspect areas and report all vandalized and otherwise damaged materials or conditions within the Limit of Work.

3.6 GRASS MAINTENANCE

A. Soil analysis: At start of the maintenance program, take soil tests in varying locations within each of the grass areas to determine fertilizer requirements of the soils. The number and exact locations shall be subject to approval by Owner. Provide minimum one test for every 5000 sq. ft..

1. For fertilizer requirements, take soil samples to a depth of 3 in. to 6 in. Take a thin, uniform slice off the straight side of a troweled or spaded V-shaped hole from top to bottom. Store each sample separately from every other sample. Spread out samples to dry on paper which is clean and free from contamination. Protect samples from contamination. After samples are collected, they shall be sent to Owner-approved agricultural testing laboratory.

B. Watering: Watering of the lawn and planting areas by the landscape irrigation system shall be applied in accord with Owner-approved irrigation schedule. The Schedule shall provide an application rate of at least 1 in. of water every 5 to 7 days. Water shall be allowed to penetrate the soil to a depth of 6 in.

1. Contractor shall familiarize itself with the existing system, and shall inform Owner regarding malfunctions or imperfections within the system. The cost of repairs to the system shall be borne by Owner, unless the repair is directly attributable to negligence of Contractor.

2. Water weak areas by and to avoid excessive irrigation in other areas. Adjust flow rates and head placements as needed to give uniform precipitation. Alter system in areas of high or low water evapotranspiration rates to avoid overly dry or wet areas. Aerate as needed to avoid poor aeration or poor water infiltration. Maintain good soil moisture.

C. Grass fertilization program: Furnish and apply commercial fertilizer at the rates recommended by the soil analysis approved by Owner.

D. Weed control:

1. If weeds occur, they shall first be identified, and the appropriate herbicide used to eradicate them. Apply herbicide in accord with manufacturer's instructions and recommendations and as approved by Owner. Application shall be carried out by Contractor as recommended by manufacturer's instructions and approved by Owner.

2. Control weeds in selected areas where weeds are present. Timing on control shall depend on type of weed (perennial or annual) and its characteristics.

3. Do not apply herbicides for weed control when the wind exceeds 5 mps. Use herbicides carefully, especially in areas adjacent to other planting. Do not apply herbicides in conjunction with lawn renovations and reseeding or overseeding. All weed control measures shall be placed under the immediate supervision of Owner.

4. Herbicide applications for control of annual grassy weeds shall be made with preemergence herbicides in accord with label instructions.

5. Herbicide applications for control of existing broadleaf weeds shall be made in accordance with label instructions.

6. Apply non-selective and/or preemergence herbicides to cracks in paved areas as necessary for weed control.

7. Apply herbicides under the supervision of a Certified Pesticide Applicator, with prior approval from Owner.

E. Disease and pest control:

1. Notify Owner of diseased or distressed grass areas, and submit diseased or distressed samples to Owner for testing. Apply insecticides and/or fungicides to grass areas only where necessary and as recommended by Owner.

2. Control insects, pests, and fungus by inspecting grass at periodic intervals for presence of grubs, chinch bugs, blight, rust, leaf spot and other pathogens, verify identifications, and treat affected areas as required. Apply all controls under the direct supervision of Owner.

F. Sod replacement:

1. If grass areas are at any time determined to be dead, in a state of damage, or decline to the point of requiring re-sodding, identify areas and report them to Owner.

2. It shall then be the responsibility of Contractor to ensure that the area is re-sodded as soon as weather conditions permit.

a. Carry out the replacement with the cost being borne by Owner, unless there has been some negligence on the part of Contractor.

b. Replacement sod shall be of the same species as is in the ground. All sodding procedures shall be as approved by Owner.

3.7 PLANTING MTERIAL MAINTENANCE

A. Weeding and edging:

1. Mulched planting beds and individual mulched plant pits shall be neat in appearance and maintained to the lines originally laid out.

2. Edging of grass around mulch shall be done as necessary to maintain a natural appearance.

3. Hand weeding of mulched planting beds and pits shall be done to maintain mulch depth of 3” minimum.

4. Debris from weeding and edging shall be removed from site and disposed of properly by Contractor.

B. Weed control:

1. All plant materials shall be closely monitored for insect and disease problems. Due to the nature of these problems, plants shall be inspected weekly. Insecticides shall be applied on a control basis under the supervision of a licensed Certified Pesticide Applicator and approved by Owner for application around animal areas.

2. A weed spray or granular material for both preemergent and perennial weeds shall be applied in the early spring, to be followed by spot treatments in trouble areas.

3. Safety measures shall be employed to ensure that toxic substances are used in a responsible manner without adversely affecting plant materials and the general public. These measures include applying materials in accord with manufacturer’s recommendations, alerting Owner regarding the timing, material, its toxicity, and its usage.

C. Disease and pest control:

1. Provide all seasonal and required spraying and/or dusting of trees, shrubs, and ground covers. Spray materials and techniques shall be as recommended by the local agricultural extension service.

2. Show spraying dates on schedule submitted to Owner.

D. Fertilization:

1. Prior to maintenance, obtain maintenance fertility recommendations from Wallace Laboratories, 365 Coral Circle, El Segundo, CA 90245. Tel: (310) 615-1116, Fax: (310) 640-6863.

2. For estimating purposes, provide 4 lb. of nitrogen per 1000 sq. ft. Nutro Coat Fertilizer 17-6-8 (360-day formulation) application techniques in accord with standard horticultural practices.

E. Mulching:

1. Maintain a minimum depth of 3 in. of mulch as specified on original Drawings and Specifications over the entire surface of the plant beds and tree pits to maintain a neat and attractive appearance. The mulch shall be maintained throughout the

growing season and new mulch shall be installed as required to keep a neat and attractive appearance.

2. Spray or treat for borers, ants, or ground insects as required. All spraying shall be done under the immediate supervision of Owner.

3. If mulch is less than 3” or not present at start of the job, notify owner and provide proposal for placing minimum 3” depth of mulch in all non-turf planting areas.

END OF SECTION

SECTION 32 13 13

SITEWORK CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section

B. Section Includes:
   1. Cast-in-place concrete pavement placement and finishing.

C. Related Sections:
   1. Concrete Forms and Accessories.
   2. Sitework Concrete
   3. Concrete
   4. Pavement markings.
   5. Special Environmental Requirements

1.02 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as inserts, anchors and vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.

B. Product Data:
   1. Mix Design: Submit a concrete mix design for each mix that will be provided for the Work. Include water/cement ratio, size of coarse aggregate, amount of any admixtures, minimum compressive strength, maximum slump and air content percentage.
   2. Manufacturer of ready-mixed concrete shall deliver to the owner's representative a certificate with each mixer truck. Certificate shall bear the signature of representative of the testing laboratory, and shall state quantity of cement, water, fine and coarse aggregate and admixtures.

C. Samples and mock ups:
   1. Samples: Submit for approval one sample of each paving color and finish illustrating concrete colors and finishes, minimum 12 inches x 12 inches in size.
   2. Mock ups: Construct one 4' x 4' minimum sample of each color, finish and joint type for approval on site. If approved, sample may be retained as final construction.

D. Certificates: Submit a notarized certificate that each of following conforms to standards indicated:
   1. Aggregates – ASTM Standards C33
   2. Admixtures – ASTM Standards C260
   3. Curing materials – ASTM Standards C171

E. Sustainable Design
Submittals: Provide the following information by filling out the Special Environmental Requirements Product Submittal Form located in Appendix A of Section 01 35 43 Special Environmental Requirements, together with required supporting documentation
1. Recycled Materials
2. Regional Materials

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

American Concrete Institute (ACI) Publication:

ACI 211 - Recommended Practice for Selecting Proportions of Concrete.

ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

ACI 305 - Recommended Practice for Hot Weather Concreting.

ACI 306 - Recommended Practice for Cold Weather Concreting.

ACI 308 - Recommended Practice for Curing Concrete.

ACI 309 - Recommended Practice for Consolidation of Concrete.

American Society for Testing and Materials (ASTM) Standards:

ASTM A 185 - Welded Steel Wire Fabric For Concrete Reinforcement.

ASTM C 31 - Making and Curing Concrete Test Specimens in the Field.

ASTM C 33 - Concrete Aggregates.

ASTM C 39 - Compressive Strength of Cylindrical Concrete Specimens.

ASTM C 88 - Soundness of Aggregates by use of Sulphate or Magnesium Sulphate.

ASTM C 94 - Ready-Mixed Concrete.

ASTM C 143 - Slump of Hydraulic Cement Concrete.

ASTM C 150 - Portland Cement.

ASTM C 171 - Sheet Materials for Curing Concrete.

ASTM C 172 - Sampling Freshly Mixed Concrete.

ASTM C 173 - Air Content of Freshly Mixed Concrete by the Volumetric Method.

ASTM C 227 - Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).

ASTM C 231 - Air Content of Freshly Mixed Concrete by the Pressure Method.

ASTM C 260 - Air-Entraining Admixtures for Concrete.

ASTM C 289 - Potential Reactivity of Aggregates (Chemical Method).

ASTM C 494 – Chemical Admixtures for Concrete

ASTM D 1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

B. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following:

1. Before installing Portland cement concrete paving, meet with representatives of authorities having jurisdiction, Owner's Representative /Landscape Architect, consultants, independent testing agency, and other concerned entities to review requirements. Notify participants at least 3 working days before conference.

C. Continuous inspection shall be provided for structural concrete at the batch plant and for transit-mixed concrete to run check sieve analysis of aggregate, check moisture content of fine aggregate, check design of mix, check cement being used with test reports, check loading of mixer trucks, and certify to quantities of materials placed in each mixer truck.

D. Inspections shall be performed by a representative of a testing laboratory selected by the Owner. Owner will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.

E. Continuous batch plant inspection requirement may be waived in accordance with CBC section 1705A.3.3. Waiver shall be in writing, including DSA approval.

F. Strength Test of Concrete: Refer Testing and Inspection within the General Provisions sections.

1.04 TOLERANCES FOR CONCRETE PAVING

A. General: Variations below list the maximum permissible deviations from established lines, grades and dimensions for all exposed concrete.

B. Variation from Plumb:
1. In the lines and surfaces of pavements: In 10 feet, maximum 1/4 inch
2. For control-joint grooves and other conspicuous lines:
   a. In any 20 feet, maximum 1/4 inch
   b. In any 40 feet or more, 1/2 inch

C. Variation from the Level or from the Grades shown per Civil Engineer Drawings:

1. In pavements:
   In any 10 feet, 1/4 inch
   In 20 feet, maximum 3/8 inch
   In 40 feet or more, 3/4 inch
2. For exposed joints and other conspicuous lines:
   In any 20 feet, maximum 1/4 inch
   In 40 feet or more, 1/2 inch

D. Variation in the Sizes and Locations of Sleeves and Wall Openings: Plus or minus 1/4 inch.

E. Variation in Cross-Sectional Thickness of Slabs:
1. Minus 1/4 inch
2. Plus 1/2 inch

F. Variation in Radii:
1. In radii of less than 10 feet:
   In any 5 feet, 1/8 inch
   In any 10 feet, 1/4 inch

2. In radii of 20 feet:
   In any 10 feet, 1/4 inch
   In any 20 feet, 3/8 inch

3. In radii of 30 feet or more:
   In any 20 feet, 1/2 inch
   In any 30 feet, 1 inch

1.05 Rejected Materials: Remove off the site all concrete below specified strength.

A. Cost of Removal and Re-testing: Pay for full costs of removal of rejected concrete and its replacement with concrete of specified strength and re-testing.

1.06 DELIVERY, STORAGE AND HANDLING

A. Mixing and Placing Concrete: Refer to Section 01: Testing and Inspection.

B. Ready-mix concrete shall be mixed and delivered in accordance with ASTM C 94 and CBC Standard 19-3 and 19-4. Each batch of concrete delivered to the Project site shall be accompanied by a time slip bearing departure time and signature of batch plant supervisor. Concrete shall be placed within 90 minutes after start of mixing.
1. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.

1.07 JOB CONDITIONS

A. Cold Weather Requirements:
1. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Surfaces, in which

concrete is to come in contact with, shall be free from frost or ice. No frozen materials or materials containing ice shall be furnished.

2. When placing concrete during freezing or near-freezing weather the mix shall have a temperature of at least 50 degrees F., but not more than 90 degrees F. when cement is added. Concrete shall be maintained at a temperature of at least 50 degrees F. for at least 72 hours after placing or until it has thoroughly hydrated. When necessary, concrete materials shall be heated before mixing. Special precautions shall be provided for protection of transit-mixed concrete.

B. Hot Weather Requirements:

1. During hot weather, proper attention shall be provided for ingredients, production methods, handling, placing, protection and curing, to prevent excessive concrete temperatures or water evaporation which could impair required strength or durability.

C. Protection: Protect the sidewalks against all damage prior to final acceptance of the work. Exclude traffic from the sidewalks by erecting and maintaining barricades and signs until the concrete is at least fourteen (14) days old, or for a longer period if so requested by College's Representative.

D. Provide written confirmation from Contractor’s surveyor that subgrade is consistent with drawings and from College's soils inspector that subgrade is firm to receive concrete work prior to pouring walks.

PART 2 - PRODUCTS

2.01 GENERAL

A. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of CBC Chapter 1905A.

B. Strength of Concrete: Concrete, unless otherwise indicated or specified, shall be provided with a minimum ultimate 28-day strength of 2500 psi (f'c). For high-early-strength concrete, age for reaching the f'c shall be as indicated on Drawings.

2.02 MATERIALS

A. Unless otherwise shown on the Architectural plans - LIGHT ACID SANDBLAST FINISH WITH INTEGRAL COLOR CONCRETE: Based on 4-inch thick pedestrian Colton Type II cement with Reliance sand aggregate, integral color as shown on drawings. Scarify and compact subgrade per geotechnical engineer’s latest report. Concrete flatwork to be installed over 4-inches of compacted washed concrete sand. Sub-base to be determined by final geotechnical report.

B. CEMENT ASTM C150, Type II or Type V Portland Cement as conforming to ASTM C150 and the latest geotechnical soils report. Cement shall be from a single source for the entire project.

C. Aggregates: Aggregates shall conform to ASTM C 33 and C 227 except as modified herein. Any suitable individual grading of coarse aggregate may be furnished, provided

Grading of Combined Aggregate indicated in following table is obtained. Refer to Section 01420: Testing and Inspection.

D. Water: Water shall be potable and free from deleterious matter.

E. Admixtures: CBC Chapter 19A, Section 1903A.

F. Pedestrian Concrete Expansion Joint: Closed Cell Flexible Foam Expansion Joint 1/4" x 4".

G. Vehicular/Wall Concrete Expansion Joint: FLEXIBLE FOAM EXPANSION JOINT" Closed Cell 1/4" x depth.

H. Backer Rod: Closed cell foam backer rod of the size recommended by the Manufacturer for the joint sealant.

I. Horizontal Flatwork Joint Sealant: Two-part, Type 1 sealant, gun-grade, polyurethane with a Shore 'A' hardness of not less than 40 after 72 hours. Custom sealant colors to match adjacent concrete finishes as approved by the Architect.

J. Vertical Wall Joint Sealant: Three-part, Type 1 sealant, gun-grade, polyurethane with a Shore ‘A’ hardness of not less than 40 after 72 hours. Custom sealant colors to match adjacent concrete finishes as approved by the Architect or Owner’s Representative.

K. Bond breaker tape to be as recommended by sealant manufacturer.

L. Color: To be specified by Architect.

M. Liquid Curing Compounds: A standard brand, clear liquid conforming to ASTM C 309, Master Builders, Grace, Antihydro or equal.

N. Abrasive Aggregate: Norton Alundum, Union Carbide Carborundum, or equal, graded #12 through #30 sizes, color as selected by Architect.

O. Underlayment: Latex underlayment for filling low spots in concrete shall be Tile-Tex by Flintkote Co., Webtex #60 or Fixallatex by Dowman Products Co or equal.

2.03 WOOD FORMS

A. Wood For Concrete Flatwork:
   1. Exposed Concrete Surfaces: Plywood, PSI; B face on contact side, Ext. Grade, Douglas Fir, Class I; not less that 5/8 inch thick. Mill oil or resin coat both surfaces at factory and seal edges; use type that will not stain or leave residue on concrete.
   2. Mill top edges of all wood form work for integral color concrete work to achieve 90 degree radius edges.
   3. Unexposed Concrete Surfaces: Board forms or plywood as specified for exposed concrete surfaces. Board forms; #2 Douglas Fir, sound, good quality, and free from loose knots; not less than 3/4 inch thick.

2.04 FORM OIL

A. Non staining mineral oil type.

2.05 FORM COATING

A. Euclid Chemical Co.'s Eucoslip, W.R. Grace's Formfilm, Noxcrete's Pre-Form, or approved equal.

2.06 SAWCUT BLADES

A. Saw BladeType: 3/16" Width for 3" handsaw.

PART 3 - EXECUTION

3.01 GENERAL

A. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the College's Representative at least 24 hours before placing concrete; do not place concrete until inspected by the College's Representative.

B. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the Architect and DSA.

3.02 PREPARATION

A. Moisture Barrier: Before installation of screeds and slab reinforcement, install a moisture barrier under slabs on grade. Place membrane in as large sheets as possible, lapped 12 inches at sides and ends, with top lap placed in the direction of the spreading of concrete. Extend membrane and lap at least 4 inches onto adjoining wall surfaces and seal with pressure-sensitive tape.
   1. Install moisture barrier on minimum 2-inch bed of sand, unless otherwise indicated, over gravel base as indicated on the Drawings.
   2. Patch punctures and tears in moisture barrier.

B. Anchor Slots: Dove-tail anchor slots at concrete walls to receive masonry veneer shall be set vertically in forms, 24 inches maximum on centers measured horizontally. Anchor slots shall be No. 24 gage galvanized sheet steel with removable fiber filler to prevent seepage of cement in slot.

C. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed , but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

3.03 INSTALLATION

A. Surface Drainage:

1. Provide for positive drainage on all concrete paving surfaces.
2. Report in writing any discrepancies or omissions on drawings and conditions on the site which would prevent proper drainage.
3. No "birdbaths" or other surface irregularities will be permitted. Properly correct irregularities.

B. Securement: Use templates for all anchor plates, bolts, inserts and other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.

C. Electrical Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum as directed by the Structural Engineer. Verify size, length and location of electrical conduit.

D. Conveying and Placing:
1. Concrete shall be placed only under direct observation of the OWNER'S REPRESENTATIVE. Do not place concrete outside of regular working hours, unless the OWNER'S REPRESENTATIVE has been notified at least 48 hours in advance.
2. Concrete mixing shall continue until concrete is completely discharged. Minimum of mixing time shall be 3 minutes at the job site.
3. Under no circumstances shall the Contractor add water to the concrete mix.
4. Concrete shall be conveyed from mixer to location of final placement by methods, which will prevent separation or loss of materials.
5. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete which has been remixed after initial set be placed.
6. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.
7. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
8. Place alternate pours of concrete within 24 hours of one another, preferably the same day, to eliminate color variations due to curing.
9. Concrete shall be thoroughly consolidated during placement, and shall be worked around reinforcement and embedded fixtures with mechanical vibrators.
10. Where conditions make consolidation difficult, or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.

3.04 FORMWORK

A. General:

1. Construct forms accurately to dimensions, plumb and true to line and grade. Use forms that are substantial, mortar tight, braced and tied so as to maintain position and shape during placing of reinforcing and concrete.
2. Wavy surfaces and bulged slab surfaces resulting from settlement or springing of formwork will be rejected.
3. Carefully verify and check all forms for alignment and level as the work proceeds. Promptly make all needed adjustments or additional bracing.
4. Pre-saturation of Subgrade: The Contractor shall pre-saturate the subgrade of all concrete flatwork prior to sand base and concrete placement as required by the Geotechnical Soils Engineer.

3.05 CONSTRUCTION JOINTS

A. Construct and assemble forms in such a manner that joints occur at accepted locations. Thoroughly clean forms before placing concrete.

B. Details: Take extreme care in all details of forming, setting and reinforcing. Except where tooled corners are indicated, provide all exposed concrete finish work with smooth, even surfaces of dense concrete with clean sharp arises and outside corners.

C. Coordination: After forms have been placed and accepted, ensure that all other trades have been properly notified and are given sufficient time to complete installation of their work.

D. Recesses and Openings: Provide as shown on the Drawings or as may be directed at the site.

E. Responsibility: Each trade shall be entirely responsible for proper installation and securing of the work during placing of concrete.

F. Prior to Placing Concrete:
1. Thoroughly clean out all forms to be used.
2. Thoroughly wet wood forms as required where form coatings are not used.

G. Removal of Forms:
1. Do not remove supporting forms or shoring until concrete has sufficient strength to carry its own weight and other loads upon it.
2. Remove forms only after concrete has properly set and without damaging concrete.

H. Compaction and Screeding:
1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.
2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.

I. Floating and Troweling:
   1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.
   2. Exterior Paving and Cement Walks: Finish as specified above, except surface shall be given a non-slip finish to match Sample reviewed by the Architect.
   3. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.

3.06 SAWCUT JOINTS

A. Install sawcut control joints and sawcut expansion joints using acceptable mechanical concrete saw with a new diamond-tipped blade as soon as concrete surface is sufficiently firm not to be torn, damaged by the blade, or cause spalling of the finish. Install sawcut control joints within 48 hours from time of placement.

B. Cut all sawcut joints to a uniform depth and width as called out on the Drawings. All joints shall be clean, smooth, and straight. Use forms or templates as required to achieve a consistent plumb and straight quality. Joints shall end cleanly at edge of slab and shall not extend into adjacent concrete pours.

C. A small radius blade (hand saw) shall be used to extend depth of cut to bring sawcut joints to within ½" of vertical surfaces and connect to perpendicular sawcut joints. Overlapping of sawcut joints into adjacent concrete panels or bands or wavy joint lines are not acceptable and will be rejected. Mis-jointed panels will be rejected.

3.07 Curing:

A. Concrete shall be maintained above 50 degrees F., and in a moist condition for 7 days after placing, except that high early strength concrete shall be maintained in a moist condition for 3 days.

B. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.

C. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.

D. Within 24 hours after finishing, exterior slabs may be cured with clear liquid curing compound immediately installed in accordance with manufacturer's directions. Perform all sawcuts within 24 hours after pouring.

3.08 FINISHING

A. Unless noted on the plans otherwise, portland cement concrete paving shall have a medium salt (medium broom) finish on all surfaces with less than 6% slope and slip resistant (heavy broom finish) on all surfaces with slopes 6% or greater.

B. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.

C. Refer to Drawings for specific finishes.

3.09 EXPANSION AND CONSTRUCTION JOINTS

A. General: Place and finish joins for sidewalks per Section 303-5.4 of the Standard Specifications for Public Works Construction, and as approved by College's representative.

B. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:
   1. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
   2. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.
   3. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.

C. Expansion Joints: Placement: Place joint materials with top edge of 1/4-inch wide foam expansion joint filler approximately 1/2 inch below the paved surface. Securely hold in place with adhesive to prevent movement during second pour.
   1. Forming: Form joints and other edges in the fresh concrete using an edging tool to provide a smooth uniform impression for sawcutting. Strike all edges before and after brooming.

D. Sawcut: Sawcut with 3/16-inch wide sawblades.

E. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

3.10 TESTING

A. Molded Cylinder Tests:
   1. Owner's Consultant will prepare cylinders. Each cylinder shall be dated, given a number, point in structure from which sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.

2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of 3 days, 7 days, and 28 days. A strength test shall be the average of the compressive strength of 2 cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'c.
3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C 31, and tested in accordance with ASTM C 39.

B. Core Test: At request of the Architect, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC and ASTM C 42.
1. Provide 4 inch diameter cores at representative places throughout the structure as designated by the Architect.
2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.
3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.

C. Concrete Consistency: Measure consistency according to ASTM C 143. Test twice each day or partial day's run of the mixer.

D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, fall below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.

E. Filling, Leveling and Patching:
1. Voids: Fill holes with a 1:3 cement and sand mortar with the same color as the adjoining concrete. Mix and place the mortar as dry as possible and finish flush with the adjacent surface..
2. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.
3. Corrective patching: Correct all defects in concrete work. Chip all voids to a depth of at least 1 inch with the edges perpendicular to the surface and parallel to form markings. Fill all voids, surface irregularities, by patching or rubbing. Ensure that all concrete surfaces so repaired duplicate the appearance of the unpatched work.
4. Cleaning: Four weeks after installation, wash the exposed concrete finishes with a mild acid solution to remove any free-lime efflorescence on the concrete surface, pressure wash and/or hand scrub the concrete finishes to thoroughly clean the concrete surfaces prior to preliminary review by the architect.

F. Defective Concrete:
1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the Architect and DSA.
2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to intended

grades and levels, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.

G. Concrete For Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall be 3,000 psi concrete. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4 inch to 1 inch aggregate as specified for concrete mix.

3.11 CLEAN UP

A. Remove rubbish, debris and waste materials immediately and legally dispose of off the Project site.

3.12 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION **32 14 00**

UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. This Section includes the following:

1. Concrete pavers set in aggregate setting bed.

1.2 SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Sample for Unit Paver.

1.3 QUALITY ASSURANCE

A. Mockups: Build 24” X 24” mockups for each form and pattern of unit paver.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.

B. Weather Limitations for Bituminous Setting Bed: Install bituminous setting bed only when ambient temperature is above 40 deg F and when base is dry.

PART 2 – PRODUCTS

2.1 CONCRETE PAVERS

A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936, resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.

2.2 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 2940, base material.

2. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

A. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

B. Drainage Geotextile: Nonwoven needle-punched geotextile made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following:

1. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
2. Permittivity: 0.5 per second, minimum; ASTM D 4491.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

B. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

1. For concrete pavers, a block splitter may be used.

C. Joint Pattern: As indicated on drawings.

D. Tolerances: Do not exceed 1/16-inchunit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

3.2 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 90 percent or as specified in project geotechnical report.

B. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.

C. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.

D. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.

E. Treat leveling course with herbicide to inhibit growth of grass and weeds.

F. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars.

G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lb compaction force at 80 to 90 Hz.

H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

END OF SECTION

SECTION **32 15 10**

DECOMPOSED GRANITE

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish materials, labor, transportation, services, and equipment necessary to install decomposed granite paving as indicated on Drawings and as specified herein.

B. Work included in this Section:

1. Aggregate sub-base preparation.
2. Installation of decomposed granite.
3. Installation of decomposed granite with binder additive.
4. Steel containment edging.

1.2 REFERENCES

A. ASTM C 136 - Method for Sieve Analysis for Fine and Coarse Aggregates.

B. Percent Compaction:

1. Percent compaction or relative compaction is required for in-place dry density of material expressed as a percentage of maximum dry density of same material determined in accordance with ASTM Test Method D 1557-78.
2. Optimum moisture content is moisture content corresponding to maximum dry density determined by ASTM Test Method D 1557-78 (C).

1.3 SUBMITTALS

A. Submit specification data cut sheets for products specified under this Section.

B. Products: One (1) five (5) pound sample with sieve analysis for decomposed granite. See plans for color, and manufacturer.

C. Steel Header: Material, Color, and Manufacturer as specified on plans. One (1) 3 foot length (min.) of steel header, and 2 header stakes for approval prior to installation.

1.4 TESTS

A. Perform gradation of decomposed granite material in accordance with ASTM C 136.

1.5 ENVIRONMENTAL CONDITIONS

A. Do not install decomposed granite paving during wet conditions.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Cover Stabilizer binder with plastic covering to prevent exposure to rainfall, debris, or removal by wind.

1.7 COORDINATION

A. Notify contractor's related to installation of his work in ample time, so as to allow sufficient time for those contractors to perform their portion of work

1.08 QUALITY ASSURANCE

A. Installer: Provide evidence to indicate successful experience in providing decomposed granite paving containing Stabilizer binder additive.

B. Installer shall have a minimum three (3) years experience.

1.09 ENVIRONMENTAL CONDITIONS

C. Do not place decomposed granite paving during, just prior to, or immediately following rainfall or during high winds.

1.10 INSPECTION OF SITE

D. Verify conditions at site that affect Work of this Section and take field measurements as required. Report major discrepancies between Drawings and field dimensions to Owner prior to commencing Work.

1.11 EXCESS MATERIALS

E. Provide Owner's Representative with the following excess materials for use in future repair of decomposed granite paving:

1. Four (4) 50- pound bags of decomposed granite with source location provided.

2. One (1) 50-pound bag of stabilizer binder additive.

PART 2 - PRODUCTS

2.1 DECOMPOSED GRANITE

A. Washed, crushed granite stone, free of clay, vegetable matter, friable materials and other deleterious substances such that it can be compacted readily under water and rolled to form a firm, stable wearing course.

B. Decomposed granite to be graded in accordance with ASTM C 136 within the following limits:

Sieve Size	Percent Passing
3/8 -inch	100
No. 4	95 to 100
No. 8	75 to 100
No. 16	54 to 85
No. 30	25 to 60
No. 50	10 to 32
No. 100	2 to 22

C. Acceptable Suppliers: Gail Materials, (951) 667-6106.

D. Acceptable Model: Per plan.

2.2 STABILIZER BINDER

A. Patented, non-toxic organic binder that is colorless and odorless concentrated powder that binds decomposed granite together to produce a firm surface.

B. Acceptable Manufacturer:

1. Natracil (951) 279-1095; Stabilizer.

2.3 GEOTEXTILE FABRIC

A. Mirafi 700X; Mirafi (800) 864-8905.

2.4 STEEL EDGING

A. Available Manufacturers:

1. Sure-Loc Edging Corporation (800) 787-3562

2. Border Concepts, Inc. (800) 845-3343

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Verify that gradients and elevations of sub-grade are correct. Ensure that a minimum of 1 ½ percent cross slope can be provided.

B. Sub-grade per Geotechnical Report.

C. Verify that soil cement base course will extend to edge of decomposed granite paving and will achieve a positive outfall for trapped water.

D. Remove loose material from compacted sub-base surface immediately before placing decomposed granite.

3.2 PREPARATION OF SUBGRADE

A. Refer to soil engineering data for sub-grade preparation recommendations. Do not commence Work until sub-grade has been approved by the Owner's Representative.

3.3 BLENDING STABILIZER

A. Blending shall be done by the supplier only per manufacturers specifications.

3.4 PLACEMENT OF DECOMPOSED GRANITE

A. Place decomposed granite (unstabilized and stabilized) in two (2) even lifts to a depth indicated on Drawings.

B. Place first lift.

C. Apply water until moisture penetrates entire depth of lift. It is imperative that decomposed granite receive water at this time.

D. After surface water disappears and decomposed granite is still moist, roll to achieve 90 percent compaction.

E. Allow first lift to thoroughly dry before applying second lift of decomposed granite.

F. Place second lift.

G. Apply water until moisture penetrates entire depth of second lift. After surface water disappears and second lift is still moist, roll to achieve 90 percent compaction.

H. Exercise care in compacting decomposed granite when adjacent to planting areas.

I. Allow surface of decomposed granite enough time to dry completely before allowing traffic access.

3.5 REPAIRS AND PROTECTION

A. Remove and replace decomposed granite paving that is damaged, defective, or does not meet requirements of this Section.

B. Protect decomposed granite paving from damage until Final Acceptance.

3.6 CLEANUP

A. Upon completion of Work under this Section, remove rubbish, waste and debris resulting from Contractor's operations. Leave Work area in a neat and clean condition.

END OF SECTION

SECTION 32 16 13

CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide the construction of concrete curbs and combination curb and gutter when not integral with the pavement slab, as shown on the Drawings and as specified, complete.

1.02 RELATED DOCUMENTS

A. Drawings, Specifications and provisions of Construction Contract, including General, Special and Supplementary Conditions and other General Requirements.

1.03 QUALITY ASSURANCE

A. Material Testing: For College-furnished testing, refer to Division 01 for Quality Control requirements.

B. Test Reports: College's testing agency will report all results of the tests to College's Representative who will approve or disapprove Contractor's work.

1.04 SUBMITTALS

A. Refer to Division 01 for procedures.

B. Miscellaneous Materials: Furnish mill tests or manufacturer's certification of compliance with the specifications for materials when requested by College's Representative. Use no membrane curing compounds until they have been approved by College's Representative.

C. Types of forms for approval.

D. Proposed curing compound.

E. Sustainable Design

F. Submittals: Provide the following information by filling out the Special Environmental Requirements Product Submittal Form located in Appendix A of Section 01 35 43 Special Environmental Requirements, together with required supporting documentation
   1. Recycled Materials
   2. Regional Materials

1.05 JOB CONDITIONS

A. Placing Temperature:

1. Warm Weather. Concrete placement will be subject to approval by College's Representative when weather conditions or limitations of facilities reported by Contractor would prevent correct finishing and curing of the concrete in accordance with the requirements of these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete is specified in Standard Specifications for Public Works Construction (SSPWC), most current edition.

B. Expansion Joint Filler: Preformed nonextruding bituminous-treated fiberboard conforming to ASTM D 1751.

C. Joint Sealer: Hot poured type consisting of a resilient and adhesive plastic. The material shall be in accordance with ASTM D 1190.

D. Curing Materials:
1. Burlap. Conform to AASHTO M-182. Burlap shall be free from holes, dirt, clay or any other substance that would have a deleterious effect on concrete. Burlap shall absorb water readily when dipped or sprayed and shall weigh not less than 7 ounces per square yard when clean and dry.
2. Waterproof Paper. Conform to ASTM C 171.
3. Membrane curing compound shall be water soluble emulsion type linseed oil base compound and conform to the requirements for Type 2 compound as specified in ASTM C 309, except that requirements for the sag test and the drying time shall not apply.

E. Forms:
1. Forms shall be of wood or steel, straight, and shall be fastened to prevent springing during depositing and consolidating the concrete.
2. The outside forms shall have a height equal to the full depth of the curb.
3. The width of outside forms for gutters shall equal the full thickness of the gutter.
4. For straight runs, forms of wood shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits, or other defects. Wood forms shall have a nominal length of 10 feet, staked to prevent distortion of the form.
5. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two (2) intermediate points. Form ends shall be interlocked and self-aligning.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Concrete:
1. General. Use metal forms unless otherwise specifically authorized by College's Representative, except that on curves having a radius of 150 feet or less, wood forms may be used. All forms shall be approved by College's Representative.

a. Form Setting. The subgrade under the forms shall be compact and cut true to grade, so that the forms will be firmly in contact with it for their entire length. Join each form section tightly by locked joints, free from play or movement in any direction. Check conformity to the alignment and grade elevation shown on the Drawings and make necessary corrections prior to placing the concrete.
b. Coating. Oil forms each time they are used.
c. Removal. Keep forms in place at least 12 hours after concrete has been placed against them or for a longer period if requested by College's Representative. Do not use crowbars or other heavy tools against green concrete in removing the forms. Clean forms completely before reoiling and reuse.

2. Finishing. Test the subgrade for elevation and density in advance of placing concrete. Correct any discrepancies in accordance with the requirements for subgrade preparation.
   a. Tamp and space the concrete so as to produce a dense concrete in which the mortar has been worked to the surface. Strike off the concrete to the required cross section and smooth the upper face of the gutter slab and the front face and top of the curb with a wood float. Use an edging tool on all exposed corners. When completed, the surface of the curb and gutter shall be straight and true, and shall conform to the shape and dimensions shown on the Drawings and shall have a first-class float finish of sandy or gritty texture as shown.
3. Joints.
   a. General. Provide contraction and expansion joints in all curb and gutters. Place and finish joints per Section 303-5.4 of the Standard Specifications for Public Works Construction and as approved by College's Representative. All joints shall be perpendicular to the finished grade.
   b. Contraction Joint. Place contraction joints so that monolothic sections shall be in 8 foot sections. Separate each section by a 1/8 inch thick steel template. Remove templates as soon as practicable after the concrete has been struck off, and set to preserve the shape of the joint.
   c. Expansion Joint. Form expansion joints by a preformed filler material cut and shaped to the cross section of the curb and gutter. Provide expansion joints at the ends of all return radii. Expansion joints shall be provided 1/2 inch in width at intervals not exceeding 48 feet.
   d. Sealing. Fill the joints with sealing material, specified in Paragraph 2.1 C above, as shown on the Drawings and as approved by College's Representative. Joints shall be cleaned, dried and poured as soon after the end of the curing period as weather conditions permit. Perform the work in a neat workmanlike manner without spilling and remove all excess material. For joints butting sidewalks at back of curb, see Section 321313, SITEWORK CONCRETE.
4. Patching. After removal of forms, fill all damaged and honeycombed areas with mortar, one part cement to two parts sand. No patching is allowed on the surface.
5. Curing.
   a. General. Cover and protect all concrete from moisture evaporation, rapid temperature change and from rain, flowing water, and mechanical injury during a period of at least 72 hours immediately following the finishing. The use of a covering material which contains, or becomes contaminated with

sugar in any form, tannic acid, or any other substance considered detrimental to portland cement, will not be permitted. The initial curing medium shall be applied so as to prevent checking, cracking, and the appearance of dry spots in the surface of the concrete. Protect the sides of concrete slabs exposed by the removal of forms immediately to provide continuance of curing and prevent injury of the curb and gutter edges and the underlying subgrade. When it is expected during the progress of the work, and before all concrete has attained final set, that the temperature may fall below 35ºF, supply straw, hay or other material approved by College's Representative to cover the concrete and to protect its surface and edges against freezing until it is at least ten (10) days old.

b. Mat Curing. Mats of burlap, cotton, or other fibrous material having similar water absorptive properties shall be wet when applied and kept continuously wet and in intimate contact with the covered surface, for the duration of the curing period. Mats shall be uniform in thickness, shall weigh not less than 20 ounces per square yard when dry, and shall be capable of absorbing at least one and one-half times their weight of water. If burlap is used, it shall be used in two or more, not single, layers. All mats shall be approved by College's Representative.

c. Membrane Curing Compound. No compound shall be used until it has been approved by College's Representative.

1) Application. Agitate curing compounds continuously during use, and spray uniformly, in a single coat, by spraying equipment, on all concrete surfaces, at a rate recommended by the manufacturer and based on moisture retention tests. Application will be made immediately following the final finishing operation.

2) Protection of Treated Surfaces. Keep concrete surfaces to which membrane compounds have been applied free from all foot and vehicular traffic and all other sources of abrasion for a minimum period of 14 days.

3) Protection. Protect the curb and gutter against all damage prior to final acceptance of the work. Exclude the traffic from the pavement by erecting and maintaining barricades and signs until the concrete is at least fourteen (14) days old, or for a longer period if requested by College's Representative.

3.02 FIELD QUALITY CONTROL

A. Workmanship: Construct all curbs at the location and to the lines and levels shown on the Drawings.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes Chain link fencing and gates as indicated.

B. Related Sections:
1. Section 31 23 33: Trenching, Backfilling, and Compaction
2. Section 32 13 13: Sitework Concrete

1.02 REFERENCE STANDARDS

A. Placeholder

1.03 SUBMITTALS

A. Shop Drawings: Submit plans and details indicating extent of fences, locations of gates, and details of attachment and footings. Indicate means and methods for surface preparation and finishing.

1.04 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.01 MATERIALS

Concrete: Class 500-C-2500 concrete furnished as prescribed in Section 201-1 "Concrete, Mortar and Related Materials" of the Standard Specifications for Public Works Construction or may be provided in the following volumetric proportions:

1.	Portland Cement	1 part
2.	Fine Aggregate	2 parts
3.	Coarse Aggregate (1/4” to 1-1/2”)	4 parts
4.	Water	7 ½ gallons max. per sack of cement

B. Chain Link Fence Fabric, Posts, Rails, and Gates: Standard galvanized.

C. Chain Link Fence Fabric: Conforming to ASTM A 392, Class C2 zinc coating, 2.00 ounces minimum per square foot of vinyl-coated wire surface, hot-dipped galvanized after weaving, and top and bottom edges knuckled.
1. Fabric for perimeter fencing and interior fencing shall be 9 gauge woven wire; with one (1) inch mesh, unless otherwise specified.

2. Installed fence fabric shall be free from barbs or other projections. Installed fence fabric with such defects will be deemed defective Work

D. Posts, Top Rails, Brace Rails and Gate Frames: Standard weight, galvanized, welded or seamless steel pipe conforming to ASTM A 53, with a minimum yield strength of 35,000 psi. Embed posts into footing 6 inches less than the depth of the footing unless noted otherwise on drawings.

E. Schedule of Posts and Footings:

Item	Height	Nominal Pipe Size (inches)	Outside Diameter (inches)	Weight (pounds per foot)	Footings*	
					Diameter(inches)	Depth (inches)
Top Rail, Brace Rails and Transom Rails	Up to 10'-0"	1-1/4	2.375	2.27	N/A	N/A
Line Posts	Up to 6'-0"	2	4.00	2.65	See Details	See Details
Terminal, Corner, Angle & Pull Posts	Up to 8'-0"	2-1/2	4.00	5.79	12	36
Pedestrian Gate Posts	Up to 8'-0"	2-1/2	6.625	5.79	See Details	
Gate Frames	Up to 8'-0"	1-1/2	8.625	2.72	N/A	N/A

F. Post Caps: Malleable iron, ASTM A 47, Grade 32510, designed to fit snugly over posts with a minimum projection of 1-1/2-inches below top of posts. Post caps shall be manufactured with a curved top.

G. Eye Tops: Malleable iron, ASTM A 47, Grade 32510, designed to fit over line posts, and for through passage of top rail.

H. Expansion Sleeve Couplings for Top Rails: Steel, six (6) inches long, designed to fit tightly on inside of rail, fitted with raised center.

I. Rail Ends for Top Rails and Brace Rails: Malleable iron, ASTM A 47, Grade 32510, with holes to receive 3/8-inch bolts for securing to rail end bands.

J. Tension Bands and Bands for Securing Rail Ends: Mild steel flats, at least 11 gage x one (1) inch, tension bands in gates shall be 11 gage x one (1) inch. Bolts for use with tension bands and rail end bands shall be 3/8-inch x 1-1/2-inches.

K. Tension Bars: Mild steel flats at least 3/16-inch x ¾-inch.

L. Tension Wire for Installation at Bottom of Fabric: 6 gauge steel spring wire, conforming to requirements of AISI Steel Products Manual, Carbon Steel Wire, Section 16, merchant quality, galvanized, soft temper with Type I coating. Wavy type wire is not acceptable.

M. Turnbuckles for installation with Tension Wires: Eye and hook type, drop forged steel, right and left hand threads, at least 3/8-inch screw diameter with at least 4-1/2-inches of take-up.

N. Tie Wire: Aluminum ties 6 gauge for fastening fabric to posts, top rails and brace rails. At bottom tension wire 9 gauge galvanized hog rings shall be installed.

O. Finish of Metal Parts: Post caps, couplings, rail ends, tension bands, tension bars, turnbuckles, rivets, bolts, and other metal parts and fittings shall be hot-dipped galvanized after fabrication, except bolts, which may be galvanized or cadmium-plated. Galvanizing shall conform to ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, and ASTM A 47 Standard Specification for Ferritic Malleable Iron Castings.

PART 3 - EXECUTION

3.01 SWING GATES

A. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC 11B-404.

B. Gate Frames: 1 ½ inch diameter steel pipe, welded corners, hot dip galvanized after fabrication.

C. Sizes: As indicated on drawings, minimum width of gates shall not be less than 36” (clearance of opening width shall not be less than 32 inches).

D. Hardware: Heavy-duty, galvanized ferrous metal industrial quality as manufactured by Master-Halco/Anchor Fence Inc., Baltimore, MD. Von Duprin, Adams Rite, Sargent, Trimco or equal as approved and in accordance with Division 01, General Requirements for substitutions.

E. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees as indicated on drawings
   1. Latch: Fork type latch capable of retaining gate in closed position, except gates with exit devices (panic hardware); Master-Halco, Series 16000 or approved equal.
   2. Locking: Provide padlock capability on non-pedestrian gates only. Do not install padlock capability on Exit Gates, gates on Path of Travel with Exit Devices and other pedestrian gates.

3.02 INSTALLATION

A. Install fences to heights indicated on Drawings.

B. Space fence posts at equal intervals between terminal, angle, corner, and gate posts, and not more than eight (8) feet apart measured from center to center of posts. Install posts so that top of eye of post caps are level with top of fabric.

C. Install angle or corner posts at each change in direction of 15 degrees or more, at change of five (5) percent or more in grade of fencing, and at the beginning and end of curved fence sections.

D. Install posts at ends of runs of fencing. Install gateposts on both sides of driveway and pedestrian gates. For double-leaf gates, net opening between gate posts shall be gate size as indicated on Drawings, plus 3-1/2-inches; for single leaf gates, net opening shall be gate size plus 2-1/2-inches

E. Where a fence is to be installed on a curb, construct footings with top of footing level with the lower finish grade. Align posts, set plumb and true before placing footings. Remove splattered concrete from exposed pipe surfaces while concrete is still soft. In bituminous surfaced areas, install seal coat on top of concrete footings.

F. Install fences with top rail. Top rail shall pass through eye tops and be secured at ends with rail-end fittings and bands.

G. Provide a transom rail and fabric at top of pedestrian gate openings. Install transom rail six (6) feet – eight (8) inches above high point of grade at gate opening. Ends of transom rails shall be pinned or riveted to rail end fittings with ¼-inch mild steel rivets. Pin or rivet must go through rail and peen. Welding on rail ends is not permitted.

H. Install bottom tension wire a minimum of three (3) inches from grade for fencing and provide a turnbuckle for each 150 feet of wire or fractional part thereof. Turnbuckles are not required in runs of 15 feet or less. Install ends of tension wires to posts in a manner to prevent slipping or loss of tension. Wrap should start from fence side of post. Turn end of wire around post tightly twisted at least three (3) times around wire. At turnbuckles, wire through eye and tightly twist end at least three (3) times around wire. Cut tail of bottom wire flush.

I. Install fence fabric on outward facing side of posts. Install fence fabric with top edge projecting above top rail of fence.

J. Install bottom of fence fabric to clear finish grades, except on bituminous surface install 3/4-inch above such surface. Locally shape and trench ground surfaces where necessary to provide uniform top and bottom alignment of fence.

K. Tightly stretch fabric and at terminal, pull corner, angle, and gateposts, secure with tension bars extending full height of fence. Secure tension bars to posts with bolted tension bands spaced not more than 14-inches apart

L. Bands and Ties: Install bands and ties in accordance with following schedule:

1. 15 bands on 16 feet fence	16 ties on 16 feet fence
1. 11 bands on 12 feet fence	12 ties on 12 feet fence
2. 7 bands on 8 feet fence	7 ties on 8 feet fence
3. 6 bands on 6 feet fence	6 ties on 6 feet fence
4. 4 bands on 4 feet fence	4 ties on 4 feet fence

M. Fasten fabric to line posts with wire ties spaced not more than 16-inches apart. Where 6 gauge aluminum ties are furnished, hook the tie at both ends. Installation of hooked ties with links is not permitted.

N. Fasten fabric to top rails, mid-rails, brace rails, with wire ties spaced not more than 18 inches apart. Bend back ends of tie wires so as not to be a hazard. At bottom tension wire, install hog rings spaced not more than 18-inches apart. Where two (2) fabrics are furnished, lap the fabrics one mesh at mid-rail and tie both fabrics with 9 gauge wire or 6 gauge aluminum ties to mid-rails.

O. Grind all field welds smooth, clean off flux and spatter, damaged galvanizing removed, burrs and projections ground off, properly prepared, then heavily coated with “Rust Bullet” as manufactured by Poliflex USA or equal product approved by Owner’s Office of Environmental Health and Safety. Install coating in accordance with written recommendations of manufacturer.

P. Fabrication of Gates:
   1. Frames: Fabricate gate frames from steel pipe of size specified, with joints at corners miter cut and continuously welded to sides.
   2. Fabric: Install fence fabric to side members with tension bars and tension bands as specified, spaced not more than 14-inches apart. Tension bars shall extend full height of gate. Install fence fabric to top and bottom members and to brace rail with wire ties as specified for top rails, spaced not more than 12-inches apart.
   3. Latches: Gate latches and strikes will be furnished by the Owner. Weld gate latches and strikes to gate posts and frames. Welding shall be performed before gate frames are galvanized, or welds shall be finished as specified for field welds.
   4. Hinges: Install and adjust hinges; burr or center punch threads of gate hinge bolts to prevent removal of nuts. Install three (3) hinges on each post for swing gates more than 16-feet wide. Hinges will be provided by the Owner.
   5. Grind welds flush and smooth. Hot-dip galvanized fabricated parts after welding, or finish weld as specified for field welds

Q. Fencing Adjustments:
   1. Where the finish grade is raised six (6) inches, or less, cut and re-knuckle the existing fence fabric. Adjust tension wire and tie to fabric. Bottom of fence fabric shall be installed ¾-inch above finish grade.
   2. Where the finished pavement is lowered; six (6) inches or less, demolish the fence footing flush with the finish grade and adjust the fabric and its attachments. Bottom of fence fabric shall be installed ¾-inch above finish grade.
   3. Post footings and fabrics that require readjustment after installation shall be entirely replaced.

R. Provide gates of the sizes indicated on Drawings. Allow clearance on gates of 1-1/2 inches at bottom and one (1) inch at top. Construct gates installed in sloping areas to conform to the grade. Provide an opening in each gate for access to locking device or padlock. Knuckle ends of fabric cut for opening to eliminate hazards.

S. Sliding Gates and Swing Barricade Gates: Fabricate and install as indicated on Drawings. Wheel housing must be designed to fit tightly to roll track and prevent gate from rolling over objects. Unsupported cantilever type roll gates are not acceptable. Install gate stops in accordance with the drawings. Both top and track stops are required.

3.03 FIELD QUALITY CONTROL

A. Completed fencing shall form continuous units between points indicated with required parts, accessories, and fittings provided and installed. Clean all exposed metal surfaces of cement, grout and other foreign substances.

B. Fill in holes left by removal of existing fence footings, except in areas where grading Work is indicated or specified, to existing grade with clean earth thoroughly compacted to at least same density as adjoining soil.

3.04 CLEANING

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.05 PROTECTION OF FINISHED WORK

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION **32 31 19**

DECORATIVE METAL FENCES AND HANDRAILS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Exterior Handrails – Material and Finish as specified on plans.

B. Related Work

1. Exterior Painting.
2. Welding

1.2 REFERENCES

A. Applicable Standards: Apply the current or latest editions of the standards described below:

1. “AWS” – “Code for Arc and Gas Welding in Building Construction” of American Welding Society, AWS D1.0
2. "AA" - Aluminum Association
3. "ASTM" - American Society for Testing and Materials
4. "UBC" - Uniform Building Code

B. Field Measurement: Make all field measurements as required prior to fabrication and installation.

C. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordination installation.

1.3 SUBMITTALS

A. Samples: Submit prior to delivery to site. Attach product name, address of manufacturer and/or supplier to each sample.

B. Product Data: Manufacturers' current catalog cuts, data sheets, and installation instructions.

1. Handrail: One (1), 24 inches long sample that includes end terminus or return. Material and finish per plan.

C. Test Report:

1. One (1) copy to be sent by testing laboratory directly to Owner's Representative.

D. Shop Drawings

1. Verification: Verify all measurements at the job. Show dimensions, sizes, thicknesses, gauges, finishes, joining, attachments, and relationship of work to adjoining construction. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
2. Coordination: Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and direction necessary to permit other trades to properly locate their work.
3. Welded Connectors, Concrete, or Masonry Inserts: Where required to receive work, show exact locations and furnish all such Drawings to the trades responsible for installing the connectors or inserts.
4. Catalogue Work Sheets: Show illustrated cuts of item to be furnished, scaled details and dimensions.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver fabricated units and components completely identified per shop drawings. Protect surfaces from damage during shipping. Inspect work for damage upon delivery to site. No materials with defects or scratches on exposed finishes will be accepted.

B. Protection: Protect work at site from damage and from weather until installed and all work has been accepted.

C. Replacement: Replace all damaged work at no cost to Owner.

1.5 JOB CONDITIONS

A. Perform General: Examine the conditions in which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

1.6 COORDINATION

A. Templates and Built-ins: Furnish all anchors, fastenings, sleeves, setting templates and layouts affecting or installed in the work of other trades.

B. Delivery: Where items must be incorporated or built into adjacent work, deliver to trade responsible for such work in sufficient time that progress of work is not delayed. Be responsible for proper location of such items.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS AND ACCESSORIES

A. Steel Tubing: ASTM A500, cold-formed, Grade A or B, welded or seamless. All drawing dimensions are to outside edges.

B. Steel Plate: ASTM A36.

C. Fastenings: All bolts, nuts, screws, clips, washers, and any other fastenings necessary for proper erection of items specified herein.

1. Ferrous Metal: Metalized.
2. Other Metals: Zinc-coated or cadmium-plated for exterior use.
3. All bolts to be grade 5 or better and coated / plated or a non-rusting material.

D. Concrete Inserts: ASTM A47 malleable iron or ASTM A27 cast steel threaded or wedge type, galvanized ferrous castings. Provide ASTM A153 hot-dipped galvanized bolts, washers and shims as required.

E. Welding Electrodes: AWS Code D1.0

2.2 SPECIALLY FABRICATED PRODUCTS

A. Ferrous Members:

1. Bar Members: Mild steel with all connections welded.
2. Pipe Members: I.P.S. unless otherwise noted. Fabricate in largest sections practicable. Weld all shop joints. Conceal all field joints with sleeves and pins.

2.3 FINISHES

A. Metalizing: All metalwork shall be metalized per all applicable ASTM standards.

B. Primer: None

C. Paints: None

D. Finish all brackets, tabs, screws, bolts, latches, hinges, etc, with two (2) coats of zinc oxide primer and two (2) coats of a rust inhibitor, finish color to match metalwork.

PART 3 - EXECUTION

3.1 CONDITION OF SURFACE

A. Verify that gradients and elevations of sub-grade are correct. Ensure that a minimum of 1 ½ percent cross slope can be provided.

3.2 FABRICATION

A. General: Fabricate all items in the shop and erected in the field by workmen specifically skilled in such work. Provide all surfaces free of file marks, dents; hammer marks (except for required textures), wire edges or any unsightly surface defects.

3.3 WORKMANSHIP

A. Layout: Set all work plumb, true, rigid, and neatly trimmed out. Miter corners and angles of exposed moldings and frames unless otherwise noted.

B. Fitting: Fit exposed connections accurately together to form tight hairline joints.

3.4 ATTACHMENTS

A. General: Do all cutting, shearing, drilling, punching, threading, tapping, etc., that is required for site metalwork or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces.

3.5 FASTENERS

A. General: Provide all lugs, clips, anchors, and miscellaneous fastenings necessary for the complete assembly and installation. Conceal all fastenings where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.

3.6 OTHER CONNECTORS

A. General: Make all permanent connections in ferrous metal surfaces using welds where at all possible. Do not use bolts or screws where they can be avoided.

3.7 WELDING

A. Standards:

1. AWS Code D1.0. (ASTM A36 for structural steel.)
2. Welding only by operators experienced in the type of work indicated.

B. Preparation: Remove all rust, paint, scale and other foreign matter. Wire brush all flame-cut edges. Clamp members as required and alternate welds, all as necessary to prevent warping or misalignment.

C. Exposed Welds: Uniformly make and ground smooth all welds normally exposed to view in the finished work.

D. Galvanized Units: Do not weld after fabrication.

E. Faulty and Defective Welding: Chip out and replace all welding showing cracks, slag inclusion, lack of fusion, bad undercut or other defects ascertained by visual or other means of inspection. Replace and re-weld at no cost to Owner.

F. Field Welding:

1. Procedure: Comply with AWS code of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
2. Protection: Protect all adjacent surfaces from damage due to weld sparks, spatter, or tramp metal.

3.8 BOLTED, SCREWED, AND RIVETED CONNECTIONS

A. Bolts: Use bolts for field connections only and as detailed on Drawings. Provide washers under all heads and nuts bearing on (wood). Draw all nuts tight and nick threads of permanent connections to prevent loosening. Use beveled washers where bearing is on sloped surfaces.

B. Screws: For permanent connections (in ferrous metal), use flat head type, countersunk, with screw slots filled and finished smooth and flush.

C. Rivets: Machine drive tight, all rivets, with heads centered, countersunk, and finished flush and smooth.

3.9 SURFACE TREATMENT AND PROTECTIVE COATINGS

A. Cleaning:

1. Thoroughly clean all mill scale, rust, dirt, grease and other foreign matter from ferrous metal prior to any galvanizing, (hot phosphate treatment) or painting.
2. Conditions which are too severe to be removed by hand cleaning methods, shall be cleaned per SSPC "Surface Preparation Specifications", "Solvent Cleaning, SSPC SP-1"; "Power Tool Cleaning, SSPC-SP"; or "Brush-Off Blast Cleaning, SSPC-SP", as required.

B. Exterior Ferrous Metal:

1. Grind smooth all welds, burrs, and rough surfaces. Clean and hot-phosphate treat completed assembly. Hot phosphate treatment not required on items which are

not exposed in the finish work or on those items where size prohibits such treatment.

2. Indicate on shop drawings where treatment is proposed to be omitted, if any.

3.10 TOUCH-UP AND PROTECTION

A. Touch-up: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas with same material to same dry-film thickness as used for shop painting.

B. Protection: Protect the work from all damage or discoloration until acceptance of work.

3.11 CLEAN-UP

A. General: Keep all areas of work clean, neat and orderly at all times. Keep paved areas clean during installation. Clean up and remove all debris from the entire work prior to Final Acceptance to satisfaction of Owner.

END OF SECTION

SECTION **32 33 00**

SITE FURNISHING

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Work Included: Provide and install including but not limited to

1. Bicycle Racks

1.2 QUALITY ASSURANCE

A. Product Data: Submit manufacturer's current literature for the following items:

1. Color, finish, texture, and size for each type of furnishing.
2. Installation instructions and recommendations for general maintenance.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Labeling: Furnish all materials in manufacturer's unopened, original containers bearing original labels showing quantity, description and name of manufacturer.

B. Delivery: Deliver and unload at the site on pallets and bound in such a manner that no damage occurs to the product.

C. Storage: Store products in a manner which will preclude all damages. Damaged materials will be rejected. Remove all damaged materials from the job site immediately and replace at no cost to Owner.

D. Handling: Furnish suitable equipment to locate all site furnishing materials carefully and efficiently. Lift materials using lifting inserts provided by manufacturer where applicable.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Refer to plans for manufacturer, model, color, finish and quantity.

B. BIKE RACK

1. Model: Olympia
2. Material: Cast Aluminum with Powdercoat Finish.
3. Mounting: Surface Mount with Embedded Anchors.
4. Manufacturer: Forms+Surfaces (800-451-0410) or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Do not install site and street furnishings prior to acceptance by Owner of area to receive such materials. Install per manufacturer recommendations and as shown on the drawings.

3.2 CLEAN-UP

A. Keep all areas of work clean, neat and orderly at all times.

B. Clean up and remove all debris from the entire work area to satisfaction of Owner prior to Final Acceptance

END OF SECTION

SECTION **32 84 00**

IRRIGATION

PART 1 - GENERAL

A. Materials, equipment and services required to install complete automatic landscape irrigation system as indicated on Drawings.

B. Irrigation components and design shall comply with current Chaffey College Campus Design Standards.

1.2 REFERENCE

A. ASTM A 126 - Gray Iron Castings For valves, Flanges and Fittings

B. ASTM A 536 – Ductile Iron Castings

C. ASTM B 42 – Seamless Copper Pipe

D. ASTM D 1784 - Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

E. ASTM D 1785 - PVC Plastic Pipe, Schedules 40, 80, and Class 200

F. ASTM D 2464 - Threaded Poly PVC Plastic Pipe Fittings, Schedule 80

G. ASTM D 2466 - PVC Plastic Pipe Fittings, Schedule 40

H. ASTM D 2564 - Solvent Cements for PVC Plastic Piping Systems

I. ASTM F 437 - Threaded CPVC Plastic Pipe Fittings, Schedule 80

J. ASTM F 438 - Socket-Type CPVC Plastic Pipe Fittings, Schedule 40

K. ASTM F 441 - CPVC Plastic Pipe, Schedules 40 and 80 and Class 200

L. ASTM F 477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe

M. ASTM F 493 - Solvent Cements for CPVC Plastic Pipe and Fittings

N. NEMA 250 - Enclosures for Electrical Equipment

O. NEMA 250 - Enclosures for Electrical Equipment

1.3 SUBMITTALS

A. In accord with Section 01330 - Administrative Requirements for Submittal Procedures.

B. List of Materials:

1. Submit a complete list of materials prior to commencing work. List of materials shall include the name of manufacturer, model number, and description of each item in-tended for use in the installation.
2. Although manufacturer and other information may differ, the following is a guide to the proper format for submittal:

Item	Description	Manufacturer	Model No.
1)	Rotor Type Popup Sprinkler	Rain Bird	T-Bird Series
2)	Field Satellite	Rain Bird	ESP Series
3)	Manual Gate Valve	Nibco	T-113
4)	Etc.	Etc.	Etc.

3. Irrigation submittal shall be specific and complete. All items shall be listed, including solvent, primer, wire, wire connectors, valve boxes, and other items needed to complete work.
4. Equipment or materials furnished without the prior approval of Owner may be rejected and required to be removed at Contractor's expense.
5. Approval of any item, alternative, or substitute indicates only that the product or products meet the requirements of Drawings and Specifications based on information submitted.
6. Submit operating and maintenance data of equipment.

C. Project Record Documents: Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Provide and keep up to date a complete red-lined record set of drawings (blueline Ozalid type prints) which shall be corrected daily. Prints for this purpose may be obtained from Owner at cost. Document every change from the original Drawings and the exact installed locations, sizes, and types of equipment.
2. Red-lined drawings shall be kept on job site and shall be used only as a record set. The record drawings shall always be available for review by Owner. Submit copies of the red-lined record drawings to Owner for review each month.
3. Red-lined drawings shall serve as record for the progress of work completed and shall be used by the Owner as a basis for measurement and payment. Should record drawings not be available for review or not be up to date at the time of review, it will be assumed no work has been completed.
4. Two weeks prior to date of substantial Completion for work under this Section, transfer all information from the redlined record set of drawings to AutoCAD electronic files. Prepare drawings in accord with Owner's AutoCAD standards. An electronic file of base drawing will be provided by Owner. Provide drawing plot for Owner's review and approval.
5. As-built locations shall be dimensioned from two permanent points of reference, such as building corners, curbs, hardscape edges, roadways, or similar elements. Offsets should be taken at 90-degree angles from reference points whenever possible.

   a. Provide the location of the following items:
      1) Pressure main line routing. Include all changes in direction
      2) Point of connection to the existing water supply lines

3) Remote control valves
4) Quick coupling valves and washdown valves
5) Gate valves (manual and automatic)
6) Communication and flow sensor cable routing
7) Flow sensors
8) Point of connection to electrical power service
9) Diagrammatic routing of irrigation control wire
10) Controller location
11) Irrigation electrical pull box locations
12) Other related equipment, as directed by Owner

b. Indicate elevations for all components where site conditions require installation deeper than 36 inches.

D. Controller Charts:

1. Submit As-built drawings for review and approval by Owner prior to preparation of controller charts.
2. Provide one controller chart for each field satellite supplied.
3. Controller charts shall be prepared in AutoCAD. Provide hard copy plots of controller charts and AutoCAD electronic files on flash drive. Provide preliminary plot for Owner approval prior to final submittal.
4. The controller chart shall indicate the area controlled by each respective controller and shall be plotted at a scale and size approved by Owner. Chart shall depict each controller station and area of coverage in separate background colors.
5. The controller charts shall be completed and approved prior to the final acceptance of system.

1.4 CONSTRUCTION DRAWINGS

A. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of their work and plan their work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.

B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Landscape Architect shall have final authority for clarification.

C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect as soon as detected. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revision necessary.

1.5 PROJECT CONDITIONS

A. Coordinate with other trades for underground improvements, location and planting of specimen trees, and other planting as applicable. Verify location of all planting requiring excavations 24 inches in diameter and larger with Owner prior to layout of main lines.

B. Provide temporary irrigation at all times to properly maintain plant materials.

C. Existing Irrigation Systems:

1. The existing computer control system shall be maintained in uninterrupted operation for the duration of the work.
2. All existing irrigation valves and irrigation systems adjacent to the work shall be protected in-place and maintained in operation. Any required disconnection or interruption in existing irrigation shall be coordinated with the Owner in advance of work.

1.6 PRE-INSTALLATION CONFERENCE

A. At least two (2) weeks prior to the commencement of work, Contractor shall arrange a pre-installation conference with the Owner. This meeting shall include all parties responsible for installation, scheduling and testing of the finish work under this section.

B. Review methods and procedures related to the work of this Section, including, but not necessarily limited to the following:

1. Products and system requirements
2. Review of required submittals
3. Review of required details
4. Schedule and sequencing of work
5. Coordination with other trades and existing site conditions
6. Forecasted weather and procedures for coping with unfavorable conditions
7. Required inspections, reviews and procedures for approvals

C. Contractor shall document in writing the conference including all decisions, directions and agreements reached. Furnish copies of record to all parties in attendance.

1.7 COORDINATION

A. Contractor shall give other contractors advance notice to allow them sufficient time to perform their portion of work.

1.8 QUALITY ASSURANCE

A. Coordinate work of this Section with other underground utilities and trades responsible for their installation.

B. Product Handling in accord with Section 01660 – Product Storage and Handling Requirements

C. Worker Qualifications:

1. On-site field superintendent shall have not less than 5 yrs. of continuous experience in the installation of commercial computer-controlled irrigation systems.
2. Documented completion of central control system manufacturer's 'Installation Certification Program for Computer Controlled Irrigation Systems.'
3. Documentation of 5 successfully completed commercial computer-controlled irrigation system installations. Provide project name, location, address, and telephone number of contact person for information regarding the completed work.

D. Tests and Inspections:

1. Do not conceal any work until all required tests and inspections have been completed.
2. Conduct the following tests, inspections and conference with Owner. Provide advanced notification of each according to the times indicated:
   a. Pre-installation conference: 7 days
   b. System layout: 24 hours
   c. Hydrostatic testing of pressure main line and non-pressure lateral lines installed under paving: 24 hours
   d. Coverage tests: 24 hours
   e. Final inspections: 48 hours
3. During final inspection, provide two-way radios and sufficient personnel to provide constant communication between inspection areas and the controller.
4. Hydrostatic Tests:
   a. Furnish force pump and all equipment required to perform hydrostatic testing.
   b. Center load backfill over pipes, leaving all joints exposed until the installation has been inspected, tested, and approved by Owner.
   c. Except for ball valves installed upstream of control valves, all testing shall be completed prior to the installation of all other valves and valve assemblies.
   d. Perform hydrostatic tests in presence of Owner. Maintain 150 psi pressure in the lines for a period of not less than 4 hours. If leaks develop, remake joints and repeat tests until the entire system has proven watertight.
5. Coverage Test:
   a. Upon completion of the sprinkler system and prior to planting of shrubs, ground cover or turf, perform a coverage test in presence of Owner to determine that irrigation coverage for all planting areas is complete and adequate.
   b. Furnish materials and perform work required to correct any inadequacies of coverage. Reschedule and perform additional coverage test with Owner for approval.

E. Final Acceptance

1. Prior to final approval of work, all of the following requirements shall be met:
   a. Landscape irrigation system completed and approved by Owner.
   b. Coverage tests completed and approved by Owner.

c. Punch list items completed and approved by Owner.
d. As-built drawings completed and approved by Owner.

2. Maintain irrigation system and sufficient watering schedule until all conditions of approval have been completed.
3. Contracted irrigation maintenance period shall begin upon Owner's final acceptance.

1.9 ADDITIONAL MATERIALS

A. Furnish the following extra system components prior to Final Approval:

1. Six sprinkler bodies of each type used on project.
2. Six sprinkler nozzles of each type used on project.
3. Six pressure compensating nozzle screens of each type used on project.
4. Two wrenches for each type rotor type sprinkler head installed on project.
5. Two valve box keys.
6. One valve key for manual valves.
7. Two quick coupler key assemblies, for every (5) washdown valves installed (or fraction there-of). Key assembly shall include; one Buckner QB7DK15 key, one Nibco T-580 1 in. ball valve, one 1 in. x 2 in. brass nipple, and one Rain Bird SH-1 hose swivel.

1.10 WARRANTY

A. Submit warranty documents as part of project closeout.

B. Warranty the entire landscape irrigation system to give satisfactory service, including all equipment and materials for a period of one (1) year from the date of Final Acceptance.

C. Warranty the temporary landscape irrigation system to give satisfactory service for a period of 6 months from the date of acceptance by Owner.

D. Should any problems develop within the warranty period due to inferior and faulty materials or workmanship, correct problems to Owner's satisfaction at no additional cost.

E. Any damages or re-work required of the landscape or hardscape due to repairs of the irrigation system shall be completed to Owner's satisfaction at no additional cost.

F. Owner reserves the right to make temporary repairs, as necessary, to keep the landscape irrigation system in an operating condition. Exercising this right does not in any way relieve the contractor of any responsibilities under the terms of the warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plastic Pipe and Fittings:

1. All buried irrigation water pipe, both pressure mainline and lateral lines, shall be white PVC pipe.
2. Wash-down main lines shall be standard white PVC pipe.
3. Pipe shall be marked with Manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi, and date of extrusion.
4. Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule:

   a. Glued socket type, for pipe sizes 3 in. and smaller; Schedule 40, PVC plastic; Grade I, ASTM D2466, Type I
      1) Solvent cement: ASTM D2546, for PVC pipe and fittings.
   b. Threaded type, for pipe sizes 3 in. and smaller; Schedule 80, PVC plastic; threaded type; Grade I, ASTM D2464, and ASTM F437
   c. Bell-end, sizes 4 in. and larger; Ductile iron, grade 70-55-05 in accord with ASTM A536, having deep bell push-on joints with gaskets meeting ASTM F477
      1) Harco 'Deep Bell' by the Harrington Corp. of Lynchburg, VA. (804) 845-7094, or Owner-approved equivalent.

B. Copper Pipe and Fittings:

1. Type K, hard tempered pipe, ASTM B42, with solder type fittings.
   a. Solder: ASTM B32, with suitable flux.

C. Brass Pipe Fittings:

1. 125 lb. class cast bronze pipe, ASTM B62, with threaded cast bronze fittings.

D. Thrust Blocks:

1. Standard concrete mix in accord with ASTM C 150, ASTM C 33, and ASTM C 94 with a compressive strength of 2000 psi. after 28 days.

E. Valve Boxes:

1. For all valves, boxes to be as specified on drawings, or owner-approved equivalent.

F. Control Wire Requirements:

1. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply lines wherever possible leaving 12 inches between pipes. Wire shall be placed in Schedule 40 PVC gray conduit.
   a. Where wire will not be run in same trench as mainline, install wire in Schedule 40 PVC gray conduit a minimum of 18 in. below finished grade.

2. An expansion curl shall be provided within 3 ft. of each wire connection. Expansion curl shall be of enough length at each splice connection at each electric control valve, so that in case of repair, the valve bonnet may be brought to the surface without disconnecting the control wires. Control wires shall be laid loosely in trench without stress or stretching wire conductors.
3. Conventional Controller:
   a. Make wire splices using 3M DBY-6, DBR-6 connectors, UL-listed. Make an expansion loop of 36 in. at each directional turn.
   b. Use a continuous wire between controller and remote-control valves. Do not use wire splices without prior approval by Owner and/or owner representative. Install each approved splice in valve box.
   c. Color of all common wires shall be white and white with a yellow stripe as noted below. When more than one wire is placed in the same trench each wire shall have a different color. Provide separate common wire for each field satellite supplied.
   d. Color code all control wires as follows:
      1) Common (1) – White
      2) Common (2) -White with Yellow stripe
      3) Spare –Red
      4) Station No. 1 – Black
      5) Station No. 2 – Blue
      6) Station No. 3 – Brown
      7) Station No. 4 – Gray
      8) Station No. 5 – Green
      9) Station No. 6 – Orange
      10) Station No. 7 – Pink
      11) Station No. 8 – Purple
      12) Station No. 9 – Yellow
      13) Station No. 10 – Black with White stripe
      14) Station No. 11 – Blue with White stripe
      15) Station No. 12 – Brown with White stripe
      16) Station No. 13 – Gray with White stripe
      17) Station No. 14 – Green with White stripe
      18) Station No. 15 – Orange with White stripe

      Station No. 21- Gray with Black stripe
      Station No. 22- Green with Black stripe
      Station No. 23- Orange with Black stripe
      Station No. 24- Pink with Black stripe
      Station No. 25- Purple with Black stripe
      Station No. 26- Red with Black stripe
      Station No. 27- Yellow with Black stripe
      Station No. 28- White with Black stripe
      Station No. 29- Black with Red stripe
      Station No. 30- Blue with Red stripe
      Station No. 31- Brown with Red stripe
      Station No. 32- Gray with Red stripe
      Station No. 33- Green with Red stripe
      Station No. 34- Orange with Red stripe
      Station No. 35- Pink with Red stripe

19) Station No. 16 – Pink with White stripe Station No.36-Purple with Red stripe
20) Station No. 17 – Purple with White stripe Station No.37-Yellow with Red stripe
21) Station No. 18 – Red with White stripe Station No. 38- Black with Green stripe
22) Station No. 19 – Blue with Black stripe Station No. 39- Blue with Green stripe
23) Station No. 20 – Brown with Black stripe Station No. 40- Brown with Green stripe

4. 2-Wire Controller:
   a. Use a two-wire path to connect from the controller to a single station or sensor decoder. Each individual remote-control valve, master valve, and flow sensor shall require a decoder compatible with the specified controller.
   b. The decoders may be wired in sequence over any combination of the two-wire paths dependent on the controller capabilities and/or additional expansions models. Each path may extend up to 10,000 ft. to the end of the wire run over 14 AWG wire, or 15,000 ft. over 12 AWG wire.
   c. The wire paths shall be twisted pair, solid-core, color-coded red/blue pairs, enclosed in a PE sleeve. Multiple colors should be used for in-ground identification in areas where multiple 2-wire paths are being ran through the same trench. Hunter Industries Model ID1xxx for 14 AWG conductors, or Model ID2xxx for 12 AWG.
   d. The two-wire paths may be spliced, or “teed”, permitting extensions of the path in multiple directions. In general, the distance from the controller to the end of any one end of a “tee” or wire run shall not exceed the maximum for the gauge of wire, even if the total of all wire exceeds that number. For example, a path comprised of 14 AWG wire, rated for 10,000 ft., could extend 5000 ft. to a “tee” splice, and each arm of the tee could extend an additional 5000 ft. The total wire connected would equal 15,000 ft., but the distance from the controller, to the end of each run, would be 10,000ft. or less, meeting the specification. All wire splices must be made in a valve box with 3M DBR-6 or equal direct-burial waterproof connectors.
   e. Decoder output to solenoid connections shall be made with 3M DBY waterproof, strain-relieving connectors, or exact equals. No substitution of wire or wire connector specifications is permissible. All connections, tees, and splices shall be positioned in valve boxes for future location and service.

G. Sensor Wire

1. The flow sensor wire shall be manufactured by Imperial, model #IFSW. No field splices allowed between flow sensor and controller.

H. Conduit for Wires:

1. All control wires installed under paving shall be installed within a PVC Schedule 40 conduit. Install flow sensor cable and communication cables within a PVC Schedule 40 conduit. Conduit Size as indicated on the Drawings.
2. Use separate conduit for each type of wire or cable

I. Copper Pipe and Fittings:

1. Copper pipe: Type K, hard tempered ASTM B88.
2. Fittings: Wrought copper, solder joint type, in accord with ASTM B828-00.
3. Solder: Make up solder joints with appropriate paste flux and solder with 95/5 solder, unless otherwise specified.

J. Valve Identification Tags:

1. Each electric control valve tag shall include the controller ID and station number.
2. Use one maxi size tag for electric control valve. Each tag shall provide valve ID information.
3. Special order tags from T. Christy Enterprises, 403 West Brenna Lane, Orange, CA 92667. Tel: (714) 771-4142, Fax: (714) 771-3029.

2.2 EQUIPMENT

1. All equipment to be as specified on drawings.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Layout of irrigation pipe and equipment indicated on Drawings is diagrammatic. Actual locations are contingent upon site conditions and integration with other underground utilities.

B. Verify dimensions, grades and points of connection in field prior to commencement of work.

C. Do not proceed with installation when it is apparent that obstructions, grade differences or conflicts in the Drawings exist. Bring all such conflicts or discrepancies are to the immediate attention of Owner for clarification.

D. Obtain and pay all plumbing permits and inspections required by governing agencies.

3.2 TEMPORARY IRRIGATION

A. Provide a temporary irrigation system for all palm trees and all boxed trees 24 in. and larger installed under this contract. This system is to ensure that installed trees will be automatically irrigated during the plant establishment period.

B. The temporary system shall be designed by a qualified irrigation design professional that is experienced with drip and low flow irrigation systems.

1. Submit for Owner approval, prior to commencing with work, schematic drawings showing intended drip irrigation design with all pertinent information for temporary water connections, equipment and installation.

C. System to be installed and operational prior to tree planting, regardless of the availability of a permanent water connection. If permanent irrigation water is not available at the time the system is installed, provide a temporary water connection until a permanent connection can be made.

D. All pipe and tubing for supplemental irrigation shall be buried and sleeved under construction or access roads, at a proper depth to prevent damage. Protect pipe during entire planting process and repair damage to landscape caused by leaking or breakage of lines. Pipe or tubing, not in a hazardous area, can be installed on-grade. Pipe installed as a part of temporary irrigation shall not be re-used as any part of the permanent landscape irrigation system.

E. The system should be designed and installed at 90% capacity in the event additional plant materials or spray stakes are required.

F. Use the following table to determine the required quantity of emitters or spray stakes; all measurements given reflect the longest dimensions

1. 1 spray stake/emitter for all rootballs up to 2 feet
2. 2 spray stakes/emitters for all rootballs up to 4 feet
3. 3 spray stakes/emitters for all rootballs up to 6 feet
4. 4 spray stakes/emitters for all rootballs up to 8 feet

G. Flow rates should be calculated using 0.5 GPM per emitter.

H. Upon completion of the permanent irrigation system, remove battery operated controllers and valves and connect the temporary system to the designated permanent control valves as shown on the Drawings. Battery operated controls to be returned to Owner.

3.3 EXCAVATION AND BACKFILLING

A. Trenching:
1. Lay-out system using an approved staking method.
2. Coordinate routing of mainline piping and trenching with specimen tree locations.
   a. Planting locations shall take precedence over sprinkler and piping locations.
   b. Notify Owner of any major deviations from original layout.
3. Excavate trenches with straight and vertical sides. Provide continuous support for pipe on bottom of trenches. Lay pipe to uniform grade.
   a. Maintain 1 inch minimum clearance between lines which cross at 45-degree to 90 degree angles.
   b. Maintain 6 inch minimum clearance between sprinkler lines and between lines of other trades. Do not install sprinkler lines directly above any another pipes or utilities.
4. Where irrigation lines occur under paving, depth of coverage shall be measured from the bottom of paving material.
   a. Provide minimum cover of 36 inches over all pressure supply main lines 6 in. and larger. Maximum cover shall be 48 inches unless otherwise approved by Owner.

b. Provide minimum cover of 24 inches over all pressure supply main lines 4 inches and larger. Maximum cover shall be 48 inches unless otherwise approved by Owner.
c. Provide minimum cover of 12 inches over non-pressure lateral lines. Maximum cover shall be 18 inches unless otherwise approved by Owner.

5. Install, under mainline, one continuous No. 14 AWG UF tracer wire in all locations where control wires are not installed in same trench as mainline. Tracer wire shall be black with white stripe.

B. Backfilling:

1. Backfill and compaction: In accord with Section 02320.
2. Initial backfill over all pipe shall be clean, fine granular material.
3. Backfill only when pipe is cool. During hot weather, pipe can be cooled by operating the system for a short time prior to backfilling.
4. Provide marking tape, as specified in Section 02505, for all pressure supply main lines. Install 6 inches of backfill to a depth 6 inches above pipe. Lay marking tape directly over the pipe, followed by remainder of backfill.
5. Properly compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken areas, humps, or other irregularities.
6. Restore grades and repair any damage where settlement may occur.

3.4 INSTALLATION

A. Point of Connection:

1. Connections to water source shall be at approximate location indicated on Drawings. Make any minor changes caused by actual site conditions without additional cost to Owner.

B. Valve Assemblies:

1. Install and connect all assemblies in accord with Drawings.
2. Do not install multiple assemblies on plastic lines. Provide each assembly with its own outlet. When used, the pressure relief valve shall be the last assembly.
3. All threaded fittings shall be assembled using Teflon tape applied to the male threads.
4. When specified, install backflow assemblies in shrub areas at the minimum height indicated on Drawings.
5. Locations for all equipment, as indicated on Drawings, such as point of connection, CCU's, field satellites and valves are approximate.
   a. Stake out all equipment locations for review and obtain Owner's approval prior to installation.
   b. Minor modifications to layout of equipment shall be provided by at no additional costs to Owner.
   c. Failure to obtain Owner's approval prior to installation may require Contractor to relocate and re-work installation at no additional costs to Owner.

C. Plastic Pipe and Fittings:

1. Install and connect plastic pipe in accord with manufacturer's recommendations.
2. Prepare all welded joints with approved primer prior to applying solvent.
   a. Allow welded joints at least 15 min. set-up/curing time before moving or handling.
   b. Partially center load pipe in trenches to prevent movement or shifting when water pressure is applied.
   c. Do not permit water in pipe for a minimum of 4 hrs. after applying solvent welds.
   d. When the temperature is above 80°F, allow solvent weld joints at least 24 hr. curing time before water is introduced under pressure.
   e. Suspended all solvent welding if air temperature falls below 40°F. Pipe and fittings installed at temperatures below 40°F shall be removed and replaced at no cost to Owner.
3. Installing pipe under existing pavement:
   a. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. Hydraulic driving will not be permitted under asphalt paving.
   b. Secure permission from Owner prior to cutting or breaking any existing pavement. Repairs or replacement to existing paving shall be approved and completed to the satisfaction of the Owner and shall be installed and finished at no additional cost.

D. Conduit:

1. Install conduit where control wires pass through or under walks, walls and paving. Conduits shall be of adequate size to accommodate retrieval of wires for repair and shall extend 18 in. beyond edges of walls and pavement.

E. Sleeves:

1. Install sleeves for pipes passing through or under walks, walls and paving as indicated on Drawings. Sleeving shall be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 18 in. beyond edges of paving or other construction.
2. Field verify the location, size and depth of existing sleeves where so noted on Drawings. Notify owner of any discrepancies prior to the start of installation.

F. Wire:

1. Make underground wire connections to electric remote control valves with UL-listed 3M ‘DBY-6’ or ‘DBR-6’ connectors (depending on wire size).
2. Install all control wire in conduit.

G. Gate Valves:

1. Install in accord with Drawings.
2. Check and tighten valve bonnet packing before backfilling.

H. Electric Control Valves:

1. Install in accord with Drawings.
2. Install at sufficient depth to provide not more than 6 in. and not less than 4 in. cover from top of valve to finish grade.
3. Install valves in a plumb position with 24 in. minimum maintenance clearance from other equipment.
4. Electric control valves shall be connected to field satellites in numerical sequence as indicated on Drawings.

I. Quick Coupler Valves/Washdown Valves:

1. Install in accord with Drawings.

J. Sprinkler Heads:

1. Install in a plumb position, perpendicular to finish grade, at intervals not to exceed maximum spacing indicated on drawings.
2. Install heads 1/2 in. above finish grade along curbs, walks, paving, and similar areas.
3. Lay out sprinkler heads and make all minor adjustments required due to differences between site conditions and Drawings. All such deviations in layout shall be within the intent of the original Drawings, and without additional cost to Owner. Routing and layout of all piping shall be approved by Owner prior to installation.
4. After all permanent sprinkler pipe lines and risers are in place and prior to installation of sprinkler nozzles, open control valves and flush out the system with a full head of water.
5. Install nozzles of the required size and pattern for the area of coverage. Install pressure compensating screens per manufacturers recommendations.

K. Field Controller Assemblies:

1. Coordinate with Owner for final controller location.
2. Secure the following services from the controller manufacture:
   a. On-site meeting to review system operation and ensure that all personnel understand system installation techniques.
   b. On-site technical assistance during installation period when requested by Contractor or Owner.
   c. Testing of grounding system.
   d. Hook-up of communication and sensor wires within assemblies.
   e. Continuity and resistance tests on communication wires.
   f. Program decoders.
   g. Verify system flow range and calibrate pulse transmitter.
   h. Test system components for proper operation.
   i. Certification that equipment conforms to and is installed in accord with Drawings, Specifications, and manufacturers' recommendations.

L. Flow Meter and Flow Sensor:

1. Install in accord with manufacturer's instructions and as indicated on Drawings.
2. Provide separate flow sensor cable from each flow sensor to its' respective pulse decoder. Run all cables in PVC Sch 40 conduit.

a. Maximum of three (3) cables from the same point of connection may be installed within the same conduit. Cables from different points of connection are not permitted within the same conduit.
b. Control and common wires for automatic gate valve, upstream of flow sensor, shall be installed within flow sensor cable conduit.

M. Grounding:

1. Grounding Equipment:
   a. Grounding Rods to be 5/8 inch x 10 foot copper clad, UL Listed.
   b. Grounding plates to be 4 inches x 96 inches x 0.06 inch copper alloy with integral connection of 25 feet of #6 AWG bare, solid copper wire, UL Listed conforming to the minimum requirements of Section 250 of the National Electric code. Connection of the wire to plate shall be performed by the plate manufacturer.
   c. Grounding connections to utilize an exothermic welding process, Cadweld connectors, UL Listed, Model GT1161G and straight through couplers.
   d. Grounding wire shall be #6 AWG, solid, bare copper wire.
   e. Ground enhancement material shall be Powerset as manufactured by Loresco, 50 pound bags.
2. Grounding installation:
   a. Each grounding rod shall be driven into the ground its full length 12 feet from the controller and connected via a Cadwell connection to #6 solid, bare copper wire. Additional rods shall be spaced at 20 ft. intervals. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 9 inches and a minimum included angle of 90 degrees. There shall be no slices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A ten inch round valve box shall be placed over the ground rod. A 4 inch grated cover as specified, set a minimum of 1 inch below grade, shall be placed over the grounding plate and a Cadweld connected for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4 inch ADS corrugated polyethylene, perforated drainage pipe. Plates shall be installed 36 inches below grade with 50 lbs. of Powerset ground enhancement material spread evenly above the plate in accordance with manufacturer's requirements. Plates shall also be covered with a 4 inch grated cover as specified, set a minimum of 1 inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4 inch ADS corrugated polyethylene, perforated drainage pipe.
   b. Multiple controller locations shall have separate grounding for each controller. Grounding rods shall be separated a minimum of 20 feet between grids, plates 3 feet. Grids shall be installed in an irrigated area.

N. High voltage wiring for field satellite:

1. 120V power connection to controllers shall be provided under Division 16 of Specifications. Refer to Division 16 for additional information.
2. All electrical work shall conform to local codes, ordinances, and authorities having jurisdiction.

O. Thrust Blocks:

1. Provide concrete thrust blocks where bell-end ductile iron fittings are installed. Thrust blocks shall be required at all changes in size and direction of bends, reducers, plugs, and the opposite side of "T" intersections. Refer to detail drawings.
2. Thrust block sizes shall be dictated by working pressure, size of pipe, type of fitting and soil conditions. Calculate area required for concrete thrust block in contact with soil. Refer to ductile iron fitting manufacturer's thrust block sizing table to determine sizes for each condition.
3. Allow concrete to cure and complete pressure tests prior to backfilling.

P. Emitter Installation and Operation:

1. Cut emitter tubing using Netafim tubing cutter.
2. Install emitters and/or self-piercing barb connectors in emitter tubing using Rain Bird Bug Gun emitter installation tool.
3. Flush all emitter tubing and PVC lateral lines prior to installation of emitters. Refresh lines after installation of emitters.

3.5 FINAL ADJUSTMENTS

A. Adjust sprinkler heights and vertical alignment, as required, to maintain proper relationship to established grades and planting. Regrade and replant around sprinkler heads as necessary.

B. Fill-in all depressions that arise from possible settlement over trenching or other excavations, with proper soil mix. Compact lightly, and replant as needed to maintain planting design.

C. Adjust nozzles to provide optimum coverage with no overspray to hardscape or building walls.

D. Replace nozzles where required to provide complete coverage.

E. Adjust or relocate moisture sensing equipment, as required, for proper operation.

F. Adjust irrigation schedule and run times to provide adequate water to maintain landscaping.

END OF SECTION 32 84 00

PART 4 - GENERAL

END OF SECTION

SECTION **32 93 00**

PLANTING

PART 1 - GENERAL

SECTION 32 **93 00** – PLANTING

PART 2 - GENERAL

1.1 SCOPE OF WORK

A. Contractor to furnish all labor, material, equipment, and services required to install all landscape planting, as indicated on the approved drawings and as specified herein, and shall perform all other incidental work necessary to carry out the intent of this specification and drawings including the following:

1. Fine grading, soil preparation, planting of trees, shrubs, vines, ground covers and lawn, guying and staking trees, weed abatement. 90-day Establishment/Maintenance Period.
2. Provide guarantee.

B. All irrigation work shall be approved by the Owner or Landscape Architect prior to any work in this section being performed.

1.2 QUALITY ASSURANCE

A. Nursery Qualifications:

1. Regularly engaged, for the preceding ten years, in the production of planting materials equivalent in species and size to those required.

2. Stocked, and having a demonstrated ability to provide plant materials required within the constraints of the accepted construction schedule.

B. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1 of the American Standard for Nursery Stock.

D. Pre-installation Conference: Conduct conference at project site with the Landscape Architect, Landscape Contractor, Owner and/or Owner’s Representative.

1.3 BIDDING

A. The amendments, quantities and procedures included herein are for bidding purposes only. Following soil testing by Contractor after rough grading, the amendments, quantities and procedures may change.

B. A minimum of six (6) Agricultural Suitability Soil Tests shall be paid for by the Contractor.

1.4 ANALYSES OF SAMPLES AND TESTS

A. Project Agronomist: Waypoint Analytical : 310-615-0116 or approved equal.

B. Pathology Testing Laboratory (Palms Excluded): Soils and Plant Laboratory: (714) 282-8777; or approved equal.

C. Pathology Testing Laboratory (Palms only for Fusarium): California Seed & Plant Lab: (916) 655-1581.

1.5 AGRONOMIC SOILS REPORT (UNDISTURBED ON GRADE CONDITIONS)

A. The Contractor shall schedule a visit with the Project Agronomist for the purpose of conducting soils analysis from the end of finish grading operations. Soil samples shall be taken by the Project Agronomist from typical tree/shrub locations for analysis by designated soil testing laboratory. Submit soils analysis and recommendations to the Architect for acceptance and re-issue of soil preparation recommendations. Soil analysis shall indicate quantities, chemical properties and recommended manufacturer or supplier. Provide a small scale site plan of testing locations. Soils analysis shall be paid for by the contractor.

1. Methodology: Soil Analysis methodology must include pH measurement in the saturation extract, electrical conductivity of the saturation extract and sodium absorption ratio of the saturation extract. The approved procedures include:
   a. pH Method 21
   b. Saturation extract Method 21
   c. Sodium adsorption ratio Method 20b

2. Approved Methods:
   a. The “American Society of Agronomy” as published in the Methods of Soils`Analysis, “Methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled “Diagnosis and Improvement of Saline and Alkaline soils.”
   b. Base Saturation Methods 18 and 20 of Agricultural Handbook Number 60.
   c. Cation Exchange Capacity – Methods 18 and 20 of Agricultural Handbook Number 60.
   d. Mehlich III texting method is not suitable for alkaline soils and therefore is not an acceptable testing method for Southern California.
   e. The approved methods are those cited by the Council on Soil Testing and Plant Analysis and those methods currently published by Soil Science Society of America Manuals, Communications in Soil Science and Plant Analysis, Soils Science and Soil Science Society of America Journal.

f. Approved methods for phosphorus are Bray P1, Bray P2, Olsen P, DTPA, ammonium acetate and ammonium bicarbonate-DTPA.
g. Approved methods for boron are hot water extract and ammonium bicarbonate-DTPA extract.

B. The following nutrients and elements must be determined with an American Society of Agronomy or Soil Science Society of America approved extraction method. Interpretation data must be given citing concentrations which are considered to be low, medium and high for boron, magnesium, manganese, molybdenum, phosphorus, potassium sodium and sulfur.

C. The saturation extract must be analyzed for calcium, magnesium, sodium, boron, chloride, phosphorus, nitrate and sulfate.

D. The presence of calcium carbonate and/or magnesium carbonate must be determined.

E. The presence of exchangeable ammonium, exchangeable hydrogen, base saturation, exchangeable potassium, calcium, magnesium, and sodium must be determined.

F. Soil Texture: (gravel, sand, silt and clay) and percent gravel must be determined.

G. Determine organic matter content by the measurement of organic carbon. The quality of the organic matter shall be determined by measuring organic carbon and total nitrogen.

H. Interpretation of nutrient deficiencies or excesses and potential toxicities must be determined.

I. Water Infiltration Rate: Method 34b of Agricultural Handbook Number 60.

J. Test results and recommendations shall be approved by the Owner prior to soil preparation to concur with recommendations shown herein.

K. Soil tests shall be performed after soil preparation to confirm that soil preparation was performed in compliance with pre-plant soils report and specifications.

1.6 SUBSTITUTIONS

A. Specific reference to manufacturers' names and products specified in this section are used as standards; this implies no right to substitute other materials or methods without written approval from the Owner.

B. Installation and warranty of any approved substitution shall be Contractor's responsibility. Any changes required for installation or any approved substitution must be made to the satisfaction of the Owner without additional cost to the Owner. Approval by the Owner of substituted equipment and/or dimension drawings does not waive these requirements.

1.7 SUBMITTALS

A. Prior to installation, the Contractor shall submit to the Owner and Landscape Architect two (2) copies of manufacturers' literature, receipts of sale, and laboratory analytical data for the following items:

1. Organic Amendments
2. Soil Conditioner
3. Topsoil (Backfill along Perimeter of Building and Podium Planters)
4. Commercial Fertilizer
5. Mulch
6. Erosion Control Fabric
7. Plant Material

B. Refer to irrigation specifications for additional submittal requirements.

1.8 DELIVERY, STORAGE AND HANDLING

A. Contractor shall furnish standard products in manufacturer's standard containers bearing original labels showing quantity, analysis, and name of manufacturer. All containers, bags, etc., shall remain on site until work is completed.

B. Contractor shall notify Landscape Architect seven (7) days prior to delivery of plant material and submit itemization of plants in each delivery.

C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Handle planting stock by root ball.

E. Where applicable, store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

F. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

G. Landscape Architect and Owner to review plants upon delivery. Plants that are not healthy or that otherwise do not meet standards will be rejected.

1.9 CLEAN-UP

A. Upon completion of each phase of work under this section, the Contractor shall clean up and remove from the area all unused materials and debris resulting from the performance of the work. The site shall be left in broom-clean condition; wash down all paved areas within the project site and leave walks in a clean and safe condition.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.

2. Warranty Periods from Date of Substantial Completion:

a. Trees, Shrubs, Vines, and Ornamental Grasses 15 gallon and larger: twelve (12) months.
b. Ground Covers, Biennials, Perennials, and Other Plants smaller than 15 gallon: Six (6) months, minimum.
c. Annuals: Two (2) months.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1) Maintenance Period for Trees and Shrubs: Three (3) months from date of Substantial Completion.
2. Maintenance Period for Ground Cover and Other Plants: Three (3) months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. All plants shall be of the size, variety, age and condition as shown on the drawings and as specified here.

B. Quality - Plants shall be in accordance with the California State Department of Agriculture's regulation for nursery inspections, rules, and grading. All plants shall have a normal habit of growth and shall be sound, healthy, vigorous, and free of insect infestations, plant diseases, sun scales, fresh abrasions of the bark, or other objectionable disfigurements. Tree trunks shall be sturdy and well 'hardened' off. All plants shall have normally well-developed branch structure, and vigorous and fibrous root systems which are not root or pot bound. In the event of disagreement as to condition of root system, the root condition of the plants furnished by the Contractor in containers will be determined by removal or earth from the roots of not less than two (2) plants of each species or variety. Where container grown plants are from several sources, the roots of not less than two (2) plants of each species or variety from each source will be inspected. In case the sample plants inspected are found to be defective, the Landscape Architect reserves the right to reject the entire lot or lots of plants represented by the defective samples.

C. Plants shall be measured when branches are in their normal upright 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 the trunk three (3) feet above natural ground line. If a range of size is given, no plant shall be less than the minimum size and not less

than 40 % of the plants shall be as large as the maximum size specified. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height and spread, shall be rejected.

D. Plants shall be nursery grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least two (2) years unless otherwise specifically authorized by the Landscape Architect. All plants shall be heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be in form, number of branches, compactness and symmetry.

E. All plants shall meet the specifications of federal, state, and county laws requiring inspection for plant diseases and insect control. All inspection certificates required by law shall accompany each shipment, invoice, or order for stock; and when such plants arrive at the site, the certificates shall be delivered to the Landscape Architect.

F. Plants shall be true to species and variety in accordance with the American Association of Nurserymen Standards. Each group of plant materials delivered to the site shall be clearly labeled as to species and variety and nursery source.

G. Plants shall not be pruned before delivery. Trees which have damaged or crooked leaders, or multiple leaders, unless specified, will be rejected. Trees with abrasions of the bark, sun scalds, disfiguring knots, or fresh cuts of limbs over ¾-inch which have not completely callused will be rejected.

H. Plants not conforming to the requirements herein specified will be considered defective and such plants, whether in place or not, will be marked as rejected. Contractor shall immediately remove rejected plans from the premises and replace with new acceptable plants at his expense.

I. There shall be no substitutions of plants or sizes for those listed on the accompanying plans except with the approval of the Landscape Architect.

J. Container stock shall have grown in the containers in which delivered for at least six (6) months, but not over two (2) years. Samples shall show no root-bound conditions. Container plants that have cracked or broken balls of earth when taken from container will be rejected by the Landscape Architect.

K. All boxed trees will require a thorough inspection of the root structure by the Owner/Landscape Architect prior to installation. Only high-quality nursery stock shall be accepted for the project in compliance with the project specifications and the Urban Tree Foundation Guideline Specifications for Nursery Tree Quality (www.urbantree.com).

2.2 TOPSOIL (BACKFILL FOR ON GRADE CONDITION)

A. Topsoil shall be free of roots, clods and stones larger than 1” in the greatest dimension.

B. Imported topsoil shall be from approved locations. Homogenize and remove or break any large clods to less than one (1) inch. Soil samples shall be provided to the Landscape Architect for distribution to Waypoint Analytical for every seven truckloads of topsoil delivered to the site. Samples uld be approved by Wallace Labs prior to trucking and

delivery to the site. Rip sub-grade to depth of 12-inch both ways prior to placing import topsoil. Imported soil placement in six (6) inch lifts and compaction shall not exceed 75%. Perform general soil prep under section 2.4.

Due to on site space restriction around the building, preparation of backfill may need to take place off site prior to trucking the soil back. Contractor is to determine the most efficient and cost-effective option.

C. If top soil imported from outside source, contractor shall notify Owner's representative. Contractor to coordinate with Wallace Labs on soil sample collecting and testing. Contractor to provide location of imported topsoil source for Soils engineer inspection of physical and drainage properties of topsoil.

D. Suitable Soil Criteria:

1. General: Topsoil shall be free of roots, clods and stones larger than 1" in the greatest dimension.
2. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil.
3. Gradation limits: ideally, amended soils should be sandy loam or loam. The definition of soil texture shall be the USDA classification scheme. Gravel over two (2) millimeters in diameter shall be less than 20% by weight.
4. Permeability Rate: ideally the hydraulic conductivity rate shall be not less than one (1) inch per hour nor more than 20-inches per hour when tested in accordance with the USDA Handbook Number 60, method 34b or other approved methods.
5. Fertility: the range of the essential elemental concentration in soil shall be as follows:

	Ammonium Bicarbonate/DTPA Extraction parts per million (mg/kilogram dry weight basis
phosphorus	10 - 40
potassium	100 - 220
iron	5 - 35
manganese	0.6 - 6
zinc	1 - 8
copper	0.3 - 5
boron	0.2 - 1
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 - 2

6. Acidity: the soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 - 7.9.
7. Salinity: the salinity range measured in the saturation extract (Method 3a, USDA Handbook Number60) shall be 0.5 - 2.5 dS/m.

8. Chloride: the maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).
9. Boron: the maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million).
10. Sodium Adsorption Ratio (SAR): The maximum SAR shall be three (3) measured per Method 20b, USDA Handbook Number 60.
11. Aluminum: Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than three (3) parts per million.
12. Soil Organic Matter Content: Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is three (3) % to six (6) %. The carbon nitrogen ratio should be about 10. A high carbon: nitrogen ratio can indicate the presence of hydrocarbons or non-humified organic matter.
13. Calcium Carbonate Content: Free calcium carbonate (limestone) shall not be present for acid-loving plants.
14. Heavy Metals: The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

Ammonium Bicarbonate/DTPA Extraction; parts per million (mg/kilogram) for dry_weight basis:

phosphorus	10 - 40
potassium	100 - 220
iron	5 - 35
manganese	0.6 - 6
zinc	1 - 8
copper	0.3 - 5
boron	0.2 - 1
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 - 2

15. Heavy Metals and Soil pH: If the soil pH is between six (6) and seven (7), the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75%. No more than three metals shall be present at 50% or more of the above values.
16. Phytotoxic constituent, herbicides, hydrocarbons: Germination and growth of monocots and dicots shall not be restricted more than ten (10) % compared to the reference soil. Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethylbenzene) shall not exceed 0.5 mg/kg dry soil measured per EPA Methods No. 8020.

E. The Contractor shall coordinate with the Landscape Architect and Wallace Labs for soil sample collecting and testing, submit soils analysis, recommendations and topsoil sample to the Landscape Architect for approval. Import topsoil shall not be delivered to the site

prior to Landscape Architect, Owner, Soil Engineer and Wallace Labs approval. The Landscape Architect may request additional testing of imported topsoil at the site to determine conformance to the approved report. Rejected topsoil shall be removed at no cost to the Owner.

F. If stockpiling is requested, locations and amounts of stockpile shall be approved by the Owner.

2.3 SOIL AMENDMENTS AND FERTILIZER FOR ON- SITE TOPSOIL

A. Recommendations:

1. Protect the planter soils from contamination of stucco, paints, welding flux, and other building materials.
2. Remove debris, trash, clods, etc. larger than one (1) inch in diameter.
3. Landscape contractor shall submit soil for test and coordinate with EPTDESIGN and Wallace Labs for soil testing prior to soil preparation.

B. General soil preparation for turf, ground cover and shrub areas:

1. Remove debris, clods, rock, gravel and foreign material larger than one (1) inch in diameter from the top 12- inches. The following amendment rates are per 1,000 square feet and are to be used for estimation during the bid process: Incorporate following homogeneously six (6) inches deep: 3 cubic yards Organic Compost; 5 pounds Ammonium sulfated (21-0-0); 6 pounds Potassium sulfate (0-0-50); 3 pounds Triple superphosphate (0-45-0); 10 pounds Agricultural gypsum; 20 pounds P.A.M. Soil Drain Amendment per manufacturer directions.
2. Cure the soil to activate the soil conditioner. Irrigate the soil to dampen the soil to a depth of six (6) inches. The soil does not need to be saturated, just damp. Allow the soil to dry or, -at least dry to the point where the stringiness has disappeared. Then re-rototill the soil to a six (6) in depth until soil is friable.

C. Preparation of backfill for container plants, boxed trees and augers (including Tree drainage and outside inspection tubes – use backfill in place of crushed rock), homogeneously blend the following materials into excavated soil. Rates are expressed per cubic yard and are to be used estimation during the bid process. Remove debris, clods, rock, gravel and foreign material larger than one (1) inch in diameter.

1. 15% - Organic Compost Amendment.
2. 85% - Native Topsoil (Must be dry and friable prior to mixing with amendments,)
3. 1 pound - Agricultural gypsum.
4. 1/4 pound- Potassium sulfate (0-0-50).
5. 1/4 pound - Ammonium sulfate (21-0-0).
6. 1/4 pound - Triple superphosphate (0-45-0).
7. 2 ounces - P.A.M. Soil Drain Amendment per manufacturer directions.

D. Organic soil amendments:

1. Soil Organic Amendment: The product shall be based upon manure, compost or sludge. Wood residues, sawdust or shavings are not acceptable. The ash content shall be at least 15% and not more than 25%. Sand content shall be less than 2%. The pH shall not be less than 5.0 or more than 7.5. The ECe shall be less than 5.0.
2. Organic Compost: Washed Steer Humus from Earthworks. Telephone: (909) 270-0088; or approved equal. “Forest Floor Humus” from Aguinagua Fertilizer Company. Telephone: (949) 751-9706; or approved equal.

2.4 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

Inorganic Soil Amendments:

1. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

   a. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve a minimum of 75 percent passing through No. 60 sieve.
   b. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
2. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
3. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
4. Aluminum Sulfate: Commercial grade, unadulterated.
5. Perlite: Horticultural perlite, soil amendment grade.
6. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
7. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
8. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
9. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.5 AMENDED SOIL MIX FOR PLANTER POTS

A. Soil to be used as planting medium for all planter pots.

B. Product: LWPS 33 (Light Weight Potting Soil) from Earthworks. Earthworks. Telephone: (951) 538-3321; or approved equal.

C. Provide Mix in sufficient quantities which allow for natural settling and compaction of the mix prior to installing Plant Materials. Mix shall be compacted to 90% density to minimize

settling. Set mix and compact accordingly in six (6) inch lifts, to within two(2) inch of top of the Planting Pot..

2.6 PESTICIDES AND HERBICIDES

A. All chemicals used for weed control shall be registered by the State of California Department of Food and Agriculture and the Environmental Protection Agency with registration identification on the label. Label shall be at job site at all times.

B. All chemicals shall be applied as per registered label instruction and manufacturer's recommendations.

C. Chemicals requiring a licensed applicator must be applied by persons registered with the local county's Department of Agriculture's Commissioner's Office as possessing a current, valid, qualified pest control applicator's license.

D. The use of any restricted materials is forbidden unless a special use permit is obtained from the local county's Department of Agriculture.

E. The herbicide shall be Fucilade for weed grasses and SpeedZone Southern for broadleaf weeds.

F. Do not apply pre-emergent herbicides until plants are established

2.7 SEED

A. Seed shall be of the species and variety specified on the plans. Wet, moldy, or otherwise damaged seed shall not be acceptable.

B. The Contractor shall have all seed to be used on the project officially tested by the California State Department of Agriculture and shall submit to the Landscape Architect prior to hydro- seeding, official seed labels, and a signed statement from the Agriculture Department certifying that the seed meets the analysis shown on the labels. Unlabeled collected seed shall be tested and analyzed and the results furnished in lieu of the seed labels.

C. The seed quantities listed shall be on the basis of pure live seed.

$$\text{Total Seed Material} = \frac{\text{Pounds pure, live seed required}}{\text{Percent purity x percent germination}}$$

2.8 TURF

A. Turf species shall be Bullseye Bermuda, as shown in the Drawings.

B. Soil base shall be sandy loam or loam.

C. Soil base shall be clean topsoil.

D. The following weed seeds are not permissible

1. Quackgrass
2. Johnson grass
3. Nutsedge
4. Poison ivy
5. Canada thistle
6. Poa annua (Annual Bluegrass)

E. Premium grade – not more than one (1) % undesirable grass species or clover. No more than ten (10) weeds per 500 square feet.

F. Commercial grade – not more than ten (10) % undesirable grass species or clover. No more than ten (10) weeds per 500 square feet.

G. Thickness of soil portion of sod should not exceed ½-inch.

2.9 STONE MULCH

A. Crushed Gravel: stone with angular surfaces; gravel size and color as indicated on plans.

2.10 STAKING MATERIALS

A. Wood Stakes: Tree stakes shall be straight grained lodge pole pine free of knots, splits, checks, or disfigurements. Stakes shall be three (3) inch minimum nominal size in diameter and 12-feet in length. All lodge pole pine stakes shall have a ten (10) inch tapered driving point and chamfered top and shall be untreated natural wood color, as manufactured by C & E Lumber Company of Pomona, CA. Telephone: (714) 626-3591; or approved equal

B. Supports for wood stakes shall be 32-inch black cinch type; two (2) double cinch ties per tree; V.I.T. Company, Inc. 15561 Product Land, D-4, Huntington Beach, CA. Telephone: (714) 891-8338.

2.11 GUYING MATERIALS

A. Guy wire shall be double stranded 12 gauge galvanized wire.

B. Turnbuckles shall be galvanized or dip-painted and weldless.

C. Cable clamps shall be galvanized or copper, size as required.

D. Guy wire cover shall be PVC ½-inch diameter and shall be six (6) feet in length or provide 90 % cover of guy wire. Apply (2) coats of black paint.

E. Guying collar shall be per V.I.T. The collar shall completely cover the wire and loop around tree limbs. It shall be long enough to permit tree movement within the loop.

F. Anchor to be two (2) inch x two (2) foot length, 15 gauge, galvanized steel pipe. Drill holes as specified to receive wire.

2.12 ROOT CONTROL BARRIERS

A. Root control barriers shall be provided as indicated on the plans, as required in the local governing agency tree planting guideline, and as specified herein.

B. Root control barriers shall be constructed of injection molded copolymer polypropylene with 50% postconsumer recycled plastic and UV inhibitors as manufactured by Deep Root Corp., Westminster, CA, or approved equal.

C. Root control barriers shall be a minimum of 18-inch depth and .08-inch thick when installed adjacent to sidewalk, 36-inch depth and .08-inch thick when installed adjacent to curb.

D. Root control barriers shall be linear.

PART 3 - EXECUTION

1.01 3.1 GENERAL

A. Perform actual planting only during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice.

B. Confirm location and depth of underground utilities and obstructions. If underground structures or utility lines are encountered in the excavation of planting areas, other locations for planting shall be approved by the Landscape Architect.

C. All planting layout and staking shall be accurately made in accordance with the plans. All trees shall be a minimum of three (3) feet from local government agency maintenance limit line.

D. Plant locations shall be approved by the Landscape Architect prior to excavation and may be subject to spacing and distances required by local governing agency standards.

3.2 FINISH GRADING

A. All grading and mounding with the exception of final planting shall be completed prior to soil preparation.

B. Planting areas shall be free of all weeds (plants not specified in planting areas), stones, stumps, roots, or other debris one (1) inch in diameter and greater.

C. Soil shall be graded to a smooth and even surface conforming to required finish grade. Finish grade adjacent to walks, paved areas, curbs, manholes, clean-outs, valve boxes, and similar features shall be one (1) inch below the surface in turf and two (2) inches below in ground cover/shrub areas. Grades between such features shall be carefully sustained and blended to eliminate abrupt changes.

D. Planting areas to receive sod shall sustain a finish grade of such depth that the top of installed sod shall be flush with finish surfaces (walks, paved areas, etc.).

E. Contractor shall allow for soil amendments when establishing sub-grade elevations. All planting areas shall have a finish grade conforming to approved plans and specifications after full settlement has occurred.

F. All planting areas adjacent to buildings shall be graded to drain away from the building at a minimum of two (2) % slope, for a minimum of five (5) feet horizontal distance.

3.3 SOIL PREPARATION

A. Cross-rip soil to a minimum depth of 12-inches. Thoroughly rototill a minimum of two (2) directions the following amendments into the top 12-inches of soil and irrigate thoroughly. (Per 1,000 square feet.) Refer to item 2.4 soil amendment.

B. Planting areas with slopes 2:1 and steeper shall not be soil prepared unless directed by Landscape Architect.

C. Contractor shall not work under muddy conditions.

D. Should 30-calendar days elapse between completion of soil preparation and commencement of planting, all areas shall be prepared again.

3.4 PLANTING OF TREES, SHRUBS, AND VINES

A. Excavation: Planting holes shall have irregular, non-glazed sides, and shall be a minimum of twice the diameter, and 1-½ times the depth of the original plant container.

B. Planting procedure for container grown material:

1. Backfill plant pit with well-tilled on-site soil without amending to the depth of the rootball. Water thoroughly and compact backfill in such a manner so that after settling, the crown of the plant stem is two (2) inches above adjacent grade. Center plant in pit.
2. Uniformly blend amended backfill at a centralized location in minimum one (1) cubic yard lots. Backfill amendments shall be as indicated on the approved agronomic soils report. Mixing in plant pits or beds will not be permitted. Make available for inspection, all delivery slips and analytical data from approved laboratories for specified organic amendments. For bidding purposes use the following mixture:
3. Refer to item 2.4 for backfill amendment. In upper 12-inches of backfill, add a soil blend Nitrogen stabilized organic amendment as recommended on item 2.4. Soil below this depth shall not contain organic amendment.
4. Place slow release fertilizer tablets in upper 18-inches of backfill. Plant tablets shall be required for all tree, shrub and vine plantings. Application rate and nutrients shall be per the manufacture's recommendation.
5. Backfill remainder of plant pit around the rootball with amended backfill. Firm down, eliminating air pickets. Do not pack. Form a shallow basin around the plant to hold enough water to saturate the rootball and backfill.
6. Immediately after planting, apply water to each tree and shrub by means of a hose. Apply water in a moderate stream in the planting hole until the material about the roots is completely saturated from the bottom of the hole to the top of the ground. Add additional amended backfill material as necessary to correct any settlement around rootball.

D. Sub Drainage: Four (4) inch diameter PVC (SDR-35) perforated for horizontal pipe at bottom of plant pit on each side of rootball, wrapped with filter fabric sock. Vertical clean out should be solid four (4) inch diameter PVC (SDR-35) with NDS black drain grate inserted at finish grade. Connect to civil storm drain where ever possible. If not possible connect to drain sump (six (6) inch diameter auger a minimum of six (6) feet below bottom of plant pit with four (4) inch diameter perforated PVC (SDR-35) and filter fabric sock, backfilled around outside of pipe with the specified clean, washed sand backfill.

3.5 GROUND COVERS

A. Ground cover plants shall not be allowed to dry out before or while being planted. Roots shall not be exposed to the air except while actually being placed in the ground. Wilted plants will not be accepted.

B. Plant ground covers in straight rows evenly spaced, and at intervals required by drawings, use triangular spacing.

C. Plant each rooted plant with its proportionate amount of flat soil. Immediately water after planting until entire area is soaked to full depth of each hole.

D. Protect plants from damage and trampling at all times.

E. In all shrub and groundcover areas, apply minimum three (3) inch layer of Commercial grade shredded hardwood bark mulch, uniform in size, and free of sticks, stones, clods or other foreign material. 0-2" "Forest Floor" from Aguinagua Fertilizer Company. Telephone: (949) 751-9706; or approved equal. Contractor shall submit sample to Landscape Architect for approval.

3.6 TURF

A. General:

1. After soil preparation, establishment of final grades, and weed abatement, carefully smooth all surfaces to be planted, roll area to expose soil depressions or surface irregularities. Re-grade as required. Prior to planting, the soil shall be loose and friable to receive turf.
2. Immediately prior to planting, evenly broadcast a pre-plant commercial fertilizer as recommended in the approved agronomic soils report. Rake in lightly. Avoid planting of turf on dry soil.
3. Turf shall be planted by seeding, hydro-seeding, stolonizing, or sodding as indicated on the plans.

3.7 INSPECTION

A. All inspections herein specified shall be made by the Landscape Architect. The Contractor shall request inspection at least two (2) working days in advance of the time inspection is required.

B. Inspection will be required for the following parts of the work:

1. During the preliminary fine finish grading and soil preparation.
2. When fine finish grading and soil preparation are completed.

3. Plants after delivery to site (prior to planting), when shrubs and trees are spotted for planting,
   but before planting holes are excavated.
4. Specimen trees at source before delivery.
5. Planting areas prior to planting.
6. All landscape construction items, prior to the start of the Maintenance period.
7. Final inspection at the end of the Maintenance period provided that all previous deficiencies have been corrected.

3.8 WATERING

A. Watering of turf to commence immediately after completion of job and to continue at a rate necessary to keep area moist without drying out or puddling. Normally irrigating ONCE AN HOUR for a short duration and continuing this procedure each and every day light hour, seven (7) days a week will be sufficient. This continual moist condition is to prevail each and every day until seeds are well rooted. After the rooting stage is completed, irrigation should still continue on the basis of at least once or twice a day until turf is well established.

B. Immediately after planting, apply water to each tree, shrub and ground cover by means of a hose. Apply water in a moderate stream in the planting hole until the material about the roots is completely saturated from the bottom of the hole to the top of the ground.

C. Water plants which cannot be watered efficiently with the existing water system by means of a hose.

D. Apply water in sufficient quantities, and as often as seasonal conditions require, and keep the ground wet at all times, well below the root system of grass and planting. Do not cause erosion damage in watering slopes.

3.9 LANDSCAPE MAINTENANCE WALK PROTOCOL

A. Interim Maintenance Start (Prior to 90-Day Irrigation Coverage Test): It shall be the responsibility of the General Contractor to establish a meeting to conduct the irrigation coverage test. Attendees shall include the Landscape Architect and Landscape Contractor. The walk shall cover irrigation coverage, functionality and color coated controller charts provided by the Landscape Contractor. A punch list will be generated in preparation for the next site walk. All equipment shall be verified during this meeting.

Pre-Maintenance Walk / Irrigation Coverage Test: It shall be the responsibility of the General Contractor to establish meeting to confirm punch list items are complete. Attendees shall include Landscape Architect, Irrigation Design Consultant, Installing Landscape Contractor, and General Contractor.

The date of the beginning of the ninety (90) day Maintenance period will be established based on the successful completion of the Pre-Maintenance walk. The walk shall cover irrigation coverage, functionality and controller charts provided by the landscape contractor, review of installed plant material, staking, mulch, decomposed granite, gravel, headers, boulders, and all other items within the Landscape Contractor's scope of work.

Remote will be required *(Landscape Contractor's Responsibility)* for all irrigation walks in order to expedite the process. Valves shall be activated from the controller by remote or

use of two-way radios. Manual valve activation is not acceptable prior to 90-day maintenance walk.

If the Pre-Maintenance walk for the irrigation is successful it will be determined at that time when the 90-day Maintenance period will be established.

If the Pre-Maintenance walk for the irrigation is not successful it will be the responsibility of the Landscape Contractor to address the irrigation punch list items prepared by the Landscape Architect. An additional punch walk with the General Contractor, Landscape Architect and Landscape Contractor will be required to check the irrigation corrections prior to establishing a date for the ninety (90) day Maintenance period.

The irrigation punch list shall be provided by the Landscape Architect to the General Contractor, Director Construction and Landscape Contractor within 72 hours. The commencement date of the ninety (90) day Maintenance period shall be provided by the Landscape Architect in a 90–Day Maintenance Letter.

B. 90-Day Final Acceptance: It shall be the responsibility of the General Contractor to establish the 90 Day Maintenance Walk for irrigation. Attendees shall include, General Contractor, Landscape Maintenance Contractor, Landscape Contractor, Landscape Architect and Owner/Representative.

This walk will review the items from the Pre-Maintenance Walk punch list and ensure these items have been completed. Maintenance will start once all items noted on the Pre-Maintenance Walk have been addressed.

C. Final Project Turnover: It shall be the responsibility of the General Contractor to establish the Final Project Turnover date with the, Owner, Landscape Maintenance Contractor, and Landscape Contractor for completion of all phases of construction.

The General Contractor shall document the final acceptance.

One (1) set of the Irrigation “as-built” plans *(30x42 – on bond)* shall be developed by the Landscape Contractor before the final phase acceptance walk. Completed “as-built” shall be submitted to the Landscape Architect for review and approval.

After approval of the Irrigation “as-built” plans the Landscape Contractor shall provide and additional sets as requested by the Owner/Representative.

The installing Landscape Contractor shall include the following items, but not limited to: Controller charts, quick coupler keys, controller operation manuals, special tools required to adjust, install, disassemble, or remove any sprinkler or valves supplied on the project where applicable and other pertinent information at final turnover.

Landscape Contractor shall provide a letter of guarantee for the completed landscape installation to the General Contractor

END OF SECTION 32 93 00

1.02

END OF SECTION

SECTION 33 05 00

INSTALLATION OF BURIED PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes placement of buried pipelines and connections.

1.02 RELATED WORK DESCRIBED ELSEWHERE

A. Section 312333 - Trenching, Backfill and Compaction

1.03 SUBMITTALS

A. Installation schedule.

B. Product data for each type of warning tape.

1.04 PAYMENT

A. Payment for the work in this section will be included as part of the unit price per linear foot bid amounts for the various types of pipe as stated in the bid documents.

PART 2 - MATERIALS

2.01 PIPE MATERIAL

A. Refer to the section on pipe by type.

2.02 ACCESSORIES

A. Non-Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick.

B. Detectable Warning Tape: Provide an inert polyethylene film detectable warning tape manufactured for marking and identifying underground utilities, 6 inches wide with a minimum metallic foil core of 0.35 mils and shall be reinforced, consisting of 5 mils total thickness.

C. Continuously inscribe warning tape with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.
   6. Purple: Reclaimed Water System

D. Detectable wire
   1. Tracer wire shall be provided when non-detectable warning tape is used for plastic piping. Insulated No. 12 copper tracer wire shall be buried with the pipe and ends brought to surface.

PART 3 - EXECUTION

3.01 DELIVERY AND TEMPORARY STORAGE OF PIPE AT SITE

A. Limit on-site pipe storage to a maximum of one week.

B. Avoid damage to the pipe. If necessary, provide suitable supports.

3.02 HANDLING OF PIPE

A. Lift pipes with handling beams or wide belt slings as recommended by the pipe manufacturer. Do not use cable slings.

3.03 SANITATION OF PIPE INTERIOR

A. During laying operations, do not place tools, clothing or other materials in the pipe.

B. When pipe laying is not in progress, close the ends of the pipe by a vermin-proof plug constructed in a manner to deter entry by children and prevent the entrance of animals and foreign materials.

3.04 PLACEMENT OF PIPE IN TRENCH

A. Control water in trench per Section 312333.

B. Lay pipes uphill if the grade exceeds ten percent (10%).

C. Where pipe bedding material is detailed below the subgrade, place and compact the bedding.

D. Cut a depression to accommodate the pipe bell and external joint filler form and spaces to permit removal of the pipe handling slings.

E. Lower the pipe onto the bedding and install it to line and grade along its full length of firm bearing except at the bell and at the sling depressions. The tolerance on grade is one-quarter inch (1/4"). The tolerance on line is one inch (1").

F. Proceed to complete the pipe embedment as specified in Section 312333.

G. The radius of curvature of the trench shall determine the maximum length of pipe section that can be used without exceeding the allowable deflection at a coupling. The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe. The manufacturer's printed installation guide outlining the radii of curvature that can be negotiated with pipe sections of various lengths shall be followed.

H. Proper implements, tools and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the work. All pipe, fittings, valves and accessories shall be carefully lowered into the trench by means of handling beams, wide belt slings or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

I. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, nor any other method that may fracture the pipe or will produce ragged, uneven edges.

J. The pipe and accessories shall be inspected for defects prior to the lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

K. When the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers or main drains, the obstruction shall be permanently supported, relocated, removed or reconstructed by the Contractor in cooperation with owners of such utility structures. Unless otherwise indicated, this work shall be performed at the Contractor's expense.

3.05 ASSEMBLING RUBBER RING JOINTS

A. Clean the ends of the pipe to be joined of foreign material.

B. Immediately prior to lowering each section of pipe into the trench, apply a nontoxic water soluble vegetable soap solution to the inside of the bell of the pipe in the trench and to the rubber gasket and spigot groove of the pipe to be installed. Stretch the rubber gasket into the groove of the spigot end of the pipe to be inserted and distribute it uniformly around the circumference.

C. Without tilting the pipe to be installed, enter its spigot into the bell of the pipe in the trench. Use come-a-longs or pipe jacks to drive spigot end home horizontally. Maintain joint recess recommended by pipe manufacturer or made-up joint. Where deflections at joints are required for curved alignment, do not exceed the pipe manufacturer's recommended maximum joint opening on one side.

3.06 OPERATIONS INCIDENTAL TO JOINT COMPLETION

A. Plan joint completion to accommodate temporary test bulkheads for hydrostatic testing.

3.07 PIPE EMBEDMENT

A. Provide sufficient space along each side of the pipe and the trench wall per plans to observe that the embedment material fills all spaces below pipe spring line under the pipe haunches.

B. Start the backfilling operations specified in Section 312333 immediately after coating the field joints.

3.08 PIPELINE CLOSURE ASSEMBLIES

A. Employ pipeline closure assemblies to unite sections of pipeline laid from opposite directions and to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations.

3.09 FLANGED CONNECTIONS

A. Lubricate nuts and bolts with oil or graphite prior to installation.

B. Coat flanges and non-stainless-steel bolts with bitumen as specified.

C. Wrap flanges which connect with buried valves or other equipment with two layers of polyethylene film specified for the valves and equipment. Extend the wrap over the flanges and bolts and secure it around the adjacent pipe circumference with tape.

END OF SECTION

SECTION 33 10 00

WATER DISTRIBUTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes water-distribution piping and specialties outside the building for the following:
   1. Domestic Services
   2. Fire services.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 31 23 33: Trenching, Backfilling, and Compaction.

C. Section 33 05 00: Installation of Buried Pipe

1.03 DEFINITIONS

A. Fire Service: Exterior domestic-water piping branch from main to building fire riser.

1.04 SUBMITTALS

A. Product Data: For the following:
   1. Piping specialties.
   2. Valves and accessories.
   3. Fire department connections.

B. Coordination Drawings: For piping and specialties including relation to other services in same area. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

C. Field Quality-Control Test Reports: From Contractor.

D. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in the “Closeout Submittals” section in Division 01, include the following:
   1. Valves.
   2. Backflow preventers.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with standards of NFPA and LACFD for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:
1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.07 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify College Project Manager not less than two weeks in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without written permission.
   3. If utility interruption is for more than eight hours, provide temporary utility service.

PART 2 - PRODUCTS

2.01 GENERAL

A. The following products shall be used as shown on the Drawings.

2.02 PVC PIPE AND FITTINGS

A. PVC pipe Class 235 – DR 14 conforming to AWWA C900. Pipe sections shall show NSF 61 stamp. Joints shall meet the requirements of ASTM D 3139 using a restrained rubber gasket conforming to ASTM F 477. Solvent welded pipe joints are not permitted.

2.03 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, Class 350 rated working pressure, thickness Class 50, with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
      a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Grooved-End, Ductile-Iron Pipe: AWWA C151, with one or both ends with cut rounded grooves according to AWWA C606.
   1. Ductile-Iron, Grooved-End Fittings: ASTM A 47, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
   2. Ductile-Iron-Piping Keyed Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

C. PIPE LINING
   1. Asphaltic Lining:
      a. Unless otherwise specified, pie and fitting shall be lined with asphaltic materials as specified in AWWA C151.
   2. Cement Mortar Lining:
      a. Where specified, interior surfaces of pipe and fittings shall be cement mortar lined in accordance with AWWA C104. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalies.

2.04 JOINING MATERIALS

A. Transition Couplings:
   1. Underground Piping, NPS 1-1/2 and Smaller: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
   2. Underground Piping, NPS 2 and Larger: AWWA C219, metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
   3. Aboveground Piping: Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Soldering Flux: ASTM B 813, water-flushable type.

D. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.

E. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.05 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, Polyethylene (PE) film, 0.008-inch minimum thickness, tube or sheet.

2.06 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   1. Manufacturers:
      a. American AVK Co.; Valves & Fittings Div.
      b. American Cast Iron Pipe Co.; American Flow Control Div.
      c. Crane Co.; Crane Valve Group; Stockham Div.
      d. Or equal.
   2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      a. Minimum Working Pressure: 200 psig.
      b. End Connections: Mechanical joint or flanged.
      c. Interior Coating: Complying with AWWA C550.

B. UL/FM, Cast-Iron Gate Valves:
   1. Manufacturers:
      a. American Cast Iron Pipe Co.; American Flow Control Div.
      b. Central Sprinkler Company.
      c. Crane Co.; Crane Valve Group; Stockham Div.
      d. Or equal.
   2. OS&Y, Rising-Stem Gate Valves: UL 262, FM-approved iron body and bonnet, bronze seating material, and outside screw and yoke.
      a. Minimum Working Pressure: 175 psig.

b. End Connections: Flanged.

C. Bronze Gate Valves:
1. Manufacturers:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Or equal
2. OS&Y, Rising-Stem Gate Valves: UL 262, FM-approved bronze body and bonnet, outside screw and yoke, and bronze stem.
a. Minimum Working Pressure: 175 psig.
b. End Connections: Threaded.
3. Ball valves: Ball valves shall be Apollo to match campus standards.

2.07 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine.
1. Manufacturers:
a. Grinnell Corporation; Mueller Co.; Water Products Div.
b. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
c. McWane, Inc.; Kennedy Valve Div.
d. Or equal
2. Tapping Sleeve: Cast- or ductile-iron or stainless steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
3. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, triangular cap with lettering "WATER", bottom section with base of size to fit over valve, and approximately 5-inch- diameter barrel.
1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FM-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.08 CHECK VALVES

A. AWWA Check Valves: As specified on the Drawings
1. Manufacturers:
a. American AVK Co.; Valves & Fittings Div.
b. American Cast Iron Pipe Co.; American Flow Control Div.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Or equal.

2.09 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:
   1. Elkhart Brass Mfg. Co., Inc.
   2. Grinnell Corporation.
   3. Guardian Fire Equipment, Inc.
   4. Or equal.

B. Exposed, Freestanding, Fire Department Connections: UL 405, cast-bronze body, with thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.
   1. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
   2. Inlet Alignment: Inline, horizontal.
   3. Finish Including Sleeve: Polished chrome plated or polished bronze as selected by the College Project Manager.
   4. Escutcheon Plate Marking: "AUTO SPKR."

2.010 BACK FLOW PREVENTOR

A. Contractor shall provide back flow preventors and double check assemblies as specified on the Drawings.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Refer to Section 31 23 33.

3.02 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
   1. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with keyed couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
   2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 2 Section "Utility Materials" for joining piping of dissimilar metals.

B. Provide stainless steel bolts, nuts and washers for piping both above ground and below ground.

3.03 PIPING INSTALLATION

A. Refer to Sections 312333 and 330500.

B. Provide concrete thrust blocks at pipe tees and bends as specified on the Drawings.

C. Unless otherwise specified by local code having jurisdiction, potable water shall maintain 10 foot horizontal and 1 foot vertical clearance from sanitary sewer pipe lines.

3.04 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FM Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

D. Water-Regulating Valves: Install aboveground between shutoff valves. Install reduced-size lockable valved bypass appropriate for demand. Provide valve suitable for throttling service such as globe or v-port ball valve. Under no circumstances will full-size gate valves be permitted for this service.

E. Relief Valves: Install aboveground with shutoff valve on inlet.

F. Detector Check Valves: Install aboveground.

3.05 DETECTOR CHECK VALVE INSTALLATION

A. Install detector check valves for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter. Provide tamper switch.

B. Support detector check valves, meters, shutoff valves, and piping on concrete piers.

3.06 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install fire department connections.

B. Install ball drip valves at each check valve for fire department connection to mains.

C. In areas near vehicle access, install protective pipe bollards on sides of each freestanding fire department connection to protect from accidental damage.

3.07 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Section 330500 – Installation of Buried Pipe for underground warning tapes.

B. Install solid copper tracer wire with all underground non-metallic piping.

3.08 CLEANING

A. Refer to Section 331300.

3.09 BACKFLOW PREVENTOR TESTING

A. Contractor shall perform all necessary back flow preventor and double check assembly testing and reporting to satisfy manufacturer specifications as well as Los Angeles County Health Department.

END OF SECTION

SECTION 33 13 00

DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the disinfection of potable water mains, services, appurtenances, and connections by chlorination, in accordance with AWWA C601 and as specified herein. Contractor to provide written copies of all test results from this section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Hydrostatic Testing of Pressure Pipelines: 331400.

1.03 JOB CONDITIONS

A. Potable water shall be used for chlorination. See Special Provisions section for availability of water.

B. Requests for use of water from the Owner's waterlines shall be submitted 48 hours in advance.

PART 2 - MATERIALS

2.01 LIQUID CHLORINE SOLUTION

A. Liquid chlorine solution shall be in accordance with the requirements of ANSI/AWWA B301, and shall be injected with a solution feed chlorinator and a water booster pump.

2.02 CALCIUM HYPOCHLORITE (DRY)

A. Calcium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300, and shall be dissolved in water to a known concentration in a container and pumped into the pipeline at a measured rate.

2.03 SODIUM HYPOCHLORITE (SOLUTION)

A. Sodium Hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300, and shall be diluted in water to desired concentration and pumped into the pipeline at a measured rate.

2.04 SODIUM HYPOCHLORITE TABLETS AND ADHESIVE

A. Chlorine Content: The tablets shall have an average weight of 0.009 pounds each and shall contain not less than 70% of available chlorine.

B. Adhesive: Adhesive shall be a type that will not impart taste, odor, or detrimental compounds to the water supply.

C. Storage: Proper care shall be taken to store hypo-chlorite tablets in tightly closed containers where they will not be accessible to children or unauthorized persons.

2.05 CHLORINE RESIDUAL TEST KIT

A. For measuring chlorine concentration, a medium range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs shall be used. The kit shall be capable of determining chlorine concentration in the range 1.0 to 25 mg/L. An adequate number of kits shall be maintained by the Contractor in good working order and available for immediate test of residuals at points of sampling.

PART 3 - EXECUTION

3.01 PROCEDURE

A. Contractor shall notify the College Project Manager two (2) working days prior to chlorination of facilities.

B. All require corporation stops and other plumbing materials necessary for chlorination or flushing of the main shall be installed by and at the expense of the contractor.

C. All mains shall be thoroughly flushed prior to disinfection.

D. Every connection served by a main being disinfected shall be tightly shutoff before water is applied to the main. Care shall be taken to expel all air from the main and services during the filling operation.

E. Water shall be fed slowly into the pipeline with chlorine applied in amounts to produce a dosage of not less than 50 ppm nor more than 100 ppm in all sections of the pipeline and appurtenances.

F. Treated water shall be retained in the system for a minimum of 24 hours and shall contain a chlorine residual of not less than 25 ppm at the end of the retention period in all sections being disinfected.

3.02 CONCURRENT TESTING

A. Disinfecting mains and appurtenances, and hydrostatic testing may run concurrently for the required 24-hour test period. In the event there is leakage and repairs are necessary, disinfection of the pipeline shall be repeated as provided in this section.

3.03 REPETITION OF PROCEDURE

A. If the initial chlorination fails to produce required residuals and bacteriologic tests, chlorination and testing shall be repeated until satisfactory results are obtained.

3.04 FLUSHING

A. After confirming the chlorine residual, excess chlorine solution shall be flushed from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water.

3.05 BIOLOGICAL TESTING

A. Samples from the newly disinfected facilities will be collected by the contractor and tested by a state certified laboratory. All facilities must successfully pass bacteriological tests prior to connecting to the existing system.

END OF SECTION

SECTION 33 14 00

HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

A. These specifications designate the requirements for field pressure and leakage testing of all new and replaced existing water mains intended for the conveyance of potable, fire water and reclaimed water under pressure. The Contractor shall furnish all labor, materials (including water), tools, and equipment necessary to provide and complete field testing as specified. All pipelines shall be tested for water tightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with the applicable requirements of AWWA C 600 except as modified herein.

1.02 SUBMITTALS

A. Hydrostatic test results shall be submitted for review and approval.

1.03 JOB CONDITIONS

A. For potable water pipelines, obtain and use only potable water for hydrostatic testing.

B. Submit request for use of water from waterlines to College Project Manager 48 hours in advance.

C. The testing shall be witnessed by the College Project Manager.

1.04 PAYMENT

A. The unit price paid for installation of pipe will include full compensation for furnishing the labor, materials, tools, and equipment, and doing all work involved in hydrostatic testing of pressure pipelines as specified herein.

PART 2 - MATERIALS

2.01 MANUAL AIR-RELEASE VALVES

A. Provide temporary manual air-release valves for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat equal to the adjacent pipe.

PART 3 - EXECUTION

3.01 TESTING AND DISINFECTION SEQUENCE

A. Perform required chlorination subsequent to hydrostatic testing, except when pipeline being tested is connected to a potable waterline.

B. The test shall be made prior to connecting the new line with existing pipe and mains. The test shall further be conducted with valves open, and the open ends of pipes, valves, and fittings suitably closed. Valves shall be operated and checked during to the test period. No leakage shall be allowed when testing across any valves.

3.02 INITIAL PIPELINE FILLING

A. Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by releasing air manually.

3.03 PRESSURE AND DURATION OF TEST

A. All pipe shall be tested at a hydrostatic pressure of 120 percent of maximum rated operating pressure of the pipe, but shall be not less than 200 psi.

B. When the system is pumped to the required test pressure, the pump shall be disconnected and maintain the test pressure for the following duration by restoring it whenever it falls an amount of 10 psi: pipe of 18 inches in diameter and smaller, 4 hours; over 18 inches to 36 inches in diameter, 8 hours; and over 36 inches in diameter, 24 hours.

C. Temporary or permanent thrust blocks shall be cast-in-place as required prior to tests, and the Contractor shall provide all necessary braces, plugs, thrust blocks, caps, flanges, and other materials to permit proper conduct of the pressure testing. Concrete blocks shall be cast not less than 5 days before the test.
   1. All concrete anchor blocks shall be allowed to cure a sufficient time to develop a minimum strength of 2,000 psi before testing, unless otherwise directed by the College Project Manager.

3.04 ALLOWABLE LEAKAGE

A. Permit one to three days for the filled pipeline to soak and to release entrapped air. Apply the test pressure with a positive displacement pump. Provide a snubber or dampener between the pump and the pipeline to reduce instantaneous pressure pulses to 10% of the specified test pressure. Draw from containers in which the volume of water can be readily measured or through a positive displacement meter. The amount of water used to maintain the test pressure during the test period is the leakage. Determine the allowable leakage by the following:

$$L = \frac{N*D(P)^{1/2}}{7,400}$$

where L is the allowable leakage in gallons per hour,
N is the number of pipe joints in the test section,
D is the inside pipe test diameter in inches,
P is the pipe test pressure (psi), which is defined as the average of the highest and lowest test pressures in the pipe section being tested.

*N does not include any flanged or welded joints.

3.05 REPETITION OF TEST

A. If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair at no additional cost to the college. All visible leakage shall be eliminated.

END OF SECTION

SECTION 33 30 00

SANITARY SEWER PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 SUMMARY

A. The locations of sewer rehabilitation work are listed and graphically shown in the Drawings. Replacement and construction locations provided in this document are approximate and based on record data that may or may not be accurate. The Contractor shall verify location of the sewer pipes prior to construction. Verification may be conducted by potholing, or surface measurement.

1.02 REFERENCES

A. Standard Specifications for Public Works Construction (SSPWC) “Greenbook” most current edition, including all supplements thereto issued prior to bid opening date, Exclusive of Part 1.

B. Standard Plans for Public Works Construction (most current edition)

C. Caltrans Standard Specifications, most current edition.

1.03 SUBMITTALS

A. General. The Contractor shall submit samples, drawings, and data for the Engineer's approval, which demonstrate fully that the construction, and the materials and equipment to be furnished will comply with the provisions and intent of these Plans and Specifications. Submittals shall be accompanied by a letter of transmittal and shall be in strict accordance with the provisions of this section. Submit priority of processing when appropriate.

1. Specific items to be covered by the submittals shall include, as a minimum, the following:

   a. Samples.

   b. Substitutions. The Contract is based on the materials, equipment, and methods described in the Contract Documents. All substitutions are subject to the Engineer's approval. The Engineer will consider proposals for substitution of materials, equipment, and methods only when full and complete technical data and all other information accompany such proposals as required by the Engineer to evaluate the proposed substitution.

   c. As-built drawings. The Contractor shall prepare the AS BUILT drawings. The Contractor shall deliver to the College one complete set of final AS BUILT hard copy drawings together with a set of AutoCAD drawing files on 3.5 inch diskettes showing completed construction, for the District records before the Contract will be accepted by the College.

B. Shop Drawings. All shop drawings shall be produced to a scale sufficiently large to show all pertinent features of the item and its method of connection to the work.

C. Submittals. Completely identify each submittal and resubmittal by showing at least the following information:
   1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
   2. Name of project as it appears in these Specifications and Specifications number.
   3. Drawing and Specifications section number other than this section to which the submittal applies.
   4. Whether this is an original submittal or resubmittal.

D. For samples, indicate the source of the sample.

1.04 PRODUCT HANDLING

A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Damaged pipe will be rejected on site. Contractor shall replace damaged pipe at no additional expense to the Owner.

B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warpage. Use protective covers where pipe may be damaged by direct sunlight.

1.05 INSPECTION

A. All materials furnished and work done under this Contract will be subject to rigid inspection. The Contractor shall furnish, without extra charge, the necessary test pieces and samples, including facilities and labor for obtaining them, as requested by the Engineer. The Engineer, or his/her authorized agent or agents, at all times shall have access to all parts of the shop and the works where such materials under his/her inspection is being manufactured or the work performed. Work or material that does not conform to these Specifications, although accepted through oversight, may be rejected at any stage of the work. Whenever the Contractor is permitted or directed to do night work or to vary the period during which work is carried on each day, he/she shall give the Engineer due notice, so that inspection may be provided. Such work shall be done under regulations to be furnished in writing by the Engineer.

B. There will be no charges for the inspection of overtime work ordered by the Engineer or required by these Specifications.

PART 2 - PRODUCTS

2.01 PIPE

A. PVC gravity – Pipe shall meet the requirements of ASTM D3034 and have a rating of either SDR 26 or SDR 35 (size of pipe and rating to be provided shall be as shown on Drawings). Pipe shall be in accordance to subsection 207-16 of the Standard Specifications for Public Works Construction. Pipe shall be for sewer mains and shall be colored green.

2.02 JOINTS AND FITTINGS

A. All fittings including 1/8 bends shall be gasket push-on type.

B. Elastomeric Gasket Joint: Manufacturer's standard. Integrally formed bell, push-fit, rubber gasketed joint system.

C. Lubricant: Manufacturer's standard.

D. Fittings: Size, grade, joint type, and lining to match pipe, and as recommended by the pipe manufacturer.
   1. PVC fittings shall meet the requirements of ASTM D3034, SDR 35, and shall have gasketed joints. Manufacturers: GPK Products; Vassiallo; or equal.
   2. DIP fittings shall conform to AWWA standard C-110, standard outside coating and cement mortar lining. Joints shall conform to AWWA standard C-111, mechanical or push-on joints.

E. Pipe Joints.
   1. PVC pipe shall have elastomeric gasket joints in accordance with Subsection 207-17.3.2 of the Standard Specifications. Joints in accordance with ASTM D312.
   2. DIP joints shall conform to AWWA standard C-111, mechanical or push-on joints.

2.03 COUPLINGS FOR DISSIMILAR PIPES

A. Transition type couplings shall be factory manufactured to ensure tight fit and smooth flow transition at the joint. Poured concrete collar and similar coupling methods will not be accepted.

2.04 STRUCTURES FOR SEWERS

A. Manholes shall be constructed at locations shown on the plans in accordance with the plans and specifications.

B. The Contractors attention is directed to Sections 70 1.02E, "Miscellaneous Iron and Steel," 70 1.02F, "Reinforcement," 70 1.02G, "Concrete," 70 1.02H, "Precast Concrete Structures," and 70 1.02L, "Excavation and Backfill" of the Caltrans Standard Specification for which the construction and installation of manholes and inlets will apply.

C. Brick: Brick for manholes shall conform to ASTM C 32 Grade SS or SM.

D. Concrete: All concrete shall be Class N-5.5 (f'c equal 3000 psi) (f'c equal 20.7 megapascals), air entrained and shall conform to ASTM C94 for ready mixed concrete.

E. Mortar and Plaster: Mortar and plaster for masonry manholes shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in the amount of not more than 25% of the volume of cement.

F. Backfill: Granular fill used as backfill shall conform to fill requirements specified in Section 312333, TRENCHING, BACKFILLING, AND COMPACTION.

G. Reinforcing Steel: Reinforcing steel shall be deformed bars except where otherwise noted on Drawings and conform to ASTM A 615, Grade 40.

H. Manhole steps shall be not less than 14 inches in width, built into and anchored in the walls and spaced uniformly 12 inches apart. The top step shall be 12 inches max below the top surface and the bottom step shall be 16 inches max above the floor. Steps will not be required unless the depth from cover of manhole or inlet to invert of main sewer exceeds 4 feet.

PART 3 - EXECUTION

3.01 GENERAL

A. The contractor shall provide all labor, materials, tools, equipment, and services required for the complete and proper completion of all the work as shown on the drawings and/or outlined in these specifications.

B. Work shall include items not specifically mentioned herein or noted on plans but necessary to make a complete working installation of all systems shown or described herein.

C. During construction of sanitary sewer facilities, existing sewage flow shall be maintained and conveyed in a watertight manner downstream of the work area.

D. All excavation spoils and existing pipelines to be replaced shall be removed from the job site and disposed of at a legal disposal site.

E. Construct the gravity sewer system, complete with appurtenances, to the lines and grades shown.

3.02 TRENCHING

A. Refer to Section 31 23 33.

3.03 BEDDING

A. Refer to Section 31 23 33.

3.04 INSTALLATION

A. Inspection: Inspect pipe for defects before lowering into the trench. Defective, damaged, or unsound pipe will be rejected.

B. The existing sanitary sewer line shall be kept operational until the new line is finished and connected.

C. Laying: After the trench bottom has been properly prepared for pipe installation as specified in Section 330500, lay pipe upgrade with the spigot ends pointing in the direction of flow. Lay each length true to line and grade, to form smooth joint transitions and to prevent sudden offsets of the flow line.

D. Cleaning: As work progresses, clear the sewer pipe interior of dirt and other debris by keeping swabs in the pipe and pulling them forward past each completed joint.

E. Pipe Cutting: Cutting for closure or other reasons shall be done neatly by methods recommended by the manufacturer. Sharp edges shall be smoothed to prevent gasket damage.

F. Jointing: Clean gaskets and seats of foreign materials prior to joint assembly. Apply lubricant as recommended by the pipe manufacturer.
   1. Push On Joint: Carefully insert the spigot end into the bell to prevent entry of dirt and incorrect entry angle. With suitable fork tool, crowbar, or by hand, make the joint to the insertion depth recommended by the manufacturer. When the selected pipe uses joints not designed for full depth insertion, prevent further closure of previously completed joints by restraining movement of the installed line while making succeeding joints.
   2. Mechanical Joint: Carefully center the spigot in the bell and position the gasket evenly in the seat. Tighten bolts alternately to an even torque, causing the follower gland to expand the gasket uniformly for a tight seal.
   3. Plain End Jointing: Install factory made couplers in accordance with manufacturers' directions. Center the coupling collar over the joint and tighten bolts or bands evenly.

G. Manholes:
   1. General. Construct manholes of brick or concrete with cast iron frames and covers, and in accordance with the Drawings, Standard Drawings, and provisions of the specifications. Precast reinforced concrete manholes conforming to ASTM C 478 will be acceptable subject to submission and approval of the Shop Drawings. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Make changes in size and grade of the channels gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base, or may be built up with brick and mortar or may be half tile laid in concrete, or may be constructed by laying full-section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Any material excavated beneath pipe entering and leaving manholes and inlets shall be replaced with concrete. Such concrete fill shall extend to the center of pipe for a distance of at least 3 feet from face of manhole and inlet and shall terminate at a joint.
   2. Jointing and Plastering. Fill mortar joints completely and make them smooth and free from surplus mortar on the inside of the manhole. Plaster brick manholes with half inch of mortar over the entire outside surface of walls. Lay brick radially with every sixth course laid as a stretcher course. When precast concrete manhole sections are used, set each section in a fresh bed of mortar to make a mortar joint with a minimum thickness of 1/8 inch. Point up all joints inside and out.
   3. Frames and Covers. Set the cast iron manhole frame in a bed of mortar and adjust to the elevations shown on the Drawings.
   4. Inspection manholes, branch connections and elbows on large diameter pipe shall be built to conform to details indicated on the Drawings.

3.05 PRESERVATION, REMOVAL, AND ABANDONMENT

A. Where a pipe or other facility is shown on the plans but is not to be replaced, the Contractor shall take precautions as necessary to not disturb the existing facilities during the course of construction. The Contractor may elect to remove existing facilities and replace it with new facility at locations where it is not feasible to preserve existing facility.

B. Where it is shown on the plans that existing sewer pipe or manhole is to be removed, the Contractor shall remove the facility in its entirety and back fill per the typical trench section detail and compacted to achieve minimum densities as shown on the typical trench section.

C. At locations on the plans where existing pipes are to be abandoned, the Contractor shall neatly cut the pipe to be abandoned, fill with grout, and construct a water tight brick and mortar plug with smooth grout all around.

3.06 BACKFILLING OF SELECT MATERIAL

A. Refer to Sections 31 23 00 and 31 23 33.

3.07 FINAL PIPE CLEANING

A. Prior to testing, clean all lines to be tested by high pressure water jet or mechanical means. Remove and dispose of fluidized material as approved.

3.08 TESTING

A. General: All gravity sewer pipes and service laterals shall be tested for exfiltration and/or infiltration and deflection, as specified. All maintenance holes shall be tested for leakage, as specified. Maintenance holes shall be tested prior to backfill placement, whereas all pipe shall be backfilled prior to testing. All leakage tests of sanitary sewer systems shall be in conformance with SSPWC Section 306-1.4.1. For pressure sewers (force main) tests), the water pressure shall be measured at the lowest point of the pipeline section being tested.

B. Water Exfiltration Test shall be in conformance with SSPWC Section 306-1.4.2.

C. Water Infiltration Test shall be in conformance with SSPWC Section 306-1.4.3. Unless otherwise specified, infiltration will be measured by the contractor using measuring devices approved by the engineer.

D. Air Pressure Test shall be in conformance with SSPWC Section 306-1.4.4.

E. Water Pressure Test shall be in conformance with SSPWC Section 306-1.4.5.

F. Deflection Test: All flexible and semi-rigid main line pipe shall be tested in accordance with SSPWC Sections 306-1.2.12 and 306-1.2.13 for deflection, joint displacement, or any other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30 days after completion of the trench backfill, but prior to permanent resurfacing.

G. All sewer maintenance holes shall be hydrostatically tested for leakage after installation, but prior to being backfilled. Prior to hydrostatic testing, all maintenance holes shall be visually inspected for leaks. All leaks or cracks shall be repaired by the contractor, prior to hydrostatic testing, to the satisfaction of the engineer and the inspector. All pipes entering the maintenance hole shall be sealed at a point outside the maintenance hole walls so as to include testing of the pipe/maintenance hole joints. The maintenance hole shall be filled with water to a level 2 inches below the top of the frame. Safety lines shall be secured to all plugs utilized. After a period of at least one hour to allow the water level to stabilize, the maintenance hole shall be refilled and the water level shall be checked. The water level shall again be checked after a period of 4 hours. If the water level is reduced by more than 1/4-inch, the leakage shall be considered excessive, and the contractor shall be required to make all necessary repairs and retest the maintenance hole. The exterior of the maintenance hole shall be inspected during this period for visible evidence of leakage. Visible moisture, sweating, or beads of water on the exterior of the maintenance hole shall not be considered leakage, but any water running across the surface will be considered leakage and shall be repaired to the satisfaction of the College Project Manager and the engineer regardless of the volume of water lost.

END OF SECTION

SECTION 33 40 00

STORM DRAINS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all storm drains as shown on the Drawings and as specified herein, complete.
   1. Drainage grates shall have maximum ½" openings perpendicular to the path of travel per CBC 11B-302.3.

B. Work Specified in Other Sections:
   1. Section 31 23 33: Trenching, Backfilling, and Compaction.
   2. Section 33 05 00: Installation of Buried Pipe

1.02 RELATED DOCUMENTS

A. Drawings, Specifications and provisions of Construction Contract, including General, Special and Supplementary Conditions and other General Requirements.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of the specified materials, quantity and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Material Testing: Refer to Division 01.

C. Allowable Tolerances: The allowable dimensional alignment for gravity sewers shall be as follows:
   1. Vertical: + 0.02 feet
   2. Horizontal: + 0.50 feet

1.04 SUBMITTALS

A. Refer to Section Div. 01 for procedures.

B. Test Reports: Contractor's testing agency will report all results of the tests to College's Representative who will approve or disapprove Contractor's work.

C. The following tests shall be performed by Contractor's testing agency:
   1. Closed circuit TV inspection video tape and report, if used.

D. Shop Drawings and Product Data: The following list includes the required shop drawings and samples that shall be submitted.
   1. Storm drain pipe and fittings.
   2. Cast iron or ductile iron castings.
   3. Manholes and structures.

4. Television inspection, video tapes, if used.

E. Certificates: Furnish manufacturer's certified analysis or certificate of compliance for all shipments of pipe, cast iron frames, grates and covers, valves and other miscellaneous material.

F. Record Documents: At closeout, submit Record Drawings of installed utility piping and products, in accordance with Division 01.

1.05 JOB CONDITIONS

A. All drains shall be connected to the building service at a point 5 feet outside the building unless otherwise indicated.

B. Protection of Existing Utilities Structures: Protect the existing utilities shown on the Drawings, or the locations of which are known prior to excavation, from damage during excavation and backfilling of trenches and, if damaged, repair them at Contractor's expense.

C. Removal of Utilities: All utilities indicated to be removed or abandoned shall be removed or abandoned in accordance with the requirements of the codes, as listed in Division 01.

D. The Drawings are diagrammatic, but shall be followed as closely as actual construction permits. All deviations from the Drawings required to make work conform to the site conditions, and to Work of others, shall be made only as necessary as approved by the Contractor and Engineer. The Sub-Contractor shall verify all dimensions prior to starting work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Brick: Brick for manholes shall conform to ASTM C 32 Grade SS or SM.

B. Concrete: All concrete shall be Class N-5.5 (f'c equal 3000 psi) (f'c equal 20.7 megapascals), air entrained and shall conform to ASTM C94 for ready mixed concrete.

C. Mortar and Plaster: Mortar and plaster for masonry manholes shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in the amount of not more than 25% of the volume of cement.

D. Inlet Covers and Grates: Area drain and atrium drain grates per Brooks Products, Kristar, or NDS Products or equal. Size as shown on Drawings.

E. Backfill: Granular fill used as backfill shall conform to fill requirements specified in Section 31 23 33, TRENCHING, BACKFILLING, AND COMPACTION.

F. Reinforcing Steel: Reinforcing steel shall be deformed bars except where otherwise noted on Drawings and conform to ASTM A 615, Grade 40.

G. Manhole steps shall be not less than 14 inches in width, built into and anchored in the walls and spaced uniformly 12 inches apart. The top step shall be 12 inches max below the top surface and the bottom step shall be 16 inches max above the floor. Steps will not be required unless the depth from cover of manhole or inlet to invert of main sewer exceeds 4 feet.

H. Storm Drain:
   1. Pipe. Use one of the following as shown on the Drawings:
      a. Reinforced Concrete Pipe (RCP) conforming to ASTM Standard C 76 and Subsection 207-2 of the Standard Specification, unless otherwise specified. Use the size, type, and D-load as shown on the Drawings. Pipe shall be spuntype pipe.
      b. High Density Polyethylene (HDPE) Pipe. HDPE Pipe shall be manufactured from a PE 3608 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D 3350 with a cell classification of 345464C. Pipe shall have a manufacturing standard of ASTM F 714. Pipe shall be DR 17 (100psi WPR) unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Manufacturers: ISCO industries, Inc. or equal.
      c. Ductile Iron Pipe (DIP) Class 350 meeting ANSI thickness CL52. Use the size and type as shown on the Drawings. Polyethylene encasement per AWWA C105-10. Manufacturers: Pacific States; U.S. Pipe; American Pipe; or equal.
   2. Pipe Joints.
      a. RCP joints shall be tongue and groove, mortar type of joint. Provide water tight joints where shown on Drawings.
      b. HDPE pipe shall have elastomeric gasket joints in accordance with Subsection 207-17.3.2 of the Standard Specifications. Joints in accordance with ASTM D312.
      c. DIP joints shall conform to AWWA standard C-111, mechanical or push-on joints.
      d. Pipe Fittings.
      e. HDPE fittings shall meet the requirements of ASTM D3034, DR 17, and shall have gasketed joints. Manufacturers: GPK Products; Vassiallo; or equal.
      f. DIP fittings shall conform to AWWA standard C-110 and C105-10, polyethylene outside coating and cement mortar lining. Joints shall conform to AWWA standard C-111, mechanical or push-on joints.

PART 3 - EXECUTION

3.01 GENERAL

A. All products specified herein and shown on the Drawings shall be installed per manufacturer’s instructions.

3.02 SYSTEM LAYOUT

A. Layout the system determining proper elevations for all components from the lines and grades shown on the Drawings.

3.03 EXCAVATING, BACKFILLING, AND COMPACTING

A. Perform excavating, backfilling, and compacting for the pipe and structures in accordance with the provisions of Section 312333 of the Specifications.

3.04 INSTALLATION

A. Pipe:
   1. Laying Pipe. Shape the bottom of the trench by hand to give uniform circumferential support to the lower fourth of each pipe. Where applicable, pipe laying shall proceed upgrade with the tongue or spigot ends pointing in the direction of the flow. Each pipe shall be laid true to line and grade indicated on the Drawings and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the low line. As the work progresses, clean the interior of the pipe of all dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, keep a swab or drag in the pipe and pull forward past each joint immediately after the joining has been completed. If the maximum width of the trench at the top of the pipe as specified is exceeded, install such concrete cradling, pipe encasement or other bedding as approved by College's Representative to support the added load of the backfill. Keep trenches for all sections of the pipe free from water until the pipe-jointing material has set and the trench has been backfilled. Do not lay pipe when the condition of the trench or the weather is unsuitable for such work. At times when the work is not in progress, keep open ends of pipes and fittings securely closed so that no trench water, earth or tamped backfill, can enter. Encase the pipe in concrete or support it on a concrete cradle as approved.
   2. Pipe Joints.
      a. HDPE Pipe. Pulling of joints or beveling pipe ends to achieve curvature will not be permitted.
      b. Ductile Iron Pipe. Install ductile iron pipe in accordance with the provisions of AWWA C-600, except that provisions relating only to pipe under pressure, such as thrust restraint, hydrostatic testing etc., or to disinfection, need not be followed. Encase all cast or ductile iron pipe in 8-mil thick polyethylene film in accordance with AWWA C105-10.
      c. Reinforced Concrete Pipe. Install the rubber gaskets, if any, in accordance with the printed recommendations of the joint manufacturer.
   3. Connection to Existing Pipe. Make connections to existing pipe by the use of one of the joints described above where possible to do so. Where the end of the existing pipe is broken or a standard joint is otherwise impracticable, install a concrete collar to make the connection.
   4. Connection to Existing Manholes. Make pipe connections to existing manholes in such a manner that the finished work will conform to the essential applicable requirements for new manholes, including all necessary concrete work, cutting and shaping.

5. Wye Branches. Install commercially manufactured wye branches where indicated on the Drawings. Cutting into the pipe for connections will not be permitted except as approved by College's Representative.
   a. Pipe Plugs. Plug all open ends of wye branches with a manufactured stopper installed in accordance with provisions for jointing. Plug open ends of sewer pipe with a manufactured stopper or concrete masonry. Concrete masonry plugs shall have a minimum thickness of 4 inches. Install all plugs so that the open end of the pipe is permanently sealed but can be removed for future extensions without damaging the pipe.
6. Jacking Pipe. Jack pipe into place at the locations shown with the minimum lengths of jacked pipe as shown on the Drawings. At Contractor's option, install additional pipe beyond these limits by jacking methods, at no additional cost to College. Prevent damage to the pipe being jacked. A corrugated metal casing pipe may be jacked in place ahead of the carrier pipe where direct jacking is not possible or where called for on the Drawings. Fill the space between the carrier pipe and the casing pipe completely with sand after the carrier pipe has been aligned.
   a. Remove materials excavated during the jacking operation so as to prevent cave-in or flow of material into the pipe. Provide shoring to prevent any damage to any facilities above or below ground. Promptly repair any damage that may occur at Contractor's expense.
   b. Jacking operations shall be continuous from the time that the jacking operation is started until it is completed.

B. Manholes:
1. General. Construct manholes of brick or concrete with cast iron frames and covers, and in accordance with the Drawings, Standard Drawings, and provisions of the specifications. Precast reinforced concrete manholes conforming to ASTM C 478 will be acceptable subject to submission and approval of the Shop Drawings. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Make changes in size and grade of the channels gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base, or may be built up with brick and mortar or may be half tile laid in concrete, or may be constructed by laying full-section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Any material excavated beneath pipe entering and leaving manholes and inlets shall be replaced with concrete. Such concrete fill shall extend to the center of pipe for a distance of at least 3 feet from face of manhole and inlet and shall terminate at a joint.
2. Jointing and Plastering. Fill mortar joints completely and make them smooth and free from surplus mortar on the inside of the manhole. Plaster brick manholes with half inch of mortar over the entire outside surface of walls. Lay brick radially with every sixth course laid as a stretcher course. When precast concrete manhole sections are used, set each section in a fresh bed of mortar to make a mortar joint with a minimum thickness of 1/8 inch. Point up all joints inside and out.

3. Frames and Covers. Set the cast iron manhole frame in a bed of mortar and adjust to the elevations shown on the Drawings.
4. Inspection manholes, branch connections and elbows on large diameter pipe shall be built to conform to details indicated on the Drawings.

C. Inlets and Junction Boxes: Construct inlets and junction boxes of the materials and to the exact dimensions and grades shown on the Drawings. Finish surfaces smooth and true. Expansion joint filler shall be preformed bituminous treated fiberboard conforming to ASTM D 994, Type III.

D. Pumps:
1. Basin to be cleaned thoroughly, with all water and debris removed prior to installing pumps.
2. Pumps shall be installed and assembled per manufacturer's instructions.

3.05 FIELD QUALITY CONTROL

A. Contractor Checking and Inspection:
1. Storm Drains
a. General. Work performed and materials furnished and installed, as shown on the Drawings or required by the Specifications, shall be subject to review by the Contractor. Provide College's Representative with unrestrictive access to the Work during construction to allow him the opportunity to review materials and workmanship. Comply with Div 01.
b. The storm drain pipe shall be checked by the Contractor when backfill has reached the top of the pipe. Both internal and external inspections for alignments shall be made at this time. The Sub-Contractor shall correct at his expense, to the Contractors' satisfaction, any section of the line found to be unsatisfactory in material, alignment, grade, or joints.

3.06 ADJUSTMENT AND CLEANING

A. Pavement Repair:
1. Where necessary to cut pavements, drives, sidewalks or other permanent surfaces, the cuts shall be made with neat lines at least 1 foot wider than the trench. Cut material shall be disposed of by Contractor.
a. The surfaces that are cut shall be restored to the condition specified before the cut was made. Keep streets open for use and also keep portions of driveways open for use.
2. Concrete for repair work shall be as specified in Section 321313, SITEWORK CONCRETE. Concrete shall be finished to match surrounding surfaces.

3.07 FINAL ACCEPTANCE

A. Final acceptance of the project shall be contingent upon the satisfactory completion of backfilling, surface repairs, passage of final tests and furnishing "as-builts" Record Drawings showing any deviations from the Drawings.

B. The Sub-Contractor shall be liable for any failure of storm drain or sanitary sewer facilities installed by him for a period of one year after the date of final acceptance.

END OF SECTION

SECTION 33 41 00

SUB DRAINAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Provide all sub drainage as specified herein, complete.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Subsoil Drainage Piping: PVC:
   1. PVC perforated pipe, ASTM D3034-81.
   2. Standard specifications for Public Works Construction 207-1.7.

B. Filter Fabric:
   1. Non woven, geotextile fabric of polypropylene or polyester fibers.
   2. Grab tensile strength: 120 pounds minimum, ASTM D1682.
   3. Grab tensile elongation: 55 percent, minimum, ASTM D1682.
   4. Mullen burst strength: 200 psi minimum.
   5. Water flow rate: 150 gpm/sf minimum.
   6. Washed equivalent opening size: 80 120.

C. Coarse Drainage Fill: Clean, well graded, crushed stone, free from shale, clay, organic materials or debris, graded to the following limits:

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	90 to 100
3/4 inch	55 to 85
3/8 inch	8 to 20
No. 4	0 to 5
No. 8	0 to 5
No. 200	0 to 2

D. Fine Drainage Fill: Clean, natural sand; free from silt, clay, organic matter or soluble materials; graded within the following limits

Sieve Size	Percent Passing
No. 4	100
No. 14	10 to 100
No. 100	4 to 30
No. 200	0

E. Fill Material:
   1. Coarse Aggregate: Refer to Section 31 23 00 Earthwork.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Subsoil Drainage Piping:
   1. Install tubing, piping, and pipe fittings in accordance with manufacturer's instructions.
   2. Place pipe sections on filtering aggregate material and complete joints. Ensure pipe perforations are installed downwards.
   3. Lay pipe to slope gradients indicated, with maximum variation from true slope of 1/8 inch in 10 feet.
   4. After testing drain lines, install coarse filter aggregate at sides and over top of tubing. Provide top cover compacted thickness of 12 inches adjacent to foundation.
   5. Place drainage in fill in maximum 4 inch lifts, consolidating each lift.
   6. Increase compaction of each successive lift. Refer to Section 02300 for compaction requirements. Do not displace or damage pipe when compacting.
   7. Connect to storm sewer system with unperforated pipe.
   8. Place filter fabric over drainage fill aggregate to prevent dirt infiltration.

B. Subsurface Drainage Mats:
   1. Install in accordance with manufacturer's written instructions for vertical surfaces with fabric placed on top of core and flat side of core placed against waterproofing protection board.
   2. Lap ends of core and filter fabric 3 inches and secure in place with manufacturer's approved system.
   3. Install mat over waterproofing with seams overlapped in direction of waterflow.
   4. Prior to placement of backfill, inspect drainage mat for defects, voids or displacement. Repair or replace as necessary to provide complete coverage.
   5. Extend and wrap fabric around foundation drainage pipe in accordance with mat manufacturer's recommendations.
   6. Protect in place matting during backfill operations in accordance with matting manufacturer's instructions.

END OF SECTION

SECTION 33 90 00

UTILITY CROSSINGS AND CONNECTIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Where utilities cross the pipeline trench but do not conflict with the permanent work to be constructed, the Contractor shall follow the procedures given below and as indicated on the Plans and in the Special Provisions. The Contractor shall notify the utility owner 48 hours in advance of the crossing construction and will coordinate the construction schedule with the utility service requirements. For utility crossings not shown on the Plans, follow the General Provisions and the instructions of the College Project Manager.

1.02 UTILITIES LOCATIONS AND POTHOLES

A. It shall be the Contractor's responsibility to determine the true location and depth of all utilities and service connections which may be affected by or affect the work. Contractor shall also determine the type, material, and conditions of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, tying in existing utilities, order materials, and take over appropriate measures to ensure that there is no delay in work, the Contractor shall field verify and pothole the utilities with potential conflict one week in advance of the pipeline construction. The contractor shall pothole the existing utilities where it deems necessary, including but not limited to that shown on the plans. All costs incurred in exposing utilities shall be included in the Contract proposal.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION

3.01 PROTECT IN PLACE

A. The Contractor shall protect all utilities in place, except those which need to be removed and replaced, and shall maintain the utility in service, unless otherwise specified on the Plans or in the Special Provisions.

B. When installing the pipe across an existing utility, a minimum 12-inch vertical clearance shall be maintained. If a minimum of 12-inch clearance is not achievable then the Engineer of Record shall be notified to determine if plan revisions are necessary.

3.02 CUT AND PLUG ENDS

A. The Contractor shall cut abandoned utility lines and plug the ends with same material of pipe or fittings, unless noted otherwise, and block with concrete thrust blocks, unless otherwise specified on the Plans or in the Special Provisions. The pipe shall be properly disposed of as unsuitable material by the Contractor.

3.03 TIE-IN TO EXISTING UTILITIES

A. A. Prior to fabrication of a new pipe and its appurtenances, which are to be connected to existing line, the Contractor shall field pothole the existing pipeline at and near the point of connection. The pothole verification shall include, but not be limited to vertical and horizontal location, size, O.D., material, pressure class and slope of the existing pipe.

3.04 SHUTDOWN OF EXISTING FACILITIES FOR REMOVAL AND NEW PIPE CONNECTION

A. The Contractor shall coordinate his work with the College Project Manager at least 48 hours in advance on the date and hour of his scheduled tie-in operation. Prior to the tie-in operation, the Contractor shall make arrangements to ensure the emergency equipment is available in the event the need arises, and identify and ensure all necessary construction materials and equipment for the tie-in operation are readily available at job site, unless noted otherwise.

B. The allowable shut-down duration for the existing water main is 8 hours maximum, unless noted otherwise.

3.05 REMOVE AND RECONSTRUCT

A. Where so indicated on the plans or in the Special Provisions or as required by the College Project Manager, the Contractor shall remove the utility and after passage, reconstruct it with new materials. The Contractor shall take appropriate measures to provide temporary service for the disconnected utility. All reconstruction work shall be in accordance with the applicable specifications.

END OF SECTION