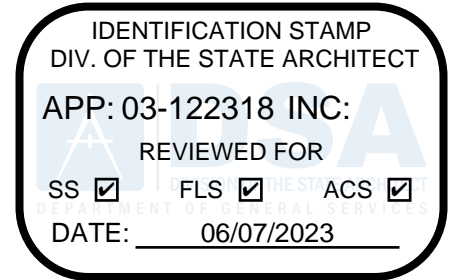


SPECIFICATIONS
FOR THE
VENTURA COMMUNITY COLLEGE DISTRICT

WAM DIESEL SHOP RENOVATION

AT

VENTURA COLLEGE
4667 Telegraph Rd,
Ventura CA 93003
In the Ventura Community College District



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TESTING AND INSPECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing and inspection services to meet requirements of the California Building Code (CBC) and the Division of the State Architect (DSA).
- B. Related Requirements:
 - 1. Section 03 2000 – Concrete Reinforcing.
 - 2. Section 03 3000 – Cast-in-Place Concrete.
 - 3. Section 05 1200 – Structural Steel Framing.
 - 4. Section 06 1000 – Rough Carpentry.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
- B. American Institute of Steel Construction (AISC):
 - 1. AISC 360 – Specification for Structural Steel Buildings.
 - 2. AISC 341 – Seismic Provisions for Structural Steel Buildings.
- C. ASTM International (ASTM):
 - 1. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 2. ASTM A370 – Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
 - 3. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

4. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 5. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 6. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 7. ASTM C1140 - Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels.
 8. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
 9. ASTM C1604 - Standard Test Method for Obtaining and Testing Drilled Cores of Shotcrete.
 10. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
 11. ASTM E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
 12. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing.
 13. ASTM E605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
 14. ASTM E1444 - Standard Practice for Magnetic Particle Testing.
 15. ASTM F606 - Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets.
- D. Association of the Wall and Ceiling Industry (AWCI):
1. AWCI Technical Manual 12-B - Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials; an Annotated Guide.
- E. American Welding Society (AWS):
1. AWS D1.1 – Structural Welding Code.
 2. AWS D1.4 – Structural Welding Code – Reinforcing Steel.

3. AWS D1.8 – Structural Welding Code – Seismic Supplement.
- F. Division of the State Architect (DSA) Interpretation Regulations (IR):
1. DSA IR 17-2 – Nondestructive Testing (N.D.T.) of Welds.
 2. DSA IR 17-3 – Structural Welding Inspection.
 3. DSA IR 17-10 – Sampling, Testing and Tagging of Reinforcing Bars.
 4. DSA IR 17-11 – Identification, Sampling and Testing of Threaded Steel Anchor Bolts and Anchor Rods.

1.03 REGULATORY REQUIREMENTS

- A. Laboratories performing testing shall have DSA’s Laboratory Evaluation and Acceptance Program approval prior to providing material testing or special inspection services.
- B. Tests of materials and inspections shall be in accordance to Section 4-213 through 4-219 of the California Building Standards Commission’s, California Administrative Code.
- C. Required material testing, inspections and special inspections are indicated on the DSA approved DSA-103, Listing of Structural Tests & Special Inspections (T&I List). OAR will provide CONTRACTOR copy of DSA-103.

1.04 TESTS

- A. OWNER will contract with a DSA approved testing laboratory to perform the testing indicated on the Contract Documents, including the Tests and Special Inspections (T&I) list.
- B. Selection of material to be tested shall be by the Testing Laboratory and not by CONTRACTOR.
- C. Any material shipped from the source of supply prior to having satisfactorily passed such testing and inspection, or prior to the receipt of notice from Project Inspector such testing and inspection is not required, shall not be incorporated into the Work.
- D. OWNER will select, and directly reimburse, the Testing Laboratory for costs of all DSA required tests and inspections; however, the Testing Laboratory may be reimbursed by CONTRACTOR for such costs as specified or noted in related sections of the Contract Documents.

- E. The Testing Laboratory is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
- F. The Testing Laboratory shall not perform any duties of CONTRACTOR.
- G. CONTRACTOR shall provide an insulated curing box with the capacity for twenty concrete cylinders and will relocate said box and cylinders as rapidly as required in order to provide for progress of the Work.

1.05 TEST REPORTS (Copies of reports shall be given to the Owner, Architect, Project Inspector, and DSA)

- A. Test reports shall include all tests performed, regardless of whether such tests indicate the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations, when and as required, shall also be reported. Reports shall indicate the material (or materials) was sampled and tested in accordance with requirements of CBC, Title 24, Parts 1 and 2, as indicated on the Contract Documents. Test reports shall indicate specified design strength and specifically state whether or not the material (or materials) tested comply with the specified requirements.

1.06 VERIFICATION OF TEST REPORTS

- A. Each Testing Laboratory shall submit to the Division of the State Architect, in duplicate, a verified report covering all tests required to be performed by that agency during the progress of the Work. Such report, covering all required tests, shall be furnished prior to Substantial Completion and/or, when construction on the Work is suspended, covering all tests up to the time of Work suspension.

1.07 INSPECTION BY OWNER

- A. OWNER, and its representatives, shall have access, for purposes of inspection, at all times to all parts of the Work and to all shops wherein the Work is in preparation. CONTRACTOR shall, at all times, maintain proper facilities and provide safe access for such inspection.
- B. OAR shall have the right to reject materials and/or workmanship deemed defective Work and to require correction. Defective workmanship shall be corrected in a satisfactory manner and defective materials shall be removed from the premises and legally disposed of without charge to OWNER. If CONTRACTOR does not correct such defective Work within a reasonable time, fixed by written notice and in accordance with the terms and conditions of the Contract Documents, OWNER may correct such defective Work and proceed in accordance with related Articles of the Contract Documents.

- C. CONTRACTOR is responsible for compliance to all applicable local, state, and federal regulations regarding codes, regulations, ordinances, restrictions, and requirements.

1.08 PROJECT INSPECTOR

- A. A Project Inspector will be employed by OWNER in accordance with requirements of Title 24 of the California Code of Regulations with their duties specifically defined therein. Additional DSA Special Inspectors may be employed and assigned to the Work by OWNER in accordance with the requirements of the CBC and DSA.
- B. Inspection of Work shall not relieve CONTRACTOR from any obligation to fulfill all terms and conditions of the Contract Documents.
- C. CONTRACTOR shall be responsible for scheduling times of inspection, tests, sample taking, and similar activities of the Work.

1.09 STRUCTURAL TESTS AND SPECIAL INSPECTIONS

- A. Soils:
 - 1. General: Periodic inspection by Geotechnical Engineer for verification of the following construction activities in conformance to CBC Table 1705A.6:
 - a. Site has been prepared properly prior to placement of controlled fill and/or excavations for foundations.
 - b. Foundation excavations are extended to proper depth and have reached proper material.
 - c. Materials below footings are adequate to achieve the design bearing capacity.
 - 2. Compacted Fills: Testing and inspections shall be in conformance to Table 1705A.6:
 - a. Geotechnical Engineer will continuously verify the use of proper materials and inspect lift thicknesses, placement, and compaction during placement of fill.
 - b. Testing Laboratory under the supervision of the Geotechnical Engineer will:
 - 1) Perform qualification testing of fill materials.

- 2) Test the compaction of fill.
3. Cast-in-place Deep Foundations (Piers): Continuous inspections by Geotechnical Engineer in conformance to Table 1705A.8:
 - a. Inspect drilling operations and maintain complete and accurate records for each pier.
 - b. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, and embedment into bedrock (if applicable). Record concrete or grout volumes.
 - c. Confirm adequate end strata bearing capacity.
 - d. Concrete Piers: Tests and inspections will be as indicated on paragraphs below for concrete.
- B. Concrete:
1. Cast in Place Concrete: Inspection and testing in conformance to CBC Table 1705A.3:
 - a. Inspection of reinforcement, including prestressing tendons and verification of placement, per ACI 318, sections 25.2, 25.2, 25.5.1 through 26.5.3.
 - b. Reinforcing bar welding: Inspect per AWS D1.4, ACI 318 26.5.4.
 - 1) Verification of weldability of reinforcing bars other than ASTM A706.
 - 2) Inspect single-pass fillet welds, maximum 5/16".
 - 3) Inspect all other welds.
 - c. Inspect anchors cast in concrete per ACI 318, section 17.8.2.
 - d. Inspect anchors post-installed in hardened concrete members:
 - 1) Continuous inspection of adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.
 - 2) Mechanical anchors and adhesive anchors, not defined in previous paragraph, per ACI 318, section 17.8.2.
 - e. Design Mix:

- 1) Verify use of required mix, per ACI 318, chapter 19 and sections 26.4.3 and 26.4.4.
 - 2) Batch Plant Inspection: The quality and quantity of materials used in transit-mixed concrete and in batched aggregates shall be continuously inspected as required by CBC section 1705A.3.2. If approved by DSA, batch plant inspection may be reduced to periodic if plant complies with CBC section 1705A3.3.1, item 1, and requires first batch inspection, weightmaster, and batch tickets.
- f. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete, per ASTM C172, ASTM C31, ACI 318, sections 26.4.5 and 26.12.
 - g. Inspect concrete and shotcrete placement for proper application techniques, per ACI 318, section 26.4.5.
 - h. Verify maintenance of specified curing temperature and techniques per ACI 318 sections 26.4.7 through 26.4.9 and CBC section 1908.9.
 - i. Inspect prestressed concrete for:
 - 1) Application of prestressing forces, per ACI 318 section 26.9.2.1
 - 2) Grouting of bonded prestressing tendons per ACI 318 section 26.9.2.3.
 - j. Inspection of erection of precast concrete members per ACI 318 chapter 26.8.
 - k. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs per ACI 318 section 26.10.1.b.
 - l. Sampling and testing of reinforcing steel per ASTM A370, DSA IR 17-10 and CBC section 1910A.2. CONTRACTOR shall submit mill certificate indicating compliance with requirements for reinforcement, anchors, ties, and metal accessories.
2. Post-installed Anchors:

- a. Special Inspector will inspect installation of post-installed anchors in hardened concrete members as required by CBC table 1705A.3, item 4.
 - 1) Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.
 - 2) Mechanical anchors and adhesive anchors not defined above, per ACI 318, section 17.8.2.
- b. Testing Laboratory will test post-installed anchors in conformance to CBC section 1905A and ASTM E488.

C. Structural Steel:

1. Special inspector will verify that all materials are properly marked in conformance with AISC 360, Section 3.3 and applicable ASTM standards.
 - a. Mill certificates indicating material properties that comply with requirements.
 - b. Materials, sizes, types and grades complying with requirements.
2. Testing Laboratory will test unidentified materials in conformance with ASTM A370.
3. Special inspector will examine seam welds of HSS shapes in conformance with DSA IR-17-3.
4. Special inspections and non-destructive testing of structural steel elements shall be in conformance to CBC section 1705A.2.1.

D. High Strength Bolts:

1. Special inspector will verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the Contract Documents, per DSA IR 17-9.
2. Testing Laboratory will test high-strength bolts, nuts and washers in conformance with ASTM F606, ASTM A370 and DSA IR 17-8.
3. Special inspector will inspect bearing-type ("snug tight") bolt connections in conformance with AISC 360, section M2.5 and DSA IR 17-9.
4. Special inspector will inspect slip-critical bolt connections in conformance with AISC 360, section M2.5.

E. Welding:

1. Verification of Materials, Equipment and Welders:
 - a. Special inspector will verify weld filler material identification markings per AWS designation listed on the Contract Documents and the WPS.
 - b. Special inspector will verify material manufacturer's certificate of compliance.
 - c. Special inspector will verify WPS, welder qualifications and equipment in conformance to DSA IR 17-3.
2. Shop Welding: Special inspector will inspect the following, per CBC 1705A.2.1, AISC 360 (and AISC 341, as applicable) and DSA IR 17-3:
 - a. Groove, multi-pass fillet welds larger than 5/16", plug and slot welds.
 - b. Single-pass fillet welds equal or less than 5/16".
 - c. Inspect welding of stairs and railing systems.
 - d. Verification of reinforcing steel weldability.
 - e. Welding of reinforcing steel, per AWS D1.4.
3. Field Welding: Special inspector will inspect the following, per CBC 1705A.2.1, AISC 360 (and AISC 341, as applicable) and DSA IR 17-3:
 - a. Groove, multi-pass fillet welds larger than 5/16", plug and slot welds.
 - b. Single-pass fillet welds equal or less than 5/16".
 - c. End welded studs (ASTM A108) installation, including bend test.
 - d. Floor and roof deck welds.
 - e. Welding of structural cold-formed steel.
 - f. Welding of stairs and railing systems.
 - g. Verification of reinforcing steel weldability.
 - h. Inspect welding of reinforcing steel.

4. Non-Destructive Testing: Testing Laboratory will test perform ultrasonic and magnetic particle testing in conformance to AISC 360 section N5.5, AISC 341 appendix Q5.2, AWS D1.1, AWS D1.8, ASTM E543, ASTM E1444, ASTM E164 and DSA IR 17-2.

F. Fire-Proofing:

1. Spray Applied:

- a. Project inspector will examine structural steel surface conditions, inspect application, take samples, measure thickness, and verify compliance of all aspects of application with Construction Documents, in conformance with CBC sections and ASTM E.605.
- b. Testing Laboratory will test bond strength in conformance with ASTM E605, per CBC section 1705A.14.6.
- c. Testing Laboratory will test density in accordance with ASTM E605, per CBC section 1705A.14.5.

2. Intumescent Fire-Resistant Coatings: Special inspector will inspect and test in accordance with AWCI 12-B, per CBC section 1705A.15.

G. Anchor Bolts, Anchor Rods and Other Steel:

1. Testing Laboratory will sample and test not readily identifiable anchor bolts and anchor rods in accordance with DSA IR 17-11.
2. Testing Laboratory will sample and test not readily identifiable threaded rod not used for foundation anchorage per procedures noted in DSA IR 17-11.

PART 2 – PRODUCTS (Not used).

PART 3 – EXECUTION (Not used).

END OF SECTION

SECTION 02 4116

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Furnishing labor, materials and equipment necessary for demolition, dismantling, cutting and alterations as indicated, specified, or required for completion of the Work. Includes items such as the following:
1. Protection of existing improvements to remain.
 2. Cleaning existing improvements to remain.
 3. Disconnecting and capping utilities.
 4. Removing debris, waste materials, and equipment.
 5. Removal of items for performance of the Work.
 6. Salvageable items to be retained by the Owner.
- B. Related Requirements:
1. Division 01 - General Requirements.
 6. Division 22 — Plumbing.
 7. Division 23 — HVAC.
 8. Division 26 — Electrical.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating the extent of items and systems to be removed. Indicate items to be salvaged or items to be protected during demolition. Indicate locations of utility terminations and the extent of abandoned lines to be removed. Include details indicating methods and location of utility terminations.

1.03 QUALITY ASSURANCE

- A. Perform the Work of this section by workers skilled in the demolition of buildings and structures. Perform the Work of this section under direct superintendence at all times.
- B. Prior to commencement of Work, schedule a walkthrough with the OAR, to confirm Owner property items have been removed from scheduled Work areas. Identify and mark remaining property items and schedule their removal.

- C. Coordinate demolition for the correct sequence, limits, and methods. Schedule demolition Work to create least possible inconvenience to the public and facility operations.
- D. Related Standard: ANSI/ASSE A10.6.

1.04 PROJECT CONDITIONS

- A. Drawings may not indicate in detail all demolition Work to be performed. Examine existing conditions to determine the full extent of required demolition.
- B. Repair damage to existing improvements or damage due to excessive demolition.
- C. Provide all measures to avoid excessive damage from inadequate or improper means and methods, improper shoring, bracing or support.
- D. If conditions are encountered that varies from those indicated, promptly notify the Architect for clarification before proceeding.

PART 2 - PRODUCTS

2.01 HANDLING OF MATERIALS

- A. Items scheduled for salvage by the Owner shall be delivered to a location designated by the OWNER. Items shall be cleaned, packaged and labeled for storage.
- B. Items scheduled for reuse shall be stored on the Project site and protected from damage, theft and other deleterious conditions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection:
 - 1. Do not commence demolition until safety partitions, barricades, warning signs and other forms of protection are installed.
 - 2. Provide safeguards, including warning signs, lights and barricades, for protection of workers, occupants, and the public.
- B. If safety of existing construction appears to be endangered, take immediate measures to correct such conditions; cease operations and immediately notify the OWNER.

3.02 DEMOLITION

- A. Do not throw or drop materials. Furnish ramps or chutes as required by the Work.
- B. Remove existing construction only to extent necessary for proper installation of Work and interfacing with existing construction. Cut back finished surfaces to straight, plumb or level lines as required for a smooth transition.

- C. Where openings are cut oversize or in improper locations, replace or repair to required condition.

3.03 CUTTING EXISTING CONCRETE

- A. Cutting of existing concrete shall be performed by skilled workers familiar with the requirements and space necessary for placing concrete. Perform concrete cutting with concrete cutting wheels and hand chisels. Do not damage concrete intended to remain.
- B. Extent of cutting of structural concrete shall be as indicated on Drawings. Cutting of non-structural concrete shall be as indicated on Drawings or as reviewed by the Architect or structural engineer. Replace concrete demolished in excess of amounts indicated.
- C. Prior to cutting or coring concrete, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

3.04 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

- A. Remove existing plumbing and electrical equipment fixtures and services not indicated for reuse and not necessary for completion of the Work. Remove abandoned lines and cap unused portions of existing lines.

3.05 REMOVAL OF OTHER MATERIALS

- A. Masonry: Cut back to joint lines and remove mortar without damaging units to remain. Allow space for repairs to backing where applicable.
- B. Woodwork: Cut or remove to a joint or panel line.
- C. Roofing: Remove as required, including accessory components such as insulation and flashings. At penetrations through existing roofing, trim cut edges back to sound roofing with openings restricted to the minimum size necessary to receive Work.
- D. Sheet Metal: Remove back to joint, lap, or connection. Secure loose and unfastened ends or edges and provide a watertight condition. Re-seal as required.
- E. Glass: Remove broken or damaged glass and clean rebates and stops of glazing channels.
- F. Modular materials such as acoustical ceiling panels, resilient tile, or ceramic tile: Remove to a natural joint without leaving damaged or defective Work where joining new Work. After flooring removal, clean substrates to remove setting materials and adhesives.
- G. Gypsum Board: Remove to a panel joint line on a stud or support line.
- H. Plaster: Saw cut plaster on straight lines, leaving a minimum 2-inch width of firmly attached metal lath for installing new lath and plaster.

- I. Remove existing improvements not specifically indicated or required but necessary to perform Work. Cut to clean lines, allowing for installation of Work.

3.06 PATCHING

- A. Patch or repair materials to remain when damaged by the performance of the Work of this section. Finish material and appearance of patch and/or repair Work shall match existing.

3.07 CLEANING

- A. Clean existing materials to remain with appropriate tools and equipment.
- B. Protect existing improvements during cleaning operations.
- C. Debris shall be dampened by fog water spray prior to transporting by truck.
- D. Debris pick-up area shall be kept broom-clean and shall be washed daily with clean water.
- E. Remove waste and debris, other than items to be salvaged. Turn over salvaged items to Owner, or store and protect for reuse where required. Continuously clean up and remove items as demolition Work progresses.
- F. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 03 1000

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Formwork for cast-in-place concrete as indicated.
2. Installation of items to be embedded in concrete, such as anchor bolts, inserts, embeds, and sleeves.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 2000: Concrete Reinforcing.
3. Section 03 3000: Cast-In-Place Concrete.

1.02 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 318 – Building Code Requirements for Structural Concrete, Chapter 6, Formwork, Embedded Pipes, and Construction Joints.
2. ACI 347 – Guide to Formwork for Concrete.

B. American Plywood Association (APA):

1. Form No. V345 - Concrete Forming Design/Construction Guide.

C. National Institute of Standards and Technology (NIST):

1. NIST Voluntary Product Standard PS 1.

1.03 SUBMITTALS

- A. Submit detailed structural calculations and drawings approved and signed by a California registered Civil Engineer where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or where provision for vehicular traffic through falsework or shoring occurs. For all other falsework and shoring submit layout signed by California registered Civil Engineer, manufacturer's authorized representative or a licensed contractor experienced in the usage and

erection of falsework and vertical shoring. A copy of the plans and calculation shall be available at the jobsite at all times.

- B. Shop Drawings: Submit Shop Drawings indicating locations of forms, construction and expansion joints, embedded items, and accessories.
- C. Product Data: Submit manufacturer's Product Data for form materials and accessories.

1.04 REGULATORY REQUIREMENTS

- A. California Building Code (CBC), Chapter 19A.
- B. California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Sections 1713 and 1717.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Storage shall prevent damage and permit access to materials for inspection and identification.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Form materials may be reused during progress of the Work provided they are completely cleaned and reconditioned, recoated for each use, capable of producing formwork of required quality, and are structurally sound.
- B. Form Lumber: WCLIB Construction Grade or Better, WWPA No. 1 or Better.
- C. Plywood: NIST Voluntary Product Standard PS 1, Group 1, Exterior Grade B-B Plyform or better, minimum 5-ply and 3/4 inch thick for exposed locations and at least 5/8 inch thick for unexposed locations, grade marked, not mill oiled. Furnished plywood with medium or high density overlay is permitted.
- D. Coated Form Plywood: For exposed painted concrete, plastic overlaid plywood of grade specified above, factory coated with a form coating and release agent Noxcrete", or equal.
- E. Tube Forms: Sonoco "Seamless Sonotubes," Ceme-Tube, Quik-Tube, or equal, of the type leaving no marks in concrete, one-piece lengths for required heights.
- F. Joist Forms: Code recognized steel or molded plastic types as required.
- G. Special Forms: For exposed integrally-colored concrete, plywood as above with high density overlay, plywood with integral structural hardboard facing or fibrous glass reinforced plastic facing, providing specified finish.
- H. For Exposed Concrete Finish:

1. Plywood: New, waterproof, synthetic resin bonded, exterior type Douglas fir or Southern pine plywood manufactured especially for concrete formwork and conforming to NIST Voluntary Product Standard PS 1, Grade B-B grade, Class I.
 2. Glass-Fiber-Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surfaces.
 3. Steel: Minimum 16 gage sheet, well matched, tight fitting, stiffened to support weight of concrete, without deflection detrimental to tolerances and appearances of finished concrete surfaces.
 4. Plywood: "Finland Form,," "Combi Form" by North American Plywood Corporation, "Plyform" by Roy O. Martin, "ProForm" by Pacific Wood Laminates, or equal. The material shall be furnished with hard smooth birch face veneers with phenolic resin thermally fused onto panel sides. Edges shall be factory sealed.
- I. Form Ties: Prefabricated rod, flat band, wire, internally threaded disconnecting type, not leaving metal within 1 1/2-inch of concrete surface.
 - J. Form Coating: Non-staining clear coating free from oil, silicone, wax, not grain-raising, "Formshield" by A.C. Horn, Inc., "Release" by Edoco/Dayton Superior, "Cast-Off" by Sonneborn/BASF Building Systems or equal. Where form liners are furnished, provide form coatings recommended by form liner manufacturer.
 - K. Form Liner: Rigid or resilient type by L.M. Scofield, Symons, Greenstreak, or equal.
 - L. Void Forms: Manufactured by SureVoid Products, Inc., Sonotube, Void Form International, or equal. Forms shall be "WallVoid" for temporary support of concrete walls and grade beams spanning between supports, and "SlabVoid" for creating gaps between concrete slabs or steps and underlying soils. Void forms shall be fabricated of corrugated paper with moisture resistant exterior, and shall be capable of withstanding working load of 1,500 psf. Provide accessories as required.

PART 3 - EXECUTION

3.01 GENERAL

- A. Forms shall be constructed so as to shape final concrete structure conforming to shape, lines and dimensions of members required by Drawings and Specifications, and shall be sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be designed so that previously placed structures will not be damaged.
- B. Use form coating at all surfaces in contact with concrete.

3.02 TOLERANCES

- A. Permitted abrupt or gradual irregularities in formed surfaces as measured within a 5 feet length with a straightedge shall per ACI 347, Table 3.1:

Class of Surface			
A	B	C	D
1/8 inch	1/4 inch	1/2 inch	1 inch

1. Class A: Use for concrete surfaces prominently exposed to public view.
2. Class B: Use for coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
3. Class C: Use as a general standard for permanently exposed surfaces where other finishes are not specified.
4. Class D: Use for surfaces where roughness is not objectionable and will be permanently concealed.

3.03 ERECTION

- A. Plywood shall be installed with horizontal joints level, vertical joints plumb and with joints tight. Back joints by studs or solid blocking, and fill where necessary for smoothness. Reused plywood shall be thoroughly cleaned, damaged edges or surfaces repaired and both sides and edges oiled with colorless form oil. Nail plywood along edges, and to intermediate supports, with common wire nails spaced as necessary to maintain alignment and prevent warping.
- B. Openings for Cleaning: Provide temporary openings at points in formwork to facilitate cleaning and inspection. At base of walls and wide piers, bottom form board on one face for entire length shall be omitted until form has been cleaned and inspected.
- C. Chamfers: Provide 3/4 inch by 3/4 inch chamfer strips for all exposed concrete corners and edges unless otherwise indicated.
- D. Reglets and Rebates: As specified in Section 03 3000: Cast-In-Place Concrete.

3.04 REMOVAL OF FORMS

- A. Forms shall not be removed until concrete has sufficiently hydrated to maintain its integrity and not be damaged by form removal operations. Unless noted otherwise and/or permitted by the Architect, columns and wall forms shall not be removed in less than five days, floor slabs in less than seven days, beams and girders in less than 15 days, pan forms for joists may be removed after three days, but joist centering shall not be removed until after 15 days, and ramp, landing, steps and floor slabs shall not

be removed in less than seven days. Shoring shall not be removed until member has acquired sufficient strength to support its weight, load upon it, and added load of construction.

- B. Compressive strength of in-place concrete shall be determined by testing field-cured specimens representative of concrete location or members, as specified in Section 03 3000: Cast-In-Place Concrete.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete steel reinforcement.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 03 1000: Concrete Forming.
4. Section 03 3000: Cast-In-Place Concrete.

1.02 REGULATORY REQUIREMENTS

- A. Fabrication and placement of reinforcing shall be in accordance with requirements of CBC, Chapter 19A.

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM):

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. ASTM A497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
6. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
7. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

- B. American Concrete Institute (ACI) Publication:
 1. ACI SP-66 – ACI Detailing Manual.
 2. ACI 318 – Building Code Requirements for Structural Concrete, as modified by CBC.
- C. American Welding Society (AWS):
 1. AWS D1.4 – Structural Welding Code – Reinforcing Steel.

1.04 SUBMITTALS

- A. Shop Drawings: Submit steel reinforcement Shop Drawings in accordance with ACI 315. Include assembly diagrams, bending charts and slab plans. Indicate lengths and location of splices, size and lengths of reinforcing steel.
- B. Closeout Submittals: Record exact locations of reinforcing that vary from Shop Drawings.

1.05 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
 2. American Welding Society (AWS).
 3. American Concrete Institute (ACI).
 4. CBC, Chapter 19A, Concrete.
- B. Source Quality Control: Refer to Division 01 Sections for general requirements and to the following paragraphs for specific procedures. Testing laboratory retained by the OWNER shall select test Samples of bars, ties, and stirrups from the material at the Project Site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A615, or ASTM A706, as applicable:
 1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.
 2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained; perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.

- C. Certification of Welders: Shop and Project site welding shall be performed by welding operators certified by AWS.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Avoid exposure to dirt, moisture or conditions harmful to reinforcing.
- B. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated for size and shape.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide reinforcing of sizes, gages and lengths indicated, bent to indicated shapes.

2.02 MATERIALS

- A. Steel Reinforcing Bars: ASTM A615, or ASTM A706 deformed grade 60 billet steel unless otherwise specified or indicated.
- B. Bars or Rod Mats: ASTM A184.
- C. Welded Wire Fabric for Reinforcement: ASTM A185.
- D. Tie Wire: ASTM A82, fully annealed, copper-bearing steel wire, 16 gage minimum.
- E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI 315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.03 FABRICATION OF REINFORCING BARS:

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.
- C. Welding: Provide only ASTM A706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and

clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings.
- B. Before installation and just prior to placing concrete, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.
- C. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.
- D. Provide metal chairs to hold reinforcement the required distance above form bottoms. In beams and slab construction, provide chairs under top slab reinforcement as well as under bottom reinforcement. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.
- E. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustations while they are still soft.
- F. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.
- G. Use deformed bars unless otherwise indicated, except for spiral reinforcement.

3.02 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cast-in-place normal weight and lightweight concrete, placement and finishing.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 32 1313: Site Concrete Work.
3. Section 03 1000: Concrete Forming and Accessories.
4. Section 03 2000: Concrete Reinforcing.

1.02 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
4. ACI 305R - Specification for Hot Weather Concreting.
5. ACI 306.1 – Standard Specification for Cold Weather Concreting.
6. ACI 308R – Guide to External Curing of Concrete.
7. ACI 318 - Building Code Requirements for Structural Concrete, as modified by CBC Sections 1903A and 1905A.

B. American Society for Testing and Materials (ASTM) Standards:

1. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.

3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C88 - Standard Test Method for Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C156 – Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid membrane-Forming Curing Compounds for Concrete.
10. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
11. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
12. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
13. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
14. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
17. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
18. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
19. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
20. ASTM C845 - Standard Specification for Expansive Hydraulic Cement
21. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
23. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
24. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
25. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
26. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
27. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
28. ASTM D1751 - Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
29. ASTM D7234 – Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
30. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
31. ASTM E1155 - Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.
32. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
33. ASTM E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
34. ASTM F710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
35. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
36. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.
37. ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use under Resilient Floor Coverings.

1.03 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.
- B. Mix Design Data: Submit concrete mix designs as specified herein and in Article 2.02.
1. Submit name, address and telephone number of the concrete production facility which the contractor intends to engage to design the concrete mixes. Submit name and qualifications of the proposed concrete technologist.
 2. Mix Design: Submit a concrete mix design for each strength and type of concrete indicated in the drawings or specified. Include water/cement ratio, source, size and amount of coarse aggregate and admixtures. Predict minimum compressive strength, maximum slump and air content percentage. Clearly indicate locations where each mix design will be used.
 - a. Water/cement ration for concrete slabs on grade shall be 0.50 maximum.
 3. Test Reports: Submit copies of test reports showing that the proposed mixes produce concrete with the strengths and properties specified. Include tests for cement, aggregates and admixtures. Provide gradation analysis.
- C. Material Samples: Submit Samples illustrating concrete finishes and hardeners, minimum 12-inch by 12-inch.
- D. Certificates: Submit certification that each of the following conforms to the standards indicated:
1. Portland cement: ASTM C150.
 2. Normal weight concrete aggregates: ASTM C33.
 3. Lightweight concrete aggregates: ASTM C330.
 4. Aggregates: Submit evidence that the aggregate is not reactive in the presence of cement alkalis. In the absence of evidence, aggregate shall be tested by one of the methods in ASTM C33 Appendix XI, Methods for Evaluating Potential for Deleterious Expansion Due to Alkali Reactivity of an Aggregate. . Aggregates deemed to be deleterious or potentially deleterious may be used with the addition of a material that has been shown to prevent harmful expansion in accordance with Appendix XI of ASTM C33, when approved by the building official, in accordance to CBC Section 1903A5A.
 5. Curing materials: ASTM C171.
- E. Admixtures: Submit product data for proposed concrete admixtures.

1.04 QUALITY ASSURANCE

- A. Continuous inspection shall be provided 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.
- B. Inspection 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.
- C. CONTRACTOR shall assist the testing laboratory in obtaining and handling samples at the project site and at the source of materials.
- D. Continuous batch plant inspection requirement may be waived in accordance with CBC Section 1705A.3.3.1. Waiver shall be in writing, including DSA approval. When batch plant inspection is waived by DSA, the following requirements shall be met:
 - 1. Approved inspector of the testing laboratory shall check the first batching at the start of work and furnish mix proportions to the licensed weightmaster.
 - 2. Licensed weightmaster shall positively identify materials as to quantity and certify to each load by a ticket.
 - 3. Tickets shall be transmitted to the Inspector by a truck driver with load identified thereon. The Inspector will not accept the load without a load ticket identifying the mix and will keep a daily record of placements, identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to DSA.
 - 4. At the end of the project, the weightmaster shall furnish an affidavit to DSA certifying that all concrete furnished conforms in every particular to proportions established by mix designs.
- E. Special Inspections and Tests shall be in accordance with CBC Chapter 17A, Reinforcement and Anchor testing per CBC Section 1910A and Specification Section 01 4523.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.
- B. Packaged materials shall bear the manufacturers and brand name label, and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.

1.06 PROJECT CONDITIONS

- A. Cold Weather Requirements: Batching, mixing, delivering and placing of concrete in cold weather shall comply with the applicable requirements of ACI 306.1.

- B. Hot Weather Requirements: Batching, mixing, delivering and placing of concrete in hot weather shall comply with the applicable requirements of ACI 305R.
- C. Concrete temperature of freshly mixed concrete shall be determined per ASTM C1064.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cement: ASTM C150. Portland Cement.
- B. Aggregates: Conform to the following standards:
 - 1. Normal weight concrete: ASTM C33.
 - 2. Lightweight concrete: ASTM C330, with fine aggregates per ASTM C33.
 - 3. Aggregate shall be tested for Potential Alkali Reactivity of Cement-Aggregate Combinations per ASTM C289.
 - 4. Nominal maximum size of coarse aggregate shall be no larger than:
 - a. 1/5 the narrowest dimension between sides of forms, nor
 - b. 1/3 the depth of slabs, nor
 - c. 3/4 the clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, or ducts.
 - d. CONTRACTOR may request the ARCHITECT and DSA waiver of the above limitations reported per ACI 318, provided that the workability and methods of consolidation are such that the concrete can be placed without honeycombs or voids.
- C. Water: Water for concrete mixes, curing and cleaning shall be potable and free from deleterious matter.
- D. Admixtures: Shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with ACI 318, Section 3.6.
 - 1. Admixtures containing chlorides or sulfides are not permitted.
 - 2. Air-entraining admixtures shall comply with ASTM C260. Air-entrained admixtures shall not be used for floor slabs to receive steel trowel finish.
 - 3. Admixtures for water reduction and setting time modification shall conform to ASTM C494.
 - 4. Admixtures for producing flowing concrete shall conform to ASTM C1017.

5. Fly ash, pozzolan and ground granulated blast-furnace slag: Modify ACI 318 Sections 3.6.6 and 3.6.7 as follows:
 - a. Fly ash or other pozzolan used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:
 - 1) Shall conform to ASTM C618 for Class N or F materials (Class C is not permitted).
 - 2) 15 percent (max.) by weight of fly ash or other pozzolans shall substitute for ASTM C150 Portland cement provided the mix design is proportioned per ACI 318, Section 318 5.3.
6. Admixtures containing ASTM C845 expansive cements shall be compatible with the cement and produce no deleterious effects.
7. Silica fumes used as an admixture shall conform to ASTM C1240.
- E. Reinforcement Fibers: Chop strands of alkali-resistant polypropylene or nylon fibers added to the concrete mix for protection against shrinkage cracks.
- F. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D1751.
- G. Curing:
 1. Curing Paper: Shall conform to ASTM C171 and consist of two sheets of kraft paper cemented together with a bituminous material in which are embedded cords or strands of fiber running in both directions. The paper shall be light in color, shall be free of visible defects, with uniform appearance.
 2. Elevated slabs and slabs on grade may be cured at CONTRACTOR's option with curing and proactive water vapor emission and alkalinity control system. Products shall be approved by OWNER's Office of Environmental Health and Safety.
 - a. VaporSeal 309, by Floor Seal Technology, Inc., or equal.
 - 1) ASTM C156: 0.39 kg/m².
 - 2) ASTM C309: Exceeds requirements.
 - 3) ASTM C1315: Exceeds requirements.
 - 4) ACI 308R-01 Compliant.
 - b. Remedial Treatment: Water vapor emission and alkalinity control treatment, MES 100 by Floor Seal Technology, Inc. or equal.
 - 1) ASTM E96: <0.1 Perms.

- 2) ASTM D1308: 14pH Resistant.
 - 3) ASTM D7234: 500+psi 100% concrete failure.
 - 4) ASTM F2170: 100%RH resistant.
 - 5) VOC Content: <100 g/L, meets SCAQMD Rule #1113.
 - 6) ASTM F3010: Meets Requirements.
- c. Self-leveling Compounds: Ardex Engineered Cements, K15, Combimix; Leveler 720. Armstrong, S-194, or equal.
- H. Floor Hardener: Water soluble, inorganic, silicate-based curing, hardening, sealing and dustproofing compound. Aquaseal W20 by Monopole Inc., Kure-N-Harden by BASF, Chem Hard by L&M, Liqui-Hard by W. R. Meadows, or equal.
- I. Underlayment: Two component latex underlayment for filling low spots in concrete for both interior and exterior applications, from featheredge to a maximum of 3/8 inch in thickness. Underlayment shall be non-shrink and suitable for repairing exposed concrete surfaces and for underlayment of carpet, resilient, tile and quarry floor coverings. La-O-Tex by TexRite, Underlay C, RS by Mer-Krete Systems, Underlayment 962 by C-Cure, or equal.
- J. Vapor Barrier: Refer to Section 07 2600, Vapor Barriers.
- K. Stair Treads and Nosings: Two part stair tread and nosing with ribbed abrasive bars. Fabricated from 6063-T5 or 6063-T6 extruded aluminum, mill finish. Anti-slip abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Color shall extend uniformly throughout filler.
1. American Safety Tread: TP-311R.
 2. Balco Inc.: DST-330.
 3. Nystrom: STTB-P3.375E.
 4. Wooster Products Inc.: WP-RN3SG.
 5. Equal.
- L. 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 7,000 psi at 7 days; of consistency suitable for application and a 30 minute working time.

2.02 CONCRETE MIX

- A. Mix shall be signed and sealed by a Civil or Structural Engineer currently registered in the State of California.

- B. Strength of Concrete: Strengths and types of concretes shall be as indicated in the Drawings. Unless otherwise indicated or specified, concrete shall be provided with minimum 28-day strength of 3000 psi (f'c).
- C. Concrete mix shall meet the durability requirements of ACI 318, Chapter 4.
- D. Concrete proportioning shall be determined on the basis of field experience and/or trial mixtures shall in accordance with ACI 318, Section 5.3. Proportions of materials shall provide workability and consistency to permit concrete to be placed readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding.
- E. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of ASTM C94.

PART 3 - EXECUTION

3.01 GENERAL

- A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.
- B. 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 Inspector at least 24 hours before placing concrete; do not place concrete until inspected by the Project Inspector.
- C. 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 TOLERANCES

- A. Concrete construction tolerances shall be as specified in ACI 117 and as modified herein.
- B. Floor Flatness (F_F) and Floor Levelness (F_L) shall be as indicated below:

	Specified Overall Value		Minimum Local Value	
	F_F	F_L	F_F	F_L
Slabs on ground: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry flooring.	20	15	15	10

Slab on ground: carpet.	25	20	17	15
Slab on ground: thinset tile and resilient flooring.	35	25	24	17
Suspended slabs: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry flooring.	20	15	N/A	N/A
Suspended slabs: carpet.	25	20	N/A	N/A
Suspended slabs: thinset tile and resilient flooring.	35	20	N/A	N/A

- C. Refer to ACI 302.1R, Tables 8.1 and 8.2 Slab on Ground and Suspended Flatness/Levelness Construction Guide, for recommended concrete placing and finishing methods.
- D. Floor Flatness and Floor Levelness shall be tested in accordance to ASTM E1155. Floor measurements shall be made within 48 hours after slab installation, and shall precede removal of shores and forms.

3.03 PREPARATION

- A. For installation of vapor barrier refer to Section 07 2600, Vapor Barriers.
- B. Reglets and Rebates:
1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
 2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.
- 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.

3.04 INSTALLATION

- A. Conveying and Placing:
1. Concrete shall be placed only under direct observation of the Project Inspector. Do not place concrete outside of regular working hours, unless the Inspector has been notified at least 48 hours in advance.

2. Concrete shall be conveyed from mixer to location of final placement by methods that will prevent separation or loss of materials.
3. 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.
4. 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.
5. 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.
6. Concrete shall be thoroughly consolidated by suitable means during placement, and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.
7. 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.

B. Cold Weather:

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. All ground with which concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.
2. The temperature of concrete at the time of placement shall not be below the minimum temperatures given in Table 3.1 of ACI 306.1.
3. Concrete shall be maintained at a temperature of at least 50° F. for not less than 72 hours after placing or until it has thoroughly hardened. Cover concrete and provide sufficient heat as required. When necessary, aggregates shall be heated before mixing. Special precautions shall be taken for protection of transit-mixed concrete.

C. Hot Weather:

1. Concrete to be placed during hot weather shall comply with the requirements of ACI 318, Section 5.13.

2. Maintain concrete temperatures indicated in Table 2.1.5 of ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square feet of exposed concrete per hour.
3. Cool concrete using methods indicated in ACI 305R Appendix B.
4. Place and cure concrete as specified in ACI 305R Chapter 4.

D. 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.

E. 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. For interior finish slabs, final troweling shall provide a hard, impervious, and non-slip surfaces, free from defects and blemishes. Finished surface shall be within tolerances indicated in Article 3.02. Avoid burnishing. Do not add cement or sand to absorb excess moisture.
 - a. Floor of Walk-In Refrigerator: Finish as specified above, to a smooth finish.
 - b. Floor of Gymnasium Locker Rooms: After floating, and while the surface is still plastic, provide a fine textured finish by drawing a fine fiber bristle broom uniformly over the surface in one direction only. Floors sloped for drainage should be brushed in the direction of flow.
3. Exterior Paving and Cement Walks: Finish as specified above, except surface shall be given a non-slip broom finish to match Sample reviewed by the ARCHITECT.
4. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.

3.05CURING

- A. Length of time, temperature and moisture conditions for curing concrete shall be in accordance with ACI 318, Section 5.11.
- 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. Immediately after finishing, monolithic floor slabs shall be covered with curing paper. Paper shall be lapped 4 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.
- E. When curing slabs with proactive water vapor emission and alkalinity control system:
 - 1. Coordinate and schedule application of curing compound with concrete pour schedule, while conforming to manufacturer's application instructions.
 - 2. When the surface of the concrete has hardened sufficiently to sustain foot traffic pre-cure slabs with liquefied product application following manufacturer's written instructions. Application shall be by trained applicators.
 - 3. Monitor Environmental Conditions: Set up weather station 20 to 30 inches above freshly placed concrete. Record temperature, humidity and wind velocity measurements at 15 minute maximum intervals.
 - 4. Calculate Evaporation Rate: Use recorded weather information in combination with nomograph per ACI 308R, Figure 4.1, Guide to Curing Concrete, to evaluate relevant evaporation rate.
 - 5. When the bleed water rate of the concrete is approximately equal to the surface water evaporation rate, spray curing compound material throughout surface of slabs and decks, following manufacturer's written instructions. Application shall be by trained applicators.
 - 6. Perform the following tests at least 28 days after placement of concrete and prior to floor covering installation. Submit to OAR test results indicating locations that do not comply with scheduled flooring installation requirements.
 - a. Calcium chloride testing per ASTM F1869.
 - b. Relative humidity testing per ASTM F2170.
 - c. Alkalinity testing per ASTM F710.
 - d. Perform concrete bond layer humidity meter testing to determine substrate surface acceptability.

7. Areas emitting moisture and alkalinity at rates exceeding floor covering manufacturer's published ASTM F1869 limits, shall receive a corrective coating, at no cost to the OWNER, as follows:
- a) Mask and protect adjacent walls and floor surfaces from effects of scarification and application of remedial treatment.
 - b) Scarify slab surface in area of application by shot blasting or other method acceptable to corrective coating manufacturer.
 - c) Prepare and fill cracks, control joints and cold joints.
 - d) Apply two-component modified epoxy penetrant and coating with roller and squeegee over required treatment area; saturate surfaces to ensure a through mechanical bond.
 - e) Clean and fill divots, chips, voids and other surface irregularities with one hundred percent Portland cement based patching compound or cementitious fill.
 - f) Apply cementitious surfacing over coating in areas to receive resilient and wood floor coverings to facilitate adhesion; apply to a thickness of 1/8 inch.

3.06 FILLING, LEVELING AND PATCHING

- A. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.
- B. 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.
- C. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.07 FINISHING

- A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.

- B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.
1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.
 2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.
- C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand-blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.
- D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish.
- E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener.
1. Protect adjacent surfaces. Clean surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, laitance, dust and dirt are removed prior to application.
 2. Apply hardener in accordance with manufacturer's instructions as soon as concrete is firm enough to work on after final troweling.
- F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.
- G. Broom Finish: Exterior stair treads and landings shall be provided with a non-slip broom finish in addition to abrasive finish specified.
- H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturers written recommendations.

3.08 EXPANSION AND CONSTRUCTION JOINTS

- A. 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.
- B. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab. Joint filler shall be 3/8 inch thick, unless otherwise indicated.
- C. 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.

3.09 TESTING

- A. Molded Cylinder Tests:
1. Inspector or testing lab personnel will prepare cylinders and perform slump tests. Samples for concrete strength shall be taken in accordance to ASTM C172. 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 three days, seven days, and 28 days. A strength test shall be the average of the compressive strength of two 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 C31, and tested in accordance with ASTM C39.
- 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 C42.
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 C143. 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, falls 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. Air Content Testing: Measure in accordance to ASTM C173 or ASTM C231, for each composite sample taken in accordance to ASTM C172.
- 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 have a minimum $f'c = 3,000$ psi. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 03 1000 Concrete Forming and Accessories, and reinforced as described in Section 03 2000 Concrete Reinforcing. 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 maximum aggregate.

3.10 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.11 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Structural steel.
2. Architecturally exposed structural steel.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523 - Testing and Inspection.
3. Section 03 3000 - Cast-In-Place Concrete.
8. Section 09 9000 - Paints and Coatings.

1.02 REFERENCES

A. CBC Chapter 22A.

B. American Institute of Steel Construction (AISC):

1. AISC – Steel Construction Manual:
 - a. AISC 360 Specifications for Structural Steel Buildings.
 - b. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - c. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
2. AISC 341 - Seismic Provisions for Structural Steel Buildings, including Supplements.
3. AISC 358 - Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.

C. ASTM International (ASTM):

1. ASTM A36 – Standard Specification for Carbon Structural Steel.
2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
4. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength.
7. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 Ksi Minimum Tensile Strength.
8. ASTM A435 - Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.
9. ASTM A490 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
10. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
11. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
12. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
13. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
14. ASTM A673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel,
15. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
16. ASTM A992 – Standard Specification for Structural Steel Shapes.
17. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
18. ASTM E23 - Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.
19. ASTM E112 - Standard Test Methods for Determining Average Grain Size.
20. ASTM F436 – Standard Specification for Hardened Steel Washers.
21. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.

22. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-Ksi Yield Strength.
23. ASTM F1852 – Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tension Strength.

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code - Steel.
2. AWS D1.8 – Structural Welding Code – Seismic Supplement.
2. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination.
3. AWS B2.1 – Specifications for Welding Procedures and Performance Qualification.

E. SSPC – Steel Structures Painting Council:

1. SP-2 - Hand Tool Cleaning.
2. PA-1 - Paint Application Specification No. 1.

1.03 REGULATORY REQUIREMENTS

- A. Structural steel shall conform to CBC requirements, except that steel manufactured by acid Bessemer process is not permitted for structural purposes.
- B. Sheet and strip steel other than those listed in CBC, if provided for structural purpose, shall comply with DSA requirements.

1.04 SUBMITTALS

A. Shop Drawings:

1. Submit Shop Drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar detailing as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked in stresses and distortion; submit sequence and technique plan for review by the ARCHITECT.
 - a. Include details of cuts, connections, camber, and holes in accordance with Figure 4.5 of AWS D1.1 or AISC Chapter J, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.

- b. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed for Work specified in other sections.
- c. Erection and Bracing Plan and Erection Procedure: Submit an erection and framing plan, including columns, beams, and girders, signed and sealed by a Structural or Civil Engineer registered in the State of California in accordance with Title 8 California Code of Regulations, Section 1710, Structural Steel Erection. Maintain a copy at the Project site as required by the California Division of Industrial Safety.
- d. Submit a list of steel items to be galvanized.
- e. Include identification and details of Architecturally Exposed Structural Steel (AESS) members, if applicable.

B. Product Data:

Submit copies of fabricator's specifications and installation instructions for the following products. Include laboratory test reports and other data required demonstrating compliance with these Specifications:

- a. Structural steel, each type; including certified copies of mill reports covering chemical and physical properties.
- b. Welding electrodes.
- c. Welding gas.
- d. Unfinished bolts and nuts.
- e. Structural steel primer paint.
- f. High-strength bolts, including nuts and washers.

C. Manufacturer's Mill Certificate:

- 1. Submit, certifying that products meet or exceed specified requirements.

D. Mill Test Reports: Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.

E. Charpy-V-Notch (CVN) Impact Test: Submit certified copies of Charpy-V-Notch (CVN) Impact Test by the manufacturer for applicable steel members and components.

- 1. Charpy-V-Notch (CVN) Impact Test for Base Metal: Moment frame columns and girders subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part I, Section 6.3, as modified by Supplement 1.
- 2. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E23.

- F. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured to be fully killed and fine grained having grain size number 5 or better as determined by ASTM E112.
- G. Welding Procedure Specifications (WPS): Submit weld procedures for all welding on project to OWNER's testing laboratory for approval. After approval by testing laboratory, submit to ARCHITECT for Record. Weld procedures shall be qualified as described in AWS D1.5, AISC 341 and AISC 358, as applicable. Weld procedures shall indicate joints details and tolerances, preheat and interpass temperature, post-heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last pass, electrode type and size, welding current, polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged; from these averages the weld heat input shall be calculated. Submit the manufacturer's product data sheet for all welding material used.
- H. Welder's Certificates: Field welders shall be Project certified in accordance with AWS D1.1. Shop welders shall be Project certified for FCAW in accordance with AWS D1.1.
- I. Test Reports: Submit reports of tests conducted on shop and field welded and bolted connections. Include data on type of test conducted and test results.
- J. Welding Material Certification: Provide certificate that welding material complies with specifications. Submit to OWNER's testing laboratory.

1.05 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement, except as otherwise indicated:
 - 1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges, modified as follows:
 - a. Replace "Structural Design Drawings" with "Contract Documents" throughout the document.
 - b. Paragraph 3.2 is hereby modified in it's entirety as follows:
 "Contract Documents including but not limited to architectural, mechanical, plumbing, electrical, civil and kitchen design drawings and specifications shall be used as supplement to the structural plans to define configurations and construction information."
 - c. Delete Paragraph 3.3.
 - d. In Paragraph 4.4, delete the following sentence:
 "These drawings shall be returned to the Fabricator within 14 calendar days."
 - e. Delete Paragraph 4.4.1.(a) in its entirety.
 - f. Paragraph 4.4.2 is hereby modified in it's entirety as follows:

“No review action, implicit or explicit, shall be interpreted to authorize changes in the Contract Documents.”

2. Perform welding in accordance with AWS Standards, AWS D1.1, and California Building Code Section 2204A.1 and approved Weld Procedure Specifications (WPS).
 3. Welding for moment frames shall be in compliance with AISC 341 and AISC 358.
- B. Shop fabrication shall be inspected in accordance with CBC.
- C. Erect mock-up panel of fabricated structural steel meeting Architecturally Exposed Structural Steel (AESS) tolerances for exposed areas. Approval by ARCHITECT is required. Mock-up to remain for comparison but may not be left as part of the work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store structural steel above grade on platforms, skids or other supports.
- B. Protect steel from corrosion.
- C. Store welding electrodes in accordance with AWS D 12.1.
- D. Store other materials in a weather-tight and dry place until installed into the Work.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Stock Materials: Provide exact materials, sections, shapes, thickness, sizes, weights, and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered if net area of shape or section is not reduced thereby, if material and structural properties are at least equivalent, and if overall dimensions are not exceeded.
- B. Shapes, bars, plates, tubes and pipes shall be made of materials with at least 16 percent recycled content if produced from Basic Oxygen Furnace (BOF) or at least 67 percent recycled content if produced from Electric Arc Furnace (EAF).

2.02 MATERIALS

- A. Structural Steel: Wide flange shapes shall conform to ASTM A992 grade 50. Other steel shall conform to ASTM A36.
- B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon bolts and nuts.
- C. High-Strength Threaded Fasteners: ASTM A325, ASTM A490 ASTM F959 or ASTM F1852 quenched and tempered, steel bolts, nuts and washers.
- D. Primers: Lead-free metal primer:

1. SSPC-Paint 20, Zinc-Rich Primer.
 2. SSPC-Paint 23, Latex Primer.
 3. SSPC-Paint 25 Zinc Oxide Primer.
- E. Steel Pipe: ASTM A53, Type E or S, Grade B.
- F. Structural Tubing:
1. Hot-formed, ASTM A501.
 2. Cold-formed, ASTM A500, Grade B.
- G. Galvanizing: ASTM A123.
- H. Welding Electrodes: Provide electrodes recommended by manufacturer for seismic connections.
1. Comply with AISC 341.
- I. Shear stud connectors: ASTM A108, Grade 1015 forged steel, headed, uncoated, granular flux filled shear connector or anchor studs by Nelson Stud Welding Division, or equal.
- J. 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 7,000 psi at seven days; of consistency suitable for application and a 30 minute working time.

2.03 FABRICATION

- A. Fabricate in accordance to AISC Code of Standard Practice for Steel Buildings and Bridges and AISC 360.
- B. Cleaning and Straightening Materials: Materials being fabricated shall be thoroughly cleaned of scale and rust, and straightened before fabrication. Cleaning and straightening methods shall not damage material. After punching or fabrication of component parts of a member, twists or bends shall be removed before parts are assembled.
- C. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall perform the cutting, punching, drilling and tapping of Work so that Work of other trades will properly connect to steel Work.
- D. Milling: Compression joints depending on contact bearing shall be furnished with bearing surfaces prepared to a common plane by milling.
- E. Use of Burning Torch: Oxygen cutting of members shall be performed by machine. Gouges greater than 3/16 inch that remain from cutting shall be removed by grinding. Reentrant corners shall be shaped notch free to a radius of at least 1/2 inch. Gas cutting of holes for bolts or rivets is not permitted.

- F. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized in largest practical sizes. Fabrication includes operations of shearing, punching, bending, forming, assembling or welding. Galvanized items shall be free from projections, barbs, or icicles resulting from the galvanizing process.
- G. Welding:
1. Type of steel furnished in welded structures shall provide chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the verification and inspection requirements of CBC Chapter 17A. Conform to AWS D1.1, and CBC Chapter 22A.
 2. Materials and workmanship shall conform to the requirements specified herein and to CBC requirements, modified as follows:
 - a. No welded splices shall be permitted except those indicated on Drawings unless specifically reviewed by the ARCHITECT.
 - b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.
 3. Welding shall be performed in accordance with requirements of the AWS Structural Welding Code.
 - a. Welded Joint Details: Comply with AISC 341, AISC 358 and drawing details.
 4. Architecturally Exposed Structural Steel: Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds ½ inch and larger. Grind flush butt welds. Dress exposed welds.
 5. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- H. Shop Finish:
1. Notify the Project Inspector when Work is ready to receive shop prime coat. Work shall be inspected by the Project Inspector before installation of primer.
 2. Structural steel and fittings shall receive a coat of primer, except:
 - a. Surfaces that will be galvanized.
 - b. Surfaces that will be fireproofed.
 - c. Surfaces that will be field welded.
 - d. Surfaces in contact with concrete.

- e. Surfaces high strength bolted.
- 3. The primer specified shall be spray applied, filling joints and corners and covering surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils.
- I. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- J. Fabricate Architecturally Exposed Structural Steel with exposed surfaces smooth, square, and free of surfaces blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
 - 1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.
 - 2. Comply with fabrication requirements, including tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for Architecturally Exposed Structural Steel.
- K. 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. Grind smooth tack welds and holes filled with weld metal or body solder. Plan and execute all operations in such a manner that the close fit and neat appearance of the structure will not be impaired.
- L. Reduced Beam Sections (RBS's): Fabrication of RBS's as defined in AISC 341 and 358.

2.04 SHOP AND FIELD QUALITY CONTROL

- A. A special inspector, approved by DSA to inspect the Work of this section, shall inspect high-strength bolted connections. OWNER will provide a DSA approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC 1704A. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- B. An AWS CWI certified special inspector, approved by DSA to inspect the Work of this section, shall inspect welded connections in accordance with CBC 1705A.2.5. The OWNER will provide a DSA approved independent testing laboratory to perform tests and prepare test reports. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.
- C. The independent testing laboratory shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.
- D. Provide access to all places where structural steel Work is being fabricated or produced so required inspection and testing can be performed.

- E. The independent testing laboratory may inspect or test structural steel at plant before shipment; however, ARCHITECT reserves the right at any time before Contract Completion to deem materials not in compliance with the specified requirements as defective Work.
- F. Correct defects in structural Work when inspections and laboratory test reports indicate noncompliance with specified requirements. Perform additional tests as may be required to reconfirm noncompliance of original Work, and as may be required to show demonstrate compliance of corrected Work.
- G. Inspection of Structural Tube Steel/Hollow Structural Sections (HSS): Structural tube steel members (round, square, rectangular), disregarding steel origin, will be inspected during shop fabrication per DSA Bulletin 07-03. Inspector will perform a visual examination of the seam weld area for visible discontinuities. When defects are suspected, non-destructive testing will be considered.
- H. Welding: Inspect and test during fabrication and erection of structural steel assemblies as follows:
1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the Work. Record Work required and performed to correct deficiencies.
 2. Inspect welds. Welds shall be visually inspected before performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved non-destructive test methods. Testing shall be performed to AWS D1.1 Table 6.3 cyclically loaded non-tubular connections.
 3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Repair and test defective welds.
 4. Rate of Testing: Completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.
 5. Welds, when installed in column splices, shall be tested by either ultrasonic testing or radiography.
 6. Base metal thicker than 1 ½-inch, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities directly behind such welds. Tests shall be performed at least 48 hours after completed joint has cooled down to ambient air temperature.
 7. Material discontinuities shall be reviewed based on the defect rating in accordance with the criteria of AWS D1.1 table 6.3 by the ARCHITECT and DSA.
 8. Other method of non-destructive testing and inspection, for example, liquid dye penetrate testing, magnetic particle inspection or radiographic inspection may be performed on weld if required.

9. Lamellar Tearing: Lamellar-tearing resulting from welding is a crack (with zero tolerance) and shall be repaired in accordance with AWS D1.1.
 10. Lamination: The rejection criteria shall be based on ASTM A435.
 11. Where testing reveals lamination or conditions of lamellar tearing in base metal, the steel fabricator shall submit a proposed method of repair for review by the ARCHITECT. Test repaired areas as required.
 12. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 – Qualification.
- I. Lamellar Tearing: Prior to welding plates 1 to 1 ½-inch thick and greater and rolled shapes within the distance from 6 inches above the top of the joint to 6 inches below the bottom of the joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur, members will be reviewed by the ARCHITECT and DSA. Welding procedure specifications in sub-section 1.5G specify welding practices to minimize lamellar tearing.
 - J. Prior Testing of Base Material: Test material before fabrication.
 - K. Lines and levels of erected steel shall be certified by a State of California licensed surveyor as set forth in related Division 01 section.
 - L. Welded studs shall be tested and inspected by the special inspector in accordance with requirements of AWS D1.1 – Stud Welding.
 - M. Record Drawings: After steel has been erected, correct or revise Shop Drawings and erection diagrams to correspond with reviewed changes performed in the field.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify governing dimensions and conditions of the Work before commencing erection Work.
 1. Report discrepancies between drawings and field dimensions to ARCHITECT before commencing work.
 2. Beginning of installation means erector accepts existing conditions and surfaces underlying or adjacent to work of this section.
- B. Provide temporary shoring and bracing, and other support during performance of the Work. Remove after steel is in place and connected, and after cast-in-place concrete has reached its design strength.
- C. Coordinate prime coat repair and application with requirements of Section 09 9000.

3.02 ERECTION

- A. Install structural steel accurately in locations, to elevations indicated, and according to AISC specifications and CBC requirements.

- B. Clean surfaces of base plates and bearing plates.
 - 1. Install base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims; cut off flush with edge of base or bearing plate before packing with grout.
- C. Maintain erection tolerances of structural steel within AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 1. Architecturally Exposed Structural Steel members and components, plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. CONTRACTOR to provide adjustable connections between Architecturally Exposed Structural Steel and the structural steel frame or the masonry or concrete supports, in order to provide the erector with means for adjustment.
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Do not permit thermal cutting during erection of structural steel.
- F. Where indicated for field connections, provide standard bolts complying with ASTM A307.
- G. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with CBC requirements.
 - 1. Allowable hole sizes: 1/16 inch larger than bolt size.
 - 2. Use friction type connection with standard hardened steel circular, square or rectangular washer under bolt nut.
 - 3. Thoroughly clean area under bolt head, nut and washer. Remove all paint, lacquer, oil or other coatings except organic zinc-rich paints in accordance with SSPC, SP-2.
 - 4. Tighten bolts by power torque wrench or hand wrench until twist-off.
- H. CONTRACTOR shall be responsible for correcting detailing and fabrication errors and for correct fitting of all members and components.
- I. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide temporary bracing, supports or connections required for complete safety of structure until final permanent connections are installed.
- J. Install column bases within a tolerance of 1/8 inch of detailed centerlines, level at proper elevations. Support bases on double nuts and solidly fill spaces under bases with cement grout.

- K. Provide anchor bolts with templates and diagrams. CONTRACTOR shall be responsible for proper location and installation of bolts. Correct deficiencies and errors.
- L. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780.

3.03 FITTING

- A. Closely fit members, finished true to line and in precise position required to allow accurate erection and proper joining in the field.
- B. Drilling to enlarge unfair holes will not be allowed. Allow only enough drifting during assembly to bring parts into position, but not enough to enlarge holes or distort the metal. Do not heat rolled sections, unless approved by ARCHITECT.

3.04 PUNCHING AND DRILLING

- A. Punch material 1/16 inch larger than nominal diameter of bolt, wherever thickness of metal is equal to or less than the diameter of the bolt plus 1/8 inch.
- B. Drill or sub-punch and ream where metal is equal to or more than the diameter of the bolt plus 1/8 inch. Make diameter for sub-punched and sub-drilled holes 1/16 inch larger than nominal diameter of bolt.
- C. Precisely locate holes to ensure passage of bolt through assembled materials without drifting. Enlarge holes when necessary to receive bolts by reaming; flame cutting to enlarge holes is not acceptable. Structural Steel members with poorly matched holes will be rejected.

3.05 FINISHING

- A. After erection, spots or surfaces where paint has been removed, damaged, or burned off, and field rivets, bolts, and other field connections shall be cleaned of dirt, oil, grease, and burned paint and furnished with a spot coat of the same primer installed during shop priming.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Install paint to exposed areas with the same material installed during shop painting. Install by brush or spray to provide a minimum dry film thickness of 1.5 mils.

3.06 FIELD QUALITY CONTROL

- A. OWNER will provide a special inspector and independent testing laboratory to perform field inspections and tests and to prepare test reports.
- B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.07 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project Site.

3.08 PROTECTION

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- A. Protect the Work of this section until Substantial Completion.

3.09 HANDLING

- A. Both in shop and in the field, transport, handle and erect to prevent damage or overstressing of any component.

END OF SECTION

SECTION 05 4100

STRUCTURAL METAL STUD FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Load-bearing metal stud systems.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 4523 - Testing and Inspection.
 - 3. Section 05 1200 - Structural Steel Framing.

1.02 SUBMITTALS

- A. Shop Drawings: Submit drawings showing framing, connection details, accessories and anchorage. Indicate location of assemblies, size and spacing of framing components.
- B. Product Data: Submit manufacturer's catalog data for each item proposed for installation.
- C. Certificates: Furnish manufacturer's certification that materials meet or exceed Specification requirements.

1.03 QUALITY ASSURANCE

- A. Comply with following as a minimum requirement:
 - 1. AISI - Specifications for Design of Cold Formed Steel Structural Members.
 - 2. Welds shall be performed by AWS certified welders. Welding shall be performed in accordance with requirements of American Welding Society (AWS) Structural Welding Code-Steel D1.1 and D1.3. Structural welding Code-Sheet Steel.
 - 3. Welding shall be inspected by a special inspector, approved by DSA to inspect Work of this section. The Project Inspector shall be responsible for monitoring work of special inspector to ensure that inspection program is satisfactorily completed.
 - 4. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by Hot Dip Process.

5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet Metallic-Coated by Hot-Dip Process.
 6. ASTM A1003 – Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
 7. ASTM A1008 – Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability.
 8. ASTM C954 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks) and Bracing or Bridging for Screw Application of Gypsum Panel Products and Plaster Bases.
 9. ASTM C955 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
 10. ASTM C1007 – Standard Specification for Installation of Structural (Axial and Transverse) Steel Framing Members and Accessories.
 11. ASTM E488 – Standard Test Methods of Strength Anchors in Concrete and Masonry.
 12. ASTM E1190 – Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
 13. Manufacturer shall be a member of the Steel Stud Manufacturers Association (SSMA).
- B. Tolerances: Install walls and partitions on straight lines, plumb, free of twists or other defects, and contacting a 10-foot straight edge for its entire length at any location within a 1/8 inch tolerance. Install horizontal framing level within a tolerance of 1/8 inch in 12 feet in any direction.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in their original unopened packages and stored protected from damage. Do not store material directly on grade. Provide adequate support to prevent bowing of material prior to installation.
- B. Store welding electrodes in accordance with AWS D12.1.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide studs, tracks, joists, header, and accessories manufactured by one of following: (All manufactures shall be per ICC ERS 3064P)
 1. ClarkWestern Building Systems.

2. Dietrich Industries, Inc.
 3. Marino/WARE.
 4. Cemco.
 5. Equal.
- B. Special Connection Accessories: Products manufactured by The Steel Network, Inc., or equal.

2.02 MATERIALS

- A. Light Gage Metal Framing:
1. Metal framing shall be formed from corrosion resistant-steel conforming to requirements of ASTM A653, 50 ksi minimum.
 2. Metal framing shall be zinc coated in conformance to requirements of ASTM A926, G60.
 3. Metal framing shall be manufactured in conformance to ASTM C955.
 4. Install metal framing per ASTM C1007, Standard Specification for Installation of Load-Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- B. Gages and properties of studs shall be as indicated on Drawings.
- C. Mechanical anchors to concrete and masonry shall be metal cinch at least 3/8 inch in diameter threaded bolt head type. Anchor bolts to be installed in concrete shall be hook type 1/2 inch diameter or more. Unless otherwise indicated.
- D. Mechanical anchors to metal framing shall be No. 10 self-tapping and self-drilling wafer-head screws.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install plumb and true. Install necessary accessories for proper installation.
- B. Anchor top and bottom runner track to ceiling or roof structure overhead and to floor structure below.
- C. Install studs squarely in top and bottom runner track with firm abutment against track webs.
- D. Align and plumb studs, and fasten to flanges of both top and bottom runner tracks.

- E. Provide three studs minimum at corners of stud walls. Locate so as to provide surfaces for attachment of interior and exterior facing materials.
- F. Members not indicated to be welded together shall be attached with manufacturer recommended screws with minimum one screw at each flange of stud to top and bottom track. Wire tying of framing members is not permitted.
- G. Provide lateral bracing and bridging in accordance with manufacturer's written recommendations or as required by CBC.
- H. Intersecting walls and partitions, whether load-bearing or not, shall be connected.
- I. Splices in axially loaded studs are not permitted.
- J. Splice or butt weld butt joints in runner tracks. No splices are permitted in tracks over lintels, diaphragm sheathing, or diagonal bracing.
- K. Weld connections by fillet welds or plug welds in accordance with AWS recommended procedures and practices.
- L. Touch-up field abrasions and welds with galvanizing touch-up material.
- M. Studs that frame door openings shall be clipped to floor with 14 gage angle clips. Each clip to have two fasteners into studs and two fasteners into floor.
- N. Provide additional joists or blocking adjacent to exterior and interior walls, openings and elsewhere as required to provide support for indicated ceiling construction.
- O. Provide an additional joist under parallel partitions where partition length exceeds $\frac{1}{2}$ joist span and around floor and roof openings which interrupt one or more spanning members.

3.02 CONNECTIONS TO METAL DECKING

- A. Provide premolded neoprene filler strips matching flute profile for non-fire-rated walls and partitions covered on one or both sides up to metal decking.
- B. Top runner track of fire-rated partitions shall be a minimum of 36 mils (20 gage), unless noted otherwise, and attached to metal deck with required fasteners at spacing required for fire rating, but in no case over 16 inches on center. Areas above runner shall be friction fit with a minimum depth of 2 $\frac{1}{2}$ inches of 4 pounds per cubic foot density mineral wool insulation. A minimum of $\frac{1}{2}$ inch of firestopping compound shall be installed to each side of mineral wool insulation for a one-hour system, and one inch of firestopping for a two-hour system. Install required special tracks, angles, fasteners and strips of gypsum wallboard to provide required fire resistance rating.
- C. Fire-rated top tracks shall be installed in accordance with manufacturer's recommendations and fire rating approval requirements.

3.03 QUALITY CONTROL

- A. Welding Inspection:

1. Inspection of field welding operations shall be performed by special inspector.
2. The special inspector shall inspect material, equipment, procedures, welds, and welder qualifications.

3.04 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.05 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rough carpentry Work.
2. Installation of glued laminated members, plywood web joists or wood chord metal web joists.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 03 1000: Concrete Forming and Accessories.
4. Section 03 3000: Cast-In-Place Concrete.
5. Section 06 2000: Finish Carpentry.
6. Section 09 2900: Gypsum Board.

1.02 SYSTEM DESCRIPTION

A. Regulatory Requirements:

1. Work of this Section shall comply with CBC Chapter 23.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Redwood structural and framing lumber shall be graded in accordance with Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
2. Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the Standard Grading Rules of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Lumber Grading Rules of the Western Wood Products Association (WWPA).

3. Plywood shall conform to requirements of Product Standard PS 1, and shall be grade marked by a recognized grading agency (APA and PTL).
- B. Lumber shall bear official grade mark of the association under whose rules it was graded or official grade mark of another recognized grading agency.
 - C. Structural and framing members 2-inch thick (nominal) and larger shall be air-dried to moisture content not to exceed 19 percent before installation.
 - D. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with CBC Chapter 23; refer to Section 01 4523: Testing and Inspection.
 - E. Lumber showing visible signs of mold growth:
 1. Lumber showing visible signs of mold growth shall be removed from the project site or cleaned as outlined below.
 2. The contractor is responsible for all costs associated with cleaning, post-cleaning testing, and reporting for lumber with mold.
 - a. Lumber that shows visible signs of mold growth prior to, or after installation, shall be cleaned pursuant to the current edition of USEPA's guidance publication "Mold Remediation in Schools and Commercial Buildings (EPA 402-K-01-001).
 - b. A minimum of 10 percent of the total locations cleaned must be sampled (tape lift method) post cleaning to ensure cleaning effort was successful. Cleaning will be considered acceptable when tape lift sample results evaluated by direct microscopic examination determine that the general abundance of mold is non-detect or rare (normal trapping to 1+).
 - c. A report prepared by a Certified Industrial Hygienist (CIH) that details the sampling and cleaning results shall be prepared and submitted to the OAR for review and approval of the LAUSD Office of Environmental Health and Safety.
 - d. Cleaned lumber shall not be installed or enclosed by finish materials until approval of test results. Cleaned lumber must meet moisture content requirements as required elsewhere in this specification prior to installation or application of finishes.

1.04 STORAGE, HANDLING AND PROTECTION

- A. The materials supplied as part of the Work of this section shall be protected from exposure to inclement weather before being covered by other Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lumber: Structural and framing lumber shall be of species and grade noted on the Structural Drawings (S001).
- B. Plywood: Plywood furnished for structural purposes, when exposed outdoors, shall be exterior type plywood. Other plywood furnished for structural purposes shall be exterior type, or Exposure 1.
- C. OSB Board or Panels:
 - 1. Oriented strand board or panels shall not be furnished as part of the Work of this section.
- D. Preservative Treated Wood:
 - 1. Wood and plywood specified; as treated wood shall be pressure treated wood in accordance with CBC requirements.
 - 2. Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of two weeks before installation. Moisture content shall be 15 percent maximum.
 - 3. Creosote or arsenic is not permitted for treating wood.
 - 4. When treated wood member have been notched, dapped, drilled, or cut, such newly cut surfaces shall be painted with a heavy coat of the same preservative material originally provided for treatment of wood member.
- E. Fire Retardant Protection: Wood and plywood specified as fire retardant protected wood shall be treated by approved methods and materials and shall be dried following treatment to maximum moisture content as follows:
 - 1. Solid sawn lumber 2-inch thick or less: 19 percent.
 - 2. Plywood: 15 percent.
- F. Plywood Subflooring: Underlayment, Group 1, Exposure 1; of thickness indicated.
- G. Mineral Fiber Panels: Asbestos-free, thickness as indicated.
- H. Adhesive: Elastomeric adhesive – follow manufacturer’s installation instructions. Product must be approved by OWNER Office of Environmental Health and Safety and conform to ASTM D 3498 or APA-AFG-01.

PART 3 - EXECUTION

3.01 FASTENINGS

A. Nails and Spikes:

1. Furnish only common wire nails or spikes whenever indicated, specified or required.
2. Whenever necessary to prevent splitting, holes shall be pre-drilled for nails and spikes.
3. Nails in plywood shall not be overdriven.
4. Machine Applied Nailing: Use of machine nailing is subject to a satisfactory Project site demonstration for each Project and approval by the Architect or structural engineer retained by the Architect as an Architect Consultant and DSA. Installation is subject to continued satisfactory performance. Machine nailing is not permitted for 5/16 inch plywood. Do not permit nail heads to penetrate outer ply. Maintain minimum allowable edge distances when installing nails.

B. Lag Screws:

1. When installing lag screws in a wood member, pre-drill hole as required by the CBC.
2. Lag screws, which bear on wood, shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.

C. Bolts:

1. Lumber and timber to be fastened together with bolts shall be clamped together with holes for bolts bored true to line.
2. Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again before completion of the Work of this section.

D. Wood Screws: When installing wood screws, pre-drill holes as required by the CBC.

E. Metal Framing Devices: Framing anchors, joist hangers, ties, and other mechanical fastenings shall be galvanized or furnished with a rust inhibitive coating. Nails and fastenings shall be of the type recommended by manufacturer.

F. Powder Driven Fasteners:

1. Loads shall not exceed 75 pounds unless indicated on the Drawings or when reviewed by the Architect.

2. The operator, tool, and fastener shall perform the following as observed by the Inspector.
 - a. Observe installation of first 10 fasteners.
 - b. Test the first 10 fasteners by performing a pullout test. Load shall be at least twice the design load, or 150 pounds, whichever is greater.
 - c. Random testing:
 - 1) Load less than 75 pounds - approximately 1 in 10 pins.
 - 2) Load 75 pounds or greater - 1/2 of the pins.
3. Failure of any test will result in testing of all installed pins.
4. Nail heads shall not break the outer skin of sheathing.
5. Non-compliant pins shall be replaced.

3.02 INSTALLATION

A. Stud Walls, Partitions and Furring:

1. Wood stud walls, partitions and vertical furring shall be constructed of members of size and spacing indicated. Provide single treated plate at bottom and double plate at top unless otherwise indicated. Interior, nonbearing non-shear partitions may be framed with a single top plate, installed to provide overlapping at corners and at intersections with other wall and partitions or by metal ties as detailed.
2. Walls and partitions shall be provided with horizontal staggered blocking at least 2 inch nominal thickness and same width as studs, fitted snugly, and nailed into studs. Blocking shall be installed at mid-height of partition or not more than 7 feet on center vertically. Install wood backing on top of top plate wherever necessary for nailing of lath or gypsum board.
3. Walls, partitions and furred spaces shall be provided with 2-inch nominal thickness wood firestops, same width as space to be firestopped, at ceiling line, mid-height of partition and at floor line. Firestops at floor line are not required when floor is concrete. If width of opening is such that more than one piece of lumber is necessary, provide two thicknesses of one inch nominal material installed with staggered joints.
4. Firestops shall be installed in stud walls and partitions, including furred spaces, so the maximum dimension of any concealed space is not over 10 feet.

5. Corners, and where wood stud walls and wood vertical furring meet, shall be constructed of triple studs. Openings in stud walls and partitions shall be provided with headers as indicated and a minimum of 2 studs at jambs, one stud of which may be cut to support header in bearing.
6. Where wood and masonry or concrete walls intersect, end stud shall be fastened at top, bottom and mid-height with one 1/2 inch diameter bolt through stud and embedded in masonry or concrete a minimum of 4 inches. Bolts shall be provided with washers under nuts.
7. Sills under bearing, exterior or shear walls shall be bolted to concrete with 5/8 inch diameter by 12-inch long bolts with nuts and washers, spaced not more than 4 feet on center unless noted otherwise. There shall be a bolt within 9 inches of each end of each piece of sill plate. Sills shall be installed and leveled with shims, washers, with nuts tightened to level bearing. Space between sill and concrete shall be dry packed with cement grout.

B. Floor Joists, Roof and Ceiling Framing:

1. Wood joists shall be of the size and spacing indicated, installed with crown edge up, and shall have at least 4-inch bearing at supports. Provide 2-inch solid blocking, cut in between joists, same depth as joists, at ends and bearings, unless otherwise indicated.
2. Floor joists of more than 4 inches in depth and roof joists of more than 8 inches in depth shall be provided with bridging. Floor joists shall be bridged every 8 feet with solid blocking or metal cross bridging. Roof joists shall be bridged every 10 feet.
3. Joists under and parallel to bearing partitions shall be doubled and nailed or bolted together as detailed. Whenever a partition containing piping runs parallel to floor joists, joists underneath shall be doubled and spaced to permit passage of pipes and blocked with solid blocking spaced at not more than 4 feet intervals.
4. Trimmer and header joists shall be doubled, when span of header exceeds 4 feet. Ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition, or wall. Tail joists over 12 feet long shall be supported at header by framing anchors or on ledger strips at least 2 by 4.
5. Provide solid blocking between rafters and ceiling joists over partitions and at end supports where indicated.

C. Beams, Girders and Joists:

1. Ends of wood beams, girders and joists which are 2 feet or less above finished outside grade and which abut, but do not enter concrete or masonry walls, as

well as wood blocking used in connection with ends of those members shall be treated with wood preservative.

2. Where wood beams, girders and joists enter masonry or concrete walls 2 feet or less above outside wall, metal wall boxes or equivalent moisture barriers shall be provided between wood and masonry or concrete.

D. Subflooring:

1. Floor sheathing: Plywood of thickness and nailing indicated. Install with the face grain direction across supports, end joints staggered and centered over supports. Provide solid blocking under plywood edges where indicated. In addition to nailing, sheets of plywood flooring shall be secured in place with elastomeric adhesive, installed at beams, joints, perimeter supports and panel edges.

E. Roof and Wall Sheathing:

1. Plywood roof sheathing shall be Structural I, Grade C-D, Exposure 1, thickness as indicated.
2. Where exposed roof sheathing is indicated, area shall be sheathed solid with dressed and center matched, V-jointed boards of sizes indicated. Boards shall be installed perpendicular to supports.
3. Soffits of overhanging eaves, where indicated, shall be boxed-in using Group I, Exterior Type, Grade A-C, plywood, thickness as indicated.
4. Plywood for shear walls shall be Structural I, Grade C-D Exterior Type, thickness as indicated. Install with the long dimension parallel or perpendicular to the supports. Blocking shall be provided behind edges not located over supports. Shear wall construction, nailing, and top and bottom anchorage shall be as indicated.
5. Provide and install metal H-clips of required size, midway between rafters at unsupported edge joints of plywood roof sheathing where rafters are spaced at 24 inches on center. Clips shall be Plyclips, by Timber Fasteners Inc., Panel Clips by Simpson Co., USP Structural Connectors, or equal.

F. Attic Space Partitions and Attic Walkways:

1. Attic space partitions shall be constructed of 2 by 4 wood members spaced at 2 feet on center maximum with 5/8 inch gypsum board.
2. Doors in attic space partitions shall be self-closing, of the same sheathing material as partition, constructed with 2 battens and a diagonal brace across back.

3. Shear walls passing through attic space shall be sheathed with 5/8 inch gypsum board on each side.
4. Attic walkways shall be constructed of 2 by 12 planks installed one-inch apart and nailed at each support with three 16d nails.

G. Furring:

1. Rafters or ceiling joists indicated to be furred for support of materials other than acoustical tile shall be furred with 2 by 4 wood members installed at right angles to supports, spaced as indicated and nailed in place. Furring shall be aligned, and bottoms shall be leveled by installing wood shims as required, and nailed as indicated.
2. Furring for protective wall padding in gymnasium shall be 1 by 3 Douglas fir, Construction Boards, S1S1E; applied horizontally to concrete walls at top and bottom of padding panels; and at uniform intermediate spacing not more than 18 inches on center. Stripping shall be shimmed where required, aligned to a true plane, and secured to concrete walls with concrete nails at not more than 18 inches on center.

H. Furring: Where metal furring is not indicated or specified, provide wood furring at points indicated and required for concealing conduit, piping, structural framing or other unfinished materials. Wood furring shall be 2-by studs of required width. Vertical members contacting concrete or masonry shall be attached as specified for anchoring interior wood stud partitions.

I. Grounds:

1. Provide and set wood grounds at points where wood trim occurs and work is to be plastered. Grounds at 3/4 inch metal lath shall be 5/8 inch thick, net, 1 1/2-inch wide Douglas Fir, S1S. Grounds shall be doubled where trim member exceeds 5-inch width, or wherever indicated. Grounds shall be applied after lath has been installed set plumb, level and true to line.
2. Apply grounds over wood framed surfaces and lath and securely nail to wood backing at each stud or bearing. Grounds applied over steel channel studs and lath shall be securely nailed at each stud or bearing to nail-blocks provided and installed in metal studs.
3. Grounds applied to concrete surfaces shall be securely nailed to woodblocks provided and built into concrete.

J. Nailing Strips and Plates:

1. Provide wood nailing strips, plates and blocking indicated or required. Nailing strips in connection with metal work shall be bolted to metal. Wood nailing blocks for securing grounds shall be built into concrete, or masonry.

2. Nailing schedule shall comply with CBC requirements.
 3. Treated wood nailing strips for lightweight insulated concrete roof decks at eaves, ridges, rakes, base of curbs and wherever else indicated, shall be provided and installed. Strips shall be treated Douglas fir, 4 inches (nominal) width by thickness of insulated concrete.
- K. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.
- L. Wood Bucks: Furnish and set wood bucks to form openings for doors and other openings in concrete or masonry walls and in steel stud or channel partitions and furring. Bucks shall be Douglas fir, S1S2E, 2 inches (nominal) thickness and of width indicated or required. Bucks in connection with concrete shall be bolted thereto, and bucks in masonry walls shall be attached by means of strap anchors embedded in masonry joints. Bucks in connection with steel studs and metal channels shall be secured with nails or screws spaced not to exceed 24 inches on centers.
- M. Bench Tops and Backs: Tops and backs shall be 3/4 inch thick asbestos free board, fabricated to minimize number of joints. Edges shall be neatly cut, smoothly finished and joints accurately fitted and butted. Tops and backs shall be secured with countersunk flathead galvanized wood screws. At bench with steel pan, apply with manufacturer's recommended adhesive. Cut and drill as required for Work to be attached to benches.

3.03 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 06 1643
GYPSUM SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Fiberglass-mat faced, moisture and mold resistant exterior gypsum sheathing.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 05 4100 - Structural Metal Stud Framing.
 - 3. Section 07 2100 Thermal Insulation.
 - 4. Section 07 9200 - Joint Sealants.
 - 5. Section 07 2719 Plastic Sheet Barriers.

1.02 PROJECT REQUIREMENTS

- A. Design Requirements: Provide systems capable of resisting deflection.
- B. Regulatory Requirements: Comply with CBC requirements for design and installation.

1.03 SUBMITTALS

- A. Material Samples: Submit 5.5" inch by 8.5" inch sample of the exterior sheathing panel. Submit 5 screws to be utilized in attaching the exterior sheathing panel.
- B. Product Data: Submit manufacturer's catalog data for the sheathing product and the attachment screws.

1.04 QUALITY ASSURANCE

- A. Comply with following as a minimum requirement:
 - 1. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - 2. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 3. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.

4. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
 5. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing.
- B. Qualifications: Installer shall have a minimum 5 years experience in installing and finishing gypsum board.
- A. CHPS Low-Emitting Materials table: Materials submitted shall meet the CHPS Low-Emitting criteria and be listed as Low-Emitting on the following web site: www.CHPS.net or be listed on UL website Greenguard.org as Greenguard Gold Certified.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, factory sealed packages, containers or bundles bearing brand name and name of manufacturer.
- B. Materials shall be kept dry. Exterior Sheathing shall be neatly stacked flat; avoid sagging and damage to edges, ends, and surfaces.
- C. Fire-rated materials shall have fire classifications numbers attached and legible.
- D. Provide all means necessary to protect Exterior Sheathing systems before, during, and after installation.
- E. Exterior sheathing showing any evidence of water damage shall not be installed. Exterior sheathing showing evidence of water damage after installation shall be removed and replaced.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS AND PRODUCTS

- A. Georgia-Pacific - Dens Glass Gold sheathing.
- B. National Gypsum Co. - Gold Bond eXP sheathing.
- C. U.S. Gypsum Co. - SECUROCK brand UltraLight glass Mat.
- D. Or equal.

2.02 MATERIALS

- A. Exterior sheathing Type X (fire-resistant): 5/8 inch thick, 4-foot wide and up to 10 feet long conforming to ASTM C1177.
 1. Edges: Square.
 2. Surfacing: Fiberglass mat on face, back, and long edges.
 3. Mold Resistance: score of 10 per ASTM D3273 in a test as manufactured.

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2.03 ACCESSORIES

- A. Fasteners: ASTM C1002, corrosion resistance of more than 800 hours per ASTM B117. In coastal environments or aggressive environments, stainless steel fasteners shall be used.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the fire rated assembly indicated on the drawings, GA-253, ASTM C1280 and the manufacturer's recommendations.
- B. Prior to application of exterior system, attachment of sheathing to framing shall be able to withstand design wind loads of building.

3.06 CLEAN-UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.07 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Continuous insulation at exterior walls.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 05 4100 - Structural Metal Stud Framing.
3. Section 07 2719 –Plastic Sheet Air Barriers.
4. Section 09 2216 - Non-Structural Metal Framing.
5. Section 09 2423 – Cement Plaster and Metal Lath.

1.02 SUBMITTALS

A. Product Data:

1. Material List: Provide a list of materials for installation under this section.
2. Provide manufacturer's printed Product Data for each type insulation and accessory.

B. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

C. Certification: Provide certification that insulation materials conform to requirements of CBC Chapter 26.

D. Recycled Content: Provide certification that insulation materials contain a minimum 30 percent recycled materials.

1.03 QUALITY ASSURANCE

A. Surface Burning Characteristics: Flame spread rating shall not exceed 25 and smoke density shall not exceed 50 when tested in accordance with ASTM E84.

- B. Combustion Characteristics: Rated as non-combustible when tested in accordance with ASTM E136.
- C. Comply with following as a minimum requirement:
 1. ASTM C209 – Standard Test Methods for Cellulosic Fiber Insulating Board.
 2. ASTM C553: Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 3. ASTM C578: Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 4. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
 5. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 6. ASTM D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.
 7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 8. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- D. CHP Low-Emitting Materials Table: Materials submitted for building insulation must be listed as low emitting on the CHPS website, www.CHPS.net, or must be tested by an independent laboratory to meet CHPS requirements. Components of an assembly must meet CHPS requirements individually or in an assembly.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site and store in a safe, dry place, with labels intact and legible at time of installation.
- B. Protect building insulation materials from damage.

1.05 PROJECT CONDITIONS

- A. Avoid exposure to humidity and moisture. Protect from exposure to sunlight.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Owens Corning.
- B. Johns Manville.
- C. CertainTeed Corporation.
- D. The DOW Chemical Company.
- E. DiversiFoam Products.
- F. Equal.

2.02 MATERIALS

A. General:

1. Provide Unfaced, friction-fit batt insulation where both sides of installation are enclosed.
2. Provide batt insulation with integral vapor barrier when one side of installation will be unenclosed.
3. Provide batt insulation with integral vapor barrier where at least one side of installation will be exposed to high humidity, such as showers.
4. Recycled content shall be a minimum of 30 percent.

B. Mineral Fiber Batt Insulation:

1. Unfaced Mineral Fiber Batt Insulation: Provide friction-fit, unfaced mineral fiber batts. Insulation shall consist of mineral fibers, glass or slag, and thermosetting resins complying with ASTM C665, Type I.
2. Faced Mineral Fiber Batt Insulation: Provide mineral fiber batts with vapor barrier consisting of mineral fibers, glass or slag, and thermosetting resins complying with ASTM C665, Type III, Class A, with vapor-retardant membrane facing.
3. Fasteners for Attaching Insulation to Wood Framing:
 - a. For faced batt insulation provide one of following types of staples: Stainless steel, monel, or copper-coated steel, size as required by manufacturer or applicable code.
 - b. For unfaced batt insulation provide 18 gage, minimum, galvanized steel wire where required to maintain proper insulation placement.
4. Fasteners for Attaching Insulation to Underside of Metal Roof Decks:

- a. Spindle Anchors: Stic-Klip Mfg. Co., Type A or B as required, with Type S adhesive; Miracle Adhesives Corp. "Miracle StukUps" with Type HT994 adhesive; or Goodloe E. Moore Gemco or Tuff-Weld with G-P Improved or Tuff-Bond Quik-Set Type Adhesive as applicable; or equal. Provide adhesives of correct type for substrates and type of anchor.
- b. String Wires: Minimum 18 gage galvanized steel wire.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Work to verify suitability to receive insulation. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Fit batt insulation, of R-value indicated on Drawings, snugly between framing members.
2. Maintain total insulation integrity over entire area to be insulated, including areas between closely spaced members.
3. Extend full thickness insulation over entire area to be insulated. Furnish manufacturer's recommended clips to tightly fit batts at joints.
4. Cut and fit batt insulation tightly around pipes, conduits and penetrations.
5. Do not compress batt insulation in excess of 10 percent (R-19 may be installed in 2 by 6 stud walls).
6. Prevent batt insulation from sagging during and after installation by installing adequate wire.
7. Metal door and window frames in acoustically insulated walls shall be filled with insulation, unless otherwise indicated.
8. Where vapor barrier is provided, install with vapor barrier facing room.
 - a. Batts in Metal Framing: Provide friction-fit batts tightly fitted to stud webs and to metal furring.
 - b. Batts under Metal Roof Decks where underside of insulation will be exposed install foil-faced flanged-type insulation batts and staple flanges together at maximum 4-inch centers and seal joints at abutting vertical

surfaces with a pressure-sensitive plastic tape. Where underside of insulation will be inaccessible, install secure with spindle anchors. Provide 18 gage galvanized string wires under batts wherever necessary to prevent sagging. Stretch wire taut.

- c. Batts in Horizontal or Sloped Applications: Provide tightly stretched string wires along center of horizontal or sloping batts where support spacing exceed 16 inch on centers.
- d. Batts in Ceiling Framing: Install batts between joists, so top of insulation is level with top of framing members. Do not install insulation over recessed lighting fixtures, speakers, or other heat producing elements in ceilings. At junction boxes, access panels, and other items requiring access from above or below ceiling, cut insulation on each side to fit item and install loosely on top. Fit insulation snugly around ducts, conduits, pipes, and other items projecting through ceiling construction.

3.03 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.04 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 07 2719
PLASTIC SHEET AIR BARRIERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Mechanically attached permeable flexible plastic sheet air barriers.
2. Flexible flashing of openings, penetrations, joints, and terminations of exterior walls and taping of seams.

B. Related Requirements:

1. Section 05 4100 – Structural Metal Stud Framing.
2. Section 06 1000 - Rough Carpentry.
3. Section 07 6000 – Flashing and Sheet Metal.
4. Section 07 9200 – Joint Sealants.
5. Section 09 2423 – Cement Plaster and Metal Lath.

1.02 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E1677 - Standard Specification for an Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.
3. ASTM E2178 – Standard Test Method for Air Permeance of Building Materials.

B. International Code Council (ICC):

1. ICC-ES Evaluation Reports.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each material and component proposed for installation.

- B. Shop Drawings: Dimensioned plans and elevations indicating:
 - 1. Complete information as to size and location of openings, sleeves, conduits, ducts, boxes, inserts, attachments, and structural interferences.
 - 2. Layout of air barrier showing sheet lapping, cutting, flashing and taping, with references to enlarged details.
- C. Installation Instructions: Submit detailed manufacturer's installation instructions.
- D. Material Samples: Submit minimum 8-1/2-inch by 11-inch samples of air barrier, and 12 inch long flashing.
- E. Test Reports: Submit Test Reports showing performance characteristics equaling or exceeding those specified.
- F. Evaluation Reports: Submit ICC-ES Evaluation Report demonstrating conformance of plastic sheet air barrier to CBC 1404.2, for use as water-resistive barrier.
- G. Qualification Statements:
 - 1. Installer: Statement from plastic sheet air barrier manufacturer indicating installer is approved, certified, or has been trained for the installation of their products.

1.04 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Plastic sheet air barrier components and accessories shall be from a single source.
 - 2. Manufacturer shall have a minimum of five years of continued experience in the manufacture of the specified products.
- B. Installer:
 - 1. Minimum five years in the installation of air/weather barriers.
 - 2. Trained or certified by manufacturer for the installation of their products.
- C. Mock-up: Refer to Section 09 2423, Cement Plaster and Metal Lath.
- D. Pre-Installation Conference: CONTRACTOR shall coordinate and conduct pre-installation conference in accordance to Section 01 3119, Project Meetings, to review the progress of construction activities related to the installation of plastic sheet air barrier. In addition to the conference attendees listed on Section 01 3119, plastic sheet air barrier installer and manufacturer technical representative shall attend pre-installation conference.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in undamaged and original packaging.
- B. Store materials in a clean, dry, protected location and within temperature range required by plastic sheet air barrier manufacturer. Protect stored materials from direct sunlight.
- C. Handle materials in accordance with Manufacturer's recommendations.

1.06 WARRANTY

- A. Provide a ten year manufacturer's standard material warranty for replacement of plastic sheet air barriers that fail due to material defects.
- B. Installation Warranty: Provide a two year installation warranty for the plastic sheet air barrier, including accessories, against loss of water-tight seal and loss of attachment.
- C. Warranty shall start on the day of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Manufacturer and Products:
 - 1. DuPont (E. I. du Pont de Nemours and Company): Tyvek CommercialWrap.
 - 2. Polymer Group Inc., TyparMetroWrap.
 - 3. Equal.
- B. Properties:
 - 1. Plastic sheet air barrier shall be Type I in accordance to ASTM E1677.
 - 2. Air Permeance: shall not exceed 0.004 cfm/ft², under a pressure differential of 0.3 in w.g. (1.57 psf) (0.02 L/m² at 75 Pa), when tested in accordance with ASTM E2178.
 - 3. Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance to ASTM E84.

2.02 MISCELLANEOUS MATERIALS

- A. Flashing: Self-adhesive butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
 - 1. DuPont (E. I. du Pont de Nemours and Company); FlexWrap and StraightFlash.
 - 2. Polymer Group Inc.; Flashing Flex and Flashing AT.

3. Equal.
- B. Fasteners: Manufacturer approved fasteners.
 - C. Tape: Three inch wide seam tape. Pressure-sensitive plastic tape recommended by air barrier manufacturer for sealing joints and penetrations in air barrier.
 - D. Sealants and Adhesive Primers: Compatible with plastic sheet air barrier and flashings system and approved by OWNER's Office of Environmental Health and Safety (OEHS).
 1. Sealant: Dow Corning 732.
 2. Spray Adhesive: Design Polymerics DP77.
 3. Equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions under which plastic sheet air barrier will be installed.
- B. Verify that substrate to receive air barrier has been completed and inspected before commencement of work.
- C. For the installation of flashing and tape, surface shall be smooth, clean, dry and free from voids, loose substrate, protrusions, or any material that would hinder adhesion.

3.02 INSTALLATION

- A. Install plastic sheet air barrier in accordance to manufacturer's installation guidelines, providing continuity throughout exterior walls. Install plastic sheet air barrier with drainage plane surface pattern in vertical position for proper drainage.
- B. Install plastic sheet air barrier starting from the bottom of the building up to ensure proper overlapping of vertical and horizontal seams. Upper layer of plastic sheet air barrier shall overlap bottom layer by a minimum of six inches. Plastic sheet air barrier shall extend over the weep screed by two inches and be taped down.
- C. Secure plastic sheet air barrier by fastening into studs at 12 to 18 inches on center vertically.
- D. Unroll plastic sheet air barrier directly over windows and doors rough openings. Do not install fasteners within six inches of the sills and jambs of the openings and within nine inches of the header, plastic sheet air barrier shall be fastened at these locations during flashing installation.
- E. Horizontal joints shall be overlapped a minimum of six inches with upper courses overlapping lower courses in water-shedding fashion. Vertical seams shall be

overlapped a minimum of six inches. Overlap corners of building a minimum of 12 inches.

- F. Tape vertical and horizontal seams using adhesive tape recommended by manufacturer. Seal tears and cuts with adhesive tape as recommended by manufacturer.
- G. Place patch or strip of self-adhered flashing over plastic sheet air barrier where base plates, metal channels, z-girts, or other hardware will be installed.

3.03 FLASHING

- A. Cut air barrier from door and window openings along jambs and sill. Cut a header flap at 45 degree angle to expose eight inches of plastic sheet air barrier to allow for head flashing installation. Install sill flashing per manufacturer instructions, overlapping up the jambs a minimum of six inches on each side.
- B. Wrap flashing around interior jamb, wall face and exterior jamb, overlapping the vertical portion of the sill flashing by at least two inches.
- C. Adhere flashing to the head following manufacturer's instructions. Flashing shall wrap jamb flashings by a minimum of two inches.
- D. Flash piping, conduit, duct and similar penetrations through walls, and flashing ledgers and sills as recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's technical representative shall inspect the work and submit a statement indicating that the installation has been done in conformance to manufacturer's installation instructions.

3.05 CLEANING

- A. Remove rubbish, debris, and waste material and legally dispose of off the Project site.

3.06 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 07 6000

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sheet metal flashings in connection with roofing.
2. Miscellaneous metal flashing and counter flashing as required, except where provided under Divisions 22, Plumbing, 23, HVAC, or 26, Electrical.
3. Roof pipe flashings.
4. Other sheet metal items not necessarily specified herein or in other sections but required to prevent penetration of water into building.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 07 9200 - Joint Sealants.
3. Section 09 2423 - Cement Plaster and Metal Lath
4. Division 22 -- Plumbing.
5. Division 23 - HVAC.
6. Division 26 - Electrical.

1.02 SUBMITTALS

- A. Shop Drawings: Submit for fabricated sheet metal indicating shapes, details, methods of joining, anchoring and fastening, thicknesses and gages of metals, concealed reinforcement, expansion joint details, sections, and profiles.
- B. Samples: Submit Samples for materials or assemblies as requested.
- C. Product Data: Submit brochures of manufactured items.

1.03 QUALITY ASSURANCE

- A. Drawings and requirements specified govern. Provide the Work of this section in conformance with the Architectural Sheet Metal Manual published by SMACNA for conditions not indicated or specified and for general fabrication of sheet metal items.
- B. Materials shall conform to following standards:
 1. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
 2. ASTM A653 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 3. ASTM B370 - Copper Sheet and Strip for Building Construction.

- C. Pre-installation Meetings: Refer to Division 07 roofing sections as appropriate. Attend the pre-installation and inspection meetings for roofing Work.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Do not install bent or otherwise damaged materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Galvanized Sheet Steel: ASTM A653, coating designation G90, hot-dip galvanized.
- B. Copper Plate, Sheet and Strip: ASTM B370, cold-rolled, tempered. Copper sheet and strip shall be cold-rolled-temper.
- C. Stainless Steel: Plate, sheet and strip shall conform to ASTM A167, Type 304 or Type 316, No. 4 finish on exposed surfaces and No. 2 finish on concealed surfaces unless otherwise specified or indicated. Furnish Type 304 for general applications and Type 316 where exposed to acidic or alkaline conditions.
- D. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. As-Milled Finish: **Mill**
- E. Fastenings:
 - 1. Galvanized Steel: Nails, rivets, and other fastenings furnished in connection with galvanized sheet steel Work shall be sealed with rust resistive coating. Rivets shall be tinned. Nails and other fastenings shall be zinc-coated.
 - 2. Copper: Nails, rivets, and other fastenings furnished in connection with copper sheet metal Work, shall be manufactured from hard-temper copper or hard brass.
 - 3. Stainless Steel: Nails, rivets and other fastenings furnished in connection with stainless steel Work, shall be 300 series alloy to match alloy of stainless steel being fastened.
- F. Soldering Flux: Raw muriatic acid for galvanized steel; rosin for tin, and tinned copper; non-corrosive soldering salts for uncoated copper and acid-type flux formulated for soldering stainless steel.
- G. Solder: ASTM B32, Grade 5A, composed of 95-5 tin-antimony. Name of product manufacturer and grade designation shall be labeled, stamped or cast onto each coil or bar.

2.02 FABRICATION

- A. General:
 - 1. Accurately form sheet metal Work to dimensions and shapes indicated and required. Cope finish molded and brake metal shapes with true, straight, sharp lines and angles and, where intersecting each other, to a precise fit. Unless

otherwise specified, all galvanized sheet steel shall be 22 gage. Exposed edges of sheet metal shall have a ½ inch minimum hemmed edge.

2. Soldering of sheet steel or copper shall be performed with well-heated copper soldering iron or soldering torch, joints full flowing, neat and consistent. Fill joint completely with solder. Clean materials at joints before soldering, and tin coppers before soldering. Exposed soldering on finished surfaces shall be scraped smooth. Lock seam work shall be fabricated flat and true to line and soldered along its entire length. Acid-fluxed Work shall be neutralized after fabrication.
3. Form and install sheet metal Work to provide proper allowances for expansion and contraction, without causing undue stresses in any part of completed Work. Installation shall be water and weathertight.

B. Gutters and Downspouts:

1. Gutters: Fabricate from 22 gage galvanized steel to match existing size and design unless otherwise indicated. Maximum length of gutter shall be 40 feet between end or expansion joints unless the system is specially designed to accommodate the greater expansion, the larger flow and the need for special supports. Drain gutter towards nearest downspout and provide an expansion joint at mid-point between downspout outlets, but not to exceed 40 feet on center. Gutters shall not pond water. Rivet joints and ends with a minimum of 6 rivets per joint or maximum rivet spacing not to exceed 1 ½-inch on center and ½ inch from the edge of the metal, consisting of 3-inch overlap. Sweat solder from inside of gutter and in horizontal position where possible. Neatly fit downspouts to gutter using a slip joint. Provide expansion joints, consisting of 3-inch lap joints at not over feet.
2. Form and install sheet metal Work to provide allowance for expansion and contraction without causing undue stresses in the completed Work.
3. Downspouts: Fabricate downspouts from 3-inch round, or 3-inch by 4-inch rectangular shapes, 16 gage steel tubing with butt joints and mitered elbows, sized as indicated. Downspouts shall be constructed with conductor heads every 40 feet to admit air and prevent vacuum. Keep downspouts offsets to a maximum of 10 feet. Downspout shall be fabricated with elbows at bottom discharge or connected to drains as indicated. Joints, except expansion joints shall be sealed with a continuous weld. Galvanize downspouts after fabrication.
4. Outlets: Fabricate outlets of 22 gage galvanized sheet steel with a 1/4 inch rolled flanged soldered continuously to gutter. Outside diameter shall be 1/8 inch less than the inside diameter of the downspout and extend into downspout 4 inches. Install a removable wire “bulb type” strainer to outlet opening. Strainer shall be fabricated of 22 gage galvanized steel and ½ inch hardware cloth.

- C. Conductor Heads: Fabricate conductor heads and outlets from 22 gage galvanized sheet steel. Cover tops of the conductor heads with 22 gage galvanized ¼ inch wire mesh soldered securely to separately fabricated frame and mechanically fastened to top conductor head with a minimum of two fasteners.

- D. Gravel Stops: Provide 24 gage galvanized sheet steel gravel stops wherever roof area drops to a lower level; at the eaves and rake of roof, where roof comes to an abrupt edge, and where indicated. Stops shall be of height indicated and shall be fabricated with two flanges. Horizontal flange shall be not less than 4 inches wide, and vertical flange shall extend down over vertical surfaces of trim or gutter. Gravel stops shall lap 4 inches at ends and corners and shall be fabricated by notching and interlocking vertical face flanges. Contact surfaces of lapped flanges, including raised areas, vertical face and corners, shall be completely covered with flashing compound. Fabricate lap joints so that they will be in the direction of water flow. Where flanges are over five inches wide, provide 20 gage continuous cleats fastened at 24 inches on center.
- E. Overflow Outlets: Provide galvanized sheet steel overflow outlets at locations and of sizes indicated. Outlets shall extend through full thickness of wall in one continuous piece and completely line the opening. On outside face of wall, top and sides of outlet shall finish 1/2 inch on surface of wall. Bottom of outlet shall project 1 1/2 inches beyond face of wall and shall be bent down slightly. Outlets shall be sealed on the surface of the building. On inside face, side and bottom flanges shall extend not less than 8 inches beyond edge of opening, and not less than 6 inches at top. Outlets shall be installed at time roof is being installed.
- F. Reglet Type Counterflashing: Where roof comes in contact with vertical surfaces, provide counterflashing. Set top of counter flashing 8 inches above roof deck unless otherwise indicated and extend down at least 5 inches or to top of cant strip. Counterflashing and reglet shall be 22 gage galvanized sheet steel. Lap counter flashing and reglet 3 inches minimum at splices and miter at angles or supply special metal corner fittings. Reglet and method of securing flashing shall be so constructed that flashing is firmly locked in place but may be readily removed for replacement.
- G. Splash Pans: Provide splash pans for all downspouts, which empty onto lower roofs. Pans shall be galvanized sheet steel 12-inch by 18-inch, unless otherwise indicated, and turned up 2 inches on at least three sides.
- H. Roof Expansion Joint Covers: Fabricate of 22 gage galvanized sheet steel, as detailed. One side of joint shall be zee shaped, with 3-inch standing leg extended over the joint and turned down. The other side shall be box shaped, fabricated to extend over the joint, over the standing leg, and turn down to form a water barrier. Prefabricated bellows type joint covers are not permitted.
- I. Miscellaneous Flashing: Unless otherwise indicated, miscellaneous flashing shall be fabricated of galvanized steel. Exterior doors and windows, unless covered by overhangs shall be provided with 22 gage galvanized steel drip flashing as detailed. At wood construction, nail flashing to framing before paper backed lath is installed.
- J. Roof Pipe Flashings:
1. PVC roofs: provide PVC flashings or prefabricated welded or seamless flashings.
 2. Tile and built up roofs: provide 24 gage galvanized steel flashings with a storm worker.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Concrete and masonry materials in contact with sheet metal shall be painted with alkali resistant coating, such as heavy-bodied bituminous paint. Wood in contact with sheet metal shall be painted with two coats of aluminum paint or one coat of heavy-bodied bituminous paint.

3.02 INSTALLATION

- A. General: Coordinate with installation of underlayment indicated in the Drawings and specified in Section 09 2423.
- B. Gutters and Downspouts:
 - 1. Anchor gutters to structure with 10 gage steel straps, galvanized after fabricating. Secure straps with galvanized fasteners at 3 feet on center. Drill pilot holes and use 12 by 2-inch pan head screws.
 - 2. Install 1/4 inch galvanized wire mesh continuous cover on gutter.
 - 3. Secure downspouts to walls with 1/8 inch by 2-inch galvanized steel straps. Straps shall be located at top, bottom, and at not over 10 feet on center. Block downspouts out 1/2 inch from the finish wall surfaces and 1 inch from the bottom of downspout grade. Secure straps to wall framing with 1/4 inch by 2-inch long galvanized anchors. Expansion type anchors shall be provided when anchoring to concrete and masonry. Provide toggle bolts for attachment to masonry or plaster. At steel columns, provide fasteners as indicated. Plastic anchors are not permitted.
 - 4. Anchor conductor heads to walls with 1/4 inch diameter by 2 1/2-inch long galvanized lag screws or 1/4 inch expansion type anchors.
- C. Reglets: Install reglets at constant height above cant or as indicated. Provide minimum 3-inch lap at end splices of reglets. Seal laps watertight.
- D. Counterflashing:
 - 1. Install at constant horizontal elevation across roof slope and slope at constant height above cant or as indicated.
 - 2. Provide minimum 3-inch lap at all end splices of counterflashing.
- E. Galvanized sheet steel parapet coping and flashing shall be continuous over top of parapet to form a watertight cap, with waterproof seams at approximately 10 feet on center, or as indicated. Anchor coping to outside of wall with a continuous cleat face nailed at 24 inch centers. Coping shall be fastened on inside wall with hex head screws and bonded sealing washers through oversized holes in the back of the coping. Corners and angles shall be lapped and soldered; do not install joint sealant.

3.03 TESTING

- A. Perform field water testing to demonstrate installation is watertight. Continue testing with a continuous hose stream applied at base of installation for at least 30 minutes. If leaking is observed, discontinue test and repair installation, then test until satisfactory results are obtained.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

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3.05 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

OF SECTION END

SECTION 07 9200

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Joint sealants.
 - 2. Preparation for application of sealants.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 07 6000 - Flashing and Sheet Metal.
 - 3. Division 08 - Openings.
 - 4. Division 09 - Finishes.
 - 5. Section 10 2813 - Toilet Accessories.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating sealant joint locations, with full-size sealant joint details.
- B. Product Data: Submit manufacturer's literature for each sealant material.
- C. Material Samples: Submit Samples indicating color range available for each sealant material intended for installation in exposed locations.
- D. Certifications: Submit manufacturer's certification materials comply with requirements specified.
- E. Site Samples: At locations required, provide a Sample of sealant for each typical installation, approximately 24 inches long, including joint preparation, backing, sealant and tooling. Allow backing to extend 6 inches beyond end of sealant for inspection of substrate.
- F. Test Reports: Submit manufacturer's adhesion compatibility test reports according to ASTM C794 for each substrate.

1.03 QUALITY ASSURANCE

- A. Qualifications of Installer: The Work of this section shall be installed by a firm which has been in the business of installing similar materials for at least five consecutive years; and

can show evidence of satisfactory completion of five projects of similar size and scope. Installer shall have applicators trained and approved by manufacturer for performing this Work.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store in accordance with manufacturer's recommendations. Provide a uniform ambient temperature between 60 and 80 degrees F.

1.05 WARRANTY

- A. Manufacturer: five year material warranty.
- B. Installer: two year installation/application warranty.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Furnish sealants meeting following in-service requirements:
 1. Normal curing schedules are permitted.
 2. Non-staining, color fastness (resistance to color change), and durability when subjected to intense actinic (ultraviolet) radiation are required.
- B. Furnish the products of only one manufacturer unless otherwise required, sealant colors as selected to match the adjoining surfaces.

2.02 MANUFACTURERS

- A. Sealants must be approved by LAUSD's Office of Environmental Health and Safety (OEHS). Check OEHS website for approved products. Not all products by a manufacturer are approved by OEHS.

2.03 MATERIALS

- A. Sealants:
 1. Sealant 1: Acrylic latex, one-part, non-sag, mildew resistant acrylic emulsion compound complying with ASTM C834, Type S, Grade NS, formulated to be paintable.
 - a. Tremco Inc., Acrylic Latex Caulk.
 - b. Pecora Corporation, AC-20.
 - c. Equal.
 2. Sealant 2: Butyl sealant, one-part, non-sag, solvent-release-curing sealant complying with ASTM C1311, gun grade and formulated with a minimum of 75 percent solids.

- a. Tremco Inc., Tremco Butyl Sealant.
 - b. Pecora Corp., BC-158.
 - c. Equal.
3. Sealant 3: Silicone sealant, one-part non-acid-curing silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25.
 - a. Dow Corning Corp., Dow Corning 790, 791, 795.
 - b. General Electric Co., Silpruf.
 - c. Tremco, Inc., Spectrem 1.
 - d. Pecora Corp., 864.
 - e. Equal.
 4. Sealant 4: One-part mildew-resistant silicone sealant, complying with ASTM C920, Type S, Grade NS, Class 25.
 - a. Dow Corning Corp., Dow Corning 786.
 - b. General Electric Co., Sanitary 1700.
 - c. Tremco, Inc., Proglaze White.
 - d. Equal.
 5. Sealant 5: One-part non-sag urethane sealant, complying with ASTM C920, Type S, Grade NS, Class 25.
 - a. Sika Corporation, Sikaflex -221e.
 - b. Equal.
 6. Sealant 6: Multi-part pouring urethane sealant, complying with ASTM C920, Type M, Grade P, Class 25.
 - a. Sika Corporation, Sikaflex 2C NS/SL.
 - b. Equal.
 7. Sealant 7: Acoustical sealant, non-drying, non-hardening permanently flexible conforming to ASTM D217.
 - a. Pecora Corp., BA-98 Acoustical Sealant.
 - b. Equal.

B. See 07 8413 - Penetration Firestopping for rated sealants.

- C. .Joint Backing: ASTM D1056; round, closed cell Polyethylene Foam Rod; oversized 30 to 50 percent larger than joint width, reticulated polyolefin foam.
- D. Primer: Non-Staining Type. Provide primer as required and shall be product of manufacturer of installed sealant.
- E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer.
- F. Sealants shall have normal curing schedules, shall be nonstaining, color fast and shall resist deterioration due to ultraviolet radiation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that joint openings are ready to receive Work and field tolerances are within the guidelines recommended by sealant manufacturer.

3.02 SURFACE PREPARATION

- A. Joints and spaces to be sealed shall be completely cleaned of all dirt, dust, mortar, oil, and other foreign materials which might adversely affect sealing Work. Where necessary, degrease with a solvent or commercial degreasing agent. Surfaces shall be thoroughly dry before application of sealants.
- B. If recommended by manufacturer, remove paint and other protective coatings from surfaces to be sealed before priming and installation of sealants.
- C. Preparation of surfaces to receive sealant shall conform to the sealant manufacturer's specifications. Provide air pressure or other methods to achieve required results. Provide masking tape to keep sealants off surfaces that will be exposed in finished Work.
- D. Etch concrete or masonry surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant installation.
- E. Perform preparation in accordance with ASTM C804 for solvent release sealants, and ASTM C962 for elastomeric sealants.
- F. Protect elements surrounding Work of this section from damage or disfiguration.

3.03 SEALANT APPLICATION SCHEDULE

	<u>Location</u>	<u>Type</u>	<u>Color</u>
A.	Exterior and Interior joints in horizontal surfaces of concrete; between metal and concrete masonry and mortar.	Sealant 6	To match adjacent material

B.	Exterior door, entrance and window frames. Exterior and interior vertical joints in concrete and masonry metal flashing.	Sealant 3 or 5	To match adjacent material
C.	Joints within glazed curtain wall system. Skylight framing system. Aluminum entrance system glass and glazing.	Sealant 3	Translucent or Black
D.	Interior joints in ceramic tile and at plumbing fixtures.	Sealant 4	Translucent or White
E.	Under thresholds.	Sealant 2	Black
F.	All interior joints not otherwise scheduled	Sealant 1	To Match Adjacent Surfaces
G.	Heads and sills, perimeters of frames and other openings in insulated partitions	Sealant 7	Match Adjacent Surfaces

3.04

APPLICATION

- A. Provide sealant around all openings in exterior walls, and any other locations indicated or required for structure weatherproofing and/or waterproofing.
- B. Sealants shall be installed by experienced mechanics using specified materials and proper tools. Preparatory Work (cleaning, etc.) and installation of sealant shall be as specified and in accordance with manufacturer's printed instructions and recommendations.
- C. Concrete, masonry, and other porous surfaces, and any other surfaces if recommended by manufacturer, shall be primed before installing sealants. Primer shall be installed with a brush that will reach all parts of joints to be filled with sealant.
- D. Sealants shall be stored and installed at temperatures as recommended by manufacturer. Sealants shall not be installed when they become too jelled to be discharged in a continuous flow from gun. Modification of sealants by addition of liquids, solvents, or powders is not permitted.
- E. Sealants shall be installed with guns furnished with proper size nozzles. Sufficient pressure shall be furnished to fill all voids and joints solid. In sealing around openings, include entire perimeter of each opening, unless indicated or specified otherwise. Where gun installation is impracticable, suitable hand tools shall be provided.

- F. Sealed joints shall be neatly pointed on flush surfaces with beading tool, and internal corners with a special tool. Excess material shall be cleanly removed. Sealant, where exposed, shall be free of wrinkles and uniformly smooth. Sealing shall be complete before final coats of paint are installed.
- G. Comply with sealant manufacturer's printed instructions except where more stringent requirements are indicated on Drawings or specified.
- H. Partially fill joints with joint backing material, furnishing only compatible materials, until joint depth does not exceed 1/2 inch joint width. Minimum joint width for metal to metal joints shall be 1/4 inch. Joint depth, shall be not less than 1/4 inch and not greater than 1/2 inch.
- I. Install sealant under sufficient pressure to completely fill voids. Finish exposed joints smooth, flush with surfaces or recessed as indicated. Install non-tracking sealant to concrete expansion joints subject to foot or vehicular traffic.
- J. Where joint depth prevents installation of standard bond breaker backing rod, furnish non-adhering tape covering to prevent bonding of sealant to back of joint. Under no circumstances shall sealant depth exceed 1/2 inch maximum, unless specifically indicated on Drawings.
- K. Prime porous surfaces after cleaning. Pack joints deeper than 3/4 inch with joint backing to within 3/4 inch of surface. Completely fill joints and spaces with gun applied compound, forming a neat, smooth bead.

3.05 MISCELLANEOUS WORK

- A. Sealing shall be provided wherever required to prevent light leakage as well as moisture leakage. Refer to Drawings for condition and related parts of Work.
- B. Install sealants to depths as indicated or, if not indicated, as recommended by sealant manufacturer but within following general limitations:
 - 1. For joints in concrete walks, slab and paving subject to traffic, fill joints to a depth equal to 75 percent of joint width, but not more than 3/4 inch deep or less than 3/8 inch deep, depending on joint width.
 - 2. For building joints, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.

3.06 CLEANING

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 CURING

- A. Sealants shall cure in accordance with manufacturer's printed recommendations. Do not disturb seal until completely cured.

3.08 PROTECTION

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- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hollow metal doors and frames or hollow metal doors as indicated.
2. Hollow metal window frames or hollow metal door and window frames.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 07 9200 - Joint Sealants.
3. Section 08 1416 - Flush Wood Doors.
4. Section 08 7100 - Door Hardware.
5. Section 09 9000 - Painting and Coating.

1.02 DESIGN REQUIREMENTS

- A. Door-and-frame assemblies or frames shall include reinforcing and provisions for hardware as shown and specified. Drawings indicate profile and general details of steel frame fabrication and installation.

1.03 SUBMITTALS

- A. Shop Drawings: Submit composite Shop Drawings indicating detailed relationships of installation including Work of adjacent construction, finish hardware, security, fire and life safety devices, glazing, sealing, and requirements for field installation. Include elevations of each hollow metal door type, details of each frame type, location schedule of doors and frames indicating same reference for details and openings as indicated on Drawings, conditions of openings of various wall sections and materials, typical and special details of construction, methods of assembling sections, location and installation requirements for hardware, material size, shape, and thickness, and joints and connections.

- B. Product Data: Submit manufacturer's Product Data indicating composition and construction for each fabricated item including louvers, coatings, finishes, and other components demonstrating compliance with referenced standards.
- C. Certification: Submit certification of compliance with referenced standards and specified criteria, including but not limited to fire ratings in accordance with UL 10C, Physical Endurance in accordance with ANSI A250.4 and Prime Paint performance in accordance with ANSI A250.10.
- D. Samples:
 - 1. Hollow Metal Frame: Corner section of typical exterior and interior frame, of sufficient composite size to illustrate corner joint construction, hinge reinforcement, closer re-enforcement, floor anchor, dust cover, and jamb anchors, and showing galvanizing and prime coat finishes.
 - 2. Hollow Metal Door: Section of typical interior door of sufficient composite size to illustrate edge, top, bottom, and core construction, hinge reinforcement and face stiffening, closer reinforcement and kick plate reinforcement, and corner of vision opening construction with glazing beads.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum documented experience of more than five years in work of this section.
- B. Installer Qualifications: Minimum documented experience of more than five years in work of this section
- C. Coordinate with hardware supplier for fabrication of doors and frames to receive hardware items.
- D. Coordinate with intrusion alarm supplier for fabrication of doors and frames to receive intrusion detection devices.
- E. References: Work shall comply with physical and performance requirements of following standards, including standards referenced in them, except for more stringent provisions specified herein or required by regulatory agencies:
 - 1. ANSI/SDI A250.8, SDI 100 Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/NFPA 252, Fire Tests of Door Assemblies.
 - 3. ANSI/UL 10B, Fire Tests of Door Assemblies.
 - 4. ANSI/UL 10C, Positive-Pressure Fire Tests of Door Assemblies.

5. ANSI/NFPA 80, Fire Doors and Fire Windows
6. HMMA, Guide Specifications for Commercial Hollow Metal Doors & Frames (Standard of National Association of Architectural Metal Manufacturers).
7. ANSI/SDI A250.4, Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
8. ANSI A250.10, Test Procedure and Acceptance Criteria for Prime Painted Steel Doors and Frames.
9. ANSI A250.6, Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

F. Standards of Fabrication and Installation:

1. Finished Work shall be of uniform profile, accurately fabricated, rigid and strong, square and true, neat in appearance, smooth and free from dents, waves, warps, buckles, open joints, tool marks and/or other defects.
2. Steel sheet shall be clean with smooth surfaces free of scale, pitting or other defects.
3. Construction joints shall be flush, tight and welded their full length, ground flush and smooth on exposed surfaces.
4. Frame and door reinforcing and hardware provisions shall be performed in fabrication shop. Provide cuts, welds, and other fabrications before galvanizing or shop priming.
5. Lines and molded members shall be straight and true with angles as sharp as practical for thickness involved, surfaces flat, and fastenings concealed.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Frames: Before shipment, install temporary spreaders at bottom of bucks and do not remove until frames are installed.
- B. Doors: Provide protection as required to protect doors during shipping and storage. Damaged doors will be rejected.
- C. Inspect hollow metal Work upon delivery for damage. Remove and replace damaged items with new Work as required.
- D. Store doors and frames in an upright position at Project Site under cover and protected from weather-related elements. Store units on minimum 4-inch high wood blocking with ½ inch air spaces between stacked doors to provide circulation. Do not store

doors and frames under plastic or canvas shelters that can create a humidity chamber. If shipping packaging becomes wet, immediately remove packaging.

1.06 WARRANTY

- A. Manufacturer shall provide a five year material warranty.
- B. Installer shall provide a two year fabrication and installation warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Doors and frames shall be products of a single manufacturer.
- B. The following are acceptable manufacturers, as are others that can demonstrate their products are equivalent in quality, performance and compliance with these specifications.
 - 1. Security Metal Products Corp.
 - 2. Curries Manufacturing, Inc.
 - 3. Steelcraft.
 - 4. Amweld Metal Doors and Frames.
 - 5. Stiles Custom Metal, Inc.
 - 6. Door Components Inc.
 - 7. CECO Door.
 - 8. Equal.
- C. Materials, fabrication and installation must comply with requirements of standards referenced in Section 1.04, Quality Assurance.

2.02 MATERIALS

- A. Steel:
 - 1. Exterior Doors and Frames: Galvanized Carbon Sheet Steel, Commercial Quality, A60 zinc coating (0.30 ounces per square foot per side), ASTM A653.
 - 2. Interior Doors and Frames: Cold-Rolled Steel Sheets, Commercial Quality Carbon Steel, ASTM A1008.

3. Steel shall be free of scale, pitting, coil breaks or other surface blemishes, and free of buckles, waves or other defects.
 4. Steel thicknesses expressed in steel gages (MSG) is for reference only. Actual steel thicknesses must meet minimum requirements of ASTM standards and as described in ANSI/SDI A250.8.
- B. Supports and Anchors: Fabricate from a minimum 16 gauge galvanized sheet steel unless noted otherwise.
- C. Fasteners: Provide as shown on Drawings and to suit conditions of secure installations. Furnish 304 Grade stainless steel types at exterior doors.
- D. Door Louvers:
1. Louver free air flow shall be 50% free area.
 2. Louvers for exterior doors shall be galvanized and furnished with not less than 12 gage frame and security grille welded to 18 gage steel blades, fully galvanized, with removable galvanized or bronze insect screen on inside. Install louver with tamperproof-head through-bolts. Anemostat PLSL, Air Louvers Inc. Model 1500-A, L & L Louvers, or equal.
 3. Fusible link louvers: Listed by State Fire Marshal, UL labeled and installed with tamperproof fasteners.
 4. Lightproof louvers (at dark rooms): DRDL by Anemostat, Air Louver Model 1000, L & L Louvers, or equal.
 5. Louvers shall be comply with SDI 111C and be furnished with factory primer.
- E. Vision panels: Manufacturer's standard, U.L. approved, finished flush with door face, with no visible fasteners on either door face.
- F. Shop Paint:
1. Conform to Steel Structures Painting Council (SSPC) for steel components.
 2. Pretreatment/priming coatings shall be compatible with Project site finish painting system in accordance with Section 09 9000.
 3. At frames to be grouted, surfaces that are inaccessible after installation shall be coated with bituminous or asphaltic base paint.

2.03 FABRICATION GENERAL

- A. General: Fabricate hollow metal units to be rigid, neat in appearance, and free from defects including warp or buckle.

1. Accurately form metal to required sizes and profiles. Fit and assemble units in manufacturer's plant. Where practical, factory or shop fit and assemble units for shipment.
2. Weld joints continuously; grind, dress, and make smooth, flush, and invisible. Filler to conceal manufacturing defects or damage is not permitted.
3. Corner Joints: Finish corner joints by mitering, or coping and butting, or a combination of both. Trim and backbend shall be continuous around corner.
4. Continuously weld joints for full depth and width of frame, trim, and backbends.
5. Clearances for Fire-Rated Doors: As required by NFPA 80.

2.04 FRAMES

- A. General: Provide fully welded steel frames with integral stops and trim for doors, transoms, sidelights, borrowed lights, and other openings, and with details indicated for type and profile. Use concealed fastenings, unless otherwise indicated.
- B. Metal Thickness of Frames (minimum):
 1. Interior hollow metal frames up to 4-foot wide 16 gage
 2. Interior hollow metal frames wider than 4-foot 14 gage
 3. Exterior hollow metal frames 14 gage
 4. Borrowed lights up to 4-foot wide 16 gage
- C. Supports and Anchors: Fabricate from at least 16-gage, galvanized steel sheet. Frame anchors shall comply with fire rated label requirements of opening.
 1. Floor Anchors:
 - a. Minimum thickness: 12 gage galvanized steel sheet or bent steel plate, securely fastened inside each jamb, with two holes in anchor at each jamb for 3/8 inch floor anchorage fasteners. For preframed wood stud walls provide an additional wood stud anchor located as close to the bottom of the jamb as is practical.
 - b. Where required at sloping and uneven floor conditions, or to coordinate adjustments for trim alignments, provide adjustable floor anchors, providing at least 2-inch height adjustments.
 2. Jamb Anchors:

- a. Locate anchors near top and bottom and at intermediate points not to exceed 24 inches on center. Provide two anchors per head for openings up to 48 inches wide; over 48 inches wide provide anchors at 24 inches on center maximum.
 - b. Anchors in masonry construction: Provide manufacturers standard jamb anchors. Steel wire complying with ASTM A510, 0.177 inch in diameter, may be furnished.
 - c. Anchors in Stud Partitions: Provide steel anchors, 16 gage minimum sheet steel, of design to suit partition construction, securely welded inside each jamb.
 - d. Through-Frame Anchors: At frames indicated to be anchored with bolts through frame, provide countersunk holes for bolts with 16 gauge minimum sheet steel stiffeners full thickness of frame, and securely welded inside each frame at each hole.
- D. Inserts, Bolts, and Fasteners: Provide manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A153 Class C or D as required.
- E. Head Reinforcing: Refer to Detail #2 of this section. Reinforcing shall not act as lintel or load-carrying member and shall comply with fire rating requirements. Provide at frames regardless of whether a closer is called for.
- F. Hardware Reinforcement and Accessories:
- 1. Butt Hinge: 7 gage minimum.
 - 2. Head assemblies: Reinforced internally with, full length, 10 gage angles on each side of frame and bar at bottom of stop for closer reinforcement in frames as shown in Detail #2 of this section.
 - 3. Reinforcing for other items of finish hardware shall be accomplished according to ANSI A250.6.
 - 4. Plaster Guards: Provide 26 gage galvanized steel plaster guards or dust cover boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.
- G. Mullion and Transom bars: Furnished and fabricated as specified for frames.
- H. Glazed Openings: Applied stops with mitered or butted corners, of minimum 18 gage galvanized steel, one-piece lengths, secured within 3" of ends and at 12" centers with oval head countersunk tamper resistant screws. Corner joints shall be furnished with contact edges closed tight, with trim faces mitered and continuously welded. Frames

for multiple openings shall be provided with mullion and/or rail members, fabricated of closed tubular shapes with no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Provide condensate weeps 4 inches on centers, maximum.

- I. Door Silencers: Except for exterior doors, drill and punch frames for three silencers at lock jamb of single swing doors or in double doors with astragal and one silencer per leaf in heads of doubled door frames.
- J. Where frames are installed in walls sitting on a concrete curb, provide a closure plate or extend backbends to provide closure where frame abuts concrete curb.

2.05 DOORS

- A. General: Custom-made, flush-panel “seamless type” with one-piece face panels; continuous weld, seamless edge construction with no visible seams or joints on faces or on vertical edges.
 - 1. Provide type and size of doors shown with louvers and openings for glazing where indicated.
 - 2. Door thickness: 1 ¾ inches.
 - 3. Face Sheet Minimum Gage: 16 gage.
 - 4. Stiffeners: Stiffen door face sheets with continuous vertical-formed steel (rib) sections or back to back hat sections, minimum 20 gage, full thickness of interior space between door faces, spaced 6” on center maximum, and spot welded to both faces 4” on center maximum.
 - 5. Acoustical Insulation: Provide sound deadening and insulating material through entire core of door (full height, width, and thickness of door). Provide STC ratings where indicated on Drawings, scheduled, or for partition ratings indicated on Drawings.
 - a. Doors shall have a minimum STC of 28 as tested under ASTM E90 and ASTM E413, unless noted otherwise..
 - 6. Thermal Insulation: Exterior doors shall be insulated to R values scheduled or indicated on drawings.
 - 7. Labeled Doors: Where fire-rated openings and conditions are indicated.
 - a. Labeled doors shall be provided with fire-resistance rating indicated and shall be constructed as tested and approved by Underwriters’ Laboratories (UL) for installation in labeled frame and door assemblies.

- b. Gaskets: Gaskets are supplied under Section 08 7100 - Door Hardware. Gaskets and installation shall conform to requirements of NFPA 105, "Installation of Smoke and Draft Control Door Assemblies."
 - c. Fabricate labeled doors with same finished appearance as specified for non-labeled hollow metal doors; with welded door edges, filled and ground smooth; with label affixed to door.
 - d. Where fire labels are required and continuous hinge is specified, install label on top of door within 6" of hinge side of door.
8. Door Edges: Join door face sheets at vertical edges of door with continuous weld full height of door. Grind, fill, and dress welds smooth to provide invisible seam with smooth, flush surface.
- a. Close ends of doors with continuous recessed channels, 16 gage steel minimum, spot welded to both face sheets. Close top and bottom edges of doors with a internal steel channel, screw attached into top and bottom of door. Channel shall be galvanized at exterior doors. No screws are allowed on visible faces of door. Provide openings in bottom closure of exterior doors to permit escape of entrapped moisture.
 - b. Profile of Door Edges:
 - 1) Single-acting swing doors: Bevel both vertical edges 1/8" in 2".
 - 2) Pairs of single-acting swing doors: Bevel hinge edge 1/8" in 2". Provide surface mounted astragals for labeled or unlabeled doors unless otherwise shown on Drawings or required.
 - 3) Double-acting swing doors: Round both vertical edges on 2" minimum radius.
9. Door Louvers: Install according to manufacturers recommendations.
10. Glass Stops:
- a. Furnish fixed stops integral with and welded at security side of door.
 - b. Finish: Factory primer.
11. Transom: Fabricate to requirements specified for flush doors.

B. Hardware Reinforcement and Accessories:

1. Provide sheet steel or plate reinforcement for finish hardware items wherever necessary. Mortise, drill and tap to template requirements for mortise type hardware.
2. Butt reinforcing: 7 gage minimum, of length 4" longer than length of butt. Minimum 3 spot welds at top and bottom.
3. Door closer reinforcement: 14 gage minimum steel channel, 6" high on each side of door. Reinforcement to extend full width of door in accordance with Detail #1 of this section.
4. Kick plate reinforcement: 14 gage minimum steel plate, 10" high on each side of door. Reinforcement to extend full width of door in accordance with Detail #1 of this section.
5. Other Hardware Requirements: Cut, reinforce, drill, and tap doors and frames for other hardware, including energy management switches or contacts and security devices, in accordance with furnished hardware templates for accessory items. Thickness and size of reinforcement shall be as required by ANSI A250.6.

2.06 SHOP PRIMING

- A. Exposed and concealed metal surfaces of hollow metal doors, frames and other hollow metal Work of this Section shall be bonderized and then shop primed.
- B. Exposed surfaces of doors, frames and accessories shall be filled, sanded smooth and cleaned before painting.
- C. Exposed surfaces shall be shop primed after assembly.

PART 3 - EXECUTION

3.01 FRAME INSTALLATION

- A. Install steel frames accurately in location, perfect alignment, plumb, straight and true. Brace frames to prevent displacement.
- B. Anchor frames in concrete and concrete unit masonry with galvanized anchor bolts; 3/8 inch diameter, counter-sunk at 24 inches on center at head and jamb unless noted otherwise.
- C. Anchor frames in steel and wood frame partitions with manufacturer recommended anchors.
- D. Install frame at fire rated openings in accordance with NFPA Standard No. 80.

- E. Furnish filler for anchor attachment screws, and sand smooth.

3.02 DOOR INSTALLATION

- A. Install steel doors in accordance with manufacturer's instructions and as indicated on Drawings and in Finish Hardware Specifications. Coordinate with Work of other trades.
- B. Ensure that door and jamb clearances comply with requirements of ANSI/NFPA 80. When wood doors are being installed in metal frames constructed pursuant to this section, allowable door and jamb clearances shall be as specified in Specification Section 08 1416.
- C. Adjust operable parts for correct function.
- D. Remove hardware, except primer-coated items, tag, box and install after finish painting has been completed.

3.03 PRIME COAT TOUCH-UP

- A. Immediately after installation, remove rust, repair damaged surfaces to new condition, sand smooth, and install touch-up primer.

3.04 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

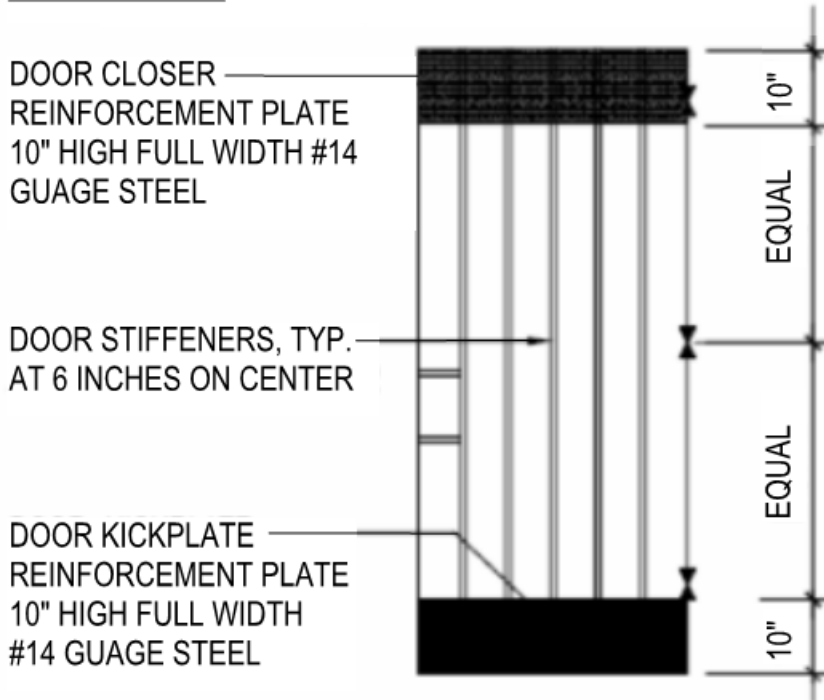
3.05 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

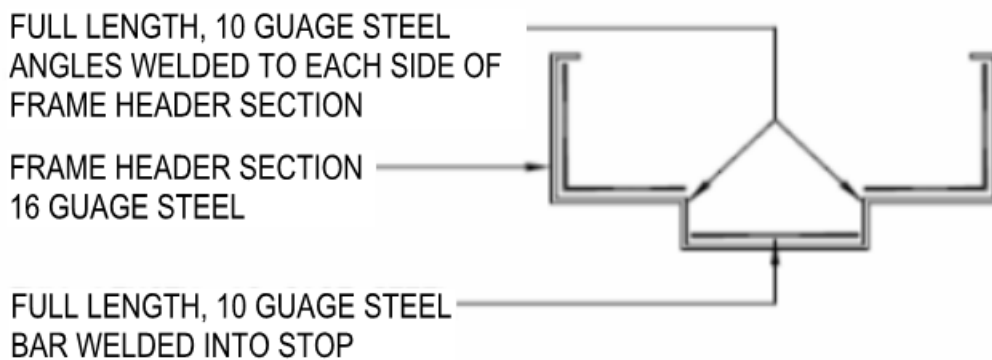
DETAIL #1 - DOOR REINFORCEMENT

ELEVATION



DETAIL #2 - DOOR HARDWARE REINFORCEMENT

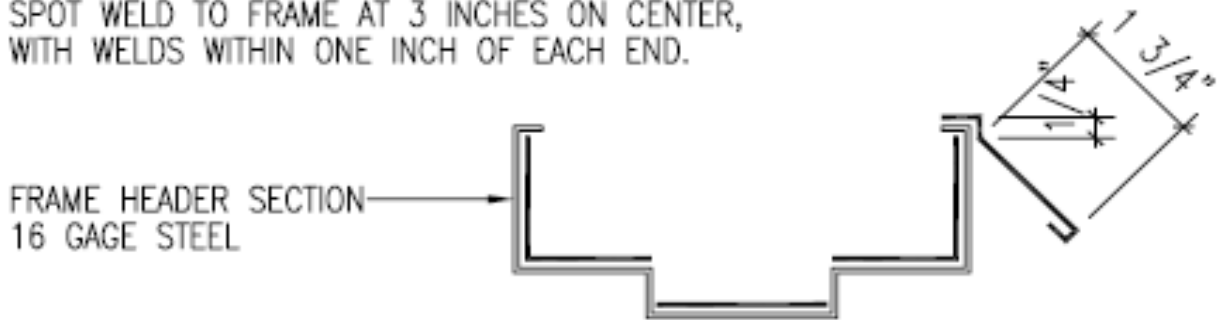
DOOR CLOSER REINFORCEMENT FOR ALL STEEL DOOR FRAMES



DETAIL # 3 - CONCRETE WALL CONDITION

DETAIL FOR EXTERIOR DOOR WHERE RAIN DRIP IS REQUIRED.
EXTERIOR SIDE WITH 22 GAGE GLAVANIZED SHEET METAL OR PAINT LOCK
RAIN DRIP WELDED IN PLACE.

SPOT WELD TO FRAME AT 3 INCHES ON CENTER,
WITH WELDS WITHIN ONE INCH OF EACH END.

DETAIL # 3A - PLASTER WALL CONDITION

DETAIL FOR EXTERIOR DOOR WHERE RAIN DRIP IS REQUIRED.
EXTERIOR SIDE WITH 22 GAGE GLAVANIZED SHEET METAL OR PAINT LOCK
RAIN DRIP WELDED IN PLACE.

SPOT WELD TO FRAME AT 3 INCHES ON CENTER,
WITH WELDS WITHIN ONE INCH OF EACH END.



SECTION 08 1416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wood doors.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 08 1113 - Hollow Metal Doors and Frames
 - 3. Section 08 7100 - Door Hardware.
 - 4. Section 09 9000 - Painting and Coating.

1.02 DESIGN REQUIREMENTS

- A. Drawings indicate sizes, locations and general details of wood door construction and installation.
- B. Regulatory Requirements:
 - 1. Fire rated doors shall be listed by a nationally recognized testing and certification agency in accordance with local building codes and acceptable to the authorities having jurisdiction. The listed doors shall meet or exceed the requirements of UL10B, NFPA 252 and NFPA 80. All door requiring fire-rating shall carry either a UL or ITS (Intertek Testing Services-Warnock Hersey) label.
 - 2. ASTM E2074 – Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure on Side-Hinged and Pivoted Swinging Door Assemblies.

1.03 SUBMITTALS

- A. Shop Drawings: Submit schedules, plans, elevations and details indicating door construction details, opening identification symbols, sizes, door type and grade, fire classification, swing, light and louver cutout size and locations, and undercuts.
- B. Product Data: Submit manufacturers technical data for each specified door type, including details of wood species, design and construction, factory finishing specifications and installation instructions.
- C. Construction Samples: Submit samples of not less than 6-inch by 6-inch for each type of door to be furnished, showing face, edge and core construction.

- D. Color/finish Samples: Submit samples of not less than 4-inch by 6-inch on representative door finish and samples of 3-inch by 8-inch for the exposed edges. Each sample shall bear a label identifying the job name, Architect, Contractor and the Woodwork Insitute finish system number.
- E. Certificates:
 1. Submit Certificate that solid core doors comply with all requirements of ANSI/WDMA I.S. 1-A.
 2. Submit certification that fire rated doors comply with CBC Section 715 or UL 10B.

1.04 QUALITY ASSURANCE

- A. Wood doors construction, manufacture, and fabrication shall conform to ANSI/WDMA I.S. 1-A, custom grade, extra heavy duty grade including the latest revisions, and special requirements specified.
- B. Doors shall be fabricated, hardware factory fitted and machined, and factory finished, unless noted otherwise.
- C. Wood Door Finishes shall comply with the North American Architectural Woodwork Standards (NAAWS) latest edition.
- D. Doors shall be products of one manufacturer.
- E. Door modifications are not permitted, unless reviewed by the OAR.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturers original, unopened, undamaged containers with identification labels intact.
- B. Deliver doors to the Project site only after building has been provided with design temperature and humidity.
- C. Store and handle in accordance with ANSI/WDMA I.S.1-A. Store doors protected from exposure to harmful conditions and at temperature and humidity conditions recommended by the manufacturer.

1.06 PROJECT CONDITIONS

- A. Do not install doors until building is enclosed and ambient conditions are within the temperature and humidity range to be expected during occupancy.

1.07 WARRANTY

- A. Manufacturer shall provide a two year material warranty for exterior doors.
- B. Manufacturer shall provide a life time material warranty for interior doors.

- C. Installer shall provide a two year fabrication and installation warranty for all doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide products manufactured by one of the following:

1. Algoma Hardwood Inc.
2. Brentwood Manufacturing.
3. Eggers Industries.
4. Mohawk Flush Door, Inc
5. VT Industries, Inc.
6. Western Oregon Door.
7. Equal.

2.02 DOOR CONSTRUCTION

- A. Interior Flush Doors:

1. Interior doors shall be furnished as follows:
 - a. Opaque Finished (Painted): Custom grade. Solid wood core, 5 ply, MDO hardboard face, fully bonded to core.
2. Edge strips: Kiln-dried birch, maple or other material as indicated.
 - a. Opaque Finished Doors: Close grain hardwood.
3. Full stile edge strip shall be not less than 1 ½ inches wide, two ply stile. Stiles shall be fully bonded to the core. The outer face stile shall be full length ¾ inch birch or maple. The inner back stile shall be ¾ inch of similar species which may have two finger joints fully bonded to core.
4. Top and bottom edge rails shall be full length and may be of glued up stock of similar species as edge strip, white fir or douglas fir, minimum density 24.33 pounds or higher per cubic foot. Top rail shall be minimum of 2 inches. Bottom rail shall be minimum of 5 inches fully bonded to core.
5. Crossbanding: Doors shall be furnished with full width crossbanding of properly dried hardwood or engineered fiber composite material, 1/16 inch thick, with a density of 52 pounds or higher per cubic foot.
6. Opaque Finished Doors: Custom grade medium density overlay hardboard.

7. Adhesive and Bonding: Bonding between veneer plies of wood face panel, and between door faces, frame and core unit shall be fabricated with type I or II waterproof adhesives for interior doors.
8. Openings: Openings for lights, louvers and grilles shall be performed by the manufacturer, or in a certified door service mill in accordance with manufacturer's details, and in compliance with testing agency requirements.
9. Vision Panels: Vision panels in fire labeled doors shall be framed with FGS-75 Fire Glass Stop by Anemostat, Air Louvers Inc. Model VLF, or equal and shall be State Fire Marshall listed. Frame shall be supplied with manufacturer's standard baked-on enamel finish. Install with tamperproof-head through bolts.

B. Fire Rated Doors:

1. Fire doors must meet the requirements of recognized fire door tests and bear certifying labels of an approved independent testing agency.
2. With exception to the requirements that would adversely affect the fire rating, rated doors shall meet the specifications listed in this section.
3. Door shall be constructed that when installed as an assembly and tested it will pass ASTM E2074 "Standard Test Method for Fire Test of Door Assemblies Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies," and can be rated as required.
4. Reinforcement Blocking: Provide hardware reinforcement blocking of size as required to secure specified hardware. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be of mineral material.

2.03 FINISHING:

A. JOB SITE FINISHING:

1. Doors indicated to be job site finished shall be factory back primed.
 - a. Doors Scheduled for Opaque Paint finish: Prime with one coat of wood primer indicated on Section 09 9000 - Painting and Coating.
2. Door Finish: Per Section 09 9000 - Painting and Coating.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install Work of this section as specified in ANSI/WDMA I.S. 1-A. Install fire doors in accordance with NFPA 80.

- B. Provide each door accurately cut, trimmed, and fitted to its frame and hardware. Clearance at lock and hanging stile and at top shall not exceed 1/8 inch, and bottom shall not exceed 1/4 inch except where otherwise indicated. Arises shall be rounded to a 1/16 inch radius, and lock rail edges shall be slightly beveled. Screws for hardware shall not be driven but screwed into pre-drilled holes.
- C. Doors shall operate freely, but not loosely, without sticking or binding, without hinge-bind conditions and with hardware properly adjusted and functioning.

3.02 CLEAN UP

- A. Remove rubbish, waste and debris and legally dispose of off the Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 08 3323
OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Overhead coiling doors as indicated.
- B. Related Requirements:
 - 1. Section 08 7100 - Door Hardware.
 - 2. Section 09 9000- Painting and Coating.
 - 3. Division 26 - Electrical.

1.02 DESIGN REQUIREMENTS

- A. Drawings indicate sizes, locations, profiles, and general details of overhead coiling door and grille construction and installation.
- B. Performance Requirements:
 - 1. Wind load: Design, engineer and fabricate doors to withstand at least twenty pounds per square foot wind load.
 - 2. Operation-cycle requirements: Design coiling doors and grilles components to a standard minimum of 25 cycles per day and a minimum of 50,000 operating cycles for the life of the door.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, rough-in diagrams, installation instruction and manufacturer's data. Submit manufacturer's data on locking devices, which are included in this Work.
- B. Shop Drawings: Indicate materials, anchorage, and installation details. Indicate details and location of vehicle sensors in pavement. Indicate concrete curb installation of pass card receiver.
- C. Closeout Submittals: Operation and Maintenance Data.

1.04 REGULATORY REQUIREMENTS

- A. Fire rated coiling doors shall bear a label of UL, Warnock Hersey, FMG or other nationally recognized testing laboratory for the fire ratings listed on the drawings, and shall be approved for use by the California State Fire Marshall and DSA.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Provide protection as required by manufacturer to protect products from damage during shipping and storage.

1.06 WARRANTY

- A. Provide manufacturer's two year warranty against defects in materials, fabrication, and installation.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Provide overhead coiling doors and grilles complete with guides, hoods, operating mechanism, and special features and control systems. Doors shall be as manufactured by The Cookson Company, Inc., Cornell Iron Works, Inc., Lawrence Roll-Up Doors, Inc., or equal.

2.02 OVERHEAD COILING DOORS

- A. Curtain: Constructed of interconnected strip steel slats conforming to ASTM A653.
 1. Slats: At least 20 gage, strip steel, flat-faced section, 5/8 inch minimum deep. Fit alternate slats with end locks and where required by wind loads, furnish wind locks.
 2. Insulated Doors: Slats shall be 3-inch high by 7/8 inch deep consisting of 22 gage interior and exterior slats separated by 13/16 inch insulation.
- B. Bottom Bar: Shall consist of two galvanized ASTM A123 steel angles placed back to back and mechanically joined together, with vinyl or neoprene closure strip.
- C. Barrel: Furnished curtain shall be coiled on a steel tube or pipe of size sufficient to carry door load with a deflection not to exceed .03 inch per foot of opening width. Curtain weight shall be evenly balanced by helical torsion springs. Spring tension shall be adjustable by means of an adjusting wheel accessible from outside. Finish steel tube with one coat of rust-inhibiting prime paint.
- D. Brackets: 3/16 inch thick minimum, steel plate designed to house ends of door coils.
- E. Hood: Galvanized sheet steel, 24 gage, contoured to fit brackets and reinforced to prevent sag. Furnish to field obtained dimensions.
- F. Guides: Fabricate of 3/16 inch minimum structural steel shaped to form a slot of sufficient depth to retain curtain under normal wind load. Where wind locks are required, guides shall be provided with wind lock bars.

- G. Gears: High grade cast iron with teeth cast from machine cut patterns. Gear ratio shall be designed for a maximum manual effort of 30 to 35 pounds to operate door.
- H. Weatherstripping: Exterior doors shall be fully weatherstripped with replaceable weather seals at bottom bar and guides, and at hood with a weather baffle.
- I. Finish: Curtain and hood:
 - 1. Hot dipped galvanized ASTM A123.
 - 2. Bonderized coating for prime coat adhesion.
 - 3. Baked-on corrosion inhibiting primer and top coat.
 - 4. Bottom bar, guides and brackets shall have a factory spray applied rust inhibiting primer finish.
 - 5. Color shall be as selected by Architect from manufacturer's standard range of colors.
- J. Operation: Unless otherwise indicated, doors shall be manually operated.
 - 1. Doors 80 square feet in area or less with maximum height of 7 feet shall be push-up type with lift handles on bottom bar.
 - 2. Doors over 80 square feet in area shall be chain-gear operated by galvanized hand chain.
 - 3. Doors shall be furnished with provision for padlocking from the inside.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall be by an authorized installer of coiling overhead door or grille manufacturer.
- B. Install curtains and operating equipment plumb, in true alignment, free of springing, forcing, racking or distortion.
- C. Provide necessary hardware, anchors, inserts, hanger and equipment supports in accordance with manufacturer's literature, as indicated.
- D. Fasten curtain guide assembly to adjacent members with galvanized fasteners at 24 inches on center for a rigid installation of curtain and operating equipment.
- E. Upon completion of installation, lubricate, test and adjust rolling doors and grilles to operate easily, free from warp, twist or distortion and fitting properly around entire perimeter.

3.02 CLEAN UP

111001

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 08 7100
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Door hardware.
2. Door Hardware Schedule.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 08 1113 - Hollow Metal Doors and Frames.
3. Section 08 1416 - Flush Wood Doors.
4. Section 08 3323 - Overhead Coiling Doors and Grilles.

C. Items listed in other sections and not included herein as “Door Hardware”

1. Cabinet hardware, except keying.
2. Bath accessories, excepting keying.
3. Nameplates, room numbers exit signs.
4. Disabled access signs.
5. Roll-up door hardware, except cylinders and padlocks.
6. Smoke detectors, 120VAC power, wiring, and conduit.
7. Door position switches.
8. Access panels, except padlocks.
9. Gate hardware, except locking devices.
10. Local alarms and annunciators.

1.02 DESIGN REQUIREMENTS

A. Design Requirements:

1. Exit doors, including each leaf of a pair of doors, shall always be operable from the inside by the simple turn of a lever or by pushing an exit device without the use of a key or any special knowledge or effort; this includes doors of toilet and storage rooms.
2. Unless otherwise specified, hand activated door opening hardware shall be located 36 inches above the finish floor.
3. Dead bolts are not permitted unless operable with a single effort by a lever type hardware.
4. The force applied to operate exit hardware shall not require more than 15 lbs. applied in the direction of travel.

B. Regulatory Requirements:

1. Comply with CBC requirements.
2. Hardware for fire doors shall conform to requirements of UL - Fire Protection and Accident Hazard Equipment and the California State Fire Marshal listing, NFPA - 80 and CBC requirements for positive pressure testing.
3. Hardware shall meet the requirements of CBC, Chapter 11B.

1.03 SUBMITTALS

A. Shop Drawings:

1. Wiring Diagrams: Submit diagrams, templates, instruction, and installation manuals, for electrical and electronic hardware.

B. Product Data: Finish Hardware Schedule:

1. Submit schedule including recap sheet:
 - a. Include manufacturer's name, catalog number, relevant dimensions, fasteners, location of item in Work, door index number, frame material, door material, door size and thickness, door type, handing, fire-rating (if any), and sound-rating (if any).
 - b. Hardware shall be listed by "Headings" in following manner:
 - 1) HEADING NO. 1
 1 SINGLE/PAIR OF DOORS NO. (Room and Number) from/to
 (Room and Number)

1 SINGLE/PAIR OF DOORS NO. (Room and Number) from/to (Room and Number)

SPEC. NO. List the appropriate numbers from the specified LIST OF FINISH HARDWARE

List of finish hardware

2) HEADING NO. 2, etc.

- C. Material Samples: Submit Samples of door hardware as required by Architect.
- D. Submittal Review Time: In lieu of what is specified in Section 01 3300, allow at least twenty-eight days in the Milestones Schedule for Architect and OAR review following receipt of submittal.

1.04 QUALITY ASSURANCE

- A. Each type of finish hardware furnished for the Work shall be of same make or manufacture, unless otherwise specified. Where existing items are being supplemented with new items, match existing items, subject to current code requirements and accessibility recommendations.
- B. Coordinate and deliver templates or physical Samples of finish hardware items to manufacturer of interfacing items, such as doors and frames, in a timely manner to insure orderly progress of Work.
- C. Comply with the following as a minimum requirement:
 - 1. Conform to Builders Hardware Manufacturers Association (BHMA) Finish Code, latest edition.
 - 2. DHI WDHS.3: Recommended Locations for Architectural Hardware for Wood Flush Doors
 - 3. DHI WDHS.4: Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors.
 - 4. HMMA 831: Recommended Hardware Locations for Custom Hollow Metal Doors and Frames

1.05 DELIVERY, STORAGE AND HANDLING

- A. Package each item of hardware and each lockset individually, complete with necessary installation instructions, screws and fastenings, and installation templates; marked with item number corresponding to number on Finish Hardware Schedule.

1.06 WARRANTY

A. Manufacturer shall provide a minimum two year material warranty except as follows:

1. Provide a ten year manufacturer's material warranty for door closers.
2. Provide a five year manufacturer's material warranty for locksets and exit devices.

1.07 MAINTENANCE MATERIALS

A. Extra Materials:

1. Provide five percent or a minimum of one, whichever is greater, of the following hardware: locksets, exit devices, closers, fire rated smoke seals, seals, and electric or electronic hardware. Transmit to OAR before Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Butts and Hinges:

1. Width of hinges shall be of sufficient size to clear trim. Where provided with magnetic holders, hinge width shall be of sufficient size to ensure door is parallel to wall when magnetic holders are engaged.
2. Furnish one pair of hinges for door leaves up to 5-foot high. Furnish one additional hinge for every additional 30 inches or fraction thereof.
3. Butts for doors shall be non-rising, loose pins, with button tip.
4. Exterior and interior out-swinging doors with butt hinges shall be furnished with hinges furnished with a setscrew in hinge barrel to make pin non-removable (NRP); Butt hinges at exterior out-swinging doors shall have stainless steel pins and bearings.
5. Hinges installed on painted doors shall be BHMA 600 finishes. Hinges installed on stained and varnished doors shall be BHMA 626 for bronze/brass base metals and BHMA 652 for steel base metal. Exterior doors shall have non-ferrous hinges. Fire-rated doors shall have steel or stainless steel hinges.

B. Locksets and Trim:

1. Unless otherwise specified, locks shall be of mortise type, complying with ANSI A156.13, grade 1.
2. Unless otherwise specified, escutcheons shall be 7 ½-inch by 2 ¼-inch wide by 0.050 thick minimum.

3. Levers shall be cast, and shall return to within ½ inch of face of door.
4. Outside lever shall be pinned. Inside lever shall be by "Allen Head Set Screw" or by "Spanner Ring Nut".
5. Lock strikes shall be curved lip type, with exposed edges and corners rounded, of sufficient length to protect jamb and trim, and shall not extend more than 1/8 inch beyond trim, jambs or face of doors in pairs. At out-swinging pairs with overlapping astragal, strike shall have a 7/8 inch lip-to-center dimension. Dust box shall be provided for door locks.
6. Locksets throughout shall be lever type of same manufacture.

C. Exit Devices:

1. Unless otherwise specified, exterior doors shall be furnished with rim touch bar device; right hand reverse active leaf - night latch function by cylinder by hardened cylinder ring by flush pull by sex nut and bolt. Left-hand reverse inactive leaf - exit only by flush pull by sex nut and bolt.
2. Unless otherwise specified, interior doors shall be furnished with rim touch bar device; right hand reverse active leaf-lever handle by cylinder, left hand reverse inactive leaf; exit only.
3. Fire labeled exit devices shall conform to UL label requirements and be listed by the California State Fire Marshal.
4. Exit devices throughout shall be touch bar types of same manufacture. Exit devices shall meet ANSI BHMA, A153.3 Grade 1.
5. Lever design shall match lock levers.
6. Exit devices shall be furnished sized for the specific door width and height.

D. Door Closers:

1. Door closers shall conform to ANSI A156.4, Grade 1.
2. Door closers shall be heavy duty, rigid parallel arm; provide regular arm for regular bevel doors.
3. Door closer shall be full rack and pinion type, adjustable back check, and sweep and latch speed with key regulating screws.
4. Door closer shall have full fitted cover of plastic or stainless steel, attached to door closer body with tamperproof screws.
5. Provide spacer block or support bracket for securing fifth screw on closer arm shoe. Provide special brackets, shoes, or other attachment devices as required.

6. Maximum pressure to operate doors shall not exceed following:
 - a. Fire rated doors: The authority having jurisdiction may determine the maximum force, not to exceed 15.0 pounds to operate fire doors to achieve positive latching.
 - b. Exterior doors: 5.0 pounds.
 - c. Interior doors: 5.0 pounds.
 7. Door closers shall be installed at the following:
 - a. Exterior doors.
 - b. Fire rated doors.
 - c. Corridor doors.
 - d. Toilet doors.
- E. Protection Plates: Furnish kick plates of 10-inch high by 2-inch less door width on single doors, 10-inch high by 1 inch less door width on pairs of doors. Provide one plate for push side of closer-equipped doors. Furnish mop plates 4-inch high by 1 inch less door width on doors swinging into toilet rooms.
1. Kick and mop plates shall be a minimum 0.050 inch thick; Type 304 stainless steel, with finished beveled edges (B4E).
- F. Stops:
1. Floor stops shall be mounted to protect door and trim.
 2. Furnish stop of appropriate height, minimum $\frac{3}{4}$ inch above undercut of door.
 3. Where the specified floor stop cannot be installed or would present a pedestrian hazard, omit and furnish a heavy-duty overhead stop (626 finish); if closer is specified, furnish closer with integral spring-cushion stop arm.
- G. Weather stripping/Gasketing:
1. Install gaskets and intumescent seals on fire rated doors and frames.
 2. Unless otherwise specified, install weather stripping on doors from air-conditioned spaces to the exterior: fastener-applied frame seals, nylon-brush door sweeps, and, at pairs, astragals.
- H. Thresholds: Unless otherwise specified, thresholds shall conform to CBC Chapter 11B accessibility standards and ADAAG.

- I. Push Plates: Plates shall be 0.050 thick, 6-inch by 16-inch minimum, with beveled edges.
 - 1. Door Pulls: Pulls shall have protective plate mounted under pull, 0.050 inches thick, 4-inch by 16-inch beveled on four edges.
 - 2. Hardware Cutouts: Pull plates and push plates installed over locking hardware shall have cylinder and turn lever cutouts as required.

- J. Automatic Flush Bolts:
 - 1. Strike plates for automatic bolts shall be provided for active door.
 - 2. Provide dust proof strikes for bottom bolts.

- K. Coordinators:
 - 1. Provide brackets as required for items fastened to coordinators.
 - 2. Provide door strike plates for both doors with coordinators.

- L. Smoke Detectors and Magnetic Holders: Coordinate electrical devices with Division 26 and the Drawings.

- M. Fasteners: Shall match finish of hardware. Provide fasteners for all hardware at toilet rooms, custodian rooms, kitchen doors, and exterior doors: stainless steel for chrome, aluminum, or stainless finish hardware; brass or bronze for brass or bronze finish hardware.

- N. Key vault: Locate box as indicated on drawings.
 - 1. Knox Box: Model 4400 series for low rise buildings with recessed mounting kit, or other as approved by local fire authority.
 - 2. Construction: High Security Industrial/Government key box. UL listed double-action rotating tumblers and hardened steel pins accessed by a biased cut key. ¼" thick steel housing with ½ inch thick steel door with interior gasket seal and stainless steel door hinge. Lock shall have a 1/8 inch thick steel dust cover with tamper seal mounting capability.
 - 3. Installation of Key Vault: Refer to manufacturer's printed instructions and LA City Fire Department's Fire Prevention Bureau's Requirement 75. Connect wiring conduit through one of the holes provided.
 - 4. Labeling: The word "FIRE" shall be placed on the Key Box door in ¾ inch contrasting letters

2.02 FINISH

- A. Unless otherwise specified, finish of hardware shall be dull chromium-plated BHMA 652 for steel-based metals, BHMA 626 for brass-based metals, except for kickplate, escutcheons, push plates, lock strike plates, and exit device touch bars, which shall be BHMA 630. Levers for locksets and exit devices shall be BHMA 626.
- B. Unless otherwise specified, overhead door closers and brackets shall be BHMA 689, to match other finish hardware in same room or space.

2.03 CYLINDERS AND KEYING

- A. Project shall be keyed in accordance with keying schedule, prepared and furnished by the OWNER.
- B. Provide a cylinder security collar (SPEC. NO. 42) at each exterior door cylinder. Provide cylinder collars and spacers at all cylinders as needed to provide a neat, tight and secure fit of the cylinder to the locking hardware.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Finish hardware shall be installed as specified in Finish Hardware Schedule.
 1. Placement of Hardware: Finish hardware shall be installed as indicated on hardware placement sheets attached to end of this section.
 2. Provide necessary screws, bolts, anchors, and fastenings, of required sizes and type for proper installation of hardware. Exposed screws shall have Phillips heads, and wood screws shall be fully threaded.
 3. Fitting: Hardware shall be accurately fitted and, with exception of prime-coated butt hinges, bar-type coordinators, and flat astragals, shall be removed before finish painting is installed. Upon completion of finish painting and/or sealing, permanently install the hardware.
 4. Anchorage of Hardware: Hardware fastened to concrete, masonry, or gunite construction shall be provided with drop-in expansion anchors by "Red Head Multi Set II", "Rawl Steel", or as otherwise required by hardware manufacturer. Pilot holes of suitably lesser diameter shall be drilled prior to the insertion of wood and sheet metal screws.
 5. Door escutcheons and push plates shall be installed with stainless steel or bronze, oval, "Phillips Head", fully threaded screws, not less than 3/4 inch - No. 6.

6. Exit devices shall be mounted with non-ferrous sex nuts and fully threaded machine screws, except where through bolts engage outside trim of locking case.
7. Mullion strike shall be installed with fully threaded machine screws.
8. Door closer shall be installed for maximum degree of opening of each door.
9. Following shall be installed with sex nuts and fully threaded machine screws.
 - a. Door closers.
 - b. Door pulls.
10. Install exterior doorstops as required. On new concrete, stops shall be installed with 1/4-20 screws. On asphalt concrete, stops shall be installed with 1/4-20 screws to an anchor plate set in a concrete monument. Anchor plate shall be Trimco 1268, or equal. Floor stops shall not be located in the path of travel and shall be located no more than 4 inches from walls.
11. Kickplate:
 - a. Kickplates shall be installed with screws at each corner, and screws evenly spaced along each side not more than 3 inches apart on centers.
 - b. Except on wood doors, screws shall be undercut pan head.
12. Thresholds shall be installed with 1/4-20 screws, set in Pour-Roc or mastic per section 07 9200, and coped to trim.
13. Sound Seals and Weather stripping / Gasketing:
 - a. A mounting screw shall be installed within 2 inches of cuts or corners of weather stripping and/or gasketing.
 - b. Sound seals and weather stripping and/or gasketing shall be installed with No. 8 - 3/4 inch Tek Phillips pan head screws.
14. Exterior doors not otherwise specified shall be provided with SPECS.1, 18, 28, 33, 36, 39, 42, 46, 54.
15. Interior doors not otherwise specified shall be provided with SPECS 2, 18, 28, 33, 35, 39, 42, 54.

3.02 ADJUSTING AND CLEANING

- A. Before Substantial Completion, hardware shall be cleaned and inspected. Where hardware is deemed defective, repair or replace as required.

- B. Door Closers: Final adjustments shall be performed before Substantial Completion, with mechanical system balanced and in operation.

3.03 EXAMINATION

- A. Upon completion of installation, verify correct installation of hardware, according to reviewed Hardware Schedule and Keying Schedule. Verify that finish hardware is in optimum working condition.

3.04 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.05 LIST OF FINISH HARDWARE

- A. Following items designated by "SPEC NO." comprise the list of Finish Hardware, from which hardware shall be furnished as specified and required to complete the Work:

1. HINGES

SPEC. NO. 1 --Full Mortise Hinges -- Non-Ferrous -- For Exterior Reverse Bevel Doors

Ball or oilite bearings, 4 1/2-inch by 4-inch, or as required to clear projections, primed or plated as required. Furnish with security studs. Furnish with stainless steel non-removable pins and bearings.

	Bommer	Hager	Mc Kinney	
Reg. Wt. -	BB5001-A	BB1191-NRP-SH	TA2314-NRP-SSF	
Heavy Wt. -	BB5005--A	BB1199-NRP-SH	T4A3386-NRP-SSF	
	Stanley	Ives	PBB	
Reg. Wt. -	FBB191-NRP-Sec. St.	5BB1 NRP/SS	BB21-NRP	
Heavy Wt.	FBB199-NRP-Sec. St.	5BB1HW NRP/SS	4B21-NRP	

SPEC. NO. 2 -- Full Mortise -- General Interior Doors

Steel, ball or oilite bearings, 4 1/2-inch by 4-inch, or as required to clear projections, primed or plated as required. Furnish with non-removable pins at outswinging doors.

Bommer	Hager	Mc Kinney	Stanley	Ives	PBB
BB5000	BB-1279	TA-2714	FBB-179	5BB1	BB81

SPEC. NO. 3 --Full Mortise Swing Clear Hinges -- Non-Ferrous -- For Exterior Reverse Bevel Doors

Ball or oilite bearings, 4 1/2-inch by 4-inch, or as required to clear projections, primed or plated as required. Furnish with security studs. Furnish with stainless steel non-removable pins and bearings.

	Hager	Mc Kinney
Reg. Wt. -	AB7001-NRP-SH	TA2395-NRP-SSF
Heavy Wt. -	AB7502-NRP-SH	T4A3395-NRP-SSF

	Ives	PBB
Reg. Wt. -	5BB1SC NRP/SS	SCBB51-NRP

Heavy Wt. -	5BB1SCHW NRP/SS	SC4B51-NRP
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2. LOCKSETS

SPEC. NO. 4 -- Lock -- Interior Doors

One cylinder: Key in cylinder locks or unlocks outside lever, inside lever always free. Protected front and deadlocking latch.

Corbin/Russwin	Sargent	Schlage	Marks	Townsteel
ML2055NSM	8237LW1L	L-9070-06N	LA318J	MSE-R-05-S

SPEC. NO. 5 -- Lock -- Classroom Security

Two cylinders: Key in inside cylinder locks or unlocks outside lever, key in outside cylinder retracts latch, inside lever always free. Protected front and deadlocking latch.

Corbin/Russwin	Sargent	Schlage	Marks
ML2052NSM	8238LW1L	L-9071-06N	LA318GJ-32D-G3

Townsteel

MSE-R-32-L-I/S Only-S

SPEC. NO. 6 -- Lock -- Cylinder Both Sides

Two cylinders: Dead bolt operated by key in either cylinder, latch bolt retracted by lever from either side. Protected front. Do not install at exit doors.

Corbin/Russwin	Sargent	Schlage	Marks	Townsteel
ML2022NSM	8226LW1L	L-9466-06N	LA118C	MSE-R-14-S

SPEC. NO. 7 -- Latchset

Latch bolt retracted by lever from either side. Protected front.

Corbin/Russwin	Sargent	Schlage	Marks	Townsteel
ML2010NSM	8215LW1L	L-9010-06N	LA118N	MSE-R-01-S

SPEC. NO. 8 -- Lock -- Private Toilet -- with Emergency Key

Latch bolt retracted by lever from either side, except when deadbolt is projected by turn inside, turning inside lever retracts both deadbolt and latch bolt simultaneously. In emergency, bolt can be operated by emergency key from outside. Turn shall be oval shaped minimum 1 3/4-inch by 1 inch at center with 1 1/4-inch projection.

Corbin/Russwin	Sargent	Schlage	Marks
ML2030NSM	8265LW1L	L-9040-06N -XL11-761	LA118LF

Townsteel

MSE-R-19-S

SPEC. NO. 9 -- Lock -- Special Rooms

One cylinder: Key in cylinder retracts latch bolt. Outside lever always rigid, inside lever always free. Protected front and deadlocking latch.

Corbin/Russwin	Sargent	Schlage	Marks
ML2057NSM	8204LW1L	L-9080-06N	LA118EW

Townsteel

MSE-R-07-S

SPEC. NO. 10 -- Lock -- Single Occupancy Faculty Toilets

Latch set contains a lever handle on each side with an oval shaped privacy bolt and latch on the inside. In an emergency, the lockset must open for the exterior with a key that overrides the privacy latch mechanism. From the interior, the occupant may open the door by activating the door lever which releases the privacy latch and door simultaneously. For existing staff use single occupancy restrooms only.

Corbin/Russwin	Sargent	Schlage	Marks
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ML2029 NSM M34 8250LW1L L-9486-06N by L538-375 LA118LH

Townsteel

MSE-R-15-S-ADA

SPEC. NO. 11 -- Lock -- Connecting Room Lock

Two cylinders: Key in cylinder locks or unlocks both levers. Protected front and deadlocking latch. Do not install at exit doors.

Corbin/Russwin Sargent Marks

ML2042-404F90-8-NSM 8237 by DBL CYL by 82-3093LW1L LA118JC

Townsteel

MSE-R-09-S x TS5621 & TS 5620

Locking Hub Rollback kit

Schlage

L-9066-06N-XL11-897

SPEC. NO. 12 -- Lock -- Special Gate Lock

Two cylinders: Latchbolt by key from either. Both levers always rigid. Auxiliary latch deadlocks latchbolt. Do not install at exit gates.

Corbin/Russwin Sargent Schlage Marks Townsteel

ML2032 NSM 8217LW1L L-9082-06N LA118WW MSE-R-30-S

SPEC. NO. 13 -- Lock – Hold Back Function

One cylinder: Key in cylinder locks or unlocks outside lever, inside lever always free. Latchbolt can be held in a retracted position by key, or released by key. Protected front and deadlocking latch. Install on non-rated doors

Corbin/Russwin Sargent Schalge Marks

ML 2056 NSM 8289LW1L L9076-06N LA118JR

Townsteel

MSE-R-06-S

SPEC. NO. 14 -- Lock – Hold Back Function

One cylinder: Key in cylinder locks retracts latch, inside lever always free. Latchbolt can be held in a retracted position by key, or released by key. Protected front and deadlocking latch. No exterior lever trim. To be used in conjunction with Spec. No. 93. Install on non-rated doors

Corbin/Russwin	Sargent	Schalge	Marks
ML 2056 NSM-M30	8291LW1L	L9076 LLL-06N	LA118JM-F5
Townsteel			
MSE-R-06-S-LO			

SPEC. NO. - 15 – Electronic Lock – Single Occupancy Public-Use Toilets

Lock is standalone, operable by keypad or HID Corp 1000 35 bit card. Keypad or HID card unlocks lever. Privacy deadbolt projected by turn inside a minimum 1 3/4" x 1" at center with 1 1/4" projection. HID or keypad is disabled when deadbolt is activated. Shall include small format interchangeable core (SFIC Best/Falcon type) less core.

Alarmlock: PDL4500 DB

3. **PANIC HARDWARE AND FIRE LABELED HARDWARE**

SPEC. NO. 16 -- Exit Device -- Single Door – Aluminum Store Front Door

Exit device shall be rim night latch function with a 3/4 inch latch bolt, dead latch, dogging device and a stainless steel touch pad. Furnish standard Allen-type dogging key with suitable hole for key ring. Furnish with offset pull (see SPEC. NO. 49).

Corbin Russwin	Precision	Sargent	Von Duprin	Dorma
ED4200 x K157	2403	8504	35A-NL-OP	5303 x JP03

Detex

4003 x CBK

SPEC. NO. 17 -- Exit Device -- Pair Doors – Aluminum Storefront Doors

Exit device shall be rim rod night latch function by exit only function with a 3/4 inch latch bolt, dead latch, dogging device and a stainless steel touch pad. Furnish standard Allen-type dogging key with suitable hole for key ring. Furnish with offset pull (see SPEC. NO. 49)

Corbin Russwin	Precision	Sargent	Von Duprin	Dorma
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Active Door

ED4200 x K157	2403	8504	35A-NL-OP	5303 x JP03
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Inactive Door

ED4200	2401	8510	35A-EO	5303
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SPEC. NO. 18 -- Exit Device -- Single Door

Exit device shall be rim night latch function with a 3/4 inch latch bolt, dead latch, dogging device and a stainless steel touch pad. Furnish standard Allen-type dogging key with suitable hole for key ring.

	Corbin/Russwin	Precision	Dorma
Int.	ED5200xN955	2108 x V4908A	9300 x YR08
Ext.	ED5200xK157	2103	9300 x HRT03
	Sargent	Von Duprin	Detex
Int.	8813-743-8ETL	98L-996L-06	1008DA
Ext.	8804X Less Pull	98NL-OP	1003 X CBK

Adams Rite 8800 Series at aluminum doors.

SPEC. NO. 18P – Exit Devices – Interior Pair Wood or Hollow Metal Doors

devices shall be surface-vertical rod types less bottom rods, ANSI 08 function, key locks and unlocks lever by exit only function.

	Corbin Russwin	Precision	Detex
Active Door	ED5470xN955xM55	2208xV4908AxLBR	2108 DA
Inactive Door	ED5470xM55	2201xLBR	2101
	Sargent	Von Duprin	Dorma
Active Door	8713-743ETL-LBR	9827L-994L-06-LBR	9400 LB x YR08
Inactive Door	8710-LBR	9827EO-LBR	9400 LB

SPEC. NO. 19 -- Exit Device -- Exit Only -- Single Door

Exit device shall be rim exit only function with 3/4 inch latches bolt, dogging device and a stainless steel touch pad. Furnish standard Allen-type dogging key with suitable hole for key ring.

Corbin/Russwin	Precision	Sargent	Von Duprin	Dorma	Detex
ED5200	2101	8810	98EO	9300	1001

SPEC. NO. 20 -- Fire Rated Exit Device -- Single Door

Exit device shall be ANSI 08 function, key locks and unlocks lever.

Corbin/Russwin	Precision	Detex
ED5200AxN955	FL2108 x V4908A	F1008 DA
Sargent	Von Duprin	Dorma
12-8813-743-8ETL	98LF-994L-06	F9300 x YR08

SPEC. NO. 21 -- Fire Rated Exit Device -- Single Door

Exit device shall be self-latching, with exit only function, less dogging feature.

Corbin/Russwin	Precision	Detex
ED5200A	FL2101	F1001
Sargent	Von Duprin	Dorma
12-8810	98EO-F	F9300

SPEC. NO. 21P –Interior Fire Rated Pair Wood or Hollow Metal Doors

Exit devices shall be surface-vertical rod types less bottom rods, ANSI 08 function, key locks and unlocks lever by exit only function. Exit devices shall be self latching, less dogging feature.

	Corbin Russwin	Precision	Detex
Active Door	ED5470B/FxN955xM55	FL2208xV4908AxLBR	F2108 LD
Inactive Door	ED5470B/FxM55	FL2201xLBR	F2101 LD
	Sargent	Von Duprin	Dorma
Active Door	12-8713-743ETL-LBR	9827LF994L-06-LBR	F9400 LB x YR08
Inactive Door	12-8710-LBR	9827EO-F-LBR	F9400 LB

SPEC. NO. 21DE – Exit Devices – Interior Fire Rated Double Egress Pair Wood or Hollow Metal Doors

Exit devices shall be surface-vertical rod type less bottom rods, exit only function. Exit devices shall be self-latching, less dogging feature. Furnish two exit devices per double egress pair.

Corbin Russwin	Dorma	Precision	Sargent
ED5470B/FxM55	F9400 LB	FL2201xLBR	12-8710-LBR
Von Duprin	Detex		
9827EO-FxLBR	F2101 LD		

SPEC. NO. 22 – Mortise Panic Exit Devices – Interior Pair Wood or Hollow Metal Doors

Devices shall be at active door a mortise panic devise with open back strike with Inactive door with surface-vertical rod types less bottom rods, ANSI 08 function, key locks and unlocks lever by exit only function.

	Corbin Russwin	Precision		
Active Door	ED5657xN955xM55	2308xV4908A		
Inactive Door	ED5470xM55 2201xLBR	2201-LBR		
	Sargent	VonDuprin	Dorma	
Active Door	8913-743ETL	9875L-994L-06	9500 x YR08	
Inactive Door	8710-LBR	9827EO-LBR	9400 LBR	

SPEC. NO. 23 -- Removable Mullion Non-labeled -- Pairs of Doors with Exit Devices

14 gage steel, approximately 2-inch by 3-inch. Furnish complete with soffit and sill fittings and fastenings as required.

Corbin/Russwin	Precision	Sargent	Von Duprin	Dorma	Detex
707A(7')708A(8')	822	980	4954	1330	90KR

SPEC. NO. 24 -- Removable Mullion Labeled -- Pairs of Doors Exit Devices

Listed as Fire Exit Hardware. Furnish complete with soffit and sill fittings and fastenings as required.

Corbin/Russwin	Precision	Sargent	Von Duprin	Dorma	Detex
707A(7')708A(8')	FL822	12-980	9954	F1300	F90KR

SPEC. NO. 25 -- Automatic Flush Bolts -- Labeled and Non-labeled Doors

Complete with necessary strikes and screws. Furnish 2 each inactive leaf.

	Door Controls	Ives	Rockwood
Wood or Composite	942 NH x 80	FB40P x DP2	1942NHx80
Hollow Metal	842 NH x 80	FB30P x DP2	1842NHx80

SPEC. NO. 26 -- Coordinator -- Labeled and Non-labeled Doors

Bar-type, complete with necessary strikes, bars, brackets, and screws.

Door Controls	Ives	Dorma	Rockwood
600 Series	COR Series	TS 93 GSR	1600

4. **AUXILIARY LOCKS****SPEC. NO. 27 -- Padlock**

Bronze or brass case, hardened steel shackle, length to fit condition; plated, brass chain, master-keyed. Furnish by same manufacturer as lock cylinder key system.

5. **DOOR CLOSERS****SPEC. NO. 28 -- Door Closer -- 180 Degree, Hold Open Arm**

	L.C.N.		Stanley
Out swing	4041-H-EDA		D-4550HEDA
In-swing	4041-H (to 120°)/4041T-H-Top Jamb (past 120°)		D-4550H/51H
	Norton	Sargent	Dorma
Out swing	PR7500H xTorx	281 PH10 x Torx	8916 SP8T
In-swing	7500 x Torx less 1618	281-H x Torx	8916 PH

SPEC. NO. 29 -- Door Closer -- 180 Degree, Delayed Action

	L.C.N.	Dorma	Stanley
Out-swing	4041 DA EDA	8916 DA AF	D-4550DAEDA
In-swing	N/A for 180°	8916 DA SPA	D-4550DA/51DA
	Norton	Sargent	

Out-swing	PR7500DA x Torx	281 P10-DA x Torx
In-swing	7500DA x Torx less 1618	281-DA x Torx

SPEC. NO. 30 –Electromechanical Door Closer – Maximum 170° Electronic Hold Open

For use on fire rated doors requiring hold open. At pairs, furnish a slave unit without smoke detector on one leaf tied into a master detector unit (types below) on the other leaf.

	LCN		
Outswing	4410ME-B80		
Inswing	N/A for 170°		
	Norton	Sargent	Dorma
Outswing	7220/7230MPS	12-80-2990	8916 EMF PT
Inswing	7210MPS	12-80-2960	8916 EMF T

6. DOOR STOPS AND HOLDERS

SPEC. NO. 31 -- Door Type Holder

Cast bronze made to template, secured to door with oval head bronze machine screws and washers; when door has kickplate, mount sex bolts under kickplate. Provide strike of recommended height; install short strike whenever possible.

Ives	Trimco	Rockwood
FS40 Series	1260-SeriesxFloor Strike	491 Series x Floor Strike

SPEC. NO. 32 – Interior Floor-Mounted Door Stop

1-3/4 inches high, secured rubber.

Don-Jo	Trimco	Rockwood
1448	1214	481

SPEC. NO. 33 – Exterior Floor-Mounted Door Stop

Cast bronze, 2-1/4 inches high, secured rubber.

Trimco	Rockwood
1214CK	481H x Trox

7. **SPEC. NO. 34 – NOT USED.THRESHOLDS****SPEC. NO. 35** -- Aluminum Threshold -- Interior Door

Width 4-inch, height 1/2 inch. Full width of opening and coped to trim.

N.G.P.	Pemko	Reese
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424A	170A	S-204A
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SPEC. NO. 36 -- Aluminum Threshold -- Exterior Door

Half-saddle, height 1/2 inch. Threshold shall have one full-length bearing. Full width of opening, and coped to trim. For 1/4 inch rise.

N.G.P.	Pemko
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653	158A
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SPEC. NO. 37 -- Aluminum Threshold Strip -- Interior Door or Opening

Where cork, vinyl composition tile and other floor coverings terminate, except at raised cement thresholds, or where other thresholds are specified. Width 1 inch to 1 3/8-inch, height 1/4 inch with 1/8 inch offset.

N.G.P.	Pemko	Reese
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432	N/A	T040A
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SPEC. NO. 38 -- Aluminum Threshold -- Interior Door or Opening

Width 2 1/4-inch or 2 1/2-inch, height 3/16 inch or 1/4 inch.

N.G.P.	Pemko	Reese
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410A	173A	S-225A
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8. **MISC. AUXILIARY HARDWARE****SPEC. NO. 39** – Kick and Mop Plates

Ives	Trimco	Don-Jo	Rockwood
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8400	KOO50/KM0050	90	K1050
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SPEC. NO. 40 – Lock Guard

9 1/2 to 10-inch by 1 1/2 to 2 1/8-inch with lugs to receive flat Phillips head through-bolts.

Don-Jo	Markar	Trimco	Rockwood
NLP-110	M-930LG	5000	321 x 630

SPEC. NO. 41 -- Astragal

Stainless steel, 2 inches by height of door, secured by Phillips flat head through-bolts.

N.G.P.	Pemko	Reese	Anemostat
139SS	357SS	183SS	FBA x SS

SPEC. NO. 42 -- Cylinder Guard Ring

Manufactured of hardened materials to resist removal by wrenches and other devices. Furnish of sufficient length for cylinder. Provide appropriate filler rings as required. Furnish plated versions only. Install with all cylinders exposed to the exterior of the building, but not necessarily limited to that application.

Corbin/Russwin	Keedex	Major
416F39	K-24/K-24L	CG/CGL

SPEC. NO. 43 – Automatic Door Bottom

At exterior doors with surface applied walk off mats in lieu of Spec 101 door sweep. To ensure ADA 5 pound door pressure opening.

	Pemko	NGP	Reese
Semi-mortise Wood	430MRL	421NA	521C
Full-mortise Wood	411RL	335N	370A
Hollow Metal	420PKL	320N	372A

SPEC. NO. 44 – Panic guard protection kickplate.

Install for latches and end caps of exit devices Existing Doors with exposed rod panic devices

Trimco PG Series Panic Guard

SPEC. NO. 45 -- Push Plate

Provide cutout for cylinder or turn lever as required. Provide beveled on all four edges.

Ives	Trimco	Don-Jo	Rockwood
8311-5 4x16	1010-3	7110	132-70C

SPEC. NO. 46 -- Anti-Vandal Pull

Stainless steel or bronze, 5-inch by 5-inch by 1 inch. Provide with attached lugs for through bolting from inside. Furnish vandal-resistant screws. Furnish without cylinder cutout for exit only doors.

Trimco	Rockwood
1111C3-black coating at wood doors	BF94 – black coating at wood doors

1096 – RC – SP at single metal outswinging doors

1097 – RC – SP at pairs metal out swinging doors and at single or pair in-swing doors

Ives

VR900 - at single metal out swinging doors

VR900LLP - at pairs metal outswinging doors and at single or pair inswing doors

SPEC. NO. 47 -- Coat and Hat Hook

Cast aluminum, Two prong, 1 1/8-inch inches projection, suitable for behind door application. Furnish three for teacher's wardrobes. Furnish quantities as indicated at other locations.

Ives	Don-Jo	Rockwood
582	302	796

SPEC. NO. 48 -- Cane Bolt

Steel, zinc-plated, 18 inches, with padlock eyes welded to bolt to lock in closed position. Two strikes each bolt to hold gate in open or closed position.

Hager	Richards-Wilcox	Stanley
1408	524-P21	1009

SPEC. NO. 49 – Offset Tube Door Pull

For installation on aluminum storefront doors with exit devices. Pulls shall be satin stainless steel (BHMA 630) and be mounted with spanner-screw through-bolts.

Don-Jo	Forms+Surfaces	Trimco	Rockwood
1158	DT1021-12"	1191-4	BF158

SPEC. NO. 50 – Wall-mounted Electro-magnetic Door Holder

For installation on fire-rated doors requiring hold-open

LCN	Norton	Rixson	Dorma	RSG
SEM7850	R6933	FM998	EM-F24120	DH1224 Series

SPEC. NO. 51 – Meeting Stile Astragals – Fire-rated Pairs with Vertical Rod Exit Devices

N.G.P.	Pemko	Reese
140PA(set)	351Cx351CS	95Cx95CP

SPEC. NO. 52 – Adhesive Smoke Seals – Fire-rated Metal Doors

N.G.P.	Pemko	Reese
5050B	S88D	797B

SPEC. NO. 53 – Adhesive Intumescent Seals – Fire-rated Wood Doors

At single doors, furnish frame seals only. At pairs, furnish both frame seals and astragal seal.

	N.G.P.	Pemko	Reese
Frame	9440B	HSS2000 x S88D	GIS x 797B
Astragal	9500B x 2525B	HSS2000 x S77D	GIS x 798B

SPEC. NO. 54 – Exterior Door Seals. Furnish frame seals and door sweeps at exterior doors. At pairs, furnish astragal in addition to frame seals and door sweep. Furnish factory-cut for narrow frames where occurs. Furnish exterior door seals with stainless steel fasteners.

	N.G.P.	Pemko	Reese
Frame Seals	700SA	2891AS	755A
Door Sweep/Drip	C627A	3452CNB	354C
Astragal	140PA (SET)	351C x 351CS	95C x 95CP

SPEC. NO. 55 -- Padlock Hasp

Steel, zinc plated, secured with galvanized bolts, nuts, and washers, 6 inches, 3 ½-inch for lead-lined cabinet doors.

Hager Stanley

WS-1941 SP-941

SPEC. NO. 56 -- Padlock Eyes

Steel, zinc plated.

Stanley

1245

SPEC. NO. 57 -- Key Tags

Furnish one fiber marker for each new file key, marked, attached, and placed as required.

Aladdin Ke-Master Lund Telkee

OG K9002 C-1507 2GF

FINISH HARDWARE SCHEDULE

A. HEADING 1

Double door (115A) - Room 115 to Room 117

SPEC. NUMBERS; 2, 4, 25, 26, 28x2, 32x2, 38, 39x2, and 41.

B. HEADING 2

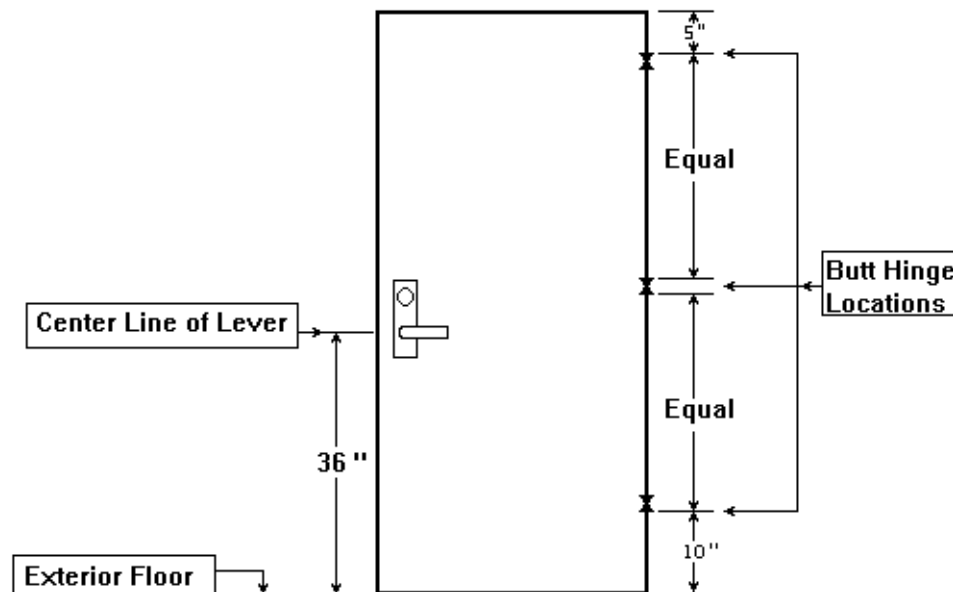
Single door (117A) – Room 117 to Exterior

SPEC. NUMBERS ; 3, 18, 29, 33, 36, 39, and 54.

HARDWARE PLACEMENT
MORTISE LOCKSET (HP-ML)

NOTES:

- Lock Strikes:** Strikes shall be boxed, with curved lip of sufficient length to protect the trim and jamb.
- Hinges** Reinforcement of steel doors and frames shall be per Specification Section 08110.
- All Frames** Head shall have door closer reinforcement, full length of head, whether or not closers are called for. Reinforcement shall be per Specification Section 08 1113. No mutes or mute holes.
- Door Closer** Install according to manufacturers' template. With closer installed, doors shall have maximum swing possible, 90 degrees minimum.
- Doorstop** Unless otherwise directed, doorstop or spike shall be mounted within 4 inches of the wall.

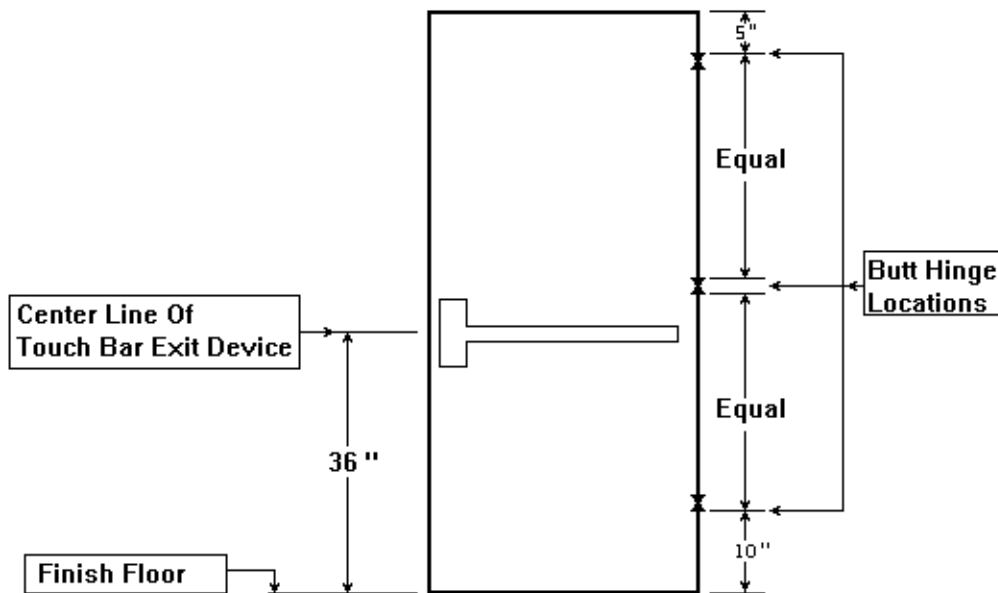


HARDWARE PLACEMENT

EXIT DEVICE (HP-ED)

NOTES:

- Kickplate Where specified 10 inches height, width 1 inch less than total width of door between stops. Secured with flat head undercut, full thread screws
- Hinges Reinforcement of steel doors and frames shall be per Specification Section 08 1113.
- All Frames Head shall have door closer reinforcement full length of head, whether or not closers are called for. Reinforcement shall be per Specification Section 08 1113. No mutes or mute holes.
- Door Closer Install according to manufacturers' template. With closer installed, doors shall have maximum swing possible, 90 degrees minimum.
- Door stop Unless otherwise directed, doorstop or spike shall be mounted within 4 inches of the wall.



END OF SECTION

SECTION 09 2423

CEMENT PLASTER AND METAL LATH

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lath and Portland cement plaster and stucco.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 3000 – Cast-in-Place Concrete.
3. Section 05 4100 - Structural Metal Stud Framing.
4. Section 07 2100 – Thermal Insulation.
5. Section 07 2719 – Plastic Sheet Air Barriers.

1.02 SYSTEM DESCRIPTION

- A. Three coat 7/8” cement plaster on metal lath over water resistive barrier over plastic sheet air barrier over sheathing over metal studs.

B.

- B. Soffits and ceilings: Three coat 7/8” cement plaster on metal lath over suspended metal framing.

1.03 REFERENCES

A. ASTM International (ASTM):

1. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.
3. ASTM A641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
4. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM C150 – Standard Specification for Portland Cement.

6. ASTM C206 – Standard Specification for Finishing Hydrated Lime.
 7. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring.
 8. ASTM C847 - Standard Specification for Metal Lath.
 9. ASTM C897 – Standard Specification for Aggregate for Job Mixed Portland Cement-Based Plasters.
 10. ASTM C926 – Standard Specification for Application of Portland Cement-Based Plaster.
 11. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
 12. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 13. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 14. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
 15. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
 16. ASTM E1190 – Standard Test Methods for Power-Actuated Fasteners Installed in Structural members.
- B. Federal Specifications (FS):
1. FS FF-N-105: Nails, Brads, Staples and Spikes: Wire, Cut and Wrought.
 2. UU-B-790A: Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent, and Fire Resistant).
- C. International Code Council (ICC):
1. ICC-ES AC11: Acceptance Criteria for Cementitious Exterior Wall Coatings.
 2. ICC-ES AC 191: Acceptance Criteria for Metal Plaster Bases (Lath).

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each material and component proposed for installation.
- B. Plaster Samples: Submit minimum 48-inch by 48-inch samples of each stucco and Portland cement plaster texture for review. Samples shall be representative of texture,

color, and proposed fabrication and finish quality. Maintain reviewed Samples on Project site for reference.

- C. Accessories Samples: Submit 12 inch long samples of metal lath accessories: control joints, expansion joints, corner reinforcements, reveals and screeds.
- D. Certificates: Submit test reports or ICC Evaluation Reports indicating that materials are in compliance with CBC requirements. Cementitious materials shall meet the acceptance requirements of ICC AC11, and metal lath the acceptance requirements of ICC AC191.

1.05 QUALITY ASSURANCE

- A. Mock-ups:
 - 1. Constructed as part of the building.
 - 2. Provide a mock-up at least 10-foot wide by 10-foot high. Include at least one control joint and, corner condition and one window opening flashing. Locate where indicated by the ARCHITECT.
 - 3. Mock-up shall be constructed by the same personnel who will be erecting the different components of the wall assembly on the project, overseen by the same personnel who will be acting as acting as supervisors during actual construction, and built with the same construction techniques and materials that will be used on the project.
 - 4. Wall/window assembly may be tested by a lab retained by the OWNER for air and water infiltration in accordance to ASTM E1105 and ASTM E783.
- B. Pre-Installation Conference: CONTRACTOR shall coordinate and conduct pre-installation conference in accordance to Section 01 3119, Project Meetings, to review the progress of construction activities and preparations for the installation of metal lath and cement plaster and other related work of this Section.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store weather sensitive materials under cover, off the ground, and kept in a dry condition until ready for use.
- B. Deliver materials to the Project site in manufacturer's sealed and labeled packages.

PART 2 - PRODUCTS

2.01 METAL LATH AND WEATHER RESISTIVE BACKING

- A. Metal Lath:
 - 1. Walls and Ceilings: Diamond mesh expanded metal lath, in conformance to ASTM C847, without paper backing. 3.4 pounds per square yard, hot-dip galvanized coating G60 in accordance with ASTM A653. Alabama Metal

Industries Corporation (AMICO), California Expanded Metal Products Company (CEMCO), ClarkDietrich, Marino-Ware, or equal.

- a. V-grooved self-furring type for installation over sheathing. Lath shall be furred out a minimum of 1/4 inch when installed over a solid surface in accordance to DSAIR 25-4.
 - b. Flat type for installation over spaced framing.
2. Walls: Self-furring Welded Wire Lath: Weight 1.95 pounds per square yard, with Class 1 galvanized coating in conformance to ASTM A641. Structa Mega Lath per ICC ESR-2017, as manufactured by Structa Wire Corp, or equal.
 3. Walls & Ceilings: Self-furring Welded Wire Lath: Weight 2.2 pounds per square yard, with Class 1 galvanized coating in conformance to ASTM A641 with heavy perforated Kraft paper. V-Truss per ICC ESR-2017, as manufactured by Structa Wire Corp, or equal.
- B. Water Resistive Barrier Backing for Metal Lath:
1. One layer of air barrier membrane per Section 07 2719, Plastic Sheet Air Barriers.
 2. One layer of asphalt saturated, water resistant Kraft paper backing conforming to Fed Spec UU-B-790A, Type 1, Grade D60, manufactured by Fortifiber, Davis Wire, Leather back, or equal. Furnish for exterior plastering (except on soffits and ceilings), and for mortar-set ceramic wall tile.
- C. Self-Adhered Flashing:
1. Compatible with the Plastic Sheet Air Barrier, minimum 25 mils thick, self-sealing and waterproof.
 2. Adhesives, primers and sealers for self-adhered flashings and water repellent backing shall be as recommended by manufacturer for installation with specified products and substrates, and shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).

2.02 METAL LATH ACCESSORIES

- A. Materials: Minimum 0.0172 inch galvanized steel or 0.0207 zinc alloy with expanded wings. PVC is not permitted. Furnish casing beads, expansion and control joints, weep and vent screeds.
- B. Manufacturers: Alabama Metal Industries Corporation (AMICO), California Expanded Metal Products Company (CEMCO), ClarkDietrich, Stockton Products, Marino-Ware, equal.
- C. Products:
 1. Exterior Stress Relief Joints: Sizes and profiles, indicated or required. Control joints shall have expanded wings when attachment flange is installed above the primary water-resistant barrier.

2. Expansion Joints: Two piece sections designed to accommodate expansion, contraction and shear forces. Industry generic name: #40-2 piece joint.
3. Control Joints: One-piece sections, with flange designed to engage plaster. Grounds shall provide full 7/8 inch thickness of cement plaster. Industry generic name: XJ-15.
4. Soffit Drip Screed: Similar to Stockton Products No. 5, with key holes.
5. Casing Beads: Expanded or standard flange type with 7/8 inch grounds to establish plaster thickness. Industry generic names: J-Mold or # 66.
6. Welded Wire Corner Reinforcement: 2-5/8 inch wire wings square or bullnose. Industry generic name: CornerAid.
7. Inner Corner Reinforcement: Shaped reinforcing expanded metal with 3 inch legs, for angle reinforcement. Industry generic name: Cornerite.
8. Lath Reinforcement: Flat expanded metal lath reinforcing units. Industry generic name: Striplath.
9. Outside Corner Reinforcing: 2 1/2" legs Class 1 Galvanized Coating complying with ASTM A641. VTruss Straight Corner per ICC ESR-2017, as manufactured by Structa Wire Corp, or equal.
10. Ventilating Screeds: Soffit, attic, fascia, edge, channel and expansion channel vent screeds, perforated web type, with integral plaster grounds, of sizes indicated on drawings.
11. Foundation Weep Screeds: Integral plaster ground and weep screed; 3-1/2" minimum attachment flange. Industry generic name: #7 Weep Screed.

2.03 LATH FASTENERS

- A. Fasteners at Locations with no Continuous Insulation:
 1. Metal Studs: Wafer head type S or S-12, corrosion resistant, with length to penetrate framing steel thickness plus three threads minimum.
 - a. Screws for fastening to steel members from 0.033 inch to 0.112 inch in thickness shall be in accordance to ASTM C954.
 - b. Screws for fastening to steel members 0.033 inch in thickness and less shall be in accordance to ASTM C1002.
- B. Wire: Wire for fastening lath to supports, tying ends and edges of lath sheets, and securing accessories to lath, 0.0475 inch diameter (# 18 wire). Galvanized soft-annealed steel wire in conformance to ASTM A641.

2.04 PLASTER MATERIALS

- A. Factory Blended Portland Cement Plaster Basecoats and Finish: Products as fabricated by California Stucco, La Habra, Shamrock Stucco, Merlex, Omega Stucco, Inc., Expo Stucco, Spec Mix, Quikrete or other manufacturer member of the Stucco Manufacturer's Association (SMA).
1. Material Standards:
 - a. Portland Cement: ASTM C150.
 - b. Hydrated Lime: ASTM C206.
 - c. Sand: ASTM C897.
 - d. Fibers: ASTM C1116.
 2. Three Coat Systems:
 - a. Scratch and Brown Coats: Factory blended fiber reinforced plaster and sand mix conforming to ASTM C926, and requiring only the addition of water. Total thickness of coats: 3/4 inch.
 - b. Finish Coat: Factory blended cementitious stucco color coat, integrally colored with fade-resistant pigments. Coat thickness 1/8 inch.
 - 1) Finish: **Light Sand**
 - 2) Color: As selected by ARCHITECT.
 3. Two Coat Systems:
 - a. Brown Coat: Factory blended fiber reinforced plaster and sand mix conforming to ASTM C926, and requiring only the addition of water. Coat thickness 3/8 to 1/2 inch.
 - b. Finish Coat: Factory blended cementitious stucco color coat, integrally colored with fade-resistant pigments. Coat thickness 1/8 inch.
 - 1) Finish: **Light Sand**
 - 2) Color: As selected by ARCHITECT.
- B. Water: Clean, potable and from domestic source.
- C. Plaster Bonding Agent: In conformance to ASTM C932 and formulated for exterior use. "Weld-Crete", manufactured by Larsen Products Co., or equal.
- D. Plaster Patching Materials:
1. Bonding Agent: Acrylic resin type, Acryl 60, LHP Bonder, or equal.
 2. Patching Plaster: Manufactured by Merlex Stucco, Inc., or equal. Furnish fast setting, compatible with existing plaster materials, "Exterior Pronto Patch,"

Portland cement base coat material, requiring only addition of water. Material shall provide initial set within 20 minutes and final set within one hour.

- E. Flashing: Single ply self-adhesive waterproofing membrane as manufactured by W.R. Grace Company, Jiffy-Seal by Protecto Wrap, W.R. Meadows, Inc., or equal. Furnish for installation behind stress relief joints and backing on horizontal and vertical surfaces exposed to weather; under metal copings and flashings; and window jambs and sills.
- F. Miscellaneous Materials: Provide additional components and materials required for a complete installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that installation of plastic sheet air barrier and flashings, per Section 07 2719, and continuous insulation per Section 07 2100 are complete before starting Work of this Section.

3.02 INSTALLATION-OF WATER RESISTIVE BARRIER

- A. Install one layer of water resistant barrier over air barrier. Install Kraft paper horizontally with each course weather lapped 2 inches over layer below and 6 inches on ends.
- B. Repair and seal tears and holes in water resistive barrier prior to installing lath.
- C. Install single ply self-adhesive flashing per manufacturer's recommendations in areas indicated on the Drawings and at locations where the plaster will be in less than a 60 degree plane or where water can pond, with a six inches extension onto the vertical wall surface. Apply self-adhesive flashing in a "shingle fashion".

3.03 INSTALLATION OF LATH AND LATH ACCESSORIES

- A. Exterior Lathing, General: Install in conformance to ASTM C1063 and CBC Chapter 25.
- B. Install longest length of metal lath as possible. Do not use pieces shorter than six feet in length. Attach lath to framing supports not more than seven (7) inches apart along framing supports only.
- C. Apply metal lath with long dimension at right angles to framing or furring supports and lap lath a minimum 1/2 inch at sides and minimum 1 inch on ends. Lap wire lath minimum one mesh on sides and ends. Stagger vertical laps at least 16 inches. Lath shall lap flanges of solid flanged trim accessories by a minimum of 50%.
- D. Ends of lath on open framing (unsheathed) shall occur over supports. Where necessary, install additional studs to provide support for lath ends and support for separate flanges of stress relief joints.

- E. Install trim accessories plumb, level and straight, attachments should not exceed 24 inches on center.
- F. Lath shall not be continuous through control joints. Two-piece Expansion Joints shall have the lath cut, be attached to framing and lath lap the flanges. Place control joints as indicated on elevations. Water resistant barrier shall be continuous behind all control joints and vertical reveals.
- G. Install a weep screed at or below foundation plate line on exterior stud walls in conformance to CBC section 2512. Screed shall be of a type permitting water to drain to exterior of building. Weather-resistant barrier and exterior lath shall cover and terminate on attachment flange of screed.
- H. Powder Actuated Fasteners shall be used on concrete/masonry substrates when lath is applied. Fasteners shall be driven home and avoid spalling of concrete. Pattern shall simulate that of framed walls.
- I. Interior Lathing, General: Install in conformance to ASTM C841 and CBC Chapter 25.
- J. Metal lath shall be fastened to metal supports with specified fastener spaced not more than 6 inches apart or with other recognized fasteners.

3.04 PLASTER APPLICATION - GENERAL

- A. Verify that installation of lath is complete prior to start plastering. Notify the Technical Service Information Bureau upon completion of lath and prior to start of plaster to schedule a lathing installation compliance meeting. TSIB will submit a written field observation report delineating any deficiencies. Site meeting shall be coordinated with OAR.
- B. Proportion, mix, apply, and cure plaster in conformance with ASTM C926 and CBC Chapter 25.
- C. Install each plaster coat to an entire wall or ceiling panel without interruption to avoid cold joints and abrupt changes in uniform appearance of succeeding coats. Wet plaster shall abut existing plaster at naturally occurring interruptions in plane of plaster (such as corner angles, openings and control joints) wherever possible. Cut joining, where necessary, square and straight and at least 6 inches away from a joining in preceding coat.
- D. Provide sufficient moisture or curing methods to permit continuous and complete hydration of cementitious materials, considering climatic and Project site conditions. If water cured, each basecoat shall be continuously damp for at least 48 hours, including weekends and holidays. Other curing methods, spray applied curing compounds, or OEHS approved equal are permitted.
- E. Provide sufficient time between coats to permit each coat to cure or develop enough rigidity to resist cracking or other damage when next coat is installed.

3.06 EXTERIOR PLASTERING

- A. Concrete surfaces, except where noted as "Exposed Concrete" or "Painted Concrete," shall be finished with stucco **light sand** finish coats, as specified.
- B. Mixing: Provide plaster mix: cementitious materials and aggregate in proportions specified, furnishing only sufficient water to obtain proper consistency before installation. Do not mix any more material at any time than can be installed within 1/2 hour after mixing. Do not re-temper. Add only enough water to allow proper application of cement plaster.
- C. Application:
1. Scratch Coat: Install with sufficient material to completely cover laths and scratch across supports.
 2. Brown Coat: Rod to a straight, true, even within 1/4 inch tolerance in 5 feet of surface and consolidate surface with a wood or neoprene float. Surface shall be left open and course, suitable to receive finish coat.
 3. Stucco Finish Coat: Install in two coats to a total thickness of 1/8 inch, each coat covering surface uniformly. First coat shall completely cover basecoat with uniform color. Second color shall provide a uniform texture.
 - a. First coat shall be installed adequately to cover surface and fill minor imperfection in the brown coat.
 - b. The second coat shall be installed by doubling back same day, when first coat is sufficiently dry.
 - c. Over concrete surfaces, second coat shall be installed 24 hours after installation of first coat. In warm weather, first coat shall be cured by light water spray after material has set.
 - d. Protection: Protect those surfaces, which are not to receive dash finish coats. Such surfaces shall be shielded and shall have any sand left from dashing operation removed.
 - e. Provide smoothed plaster finish to comply with ADA requirements behind handrails.
- D. Curing Exterior Plaster: Adhere to current edition of CBC for curing requirements.
- E. Option for Machine Application, Scratch and Brown Coats: Instead of hand installed plaster, the furnishing of plastering machines for interior or exterior scratch and brown coats or single base coat is permitted. Machine installation shall be in accordance with the following:
1. Qualifications: Provide proper equipment and apparatus.
 2. Apparatus: Pump shall be equipped with an air pressure gage or factory installed blow-off valve and required safety devices. Hoses and connections shall be tight and pressure shall be maintained constant.

3. Proportion and Application: Proportioning, mixing, number of coats and thickness shall be same as specified for hand application. Cement aggregate and water shall be mixed to plaster machine. Plaster mix shall be projected into and conveyed through a hose to the nozzle at end of hose and deposited by pressure in its final position ready for manual straightening and finishing.
4. Follow-Up: Perform scoring operation of plaster, based on settings and drying conditions at time of installation. Curing shall be as previously specified.
5. Protection: Before installing any plaster, thoroughly protect other adjacent Work.

3.08 QUALITY CONTROL

- A. Finish interior and exterior plaster to a uniform texture, free of imperfections and flat within 1/4 inch in 5 feet. Form a suitable foundation for paint and other finishing materials. Avoid joining marks in finish coats.

3.09 REPAIR OF DAMAGED PLASTER

- A. Plaster Detached from Framing:
 1. Remove loose and broken plaster.
 2. Repair or replace damaged water-resistant backing and lath in compliance with specified standards.
 3. Remove stucco finish from surrounding area in the same plane by sandblasting.
 4. Install a scratch coat and a brown coat mixed with liquid bonding agent instead of water to the areas devoid of plaster.
 5. Install a coat of liquid bonding agent to entire wall plane.
 6. Install a 1/8 inch thick stucco finish coat to entire wall plane and match existing texture and color.
- B. Cracked Plaster 1/8 inch to 1/2 inch:
 1. Remove loose material from crack with a wire brush.
 2. Fill crack with slurry of stucco and liquid bonding agent.
 3. Install a coat of liquid bonding agent to entire wall plane.
 4. Install 1/8 inch thick stucco finish to entire wall plane and match existing texture and color.
- C. Cracks Larger than 1/2 inch - Painted:
 1. Remove loose material from crack with a wire brush.

2. Fill crack with slurry of one part Portland cement to three parts masonry or stucco sand and liquid bonding agent to match existing texture of adjacent surface.
3. Paint entire wall plane, color to match existing.
4. Where patching of plaster over existing lath is feasible, fasten loose lath and install new lath with nails at 6 inch centers. Where metal is furnished, lap new lath over existing 6 inches and tie at 6 inch centers. Install paper backings as required, shingled into existing.
5. Patching of Holes, Cracks, and Gouges: Holes, cracks, gouges, missing sections, and other defects in existing improvements shall be patched. For holes over 1 inch in size, cut small sections of lath and place in opening attached to existing material. Install 3 coats of plaster. For holes one inch and smaller, install bonding agent to existing surfaces and neatly fill hole with plaster, installing necessary coats to match adjacent surfaces, eliminate cracks and match existing surface texture. Cracks, gouges, and other defects shall be filled with plaster or spackle as required and neatly finished to match adjacent existing improvements.

3.10 CLEANING

- A. Remove rubbish, debris, and waste material and legally dispose of off the Project site.

3.11 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 09 2900

GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Gypsum board wall and ceiling systems.
2. Gypsum Liner.
3. Cement Tile Backer Board.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 05 4100 - Structural Metal Stud Framing.
3. Section 06 1000 - Rough Carpentry.
4. Section 07 9200 - Joint Sealants.
5. Section 09 2216 - Non-Structural Metal Framing.
6. 09 9000 Painting Coating.

1.02 PROJECT REQUIREMENTS

- A. Design Requirements: Provide systems capable of resisting deflection as required by CBC and authorities having jurisdiction.
- B. Regulatory Requirements: Comply with CBC requirements for design and installation.

1.03 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating complete suspension system including connections, anchorage, and trim features.
- B. Material Samples: Submit 18 inch by 18 inch Samples of the texture coat of gypsum board panels with edges taped.
- C. Product Data: Submit manufacturer's catalog data for each product proposed for installation.

1.04 QUALITY ASSURANCE

- A. Comply with following as a minimum requirement:

1. ASTM C475 – Standard Specification for Joint Compound and Joint Tape for finishing Gypsum Board.
 2. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
 3. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 4. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 5. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 6. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
 7. ASTM C1396 - Standard Specification for Gypsum Board.
 8. ASTM C1629 - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 9. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 10. ASTM D3274 – Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation.
 11. Underwriters Laboratories (ULI) requirements and listings for fire-rated materials and products classification.
 12. GA 214 - Gypsum wallboard finish shall conform to requirements of GA 214, Application and Finishing of Gypsum Panel Products, published by the Gypsum Association, and as specified herein.
 13. GA 600 - Gypsum wallboard shall conform to requirements of GA 600 Fire Resistance Design Manual, published by the Gypsum Association.
 14. American National Standards for the Installation of Ceramic Tile.
 15. ANSI A118.9 - Specification for Cementitious Backer Units.
- B. Qualifications: Installer shall have a minimum 5 years experience in installing and finishing gypsum board.
- C. CHPS Low-Emitting Materials table: Materials submitted must meet the CHPS Low-Emitting criteria and be listed as Low-Emitting on the following web site: www.CHPS.net or be listed on UL website Greenguard.org as Greenguard Gold Certified

1.05 DELIVERY, STORAGE AND HANDLING

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- A. Deliver materials in original, factory sealed packages, containers or bundles bearing brand name and name of manufacturer.
- B. Materials shall be kept dry. Gypsum wallboard shall be neatly stacked flat; avoid sagging and damage to edges, ends, and surfaces.
- C. Fire-rated materials shall have fire classifications numbers attached and legible.
- D. Provide all means necessary to protect gypsum board systems before, during, and after installation.
- E. Gypsum wallboard showing any evidence of water damage shall not be installed. Gypsum wallboard showing evidence of water damage after installation shall be removed and replaced.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Georgia-Pacific.
- B. National Gypsum Co.
- C. U.S. Gypsum Co.
- D. Or equal.

2.02 MATERIALS

- A. Gypsum Board Type X (fire-resistant) or Type C or Type ULIX as required by fire rated design and acoustic requirements: 5/8 inch thick, 4-foot wide and up to 16-foot long conforming to ASTM C1396 with long edges tapered.
- B. Impact Resistant Gypsum Board, Type X (fire-resistant): 5/8 inch thick or Type C as required by fire rated design and acoustic requirements, 4-foot wide and up to 16-foot long complying with the following:
 - 1. Fire resistant rated gypsum core with additives to enhance impact resistance, faced with moisture and mold resistant paper and reinforcing fiber mesh. Comply with ASTM C1629 level 3 hard body impact resistance.

2.03 ACCESSORIES

- A. Metal Trim: Paper-faced metal drywall beads and trim meeting ASTM C1047, as manufactured by USG/Beadex, or equal. Trim units shall be of size and type to fit gypsum board construction and shall include corner beads, casings, edge trim and other shapes indicated and required. Provide 30 year warranty against edge cracking.
- B. Joint Compound for gypsum board products: meeting the following requirements:
 - 1. Shall conform to ASTM C475.

2. In areas subject to moisture after installation such as bathrooms and locker areas use setting type joint compound.
 3. Interior areas not subject to moisture after installation use drying Type Joint compound.
- C. Joint Tapes for gypsum boards: Shall conform to ASTM C475.
- D. Finishing Materials: Texture coat finish material shall be manufactured by U.S. Gypsum, Hamilton, or Highland Stucco and Lime Products, Inc., or equal.
- E. Acoustical Sealant: Non-hardening, non-shrinking, for use in conjunction with gypsum board, as recommended by Board Manufacturer and conforming to ASTM C919. Sealant shall maintain fire and sound rating assembly.
- F. Fasteners:
1. Self-drilling, self-tapping bugle-head drywall screws; in conformance to ASTM C1002. No. 6 Type S or S12, 1 5/8-inch long for metal framing,
 2. Wood framing: Screws: Type W 1 5/8-inch minimum length for single-layer panels. Screws shall be furnished with a corrosion-resistant treatment.
 3. Adhesive: as recommended by board manufacturer and in compliance to ASTM C557.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Metal Trim:
1. Provide corner beads at outside corners and angles, metal casing where gypsum board terminates at uncased openings, metal edge trim where board edges abut horizontal and vertical surfaces of other construction.
 2. Install trim in accordance with manufacturer's directions with appropriate joint compound. Install trim in longest practical pieces.
- B. Gypsum Board:
1. Install gypsum board in conformance with ASTM C840, fire rated design, and sound rating.
 2. Gypsum board shall be cut by scoring and breaking or by sawing, working from face side. Where board meets projecting surfaces it shall be scribed and neatly cut. Unless conditions require otherwise, gypsum board shall be installed first to ceilings, then to walls. End joints shall occur over a support. Install panels of maximum practical length so a minimum number of end joints occur.

3. End joints shall be staggered and joints on opposite sides of a partition shall be arranged to occur on different studs. Joint layout at openings shall be installed so no end joints will align with edges of openings.
4. Except where specified otherwise, fasteners shall be spaced not less than 3/8 inch from edges and ends of gypsum board. Do not stagger fasteners at adjoining edges and ends.
5. Install gypsum board vertically or horizontal as permitted by specific UL Design at walls. Fasten board with drywall screws spaced not to exceed 8 inches on centers around perimeter of boards and 8 inches on centers on intermediate studs. Space screws at 8 inches on centers along top and bottom runners. Screws shall be driven to provide screwhead penetration just below gypsum board surface without breaking surface paper. Where electrical outlet and switch boxes are indicated, provide adjustable attachment brackets between studs.
6. Install gypsum board to ceiling framing with long dimension at right angles to furring channels, or wood framing members, and fasten with specified drywall screws or nails spaced 6 inches to 7 inches on centers across board. Screws or nails shall be not less than 1/2 inch from side joints and 3/8 inch from butt end joints. Abutting end joints shall occur over furring channels and end joints of boards shall be staggered. Support cutouts or openings in ceilings with furring channels.
7. Install access doors, furnished under another section, in correct location, plumb, or level, flush with adjacent construction, and securely fastened to framing.

3.02 TOLERANCES

- A. System shall appear flat and monolithic with no exposed joints.

3.03 JOINT TREATMENT AND FINISHING

*At completion of specified taping and finishing, install one coat of drywall primer as specified hereafter

- B. Levels: Install tape bedding compound, tape, and finishing cement on joints in wallboard as required for specified levels of finish.
- C. Levels 2 through 5:
 1. Install joint cement and finishing cement over screw heads. Treat all inside corners with joint cement, tape, and finishing cement. Treat outside corners with corner beads and finishing cement.
 2. Provide metal casing beads at all edges of gypsum wallboard, which abut ceiling, wall, or column finish, and elsewhere as required, such as openings, offsets, etc. Install all exposed joints, trims, and attachments non-apparent following installation of paint or other finishes. If joints and fasteners are visibly apparent, correct defects as required.

3. Seal raw edges of plumbing openings and boards that have been cut to fit with sealing compound brushed on.
 4. When entire installation is completed, correct and repair broken, dented, scratched or damaged wallboard before installation of finish materials by other trades.
- D. Levels 3 and 4: Install one coat of drywall primer over entire surface prior to painting.
- E. Level 5: Install one coat of skim coat over entire surface, followed by one coat of drywall primer over entire surface prior to painting.

3.04 REQUIRED LEVELS OF FINISH

- A. Finishes shall conform to GA 214
- B. Unless otherwise indicated or specified, levels of finish required shall be as follows:
1. Level 1: Plenum areas above ceilings, insides of shafts, and other concealed areas. Taping to be as required for fire rated assemblies.
 2. Level 2: Water-resistant wallboard backing for high moisture areas to be covered with a water resistant surface other than tile, vinyl or paint, i.e stainless steel cladding etc.
 3. Level 3: Backing for vinyl wall covering and adhered acoustic tile. Also, provide where textured finish is indicated.
 4. Level 4: Exposed painted wallboard in classrooms, utility rooms, and similar spaces not requiring Level 5 finish.
 5. Level 5: Exposed, painted wallboard in offices and corridors.

3.05 TEXTURE COAT

- A. Spray install texture coat to interior gypsum board surfaces where indicated on Drawings.
- B. Texture coat shall provide a uniform splatter pattern finish with an 80 percent minimum coverage of the entire surface area.
- C. Provide protection from spray for interior surfaces of electrical boxes and wiring.

3.06 CLEAN-UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.07 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 09 6513

RUBBER BASE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Topset coved rubber base for installation with surface flooring.

B. Related Requirements:

1. Division 01 - General Requirements.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's published technical data describing materials, construction and recommended installation instructions. Submit technical data and installation instructions for each adhesive material.

- B. Maintenance Instructions: Submit manufacturer's recommendations for maintenance, care and cleaning of base.

- C. Samples: Submit Samples of topset base in each available color. Following color selections, submit Samples, not less than 12 inches long of each selected color and type. Submit pint cans of each type adhesive.

- D. Maintenance Materials: Before Substantial Completion, deliver at least 50 lineal feet and five outside corner units of each color of rubber base installed. Deliver the materials in unopened factory containers or in sealed cartons with labels identifying the contents, matching installed materials. Include unopened cans of adhesives adequate to install the maintenance materials.

1.03 QUALITY ASSURANCE

- A. Qualifications of Installer: Minimum five years experience in successfully installing the same or similar flooring materials.

B. Comply with the following as a minimum requirement:

1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM F1861: Standard Specification for Resilient Wall Base.
3. Comply with current CHPS requirements, www.chps.net.

- 4. Chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by Owner's Office of Environmental Health and Safety (OEHS).
- 5. Each selected color and configuration shall be from same dye lot and color.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name. Store materials at room temperature, but not less than 70 degrees F, for a minimum of 48 hours before installation, unless otherwise indicated in manufacturer's printed instructions.

1.05 PROJECT CONDITIONS

- A. Ventilation and Temperature: Verify areas that are to receive rubber base are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for site installation conditions.

1.06 WARRANTY

- A. Manufacturer shall provide a five year material warranty.
- B. Installer shall provide a two year fabrication and installation warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Mannington/Burke Wall Base.
- B. Armstrong Wall Base
- C. Roppe, Pinnacle Rubber Base.
- D. Flexco Company, Wallflower Premium Rubber Wall Base.
- E. Equal.

2.02 MATERIALS

- A. Rubber base: Conform to ASTM F1861; Group 1, solid (homogeneous); Type 1, TS, (thermoset) vulcanized rubber, Style B (coved), 4-inch high unless otherwise

indicated, integral colors as selected, non-shrinking, 1/8 inch thick, with matching molded outside corners.

- B. Base Adhesive: Water based, low odor type, as recommended by manufacturer of rubber base.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate the Work of this section with other sections to provide a level, smooth and clean finish surfaces to receive rubber base.

3.02 EXAMINATION

- A. Field verify dimensions and other conditions affecting the Work of this section before commencing the Work of this section.
- B. Before Work is started, examine surfaces that are to receive rubber base. Deficiencies shall be corrected before starting the Work of this section.

3.03 PREPARATION

- A. Do not start preparation until adjacent concrete floor slabs are at least 90 days old and finish flooring is installed.
- B. Install rubber base when ambient temperature is 70 degrees F. or higher.

3.04 INSTALLATION

- A. Install topset base at:
 - 1. Hard floors, including resilient flooring, concrete and wood, carpet tile and other soft floors.
 - 2. Along cabinetry base and where flooring extends into open cabinets.
- B. Install all wall base with pre-molded outside corners. Clean and prep existing wall and apply adhesive to the wall or back of base. Ensure that not less than 18-inch-long filler or end pieces are not installed. Roll base to ensure that the top of the base installed is tight against the wall and toe is tight against the floor, all end joints to be tight with no gaps. Install matching factory pre-molded outside corners at all offsets. Should pre-molded outside corners become unavailable and confirmed, corners are to be wrapped tight by slightly gouging the back of the Base and apply adhesive at gauge. Wrap base around the corner, Push base down at the corner to form a consistent toe, ensuring that it is snug to the floor on both sides of the corner, All Inside corners shall be scribed fit tight with no gaps at the top or bottom of the base. Wrapped inside corners are not acceptable.

- C. Use of adhesive gun is prohibited. Apply adhesive directly to substrate using the appropriate notched trowel or spreader according to manufacturer's instructions. Maintain 1/8 inch gap from top of base to prevent adhesive oozing onto adjacent surfaces.
- D. Base and outside corners shall be rolled with a seam roller before adhesive sets.

3.05 CLEANING

- A. Maintain surfaces of base clean as installation progresses. Clean rubber base when sufficiently seated and remove foreign substances.
- B. Clean adjacent surfaces of adhesive or other defacement. Replace damaged and/or defective Work to the specified condition.

3.06 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 09 9000
PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior and exterior painting.

B. Following items shall not be painted:

1. Brass valves, chromium or nickel-plated piping and fittings.
2. Boiler control panels and control systems.
3. Fabric connections to fans.
4. Flexible conduit connections to equipment, miscellaneous name plates, stamping, and instruction labels and manufacturer's data.
5. Mechanical and electrical utility lines, piping and heating and ventilation ductwork in tunnels, under-floor excavated areas or crawl spaces, attic spaces and enclosed utility spaces.
6. Flag, floodlight, parking light poles and loudspeaker poles, metal stairs, handrails and chain-link fence with a galvanized finish, unless otherwise noted.
7. Structural and miscellaneous steel, open web steel joists and metal floor decking, which will not be exposed in final construction, shall have no finish other than one coat of shop primer.
8. Hardboard covering on tops and backs of counters and benches.
9. Brass, bronze, aluminum, lead, stainless steel and chrome or nickel-plated surfaces.
10. Non-metallic walking surfaces unless specifically shown or specified to be painted.

1.02 REGULATORY REQUIREMENTS

- A. Paint materials shall comply with the Food and Drug Administration's (F.D.A.) Lead Law and the current rules and regulations of local, state and federal agencies governing the use of paint materials.

1.03 SUBMITTALS

- A. List of Materials: Before submittal of samples, submit a complete list of proposed paint materials, identifying each material by distributor's name, manufacturer's name, product name and number, including primers, thinners, and coloring agents, together with manufacturers' catalog data fully describing each material as to contents, recommended installation, and preparation methods. Identify surfaces to receive various paint materials.
- B. Material Samples: Submit manufacturer's standard colors samples for each type of paint specified. Once colors have been selected, submit Samples of each color selected for each type of paint accordingly:
 - 1. Samples of Paint and Enamel must be submitted on standard 8 ½" x 11" Leneta Opacity-Display Charts. Each display chart shall have the color in full coverage. The sample shall be prepared from the material to be installed on the Work. Identify the school on which the paint is to be installed, the batch number, the color number, the type of material, and the name of the manufacturer.
 - 2. Elastomeric shall be submitted in duplicate samples of the texture coating. Samples will be not less than 2 ½ by 3 ½ in size and installed upon backing. Finished Work will match the reviewed Sample in texture.
 - 3. Materials and color samples shall be reviewed before starting any painting.
- C. For transparent and stained finishes, prepare samples on same species and quality of wood to be installed in the Work, with written description of system used.

1.04 QUALITY ASSURANCE

- A. Certification of Materials: With every delivery of paint materials, the manufacturer shall provide written certification the materials comply with the requirements of this section.
- B. Coats: The number of coats specified is the minimum number. If full coverage is not obtained with the specified number of coats, install additional coats as required to provide the required finish.
- C. Install coats and undercoats for finishes in strict accordance with the recommendations of the paint manufacturer as reviewed by the Architect.
- D. Paint materials shall comply with the following as a minimum requirement:
 - 1. Materials shall be delivered to Project site in original unbroken containers bearing manufacturer's name, brand number and batch number.
 - 2. Open and mix ingredients on premises in presence of the Project Inspector.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Storage and Mixing of Materials: Store materials and mix only in spaces suitable for such purposes. Maintain spaces clean and provide necessary precautions to prevent fire. Store paint containers so the manufacturer's labels are clearly displayed.

1.06 SITE CONDITIONS

- A. Temperature: Do not install exterior paint in damp, rainy weather or until surface has thoroughly dried from effects of such weather. Do not install paint, interior, or exterior, when temperature is below 50 degrees F, or above 90 degrees F, or dust conditions are unfavorable for installation.

1.07 WARRANTY

- A. Manufacturer shall provide a three year material warranty.
 B. Installer shall provide a three year application warranty.

1.08 MAINTENANCE

- A. Provide at least one gallon of each type, color and sheen of paint coating installed. Label containers with color designation indicated on Drawings.

PART 2 - PRODUCTS

2.01 PAINT MATERIALS

- A. Furnish the products of only one paint manufacturer unless otherwise specified or required. Primers, intermediate and finish coats of each painting system must all be the products of the same manufacturer, including thinners and coloring agents, except for materials furnished with shop prime coat by other trades.
- B. Factory mix paint materials to correct color, gloss, and consistency for installation to the maximum extent feasible.
- C. Paint materials to be minimum "Architectural Grade".
- D. Gloss degree standards shall be as follows:

HIGH GLOSS	70 and above	EGGSHELL	30 to 47
SEMI-GLOSS	48 to 69	SATIN	15 to 29

2.02 MANUFACTURERS

- A. Acceptable manufacturers, unless otherwise noted:
1. Dunn-Edwards Corporation Paints
 2. Frazee Paints and Wall coverings
 3. Vista Paints
 4. Sherwin Williams
 5. ICI Paints

6. Equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine surfaces to receive paint finish. Surfaces which are not properly prepared and cleaned or which are not in condition to receive the finish specified shall be corrected before prime coat is installed.
- B. New woodwork shall be thoroughly cleaned, hand sandpapered, and dusted off. Nail holes, cracks or defects in Work shall be filled. On stained woodwork, fill shall be colored to match stain. Filling shall be performed after the first coat of paint, shellac or varnish has been installed.
- C. Plaster surfaces except veneer plaster shall be allowed to dry at least 3 weeks before painting. Veneer plaster shall be allowed to dry sufficiently to receive paint as determined by moisture meter tests.
- D. Metal surfaces to be painted shall be thoroughly cleaned of rust, corrosion, oil, foreign materials, blisters, and loose paint.
- E. Do not install painting materials to wet, damp, dusty, dirty, finger marked, rough, unfinished or defective surfaces.
- F. Concrete surfaces shall be dry, cleaned of dirt and foreign materials and in proper condition to receive paint. Neutralize spots demonstrating effects of alkali.
- G. Mask off areas where necessary.

3.02 APPLICATION

- A. Backpainting: Immediately upon delivery to the Project site, finish lumber and millwork shall be backpainted on surfaces that will be concealed after installation. Items to be painted shall be backpainted with priming coat specified under "Priming".
- B. Priming: New wood and metal surfaces specified to receive paint finish shall be primed. Surfaces of miscellaneous metal and steel not embedded in concrete, and surfaces of unprimed plain sheet metal Work shall be primed immediately upon delivery to the Project site. Galvanized metal Work and interior and exterior woodwork shall be primed immediately after installation. Priming of surfaces and priming coat shall be as follows:
 - 1. Knots, Pitch and Sap Pockets: Shellac before priming.
 - 2. Exterior Woodwork and Wood Doors: Prime with one coat of exterior waterborne emulsion wood primer.
 - 3. Interior Woodwork: Where indicated to be painted, prime with one coat of waterborne wood primer.

4. Stain: Woodwork indicated to receive a stain and varnish finish shall be stained to an even color with water borne stain. On open-grained hardwood, mix stain with paste filler and completely fill pores in wood.
 5. Galvanized Metal Work: Clean oil, grease and other foreign materials from surfaces. Install vinyl wash pretreatment coating. Follow manufacturer's instructions for drying time, and then prime with one coat of metal primer.
 6. Unprimed Iron, Steel, and Other Uncoated Metals: Where specified to be painted, prime with one coat of metal primer.
 7. Shop Primed Metal Items: Touch up bare and abraded areas with metal primer before installation of second and third coats.
 8. Coats shall be installed evenly and with full coverage. Finished surfaces shall be free of sags, runs and other imperfections.
- C. Allow at least 24 hours between coats of paint.
- D. Rollers shall not be used on wood surfaces.
- E. Each coat of painted woodwork and metal, except last coat, shall be sandpapered smooth when dry. Texture-coated gypsum board shall be sanded lightly to remove surface imperfections after first coat of paint has been installed.
- F. Each coat of paint or enamel shall be a slightly different tint as required. Each coat of paint, enamel, stain, shellac, and varnish will be inspected by the IOR before next coat is applied. Notify the Project Inspector that such Work is ready for inspection.
1. Tinting Guideline: The first coat, primer/undercoat(s) to be untinted or tinted up to 50 percent lighter or darker (at the discretion of the installer) than the finish coat. The second coat (or third coat if a seal coat and undercoat have been specified) is to be factory tinted in the range of 10 percent to 15 percent lighter or darker (at the discretion of the installer) than the finish coat. The final coat is to be factory tinted to the required color selected. These tinting guidelines shall be provided on all surfaces receiving paint.
- G. Do not "paint-out" UL labels, fusible links and identification stamps.
- H. Paint Roller, brush and spray.
1. Only Paint rollers shall be used on interior plaster, drywall, masonry/plaster and plywood surfaces, nap shall not exceed one half inch in length.
 2. First coat on wood overhang and ceilings shall have material applied by roller and then brushed out in a professional manner to leave surface free of imperfections. Finish coat may be sprayed.
 3. Other surfaces shall have all coatings applied with brushes of proper size.
 4. Spray work is permitted only on radiators, acoustic plaster, masonry and plaster.

- I. Where ceilings are specified to be painted, beams, cornices, coves, ornamental features, plaster grilles, etc. shall be included.
- J. Ceilings shall be white, including classrooms, storage rooms, offices, arcades, etc. Boiler room and fan room ceiling color shall match adjacent walls.

3.03 CLEANING

- A. Remove rubbish, waste, and surplus material and clean woodwork, hardware, floors, and other adjacent Work.
- B. Remove paint, varnish and brush marks from glazing material and, upon completion of painting Work, wash and polish glazing material both sides. Glazing material, which is damaged, shall be removed and replaced with new material.
- C. Clean hardware and other unpainted metal surfaces with recommended cleaner. Do not furnish abrasives or edged tools.

3.04 SCHEDULE

- A. Interior:
 - 1. Woodwork, Painted: 3 coats.
 - a. First Coat: As specified in this section under Priming.
 - b. Second and Third Coats: Interior enamel, semi-gloss or gloss as indicated.
 - 2. Gypsum Board: 4 coats.
 - a. First Coat: Drywall sealer.
 - b. Second Coat: Enamel under coater.
 - c. Third and Fourth Coats: Interior enamel, semi-gloss or gloss as indicated.
 - 3. Concrete: 3 coats.
 - a. First: Concrete sealer.
 - b. Second and Third: Interior enamel, semi-gloss or gloss as indicated.
 - 4. Metal: Shall be cleaned, pre-treated and painted with 3 coats. Items to be painted include, but are not limited to: exposed structural and miscellaneous steel, metal doors and frames, ladders, table and bench legs.
 - a. First Coat: Metal primer.
 - b. Second and Third Coats: Interior gloss enamel, except metal doors and frames which shall be semi-gloss or gloss to match adjacent wall.

B. Exterior:

1. Plaster and Stucco: 3 coats. Flat 100 percent acrylic.
 - a. Prime Coat: Alkali resistant primer/sealer.
 - b. Exterior 100 percent acrylic.
2. Concrete: 3 coats. Flat 100 percent acrylic.
 - a. First Coat: Concrete sealer.
 - b. Second and Third Coats: Exterior 100 percent acrylic.
3. Metal: 3 coats. Shall be cleaned and pre-treated. Items to be painted include, but are not limited to: steel columns and miscellaneous steel items, gravel stops, metal doors and frames, hoods and flashings.
 - a. First Coat: As specified in this section under Priming.
 - b. Second and Third Coats: Exterior gloss enamel.

C. Mechanical and Electrical Work:

1. Except where interior mechanical and electrical Work to be painted is specified to receive another paint finish, Work occurring in finished rooms and spaces shall be cleaned, pre-treated, and painted with 3 coats. Items to be painted include, but are not limited to: steel and copper piping, pipes, vents, fittings, ducts, plenums, miscellaneous supports and hangers, electrical conduit, fittings, pull boxes, outlet boxes, unfinished surfaces of plumbing fixtures, miscellaneous metal cabinets, panels, and access doors and panels.
 - a. First Coat: As specified in this section under Priming.
 - b. Second and Third Coats: Interior enamel, semi-gloss or gloss to match adjacent wall or ceiling finish.
2. Insulation and Taping on Pipes and Ducts: 3 coats.
 - a. Finished Rooms:
 - 1) First Coat: Interior waterborne primer.
 - 2) Second and Third Coats: Interior semi-gloss or gloss enamel to match adjoining wall or ceiling finish.
 - b. Building Exterior:
 - 1) First Coat: Exterior waterborne primer.
 - 2) Second and Third Coats: Exterior gloss enamel.

3. Inside surfaces of ducts, vents, dampers and louvers as far back as visible from room in which they open shall be painted with 2 coats of flat black paint.

3.05 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 10 1400
SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior and exterior accessibility, identification, directional and informational signs.
2. Parking signs.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 08 1113: Hollow Metal Doors and Frames.
3. Section 08 1416: Wood Doors.
4. Division 09: Finishes.
5. Section 32 1313 - Site Concrete Work.

1.02 REFERENCES

A. ASTM International:

1. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM D4802 - Standard Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.

1.03 SUBMITTALS

- A. Product Data: Submit material descriptions, finishes and color charts for each type of sign.
- B. Shop Drawings: Submit Shop Drawings indicating sign style, lettering, overall dimensions and quantities. Submit floor plans showing locations for each sign.
- C. Material Samples: Submit three samples illustrating full size sample sign, of type, style and color specified.

- D. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Pre-Installation Conference: Notify OAR 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.
- B. Provide signs from one manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site and protect from damage. Store until immediately prior to installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products of following manufacturers are acceptable and are the basis for intended design and quality.
 - 1. H. Toji and Company.
 - 2. Karman Ltd., Architectural Signs.
 - 3. Vomar Products Inc.
 - 4. ASI-Modulex, Inc.
 - 5. Mohawk Sign Systems, Inc.
 - 6. Accent Signage Systems.
 - 7. The Gruenke Company.
 - 8. Ada Sign Products.
 - 9. AccuBraille.
 - 10. Equal.

2.02 MATERIALS AND FABRICATION

- A. Interior Sign Materials:
 - 1. Substrate Panel: 1/8 inch minimum thick, integrally colored or clear acrylic plastic, or laminated acrylic. Conforming to ASTM D4802; non-glare (matte), UV stable, suitable for interior and exterior use.

- a. Corners shall be [square], [radius].
 - b. Edges shall be square and eased.
 - c. Colors as selected by ARCHITECT from manufacturer's custom color range.
2. Fasteners:
- a. Stainless steel tamper-proof screws and plastic anchors.
 - b. Signs mounted on fire-rated doors shall be secured with adhesive.
- B. Exterior Sign Materials:
- 1. Sign: ASTM B209 aluminum sheet, 0.080 inch thick with rounded corners of at least 1/8 inch radius and eased edges. White figure on a blue background; non-glare, high contrast signs. The blue shall be equal to color number 15090 in Federal Standard 595B.
 - 2. Post: 2 by 2 inch galvanized steel tubing, weighing minimum of 4.31 pounds per foot and conforming to ASTM A500, Grade B, 3/16 inch thick wall thickness.
 - 3. Concrete Post Footings: Refer to Section 32 1313, Site Concrete Work.
 - 4. Fasteners: Stainless steel carriage bolts with tamper resistant nuts.
- C. Characters and Symbols: Shall be fabricated by one of the processes described below:
- 1. Computer cut raised characters and graphics shall be cut from 1/16 inch integrally colored acrylic. Raised characters and graphics shall be inlaid 1/32 inch minimum into first surface of sign background, secured with adhesive so it cannot be removed without the use of tools. Raised characters and graphics shall have beveled, eased or rounded edges. Non-tactile text and graphics shall be applied to the second surface, and background color shall be applied to the second surface and protected with film or an additional backplate. Pictograms and other symbols including the International Symbol of Accessibility, which are included on signs with raised characters and Braille, are not required to be raised.
 - 2. Raised characters and graphics including braille shall be integral to sign face and shall be formed into sign face by high pressure thermoforming using a negative mold. No applied, glued, welded tactile elements are acceptable. Raised characters and graphics shall have beveled, eased or rounded edges. No sharp, square edges are acceptable. Non-tactile text and graphics shall be applied to the second surface, and background color shall be applied to the second surface and protected with vinyl film. Pictograms and other symbols including the International Symbol of Accessibility, which are included on signs with raised characters and Braille, or other signs are not required to be raised.

2.03 COMMUNICATION ELEMENTS AND FEATURES

- A. Raised Characters Raised characters shall comply with CBC 11B-703.2.

1. Character Type: Characters on signs shall be raised 1/32 inch minimum above their background and shall be sans serif uppercase characters duplicated in Braille. Characters and Braille shall be in a horizontal format.
 2. Character Height: Character height measured vertically from the baseline of the character shall be 5/8 inch minimum and 2 inch maximum based on the height of the uppercase letter "I".
 3. Character Proportions: Characters shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the letter "I".
 4. Stroke Thickness: Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character.
 5. Character and Line Spacing shall be in conformance to CBC 11B-703.2.7 and 11B-703.2.8.
 6. Character Placement: Shall be placed in accordance to Paragraph 2.03, C below.
- B. Visual Characters: Visual characters shall comply with CBC Section 11B-703.5. Characters shall be conventional in form, and shall be uppercase or lowercase or a combination of both, as indicated on the drawings. Characters shall not be italic, oblique, highly decorative, or of other unusual forms.
1. Finish and Contrast: Characters and their backgrounds shall have a non-glare finish. Characters shall contrast with their background with either light characters on a dark background or a dark characters on a light background.
 2. Character Proportions: Characters shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase of the letter "I".
 3. Character Height: Minimum character height shall comply with CBC Table 11B-703.5.5.
 4. Height from Finish Floor or Ground: Visual characters shall be a 40 inches minimum above the finish floor or ground
 5. Stroke Thickness: Uppercase letter "I" shall be 10 percent minimum and 20 percent maximum of the height of the character.
 6. Character and Line Spacing: Shall be in accordance to CBC 11B-703.5.8 and 11B-703.5.9.
- C. Braille: Contracted Grade 2 Braille, conforming to CBC 11B-703.3. Braille characters shall be inlaid optically correct acrylic Raster beads into computer drilled holes in the panel surface.
1. Dimensions and Capitalization: Braille dots shall have a domed or rounded shape and shall comply with CBC Table 11B-703.3.1. The indication of an uppercase letter or letters shall only be used before the first word of sentences,

- proper nouns and names, individual letters of the alphabet, initials, and acronyms.
2. Position: Braille shall be positioned below the corresponding text in a horizontal format, flush left or centered. If text is multi-lined, Braille shall be placed below the entire line of text. Braille shall be separated 3/8 inch minimum and 1/2 maximum from any other tactile characters and 3/8 inch minimum from raised borders and decorative elements.
- D. Pictograms: In conformance to CBC 11B-703.6. Pictograms shall have a field height of 6 inches minimum. Characters and Braille shall not be located in the pictogram field.
1. Finish and Contrast: Pictograms and their field shall have a non-glare finish. Pictograms shall contrast with their field with either a light pictogram on a dark field or a dark pictogram on a light field.
 2. Text Descriptors: Pictograms shall have text descriptors located directly below the pictogram field, and shall comply with CBC 11B-703.2, 11B-703.3 and 11B-703.4.
- E. International Symbol of Accessibility (ISA): Shall comply with CBC 11B-703.7 and CBC Figure 11B-703.7.2.1. The ISA shall consist of a white figure on a blue background. The blue color shall be approximate to FS. 15090 in Federal Standard 595C.
- F. Mounting Locations and Height: Signs with tactile characters shall be as indicated on the drawings and in conformance to CBC 11B-703.4.
1. Mounting Locations:
 - a. Identification signs for rooms and spaces shall be located on the wall adjacent to the latch side of the door, as one enters the room or space.
 - b. Signs that identify exits shall be located at the exit door when approached in the direction of egress travel.
 - c. Signs containing tactile characters shall be located so that a clear floor space 18 inches minimum by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
 - d. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side.
 - e. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located at the inactive leaf.
 - f. Where a tactile sign is provided at double doors with two active leaves, the sign shall be located to the right of the right hand door.

- g. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
- 2. Mounting height above finish floor or ground: Tactile characters on signs shall be located 48 inches minimum above the finish floor or ground surface, measured from the baseline of the lowest Braille cells and 60 inches maximum above the finish floor or ground surface, measured from the baseline of the highest line of raised characters.

2.04 ROOM IDENTIFICATION SIGNS

A. Room Identification Sign Types:

- 1. Room Identification Sign with Changeable Insert: 7 inches high by 9 inches wide, minimum, with 4 inches high by 9 inches wide window for name and title removable insert. Locate room name immediately below window, and centered above room number. Room name shall be raised characters 3/4 inches high minimum, and room number 1 inch minimum; and shall be accompanied with Braille indicators.
- 2. Room Identification Sign with Room Name and Room Number: 7 inches high by 9 inches wide, minimum. Room name shall be raised characters 3/4 inches high minimum, and room number 1 inch minimum; and shall be accompanied with Braille indicators.
- 3. Room Number Sign: 7 inches wide by 4 inches high; room number, 1 inch high minimum, raised character, accompanied by Braille indicator immediately below.

B. Room Identification Sign Requirements:

- 1. Finish and Contrast: Refer to paragraph 2.03.B.
- 2. Raised Characters and Proportions: Refer to paragraph 2.03.A.
- 3. Braille: Refer to paragraph 2.03.C.
- 4. Mounting Location and Height: Refer to paragraph 2.03.F.

2.05 RESTROOM SIGNAGE

A. Multiple-Occupancy restrooms shall be provided with geometric symbols and wall mounted pictograms with text descriptors.

B. Geometric Symbols:

- 1. Doorways leading to toilet rooms shall be identified by a geometric symbol complying with CBC Section 11B-703.7.2.6.
- 2. Male Restroom Door Symbol: 1/4 inch thick equilateral triangle with edges 12 inches long, with vertex pointing upward, the triangle symbol shall contrast

with the door, either light on a dark background or dark on a light background. A male silhouette shall appear within the equilateral triangle in contrasting color to it.

3. Female Restroom Door Sign: 1/4 inch thick circle 12-inch diameter, the circle symbol shall contrast with the door, either light on a dark background or dark on a light background. A female silhouette shall appear within the circle in contrasting color to it.
 4. “All Gender” Restroom Door Sign (Single occupancy restrooms): 1/4 inch thick circle, 12-inch diameter with a 1/4 inch thick equilateral triangle with the vertex pointing upward superimposed on the circle and within the 12-inch diameter. Triangle and circle shall be of contrasting colors; the circle symbol shall contrast with the door. A female and male silhouettes shall appear within the equilateral triangle in contrasting color to it, and the word “restroom” shall appear on the bottom part of the circle in contrasting color to it.
 5. Edges and Vertices on Geometric Symbols: Shall be eased or rounded at 1/16 inch minimum, or chamfered at 1/8 inch maximum. Vertices shall be radiused between 1/8 inch minimum and 1/4 inch maximum.
 6. Location and Mounting Height: Symbols shall be mounted at 58 inches minimum and 60 inches maximum above the finish floor or ground surface measured from the centerline of the symbol. Where a door is provided the symbol shall be mounted within one inch of the vertical centerline of the door.
 - a. At locations with no restroom doors, locate sign adjacent to the opening. Tactile room name accompanied by Braille shall be located on symbol sign.
- C. Room Identification for Multiple-Occupancy Restrooms: Provide a 16 inch long by 6 inch tall room identification sign, including a pictogram of the International Symbol of Accessibility on a side. Restroom names shall be “Girls” or “Boys”, for students, and “Women” and “Men” for staff. Characters, Braille, pictograms and mounting locations and height shall be in conformance to Article 2.03.

2.06 RAISED CHARACTER AND BRAILLE EXIT SIGNS

- A. Tactile Exit Sign Types:
 1. “EXIT”.
 2. “EXIT ROUTE”.
 3. “TO EXIT”.
- B. Sign Requirements:
 1. Finish and Contrast: Refer to paragraph 2.03.B.
 2. Raised Characters and Proportions: Refer to paragraph 2.03.A.

3. Braille: Refer to paragraph 2.03.C.
4. Mounting Location and Height: Refer to paragraph 2.03.F.

2.07

2.13 ACCESSIBILITY ENTRANCE SIGNS AND PATH OF TRAVEL DIRECTIONAL SIGNS

- A. Entrance Sign: Provide at each building entrance an International Symbol of Accessibility sign. Signs shall be visible to persons along approaching pedestrian ways.
- B. Directional Signs: Provide where indicated on the drawings with arrow indicators and International Symbol of Accessibility.
- C. Signs shall be mounted on wall with lower edge between 48 inches and 60 inches above ground surface or finish floor. Pole mounted, overhead and projecting signs shall have the lower edge at least 80 inches from the ground surface or finish floor.
- D. Sign shall comply with the following requirements.
 1. Directional Signs: Refer to paragraph 2.03.B.
 2. Symbol of Accessibility: Refer to paragraph 2.03.E.
- E. No Smoking Sign: Provide at each building entrance. Reverse cut white vinyl sign with 4 1/2-inch high no smoking symbol, mounted on glass entry doors. Under No Smoking symbol, place words "No Smoking", 1/2 inch high minimum, San Serif upper and lower case characters.

2.14 PARKING SIGNS

- A. Tow-Away Sign: 18 inches by 24 inches with rounded corners. Black graphics on white background, with lettering not less than 1 inch high. Sign to read: "UNAUTHORIZED VEHICLES PARKED IN DESIGNATED ACCESSIBLE SPACES NOT DISPLAYING DISTINGUISHING PLACARDS OR SPECIAL LICENSE PLATES ISSUED FOR PERSONS WITH DISABILITIES WILL BE TOWED AWAY AT THE OWNER'S EXPENSE. TOWED VEHICLES MAY BE RECLAIMED BY TELEPHONING (805) ___-___".
- B. Parking Space Identification Sign: 12-inch by 18-inch with rounded corners. White reflectorized graphic on dark blue background, and shall display an 8-inch high International Symbol of Accessibility per paragraph 2.03.E.
 1. Additional language or an additional sign below the International Symbol of Accessibility shall state I "Minimum Fine \$250".

2. Signs identifying van accessible parking spaces shall contain additional language or an additional sign with the designation "Van Accessible".
- C. Signs shall be mounted on posts at head of each accessible parking with lower edge 80 inches minimum above ground surface, or mounted on walls at a minimum height of 60 inches from ground surface.

2.15 OCCUPANT LOAD SIGNS

- A. Provide maximum occupancy load signs. Post in a conspicuous place near the main exit or exit access doorway from the room or space of rooms and areas indicated in the drawings.
- B. Minimum size: 4 inches high by 8 inches wide, 7/8 inch high letters, 1 inch high numerals.
- C. Sign to read: "MAXIMUM OCCUPANCY LOAD XXX". Indicate occupant load shown on drawings.

2.20 FIRE SPRINKLER RISER ROOM SIGN

- A. Locate one sign at each fire sprinkler riser room door as indicated in drawings.
- B. Text: Sign to read "Fire Sprinkler Riser Inside", white characters, 1 inch high on red background.
- C. Sign Requirements:
 1. Raised Characters and Proportions: Refer to paragraph 2.03.B.
 2. Braille: Refer to paragraph 2.03.C.
 3. Mounting Location and Height: Mounted on the door, refer to paragraph 2.03.F.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means installer accepts condition of existing surfaces.

3.02 METHODS OF INSTALLATION

- A. Interior Identification Signs and Interior Directional Signs:
1. Fasten to wall with four tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
 2. When concealed installation is specified, install backplate to wall as above. Fasten sign to backplate with very high-bond double-faced tape.
 3. For installation on glass, fasten sign to glass with very high bond double faced tape. On opposite side of glass, anchor matching backplate to glass with very high-bond double-faced tape.
- B. Geometric Signs: Geometric toilet room signs shall be fastened to doors with three tamper-proof oval-head counter-sunk screws.
- C. Exterior Post Mounted Directional Signs: Size of required footing shall be as indicated on the drawings. Fasten sign with tamperproof stainless steel bolts.
- D. Exterior Wall Mounted Identification Signs and Directional Signs:
1. Aluminum signs: Fasten to wall with 4 tamper-proof round-head screws, one at each corner of sign. Furnish plastic anchors.
 - a. Cement Plaster, Brick, or Masonry: Provide plastic anchors. For signs greater than 640 square inches use Leadwood Screw Anchors, concrete fasteners 1WSA 10112, or equal.
 - b. Chain Link Fence: Fasten with 9 gage hog rings, King Hughes Fasteners 5150DG50, or equal, with 11/16 inch opening at each corner of sign.
 - c. Wrought Iron Fence: Install at each corner with 3/16 inch stainless steel rivets.
 2. Acrylic signs: Install backplate to wall as indicated above. Fasten sign to backplate with high-bond double-faced tape and silicone.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

3.04 PROTECTION

- A. Protect Work of this section until Substantial Completion.

END OF SECTION

SECTION 21 13 00

FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 GENERAL AND SPECIAL CONDITIONS

- A. General and special conditions apply to the work in this section.
- B. The Contractor shall 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 Authorities Having Jurisdiction. 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. The omission by the Owner of any necessary system component as required by the Authorities Having Jurisdiction, in the specifications shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the Owner. 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. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Owner, Architect, and Engineer for clarification prior to the bid due date.
- C. The Contractor shall provide all devices and equipment required by these specifications. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

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 – Amador Whittle 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 – Schram Fire Protection Engineering.
- 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 FM Global 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. Revise the fire protection system for the Welding/Auto/Manufacturing Building as outlined in the project specifications, including all labor, materials, permits, shop drawings and hydraulic calculations needed to furnish and install a complete and functional automatic sprinkler system, and all of the following:
 - 1. Coordinate all work with other trades.
 - 2. Install pipe offsets as required to coordinate around other trades.
 - 3. As-built drawingWs. The Contractor will be required to provide as-built drawings on disk/CD in AutoCAD format, in addition to required reproducible and blueline drawings.
 - 4. On-site project supervision.

5. 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.
6. All required system testing in accordance with NFPA 13, 24, and 25.
7. Warranty on all materials and labor.
8. 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 Contractor.
4. Grading.

B. Materials furnished and installed in this section but wired by others:

1. Valve supervisory devices shall be furnished and installed by the Contractor but wired by the alarm contractor.
2. Waterflow switches shall be furnished and installed by the Contractor but wired by the alarm contractor.

1.5 DESIGN CRITERIA

A. Sprinkler System

1. Wet system with a K-Factor of 5.6, spaced to a maximum of 130 square feet per sprinkler. The system shall be designed to provide 0.20 gpm per square foot for the most remote 1,500 square foot area with a hose demand of 250 gpm (Ordinary Hazard Group I).

B. Water Supply

1. Pipe sizing will be determined by hydraulic calculations in accordance with NFPA 13 requirements and will be based upon the simulated flow model results from Ventura Water & Sanitation as follows:

Date: February 3, 2022

Performed by: Jake Badilla - San Buenaventura Water District

Flow Hydrant: 4895 Loma Vista

Residual Hydrant: 4757 Loma Vista

Static Pressure: 50 PSI

Residual Pressure: 48 PSI

Flow: 919 GPM

1.6 APPLICABLE STANDARDS

- ##### A. National Fire Protection Association 13 (NFPA 13) – “Standard for the Installation of Sprinkler Systems,” 2016 Edition.

- B. National Fire Protection Association 24 (NFPA 24) – “Standard for the Installation of Private Fire Service Mains,” 2016 Edition.
- C. National Fire Protection Association 25 (NFPA 25) – “Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems,” 2013 CA Edition as amended by the State of California.
- D. California Building Code (CBC), 2019 Edition.
- E. California Fire Code (CFC), 2019 Edition.
- F. DSA Policies.
- G. American National Standards Institute, Inc. (ANSI) Standards, current editions:
 - 1. A21.10 a – Gray-Iron and Ductile-Iron Fittings, 2 inch through 48 inch for Water and Other Liquids.
 - 2. A21.11 – Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.
 - 3. B16.1 – Cast-Iron Pipe Flanges and Flanged Fittings, 24, 125, 250, and 800 pounds.
 - 4. B16.3 – Malleable-Iron Threaded Fitting, Class 150 and 300.
 - 5. B16.4 – Cast-Iron Threaded Fitting, Class 125 and 250.
 - 6. B18.2.1 – Square and Hex Bolts and Screws.
 - 7. B18.2.2 – Square and Hex Nuts.
 - 8. B36.10 – Welded and Seamless Wrought Steel Pipe.
 - 9. B112.1 – Hose Valves for Fire Protection Services.
- H. American Society for Testing and Materials (ASTM) Standards, current edition:
 - 1. A 53 – Specifications for Welded and Seamless Steel Pipe.
 - 2. A 307 – Carbon Steel Externally and Internally Threaded Standard Fasteners.
- I. Federal Specifications (Fed. Spec.):
 - 1. GG-G76D – Gages, Pressure and Vacuum, Dial Indicating, (for Air, Steam, Oil, Water, Ammonia, and Chloro-Floro Hydrocarbon Gases).
 - 2. WW-P-421c – Pipe, Cast Gray and Ductile Iron, Pressure (for Water and Other Liquids).
 - 3. WW-P-521f – Pipe Fittings, Flange Fittings and Flanges, Steel and Malleable Iron (Threaded and Butt-Welding) 150 Pound.
 - 4. 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).
 - 5. WW-V-58B – Valves, Gate, Cast Iron; Threaded and Flanged (for Land Use).
- J. FM Publication:
 - 1. Approval Guide.
- K. Underwriters Laboratories, Inc. (UL) Publication:
 - 1. Fire Protection Equipment List (Annually with Quarterly Supplements).

L. American Water Works Association (AWWA) Standards, current editions:

1. C200-75 – Steel Water Pipe 6 Inches and Larger.
2. C207-55 – Steel Pipe Flanges.
3. C500-71 – Gate Valves – 3 through 48 inch – for Water and Other Liquids.
4. C105 – Polyethylene Encasement.

M. American Welding Society (AWS) Standards, current edition:

1. D10.9 – Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR-3.
2. B2.1 – Specifications for Qualification of Welding Procedures and Welder for Piping and Tubing.

N. American Standard Mechanical Engineers (ASME) Standards, current edition:

1. B1.20.1 – Pipe Threads, General Purpose.

1.7 APPROVALS

- A. Schram Fire Protection Engineering has prepared permit drawings, which have been approved by DSA. The Contractor shall use these drawings to prepare shop drawings to be used in system installation. The Contractor shall submit the shop drawings to Schram Fire Protection Engineering for approval prior to system installation.

1.8 SUBMITTALS

A. Shop Drawings

1. Submit three sets of complete shop drawings, three sets of manufacturer's data and three sets of hydraulic calculations to Architect and Engineer for all necessary reviews prior to fabrication of materials.
2. Contractor shall submit complete system packages. Partial system submittals will be rejected.
3. Hydraulic calculations shall include a water supply graph and hydraulic cover sheet. The cover sheet shall include the name and location of the calculated area, ceiling height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make, model, K-factor and temperature rating, flow requirements, C-factor used, water supply data and source of information.
4. Prepare shop drawings with a minimum scale of 1/8 inch = 1 foot-0 inch for plans, and 1/4 inch = 1 foot-0 inch for details. 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. When welding is planned, shop drawings shall indicate the sections to be shop welded and the type of welded fittings to be used. All drawings shall be prepared using AutoCAD.
5. Design shall be based on these specifications and the appropriate NFPA standards.
6. Shop drawings shall include details of earthquake sway bracing, including the appropriate calculations.
7. Shop drawings shall include details of underground thrust blocking/restraints.

B. Changes

1. Make no changes in installation from layout as shown on the approved drawings unless change is specifically approved by the Engineer and AHJ. This does not include minor revisions for the purpose of coordination.
2. Any pipe fabricated and/or installed before all approvals are obtained at the Contractor's own expense and responsibility. Any changes made to the approved drawings other than as stated above are at the Contractor's own expense and responsibility.

C. Manufacturer's Data

1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices that are provided or furnished involve work by someone other than the Contractor, submit additional data copies directly to the Contractor. 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. Waterflow devices.
 - g. Valve supervisory devices.
 - h. Bell.
 - i. Fire stopping materials (including installation detail).

D. As-Built Drawings

1. Maintain at the site an up-to-date marked set of as-built drawings, which shall be corrected and delivered to the Owner upon completion of work.
2. Upon completion, furnish the Owner with three (3) sets of reproducible sepia prints, and one set in electronic AutoCAD "DWG" format of each reviewed shop drawing, revised to show "as-built" conditions

E. Samples

1. Provide one sample of each type of sprinkler and escutcheon.

F. Final Inspection and Test

1. The Contractor shall make arrangements with the Owner, Architect, and Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect, and the Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the AHJ, and the Owner.
3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be deducted from payments by the Owner 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.

G. 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. The plans 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 NFPA 25 and bound set of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

1.9 SPARE PARTS

- A. Provide and install one spare sprinkler cabinet, complete with 12 sprinklers of all types and temperature ratings used throughout the installation. The cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
- B. Confer with the Owner's representative for exact location of cabinet.

1.10 GUARANTEE

- A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

1.11 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.

1.12 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.

1.13 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.

1.14 EMERGENCY SERVICE

- A. The Contractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the Owner during the warranty period. This service shall be available on a 24-hour per day, seven-day per week basis.

1.15 TRAINING

- A. The Contractor shall conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation, and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a mutually agreeable time to the Contractor and the Owner.

1.16 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 granted in writing.

2.2 ABOVEGROUND PIPE

A. Feed Mains and Branchline 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 used 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 sizes 2 inches and less. Pipe ends shall be threaded or roll grooved in accordance with NFPA 13.
 - c. Schedule 10 pipe is acceptable in sizes 2-½ inches and larger. Pipe ends shall be welded or roll grooved in accordance with NFPA 13.
 - d. Hot-dipped galvanized pipe shall be used when exposed to the outside.
 - e. Hot-dipped galvanized pipe shall be used for drain pipe.
 - f. A seismic separation assembly shall be installed where sprinkler piping crosses a buildings seismic separation joints.

2.3 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.

2.4 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 ordinary hazard occupancies shall be upright or pendent, quick response type, K-factor of 8.0, and ordinary temperature rating.
- C. Sprinklers in unfinished areas shall be rough brass finish. Sprinklers in finished areas shall have special finishes, factory painted as selected at time of final design by the Architect.
- D. Pendent sprinklers installed in areas where ceilings are located shall be recessed. Sprinklers shall be installed in quarter point or center of tile.
- E. Standard-response horizontal sidewall sprinklers with a K-Factor of 5.6 shall be installed in the exhaust hood area.

2.5 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.
 - 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 with out removing the valve from the system.
 - 2. Check valves in the trim shall be approved.

2.6 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.

2.7 WATER FLOW ALARM AND SUPERVISORY DEVICES

- 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 valve manufacturer.

2.8 SIGNS

- 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.

2.9 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 Materials: 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.

D. Safety

1. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
2. Contractor shall attend all job safety meetings.

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 manufacturer's 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 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 headroom.

3.4 SPRINKLERS

A. General

1. Sprinklers below ceilings of exposed piping shall be listed and approved regular bronze upright type, in upright position. 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.

C. Drains

1. Provide main drain valves at system control valves, sized in accordance with NFPA 13 and AHJ requirements that extend piping to exterior.
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 hot-dipped galvanized.
6. The contractor shall comply with all water discharge restrictions.

3.5 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.

D. Pressure Relief Valves.

1. Pressure relief valves for sprinkler system risers shall be listed/approved, not less than ½-inch in size, set to open at not more than 175 psi.

3.6 FIRE DEPARTMENT CONNECTION

A. Refer to Civil drawings.

3.7 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.

3.8 HANGERS, SUPPORTS, AND EARTHQUAKE BRACING

A. General

1. All piping must be substantially supported from building structure and only approved types of hangers shall be used. 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 joined by grooved couplings.
2. Use flexible couplings where more than two couplings are used per run.

- 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.

3.9 SLEEVINGS, WALL & FLOOR PENETRATIONS

- 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. The space between sleeve and pipe shall be filled with noncombustible, UL listed fire-stopping materials. Provide chrome wall plates at each side of wall.
- C. Sleeves through floors shall be watertight. Penetrations through fire rated construction shall be adequately fire stopped to maintain the fire resistance rating required.
- D. Where sleeves are not installed, provide clearance around piping penetrations in accordance with NFPA 13. The space between the wall/floor and pipe shall be filled with noncombustible, UL listed fire-stopping materials. Provide chrome wall plates at each side of wall.

3.10 SIGNS

- A. Valves
 - 1. Secure to each valve with corrosion resistant wire or chain, sign stating, "control valve."
- B. Hydraulic Design Information
 - 1. Secure to each system riser with corrosion resistant fasteners.

3.11 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.

3.12 INSPECTOR'S TEST

- A. Provide inspector's test connections, as specified in NFPA 13, at required points for testing each waterflow alarm device. Special discharge nozzle 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.

3.13 SYSTEM ACCEPTANCE

A. Tests

1. General system test shall be coordinated with the owner's representatives for training and witnessed by the AHJ. Problems noted during testing such as air or water leaks, difficulty in operating valves, alarm failures, etc. shall be corrected before the Contractor leaves the job.
2. Hydrostatically test all piping, including fire department connections between the check valve and connection, at 200 psi for two hours. 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) pressure.

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 shall be completed for each system/floor and signed by the Contractor and witnessed by the owner's representative/AHJ. Provide the NFPA certificate(s) to the owner, local fire official, 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 NFPA 25.
 3. Spare Parts
 - a. Provide 12 spare sprinklers of all types and ratings that are installed, in a steel cabinet complete with special sprinkler wrenches. Install cabinet as directed by owner.

3.14 ADJUSTMENT AND CLEANING

- A. Cleaning: Flush all piping in accordance with NFPA Standards for test procedures.

END OF SECTION 211300

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to the General Requirements.
- B. Mechanical work includes the following: furnish and install all mechanical equipment shown on the mechanical, plumbing, architectural, and electrical engineering drawings and described in these specifications. Contractor shall furnish and install, make operable, and test all mechanical equipment shown on the plans. In connection therewith, contractor shall also furnish and install all necessary work, devices, hardware and systems required to make said equipment properly and safely operable, including but not limited to, mounting hardware and framing, vibration control devices, duct systems, flashing, systems, energy management systems, cutting and patching.

1.2 WORK SEQUENCE

- A. Install work in phases to accommodate Owner's construction requirements. Refer to Architectural, Structural, and Electrical Drawings for the construction details and coordinate the work of this division with that of other divisions. Order the work of this division so that progress will harmonize with that of other divisions and all work will proceed expeditiously. During the construction period, coordinate mechanical schedule and operations with General Contractor and any other related subcontractor.

1.3 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work as required.

1.4 SUBMITTALS

- A. Submit the following:
- B. Proposed Products List: Include Products specified in the following Sections:
 - 1. Section 23 - Mechanical.
 - 2. Project Drawings

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- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal. Submittals shall be specific to the fixtures/device/unit being submitted; the data shall be highlighted or marked to be quite clear as to the fixtures/devices/units that shall be provided.
- D. Equipment and materials shall be ordered only after satisfactory review by Owner and Engineer.
- E. The following statement applies to all items reviewed. "Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for dimensions which shall be confirmed at the job site; fabrication processes and techniques of construction; coordination of his work with that of other trades; and the satisfactory performance of his work."
- F. Contractor shall clearly mark the submittal sheet as to which model number, size, color, etc. when there is more than one choice available.
- G. Maintain a complete set of the most current reviewed submittal and shop drawings on site during construction.
- H. Submittals shall have table of contents organized by specification section and shall clearly identify electrical characteristics, options provided, color, model number and equipment tag as indicated on the drawings.

1.5 REGULATORY REQUIREMENTS

- A. Conform to 2019 California Building Code.
- B. Fire Protection: Conform to 2019 California Fire Code, and California State Fire Marshall Regulations, Title 19, Public Safety.
- C. Plumbing: Conform to 2019 California Plumbing Code.
- D. Mechanical: Conform to 2019 California Mechanical Code.
- E. Electrical: Conform to 2019 California Electrical Code.
- F. Obtain approved inspections from authority having jurisdiction.
- G. Conflicts: Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.6 PROJECT/SITE CONDITIONS

- A. Install work in locations shown on drawings, unless prevented by project conditions.

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- B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other Sections. Obtain permission of owner before proceeding.
- C. Piping locations: Piping locations shown are diagrammatic only. Contractor shall verify locations of all lateral stubs, offsets, etc. required in the field. The actual locations of lines, cleanouts and connections may vary provided that complete systems are installed in compliance with codes. It is not the intent of the drawings to show necessary offsets required to avoid structure or other trades. It is the intent of this paragraph that all costs associated with this paragraph be borne by the contractor.
- D. Construction observation: In addition to the requirement for obtaining inspections by the local jurisdiction, contractor shall notify Engineer at appropriate times during the construction process so that Engineer can visit site to become generally familiar with the progress and quality of contractor's work and to determine if the work is proceeding in general accordance with the contract documents.
- E. Scaling of drawings: In no case shall working dimensions be scaled from plans, sections, or details from the working drawings. If no dimension is shown on the architectural drawings, the prime contractor shall request in writing that the architect or engineer provide clarification or the specific dimension.
- F. As equal: For an item to be substituted "as equal" the contractor must provide to the engineer a complete submittal no later than 7 days prior to the bid opening. Contractor shall be responsible for any cost associated with the change including architectural design, mechanical, structural and electrical engineering and changes in any element of the building.
- G. Unit and duct locations: Heating and air conditioning unit and duct locations shown are approximate only. Contractor shall verify locations of all structural members, other trades, and existing conditions in the field, and locate units and ductwork to avoid interference. All clearances required by unit manufacturer shall be maintained. Entire installation shall be in accordance with codes and the recommended installation procedures published by the manufacturers. It is not the intent of the drawings to show necessary offsets and transitions required to avoid structure or other trades. It is the intent of this paragraph that all costs associated with this paragraph be borne by the contractor.

1.7 QUALITY ASSURANCE

- A. Qualification of Manufacturer: Products used in work shall be produced by manufacturers regularly engaged in the manufacture of similar items.
- B. Qualification of Installer: Use adequate number of skilled workmen, thoroughly trained and experienced in the necessary crafts, and completely familiar with the specified requirements contained in the plans and specifications.

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- C. Maintain uniformity of manufacturer for equipment used in similar applications and sizes.
- D. Provide products and materials that are new, clean, free from defects, damage, and corrosion.
- E. Provide name/data plates on major components with manufacturer's name, model number, serial number, date of manufacturer, capacity data, and electrical characteristics permanently attached in a conspicuous location on the equipment.
- F. Applicable equipment and materials to be listed by Underwriters' Laboratories and manufactured in accordance with ASME, AWWA, or ANSI standards. Power using equipment shall be meet the California energy efficiency standards as defined in the current Title 24 requirements.

1.8 DRAWINGS AND SPECIFICATIONS

- A. Drawings and specifications are intended to complement each other. Where a conflict exists between the requirements of the drawings and/or specifications, immediately and before commencing work, request clarification from Engineer.
- B. The Engineer shall interpret the drawings and the specifications, and the Engineer's decision as to the true intent and meaning thereof and the quality, quantity, and sufficiency of the materials and workmanship furnished thereunder shall be accepted as final and conclusive.
- C. In case of conflicts not clarified prior to Bidding deadline, use the most costly alternative (better quality, greater quantity, or larger size) in preparing the Bid. A clarification will be issued to the successful Bidder as soon as feasible after the Award and if appropriate a deductive change order will be issued.
- D. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".
- E. Examine and compare the contract drawings and specifications with the drawings and specifications of other trades. Report any discrepancies to the architect. Install and coordinate the work in cooperation with the other trades.

PART 2 – NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment per the manufacturer's instructions for installing, connecting, and adjusting. A copy of the instructions shall be kept at the equipment during installation and provided to the engineer at his/her request.

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- B. Adjust pipes, ducts, panels, equipment, etc., to accommodate the work to prevent interferences.
 - 1. Right-of-Way: Lines which pitch have the right-of-way over those which do not pitch. Lines whose elevations cannot change have right-of-way over lines whose elevations can be changed.
 - 2. Provide offsets, transitions, and changes in directions of pipes and ducts as required to maintain proper head room and pitch on sloping lines. Provide traps, air vents, drains, etc., as required.
- C. All equipment shall be firmly anchored to building structural elements.
- D. Install all equipment to permit proper service of equipment. Arrange pipes, ducts, conduits, etc to allow accessibility to equipment.
- E. Do not install equipment, pipes, or ducts above electrical room

3.2 COORDINATION OF WORK

- A. The contract documents establish scope, materials, and quality but are not detailed installation instructions. Drawings are diagrammatic.
- B. The contract documents show the general arrangement of equipment, ductwork, piping, and accessories. Provide offsets, fittings, and accessories which may be required but are not shown on the drawings. Investigate the site and review the other trades installation locations and requirements to determine conditions affecting the work and provide such work and accessories as may be required to accommodate such conditions.
- C. Whenever work interconnects with the work of other trades, coordinate to insure that all parties concerned have the necessary information required for a proper installation.
- D. Provide access doors as required to allow service and accessibility to valves, dampers, coils, etc. Install fire rated access doors in rated assemblies. Coordinate with framing and ceiling contractors.
- E. Furnish and set sleeves for passage of pipes, ducts, and conduits that pass through structural masonry and concrete walls, roofs, floors and elsewhere as required for the proper protection of each item passing through the building elements. See structural drawings for further details.
- F. Install UL Approved firestopping around all pipes, conduits, ducts, etc which pass through rated walls, partitions, and floors in strict accordance with manufacturer's listing and element rating.

3.3 OPERATING INSTRUCTIONS AND OPERATOR TRAINING

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- A. Provide two copies of all operating and maintenance manuals to owner. Include parts lists and suppliers' names and phone numbers.
- B. Provide four hours of training to the owner for the proper operation (start-up, operation, and shutdown) and servicing of the installed equipment. Provide three weeks notice to the owner, architect and engineer of the date of the training. Arrange for subcontractors to attend and participate where applicable.

3.4 RECORD DRAWINGS

- A. Maintain on a daily basis at the project site a complete set of record drawings reflecting an accurate dimensional record of all deviations between work shown on the drawing and are installed.
- B. Show any changes to specified equipment such as manufacturer, voltage, model number, capacity, etc. on record drawings.
- C. Provide two reproducible copies of the record drawing to the owner.

3.5 COMMISSIONING

- A. At the conclusion of the installation the contractor shall convene a pre-commissioning meeting to review the implementation of the commissioning process.
- B. Contractor shall verify that all building services, electric, and information technologies are functional prior to beginning commissioning.
- C. The commissioning team shall comprise the general, mechanical, electrical, controls and plumbing contractors, the project manager, test and balance company, and the mechanical engineer. Provide sample forms for review to the mechanical engineer prior to pre-commissioning meeting.
- D. The commissioning process shall be including function testing all equipment, controls, and electrical systems. All testing shall be documented in an item by item report with dates of test, test parameters and results.
- F. Provide commissioning report to project manager within two weeks of completion.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel 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.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

- C. Design seismic-restraint hangers and supports for piping and equipment per 2008 SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems. Hazard level is "A."

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.

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- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Refrigerant Pipe Support: Provide EPDM clamp insert at all pipe clamps at refrigerant piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: At Interior - Manufacturer's standard finish – At exterior - Hot dipped galvanized.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type interior/exterior steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Install per ICC listing.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
- C. Wood Screws for secure pipe and duct supports to wood structure
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Simpson SDS Screws
- b. or equal with self drilling feature and ICC report

D. Sheet Metal Screws

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TEK Screws
 - b. or equal with self drilling feature and ICC report

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized. All exterior steel shall be hot dipped aluminized.
- 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.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 rubber pipe isolators at refrigerant pipe clamps.
- E. 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 non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. 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.
 3. 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.
 4. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
- F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. 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.
- H. 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.
- I. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- J. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- K. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: 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 above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing 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.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. 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.
- I. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- K. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

- c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and 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.
3. 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.
4. Insert Material: Min. length as long as the protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

L. All pipes and ducts shall be braced per 2008 SMACNA Seismic Restraint Manual Guidelines
For Mechanical Systems. Seismic hazard level is "A".

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Provide lateral bracing, to prevent swaying, for equipment supports.
- C. Anchor all equipment to resist seismic motion.

3.4 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 Procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 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.

3.6 PAINTING

- A. Touch Up: 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. If material is galvanized spray with cold galvanizing.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply three coats of galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 230553

IDENTIFICATION FOR HVAC DUCT AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Duct labels.
 - 4. Stencils.

1.3 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.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Exterior Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness and having predrilled or stamped holes for attachment hardware.
2. 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).
3. 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-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Interior Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. 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).
6. 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-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. 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), plus the

Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

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3.3 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Balancing Air Systems:

- a. Variable Frequency System

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Certified TAB reports.
- B. Sample report forms.
- C. 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.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT 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.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 systems for installed 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 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 and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas.
- 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.
- 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 filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. 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.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Equipment and duct access doors are securely closed.
 - 3. Balance, smoke, and fire dampers are open.
 - 4. Isolating and balancing valves are open and control valves are operational.
 - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 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", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or SMACNA's "HVAC Systems – Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2016, Section 7.2.2, "Air Balancing."
- 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, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC 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 inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

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- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and –treating equipment.

- a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.8 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 weekly 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.

3.9 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.
- 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.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Terminal units.
 5. Balancing stations.
 6. Position of balancing devices.
- E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:

- a. System and air-handling-unit number.
- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft..
- g. Indicated air flow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual air flow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

G. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary air flow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final air flow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

H. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.10 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Engineer.
3. Engineer 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.
4. 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."
5. 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.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. 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 contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

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3.11 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 0900

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. The contract documents shall apply in their entirety to the work specified herein.
- B. Submittals: Submit shop drawings and manufacturer's data in accordance with this section.
- C. Maintenance and Operation Manuals: Provide 2 copies of manufacturer's operation and maintenance manual to owner.
 - 1. Include: Shop drawings, wiring diagrams, network architecture and manufacturers' Owners manuals.

1.2 SYSTEM DESCRIPTION

- A. This document contains the specification, input/output summaries for the Building Automation and Control System (BACS). The system architecture shall be an EIA-485 BACnet controller network. Operator Workstations may be connected to the controller network via direct EIA-232, modem, or Ethernet local area network connections through a microprocessor-based communication device.
- B. Owner currently is operating a Campus-wide Automated Logic Control System. No substitution is allowed.

1.3 SCOPE OF WORK

- A. General: Furnish and install all necessary hardware, software, wiring and computing equipment as defined in this specification.
- B. System Requirements:
 - 1. All materials and equipment used shall be standard components, regularly manufactured and available and not custom designed especially for this project. All systems and components, except site specific software, shall have previously been thoroughly tested and proven in actual use prior to installation on this project.
 - 2. The system architecture shall be fully modular permitting the expansion of application software, system peripherals, and field hardware.
 - 3. The DDC system upon completion of the installation and prior to acceptance of the project shall perform all operation functions as detailed in these specifications.

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- C. System hardware shall include all necessary controllers, thermostats, control transformers, relays, wiring and all other devices and equipment required to provide a complete and operating system.
- D. Include all programming and building graphics to control the HVAC systems shown on the plans. Included in the programming shall be alarm limits and system trending.

1.4 SUBMITTALS, DOCUMENTATION AND ACCEPTANCE

- A. Submittals:
 - 1. Shop drawings. A minimum of three copies of shop drawings shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog sheets and installation instructions. Shop drawings shall also contain complete wiring and routing, ID numbers of devices and any other details required to demonstrate that the system will function properly. Drawings shall show proposed layout and installation of all equipment and the relationship to other parts of the work.
 - 2. Programming.
 - 3. Block diagram.
 - 4. Equipment.
- B. Project Specific Manuals.
- C. Acceptance Test and Acceptance.

PART 2 - PRODUCTS

2.1 HARDWARE

- A. Network Computer
 - 1. Owner has existing computer with Automated Logic Programming installed.
- B. System Components – The Contractor shall provide the following:
 - 1. All controllers necessary to perform standard HVAC operations.
 - 2. All relays, conduit, transformers, conduit, j-boxes, switches, indicating devices, and transducers are required to provide a complete and functional control system.
 - 3. All control enclosures shall be manufactured by Hoffman and listed for the intended service.

2.2 CONTROLS MANUFACTURER

- A. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - 1. Automated Logic Controls.

2.3 SOFTWARE MANUFACTURER

- A. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - 1. Automated Logic Controls. No substitution allowed.
- B. Install the most recent version of program. Upgrade existing campus programming as needed to be compatible with new software version.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Provide all necessary programming to fully optimize the operation of the building's HVAC systems. Provide fully commented programming and notes to owner. Provide submittal of control block diagram for Owner's and Engineers review and approval. Include in bid two revisions of programming for control optimization. Integrate programming and graphics into existing system. Coordinate any system shutdowns with Owner.
- B. Provide 4 hours of training to Owner's representative after system is fully functional.
 - 1. Provide system manual to Owner.
 - 2. Provide documentation of complete system testing.
- C. Install all necessary equipment including but not limited to: controllers, thermostats, computer interface, programming, surge protectors, wiring, cables, connectors, conduit, relays, etc. required to provide a complete working energy management system.
- D. Label all control components per Division 16 requirements. All boxes with controller shall have an accurate laminated control diagram fixed to the inside cover.
- E. Minimum conduit size shall be 3/4 inch.
- F. Provide for 2 sets of minor programming changes to any and all systems to optimize system after continuous operation is observed in both heating and cooling seasons respectively.

3.2 SEQUENCE OF OPERATION

- A. The new Building Automation System (bas) shall control all mechanical equipment, except where noted. The bas shall be Automated Logic Corp. (alc) controls system. The system shall control, monitor and generate alarms as specified herein. The system program shall maintain trending information on all system functions, unless otherwise specified. Each piece of mechanical equipment shall be controlled by a unitary control module (module), unless otherwise specified.
- B. Exhaust Fans: The bas system shall start and stop the exhaust fans on a schedule per College parameters. The bas system via a current sensor shall monitor the exhaust fans, except where noted on the mechanical plans.

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3.3 TESTING

- A. All control functions shall be tested for performance. This testing shall be done after all programming and graphics have been completed and installed on the Owner's computer system.
- B. Reports shall be provided that details each element, including but not limited to sensors, vav boxes, controllers, and its verified performance.
- C. After the reports are provided and reviewed, the Engineer and Owner shall witness test (with Controls Contractor) the operation of the system.

END OF SECTION

SECTION 23 0914

VARIABLE FREQUENCY DRIVE

Part 1 - GENERAL

1.01 DESCRIPTION

- A. This specification details a complete Variable Frequency Drive (VFD) used to control the speed and torque of NEMA design B induction motors.
- B. The VFD manufacturer shall supply the VFD and all necessary controls as herein specified.
- C. The VFD shall be manufactured by a company with at least twenty (20) years experience in the production of this type of equipment.
- D. All VFD's installed on this project shall be from the same manufacturer.
- E. It is required that the VFD manufacturer have the following resources available:
 - 1. Sales engineers and applications engineers for VFD products, with expertise in machinery applications and controls.
 - 2. A network of distributors with ready access to inventory
 - 3. An independent service organization
 - 4. Global availability and technical support

1.02 QUALITY ASSURANCE

- A. The VFD manufacturing facility shall be ISO 9001 and ISO 14001 certified.
- B. All printed circuit boards shall be completely tested before being assembled into the complete VFD. The VFD shall be subjected to a functional test and load test. The load test shall be at full rated load, or cycled load. A testing results summary shall be available upon request.
- C. The VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component.

1.03 QUALIFICATIONS

- A. The VFD shall meet the following specifications
 - 1. ANSI/UL 61800-5-1:2015 - Underwriter's Laboratory. The VFD and any options shall be UL listed as a complete assembly and carry the UL mark. VFD's certified to UL508C, the standard that preceded UL 61800-5-1, are not acceptable. VFD's marked as UL recognized components are not acceptable.
 - 2. CSA C22.2 No. 274-13 - Canadian Standards Association. The VFD shall be C-UL listed and carry the appropriate mark.
 - 3. The VFD shall comply with the following European Union's CE directives. The VFD shall carry the CE mark.
 - a. EN ISO 13849-1:2015 Safety of machinery
Safety related parts of the control systems – Part 1: general principles for design

- b. EN ISO 13849-2:2012 Safety of machinery
Safety-related parts of the control systems – Part 2: Validation
- c. EN 60204-1:2006 + A1:2009 + AC:2010
Safety of machinery. Electrical equipment of machines.
Part 1: General requirements.
- d. EN 62061:2005 +AC:2010 + A1:2013 + A2:2015
Safety of machinery – Functional safety of safety-related electrical, electronic, and programmable electronic control systems
- e. EN 61800-3:2004 + A1:2012 & IEC 61800-3:2004 + A1:2011
Adjustable speed electrical power drive systems.
Part 3: EMC requirements and specific test methods
- f. IEC/EN 61800-5-1:2007
Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy

B. The VFD shall have the following certifications:

1. RCM – The VFD shall conform to the Australian and New Zealand RCM standard for EMC, telecommunications, and electrical safety. This replaces the C-Tick marking, which is no longer acceptable.
2. EAC – The VFD shall conform to the Eurasian Conformity EAC standard to indicate the VFD meets the requirements for the Eurasian Customs Union and meet all requirements of the corresponding technical regulations and have passed all conformity assessment procedures This mark replaces the GOST and TR marks which are no longer acceptable.
3. RoHS – The VFD shall be in compliance with the European RoHS directive that restricts the use of certain hazardous substances in electric and electronic equipment.
4. WEEE – The VFD shall be in compliance with the European WEEE directive that defines the regulated disposal and recycling of electric and electronic equipment

C. Acceptable manufacturers

1. ABB Inc. – ACS380 series VFD’s
2. VFD manufacturer must design, manufacture, ensure quality, and manage the life cycle of all products offered on this project.
3. VFD vendors that are designed and/or manufactured by a third party and “brand labeled” are not acceptable and shall not be allowed.
4. Requests for the acceptance of alternate manufacturer’s VFD’s shall be submitted for approval in writing to the Engineer at least 10 working days prior to bid. Approval does not relieve supplier of specification requirements.

1.04 SUBMITTALS

A. Submittals shall be available that include the following information:

1. Outline Dimensions and Weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description including a complete list of options provided.

Part 2 - DESIGN

2.01 DESCRIPTION

- A. The VFD shall be a solid state AC to AC inverter controlled device utilizing the most current isolated gate bipolar transistor (IGBT) technology.
- B. The VFD shall utilize advanced motor control algorithms and three phase current measurement to achieve precise motor control capable of developing high torque at low speed. In vector mode in the VFD shall provide both open loop and closed loop speed control as well as torque control. The VFD must also provide a scalar mode of operation for V/Hz control.
- C. The VFD shall have the ability to operate AC induction motors or permanent magnet synchronous AC motors.

2.02 RATINGS

- A. The voltage designations for the VFD series shall use a nominal rating that denotes an operational range plus a tolerance:
 - 1. 230V: 200 to 240V, +10% / -15%
 - 2. 480V: 380 to 480V, +10% / -15%
- B. The VFD shall have the following environmental operating characteristics:
 - 1. Continuous, full rated operation from -10 to 50° C (14 to 122° F) ambient temperature. VFD's with internal fans can operate up to 60° C (142° F) with derating.
 - 2. VFD's limited to a maximum ambient of 40° C are not acceptable.
 - 3. Full rated current at installation sites up to 3300 feet (1000 m) above sea level. Above this altitude, the output amps of the VFD's are derated by 1% for every 100 m (330 ft.) above 3300 ft. (1000m) to the maximum elevations listed in a & b:
 - a. 230V units to a maximum of 6600 ft. (2000 m)
 - b. 480V units to a maximum of 13200 ft. (4000 m)
 - 4. Relative humidity: 5 to 95% no condensation allowed
- C. The VFD shall be offered from 0.5 HP to 30 HP in similar construction and operation, using the same technology.
- D. The VFD shall be rated to operate from input power from 48Hz to 63Hz.
- E. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
- F. The Light Duty overload current capacity shall be 110% of rated current for one (1) minute out of five (5) minutes.
- G. The Heavy Duty overload current capacity shall be 150% of rated current for one (1) minute out of five (5) minutes.
- H. The VFD efficiency shall be 98% or better of the full rated capability of the VFD at full speed and load.

2.03 CONSTRUCTION

- A. All models shall provide a complete, ready-to-install solution.
- B. The most current and most efficient IGBT power technology shall be used to produce a PWM output waveform. This technology shall be used for all power and voltage ranges offered by the manufacturer. Other VFD technologies are not acceptable.
- C. The VFD shall offer microprocessor based control logic that is isolated from power circuitry.
- D. The VFD shall use the same main control board for all ratings.
- E. Control connections shall remain consistent for all power ratings.
- F. IP20 enclosure shall be standard with optional UL Type 1 enclosure kits available. Enclosures with NEMA ratings are not acceptable.
- G. The VFD shall be wall or DIN rail mountable without the addition of any mounting kits.
- H. The VFD specified here shall have an integrated control panel with a backlit digital LCD display and eight keys using icon-based navigation for programming.
- I. VFD's with frame designations R1-R4 shall have a cooling fan that is designed for easy replacement. The product shall be designed so that removing the VFD from the wall or the removal of circuit boards is not required for replacement of the cooling fan. The VFD cooling fan shall operate only when required.
- J. All circuit boards shall have conformal coating.
- K. An internal power supply rated for +24 VDC +/-10%, max. 200 mA shall be standard with the VFD.
- L. Standard VFD's shall have a C4 or C3 level of electromagnetic compatibility for EU compliance. Devices complying with a C3 level will include a disconnectable internal EMC filter to protect the VFD in corner-grounded power networks. A variant of the VFD with a C2 level filter shall be available as a special order.
- M. Packaging shall be made from sustainable/recyclable materials, principally corrugated cardboard and molded pulp. Expanded polystyrene packaging material is not acceptable.
- N. A braking chopper capable of 100% continuous duty operation shall be standard in all frame sizes and for all power ratings.
- O. The VFD product line shall have two mounting locations for option modules:
 - 1. Front mounting location for I/O or serial communications modules. When using serial communications modules, the I/O shall be expandable using an additional module co-mounted with the Fieldbus module.
 - 2. Side mounting location shall be available for either expanding the number of relay outputs, connecting an external 24V control power source, or adding an HTL/TTL pulse encoder interface.
- P. To facilitate panel mounting, the dimensions of the product line shall have minimal variation as the VFD's increase in power rating. The height and depth of the product

line shall remain the same with only the width of the VFD changing as the power rating increases.

- Q. Adapter modules and I/O expansion modules shall be mounted by the VFD manufacturer and shall also be available as field installable kits as an alternative. All optional features shall carry all of the necessary certifications as described in Section 1.03. Field installed kits shall not affect the VFD's certification.

2.04 PROTECTIVE FEATURES

- A. The VFD shall display a fault code for each programmed warning and fault protection function. The three (3) active and most recent fault messages and times shall be stored in the VFD's fault history.
- B. The VFD shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
- C. Output short circuit and ground fault protection rated for 100,000 amps without relying on line fuses shall be provided per UL61800-5-1.
- D. Motor phase loss protection shall be provided.
- E. The VFD shall be protected against cross connection. If input power is connected to the motor terminals, the VFD shall trip on a cross connection fault.
- F. The VFD shall provide electronic motor overload protection qualified per UL61800-5-1.
- G. The VFD shall protect itself against an open fuse, loose input power connection, or input supply imbalance by displaying an input phase loss fault.
- H. A power loss ride through feature shall allow the VFD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor/load and regenerated back to the DC bus.
- I. Stall protection shall be programmable to provide a warning or to stop the VFD after the motor has operated above a programmed torque level for a programmed time limit.
- J. Underload protection shall be programmable to provide a warning or stop the VFD after the motor has operated below a selected underload curve for a programmed time limit.
- K. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.
- L. Terminals shall be provided for connecting a motor thermistor (PTC type) to the VFD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.
- M. The UL listing for the VFD shall allow for the use of either for fuses (100kAIC) or Type E resettable devices (65kAIC) for short circuit protection.
- N. The VFD shall use direct measurement of all three output phases for enhanced motor control and phase-to-ground detection. VFD's using DC bus calculation to estimate output power are not acceptable.

2.05 CONTROL INPUTS AND OUTPUTS

A. Digital inputs

1. Standard VFD variants: Four (4) digital inputs & two (2) convertible digital inputs/outputs.
2. Configured VFD variants: Two (2) digital inputs
3. Configured VFD variants with I/O expansion module: An additional three (3) digital inputs for a total of five (5)
4. Digital inputs shall also be configurable as frequency inputs.
5. On/off delay shall also be an optional mode of operation for digital inputs
6. The digital inputs shall be independently programmable with at least 30 function selections (ready run, enabled, started, reverse, warning, fault, etc.).
7. Inputs shall be designed for use with either the VFD's internal 24 VDC supply or a customer supplied external 24 VDC supply.

B. Relay outputs

1. One (1) form C relay contact outputs shall be provided with the base VFD. An option module shall be available for an additional four (4) relay outputs.
2. All outputs shall be independently programmable to activate with at least 30 function selections including;
 - a. Operating conditions such as drive ready, drive running, reversed and at set speed, overcurrent, overvoltage, drive temp, motor temp, etc.
 - b. General warning and fault conditions
 - c. Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque, and PID feedback.
 - d. Relay contacts shall be rated to switch 2 Amps at 30 VDC or 250 VAC.

C. Analog Inputs

1. Standard VFD variants: Two (2) analog inputs shall be provided
2. Configured VFD variants with I/O expansion module: One (1) analog input
3. Must be selectable for either a current or a voltage input.
4. Inputs shall be independently programmable to provide signals including speed / frequency reference, torque reference or set point, PID set point, or PID feedback / actual.
5. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.
6. If the input reference is lost, the VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. The following options shall be available:
 - a. Stopping and displaying a fault
 - b. Running at a programmable preset speed
 - c. Hold the VFD speed based on the last good reference received
 - d. Cause a warning to be issued, as selected by the user.

D. Analog Outputs

1. Standard VFD variants: One (1) analog output shall be provided

2. Output shall be independently programmable for 0-20 mA or 0-10VDC output to provide signals proportional to output function selections including output speed, process PID signal, frequency, torque, voltage, current or power.

E. Digital Outputs

1. Standard VFD variants: Two (2) convertible digital inputs/outputs
2. Configured VFD variants with I/O expansion module: One (1) digital output
3. The digital inputs shall be independently programmable with at least 30 function selections (ready run, enabled, started, reverse, warning, fault, etc.)
4. Digital inputs shall also be configurable as frequency inputs.
5. Inputs shall be designed for use with either the VFD's internal 24 VDC supply or a customer supplied external 24 VDC supply.

F. Safety Inputs

1. The VFD shall have a Safe Torque Off (STO) circuit with terminals integrated in the VFD as standard.
2. The STO function shall meet a Safety Integrity Level (SIL) 3 with a Performance Level (PL) e and be in compliance with EN/IEC61800-5-2: IEC61508 ed2: SIL 3, IEC 61511: SIL 3, IEC 62061: SIL CL 3, EN ISO 13849-1: PL e

2.06 SERIAL COMMUNICATIONS

- A. The VFD shall be capable of communicating with other VFDs or controllers via a serial communications link. A variety of communications adapter modules for the typical overriding control systems shall be available.
- B. Adapter modules shall be available for a wide selection of protocols including but not limited to:
 1. Modbus RTU
 2. Ethernet/IP™
 3. ModBus TCP
 4. DeviceNet™
 5. PROFIBUS
 6. PROFINET
 7. CANOpen®
 8. EtherCAT®
 9. Ethernet POWERLINK
- C. Adapter modules shall mount directly to the VFD control board to minimize interference and provide maximum throughput.
- D. At the first power-up, fieldbus adapter modules shall preconfigure parameter settings related to their functionality.
- E. I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:
 1. Run-Stop control
 2. Hand-Off-Auto Control
 3. Speed Adjustment

4. PID (proportional/integral/derivative) control adjustments
 5. Current Limit
 6. Accel/Decel time adjustments
- F. The VFD shall have the capability of allowing the overriding controller to monitor feedback such as: process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.
- G. A connection shall also be provided for personal computer interface. Software shall be available for VFD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of VFD performance.

2.07 CONTROL FUNCTIONS AND ADJUSTMENTS

- A. Output frequency shall be adjustable between 0Hz and 599Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.
- B. Stop mode selections shall include coast to stop and ramp to stop.
- C. It shall be possible to enter the motor data manually or perform an ID run using built-in functionality to provide an enhanced motor model. It shall be possible to select different ID run formats based on time and accuracy; with the motor coupled or uncoupled; standing still or spinning. The ID run will be performed automatically in vector mode at the first start-up. An ID run can be manually selected for scalar control.
- D. The VFD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.
- E. The VFD shall be capable of starting into a rotating motor with or without existing magnetic flux on the motor regardless of the motor direction (flying start). From the time the start signal is given to the VFD to the time the VFD has control of the motor shall not exceed two (2) seconds. Once the VFD has control of the motor it shall then accelerate or decelerate the motor to the active reference speed without tripping or faulting or causing component damage to the VFD. The VFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.
- F. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
- G. Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.
- H. Speed control functions shall include:
 1. Adjustable min/max speed limits.

2. Selection of up to 7 preset speed settings for external speed control.
 3. Three (3) programmable critical frequency lockout ranges shall be provided to prevent the VFD from operating the load continuously at an unstable speed.
 4. An integrated PID controller with two different parameter sets for process control with one parameter set in use at a time. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. The process reference signal shall be selectable to include 4-20mA, 0-10V, or serial communications. The controller shall allow for alternation between the two parameter sets based on manual control, timed function or the monitoring of other supervision inputs.
- I. Functions shall include energy optimization for optimizing efficiency and limit the audible noise produced by the motor by providing the optimum magnetic flux for any given speed / load operating point.
 - J. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VFD shall be programmable to signal this condition via a warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that shall allow for VFD acceleration from zero speed without signaling a false underload condition.
 - K. The VFD shall offer software to select the VFDs action in the event of a loss of the primary speed reference.
 - L. The VFD shall have the capability of monitoring signals and determining if a warning or fault should be generated when signal has gone beyond upper and lower limits. A total of six (6) supervision functions can be determined with three (3) of them active.
 - M. The VFD shall utilize pre-programmed Application Macro's specifically designed to facilitate start-up. The macros shall provide one command to preprogram all parameters and customer interfaces for a particular application to reduce programming time.
 - N. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the VFD to be started and stopped from the level of a process feedback signal.
 - O. The VFD shall have the ability to be connected to a common DC bus system where the VFD can be powered and regenerate onto a common DC bus.
 - P. The VFD shall have the ability for customized operation using a PC-based tool to create customized programs. A graphical user interface shall be used to build programs using function blocks containing arithmetic and logical functions. Physical inputs, VFD status information, actual values, constants, and parameters can be used as the input for the program. The output of the program can be used as a start signal, external event or reference, or connected to the VFD outputs. An adaptive program can contain base program and sequence programming elements.
 - Q. The VFD shall include a specific parameter group for mechanical brake control. This feature shall use state machine logic for controlling the function of a holding brake using internal and external signals.

- R. The VFD shall include a specific Limit to Limit Control function that restricts the forward and reverse movement of a load inside two extreme points. The function supports the monitoring of two sensors at both ends of the movement range: one for the slow down point and the other for the stop point. The sensors or limit switches are provided by the installer.
- S. The VFD shall be equipped for resistor braking as standard. A braking chopper, software, and DC connections must be included with all frame sizes and power ratings. Braking resistor sizing tables shall be available from the vendor and available to order with the VFD.
- T. The VFD shall include motor magnetization control for different phases of motor start/rotation/stop: pre-magnetization, DC hold, post-magnetization and pre-heating (motor heating).
- U. The VFD shall be capable of different operating modes using speed, torque, or frequency references.
- V. The VFD shall include autophasing, an automatic measurement routine to determine the angular position of the magnetic flux of a permanent magnet synchronous motor or the magnetic axis of a synchronous reluctance motor. This function shall be operable in an open-loop format or with an encoder reference.
- W. A suite of control programs for crane applications shall be standard software on the VFD product line.
- X. The VFD shall include energy-saving calculators that can display:
 1. Energy-savings in GWh, MW, or kW
 2. Monetary savings
 3. CO2 reduction in tons or kilotons
 4. Peak values – hourly, daily, monthly, or lifetime
- Y. The VFD shall include a switching frequency control circuit that allows setting a reference frequency and a minimum frequency. The control circuit will maintain the highest frequency allowed by actual temperature of the VFD. As the VFD temperature increases, the control circuit will automatically reduce the frequency to the minimum setting. If heating continues the control reduces output current to compensate.
- Z. The VFD shall include pass code protection against unauthorized parameter changes.

Part 3 - OPTIONS

3.01 OPTION MODULES, CONNECTION INTERFACES, & KITS

- A. UL Type 1 enclosure kits shall be available. Enclosure kits with NEMA ratings are not acceptable.
- B. Mounting kits for attaching remote control panels on enclosure or cabinet doors shall be available.
- C. A cold configuration tool shall be available for programming an un-powered VFD

- D. An I/O + Modbus RTU connection interface shall be available as an assembled component for the standard variant of the VFD and as a separate item. The interface module shall include:
1. RS-485 connection terminals for Modbus RTU with
 2. Termination and bias selection jumpers
 3. Two (2) digital inputs
 4. Two (2) configurable digital inputs/outputs
 5. Two (2) analog inputs
 6. One (1) analog output
- E. Fieldbus adapter modules as assembled components for the configured variant of the VFD and as separate items. Adapter modules shall be available for the following protocols:
1. Modbus RTU
 2. Ethernet/IP™
 3. ModBus TCP
 4. DeviceNet™
 5. PROFIBUS
 6. PROFINET
 7. CANOpen®
 8. EtherCAT®
 9. Ethernet POWERLINK
- F. An I/O expansion module shall be available for use with the fieldbus adapters. The module shall include the following:
1. Three (3) digital inputs
 2. One (1) digital output
 3. 10V power connection
 4. One (1) analog input
- G. Expansion modules to increase the functionality of the VFD shall be available
1. Relay module to add four (4) relay outputs
 2. Auxiliary power module to enable the use of external 24V power to keep the control panel powered if power to the VFD is disconnected
 3. Pulse encoder interface module to enable closed-loop speed control using feedback signals from HTL or TTL type pulse encoders for closed loop control.
- H. The VFD shall be compatible with a personal computer based tool used for commissioning and maintenance of all ABB All-Compatible VFD's. Connection shall be possible using the panel port connector on the top of the VFD or thru a USB connection on the remote operator interface.
- I. A USB to RJ45 cable shall be available for connecting a personal computer directly to the VFD thru the panel port connector.
- J. Braking resistors, input reactors, and output filters shall be pre-selected in the vendor's sales literature and available to order with the VFD.

3.02 REMOTE OPERATOR INTERFACE

- A. The VFD shall interface with the external control panel that is common to the manufacturer's other all-compatible product lines regardless of HP rating or type.
- B. The device shall include a four- (4) line back-lit alphanumeric LCD display that is 240x160 pixels. Configurable displays showing, bar graph and meter. Keypad shall have 10 soft keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.
- C. The control panel shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
- D. When transferred between product lines, the control panel must automatically establish contact with the VFD and adjust communications without user input.
- E. The display of the control panel shall have the following features:
 - 1. All parameter names, fault messages, warnings and other information shall be displayed in complete American English words or standard American English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
 - 2. Additional languages including French, Spanish, Portuguese, German, Italian, Dutch, Danish, Swedish, Finnish, Russian, Turkish and Chinese shall be selectable.
 - 3. During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:
 - a. Speed/torque in percent (%), RPM or user-scaled units
 - b. Output frequency, voltage, current and torque
 - c. Power and kilowatt hours
 - d. Heatsink temperature and DC bus voltage
 - e. Status of discrete inputs and outputs
 - f. Values of analog input and output signals
 - g. Values of PID controller reference, feedback and error signals
- F. The control panel shall have a face mounted USB connector for connecting the control panel to a PC and transferring data.
- G. The control panel shall be used for either local or remote control, for setting all parameters, and for stepping through the displays and menus.
- H. The remote control panel shall include a built-in time real time clock used to date and time stamp faults and record operating parameters at the time of fault.
 - 1. The clock shall have a battery backup with 10 years minimum life span. Capacitor back-up is not acceptable.
 - 2. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up.
 - 3. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays.

4. There shall be twelve (12) separate, independent timer functions with the capability for defining schedules based on all seven (7) days of the week, seasons, holidays, workdays, and exceptions.
- I. Variations of the external control panel shall include the standard industrial panel, a version with Bluetooth connectivity, a basic panel with the same functionality as the integrated panel, and limited functionality panels (standard vs. industrial).
- J. A copy function to upload and store parameter settings from a VFD and download stored parameter settings to the same VFD or to another VFD shall exist.
- K. An intelligent start-up assistant shall be provided as standard. The Start-up routine shall guide the user through all necessary adjustments to optimize operation.
 1. The Start-Up routine shall include “plug and produce” operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.
 2. The Start-Up routine shall prompt the user for Motor Nameplate Data including power, speed, voltage, frequency and current.
 3. An auto-tune function shall identify the optimal motor tuning parameters for typical applications.
 4. An auto-tune function shall also be available to tune the PID speed regulator loop. Manual adjustments shall also be allowed.
 5. The Start-up routine shall interface with the setup macros that are included in the VFD software.

Part 4 - EXECUTION

4.01 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the VFD in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.
- B. The VFD manufacturer shall provide adequate drawings and instruction material to facilitate installation of the VFD by qualified electrical and mechanical personnel employed by others.

4.02 PRODUCT SUPPORT

- A. Factory trained application engineers and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations.
- B. A 24/365 technical support line shall be available on a toll-free-line.

4.03 WARRANTY

- A. Standard Warranty shall be 12 months from the date of installation, not to exceed 24 months from the date of shipment. The warranty shall include replacement with the return of the failed VFD.

- B. There shall be 24/7/365 support available on a toll-free-line.

END OF SECTION

SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

- A. 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" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2019.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Ductwork materials
 - 2. Sealants and gaskets.
- B. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Structural members to which duct will be attached.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. 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.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2019, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2019, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL ROUND DUCTS 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
 - f. Omni Duct Systems.

2.2 SHEET METAL 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: G60 or G-90 at exterior.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
 - 3. Beaded coupling connections sealed with high-temperature silicone.
- C. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

- D. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- E. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- F. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- G. 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.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide a product by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Mason Industries.
 - 5. Unistrut Corporation; Tyco International, Ltd.

PART 3 - EXECUTION

3.1 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 round and flat-oval 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 1 inch, 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 DUCT SEALING

- M. 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."
- N. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Exhaust Ducts: Seal Class B.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "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.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.

- D. 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.
- E. 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.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- F. 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."
- G. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install cable restraints on ducts that are suspended with vibration isolators.

3.5 CONNECTIONS

- J. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- K. 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.

3.7 DUCT SCHEDULE

- L. Elbow Configuration:
 - 1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "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.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

M. Branch Configuration:

- 1. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
 - a. Velocity 1000 fpm or less 45-degree lateral.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 2. Visually inspect duct system to ensure that no visible contaminants are present.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Remote damper operators.
 - 4. Flexible connectors.
 - 5. Duct accessory hardware.
 - 6. Motorized hose reel

- B. Related Sections:
 - 1. Division 23 Section "Metal Ducts".

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

1.4 QUALITY ASSURANCE

- 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 AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. 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: G60 (Z180) and G90 (Z275).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. 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).

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. METALAIRE, Inc.
 - d. Nailor Industries Inc.
 - e. Pottorff; a division of PCI Industries, Inc.
 - f. Ruskin Company.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Single blade for ducts up to 24". Multiple blades for ducts greater than 24".
 - b. Opposed blade design for multiple blade dampers.

- c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
- 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.
 - 9. Where damper is not accessible install remote damper operator adjustment assembly.

2.3 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
- B. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel for galvanized steel ducts.
- D. Material: Stainless steel for stainless steel ducts.
- E. Gage and Shape: Match connecting ductwork.

2.4 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff; a division of PCI Industries, Inc.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 2 inches (50 mm) deep.
- F. Wall-Box Cover-Plate Material: Steel.

2.5 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Plymovent
- B. Materials: Design for hazardous fumes and high-quality synthetic composite fabric that can endure exhaust gas temperatures up to 570 def Fahrenheit.

2.6 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.

2.7 MOTORIZED HOSE REEL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Plymovent

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and stainless-steel accessories in stainless-steel ducts.
- C. Install volume dampers at points on 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.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
3. At each change in direction and at maximum 50-foot (15-m) spacing.
4. Control devices requiring inspection.
5. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

3.2 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 remote damper operators to verify full range of movement of operator and damper.
4. Test damper operation and fire alarm connection in the presence of the inspector.

END OF SECTION

SECTION 23 3416
CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exhaust Fan.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue 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 Calculating Fan Sound Ratings from Laboratory Test Data.

G. NEMA MG1 - Motors and Generators.

H. NFPA 70 - National Electrical Code.

I. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.4 SUBMITTALS

A. Product Data: Provide data on 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.

B. Manufacturer's Installation Instructions.

1.5 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.8 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See equipment schedule on plans.

2.2 GENERAL

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Conform to AMCA 99.
- D. Performance Base: Sea level conditions.
- E. Temperature Limit: Maximum 600 degrees F (315 degrees C).
- F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.3 FANS

- A. Manufacturer

- 1. Greenheck

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with Manufacturer's instructions.

END OF SECTION

SECTION 26 0000

GENERAL PROVISIONS

PART 1 - GENERAL

- A. The general contract provisions apply to this section and take precedent over this section in case of conflict.

1.01 GENERAL PROVISIONS

- A. This division supplements the applicable requirements of other divisions.

1.02 DEFINITIONS

- A. For the purposes of Division 260000, the following definitions apply:
 - 1. Provide: Furnish and install.
 - 2. Indicated: As shown on the drawings or specified herein.
 - 3. Circuit Designation: Panel designation and circuit number, i.e., LA-13.
 - 4. Approved equal: Approved by the engineer of record as equal in his sole determination.

1.03 SCOPE OF WORK

- A. The Specifications for Work of Division 260000 include, but are not limited to the following sections:

- 26 0000–General Provisions
- 26 0030–Tests and Identification
- 26 0050–Basic Electrical Materials and Methods
- 26 0060–Minor Electrical Demolition for Remodeling
- 26 0111–Conduits
- 26 0120–Conductors
- 26 0130–Electrical Boxes
- 26 0140–Wiring Devices
- 26 0142–Nameplates and Warning Signs
- 26 0164–Branch Circuit Panelboards
- 26 0170–Disconnects
- 26 0190–Support Devices
- 26 2450–Grounding

26 2510–Lighting Fixtures
26 4901–General Control Devices
26 4920–Motor Control

- B. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this division, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all divisions for related work required to be included as work under this division.
 - 2. General provisions for electrical work.
 - 3. Site observation including existing conditions.
- C. Related Work Specified Elsewhere but included in the scope of work:
 - 1. Motors and their installation.
 - 2. Control wiring and conduit for heating, ventilating and air conditioning.
- D. Work Not In Contract (N.I.C.):
 - 1. Telephone instruments.
- E. Coordination
 - 1. The following supplements are additional General Requirements pertaining to work of this Division. Provisions of Division 1 - General Requirements shall remain in effect.
 - a) Coordinate work of various sections of Division 26 and 27.
 - b) Coordinate work of this Division 26 with work of Divisions 2 through 25.

1.04 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI).
- B. Association of Edison Illuminating Companies (AEIC).
- C. Electrical Testing Laboratories (ETL).
- D. Illuminating Engineering Society (IES).

- E. Institute of Electrical and Electronic Engineers (IEEE).
- F. Insulated Cable Engineers Association (ICEA).
- G. National Electrical Manufacturers Association (NEMA).
- H. National Fire Protection Association (NFPA).
- I. Underwriters Laboratories, Inc. (UL).
- J. California State Fire Marshal (CSFM).
- K. California Energy Commission (CEC) Title 24.

1.05 QUALITY ASSURANCE

- A. Regulations: All the electrical equipment and materials, including their installations, shall conform to the following applicable latest codes and standards:
 1. California Electric Code, Latest Adopted Edition (NEC), 2014 unless a more current version has been adopted.
 2. Local and State Fire Marshal.
 3. Occupational Safety and Health Act (OSHA).
 4. Requirements of the Serving Utility Company.
 5. Local Codes and Ordinances.
 6. Requirements of the Office of the California State Architect (OSA).
 7. California Administrative Code, Title 8, Chapter 4, Industrial Safety Orders.
 8. California Administrative Code, Title 24.
 9. County of Ventura Codes and Regulations.
- B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply. In instances where plans and specifications are at variance or conflict the most restrictive requirement shall apply. Contractor shall be responsible for all his associated work and materials and also the work and materials of related or affected trades.
- C. Contractor's Expense: Obtain and pay for all required bonds, insurance, licenses, and pay for all taxes, fees and utility charges required for the electrical work.

D. Testing and Adjustment:

1. Perform all necessary tests required to ascertain that the electrical system has been properly installed, that the power supply to each item of equipment is correct, and that the system is free of grounds, ground faults, and open circuits, that all motors are rotating in the proper directions, and such other tests and adjustments as may be required for the proper completion and operation of the electrical system. Contractor shall provide a copy of all test reports to prove these tests have been performed.
2. If, during the course of testing, it is found that system imbalance is in excess of 20%, rearrange single-pole branch circuit in lighting and receptacle panels to bring system balance to within 20% on all phases. Record all such changes on the typewritten panelboard schedule and submit a summary of changes to the Engineer on the record drawings.

1.06 SUBMITTALS

A. Procedure: In accord with the Submittal Section.

B. Shop drawings: Detailed shop drawings for the following equipment:

1. Distribution panelboards.
2. Branch circuit panelboards.
3. Circuit breaker.
4. Switchboards.
5. Motor control centers.
6. Contactors and cabinet.

C. Product data: Detailed manufacturer's data for:

1. Cabinets.
2. Disconnects.
3. Lighting fixtures and associated equipment including control.

D. Test results for the following:

1. Grounding systems.
2. Cables.

- E. Include sufficient information to indicate complete compliance with Contract Documents. Include illustrations, catalog cuts, installation instructions, drawings, and certifications. On each sheet show manufacturer's name or trademark.
- F. Operating, maintenance, and instruction data for:
 - 1. EM inverter
- G. Instruction materials:
 - 1. Provide at the time of personnel instruction period three bound copies of instruction manuals for the systems as listed in Subparagraph 1.04.A.4.f.
 - 2. Include the following (minimum) information in each copy of instruction manual:
 - a) Manufacturers' names and addresses including phone numbers.
 - b) Serial numbers of items furnished.
 - c) Catalog information, exploded views and brochures, complete with technical and performance data for all equipment, marked to indicate actual items furnished and intended use.
 - d) Recommended spare parts.

1.07 OWNER'S PERSONNEL INSTRUCTIONS

- A. Prior to completion of the contract, and at the Owner's convenience, instruct verbally and demonstrate to the Owner's personnel, the operation of the systems as listed under operating, maintenance, and instructional data and/or emergency generator, automatic transfer switch and fire alarm annunciator panel.

1.08 CLEANING

- A. Clean exterior surfaces and interiors of equipment and remove all dirt, cement, plaster and other debris. Protect interior of equipment from dirt during construction and clean thoroughly before energizing.
- B. Clean out cracks, corners and surfaces on equipment to be painted. Remove grease and oil spots so that paint may be applied without further preparation.

1.09 PROJECT RECORD DOCUMENTS - Prepare the following and submit to the engineer before final acceptance:

- A. Mark Project Record Documents daily to indicate all changes made in the field.

1. In addition to general requirements of Project Record Drawings, indicate on drawings, changes of equipment locations and ratings, trip sizes, and settings on circuit breakers, alterations in raceway runs and sizes, changes in wire sizes, circuit designations, installation details, one-line diagrams, control diagrams and schedules.
 - B. Use green to indicate deletions and red to indicate additions.
 1. Use the same symbols and follow the same drafting procedures used on the Contract Drawings.
 - C. Locate dimensionally off of contract drawings all underground conduit stubbed-out for future use, underground feeder conduits, and feeder pull box locations using building lines by indicating on the Project Record Drawings.
 - D. At the completion of underground conduit installation provide underground conduit record documents to owner's representative.
 - E. Two copies, in binder form, of all test results as required by these specifications
 - F. Two copies of local and/or state code enforcing authority final inspection certificates.
 - G. Two copies, in binder form, of electrical equipment cut sheets, manufacturer's installation instructions, warranty certificates, and product literature for all products utilized on project.
- 1.10 SERVICE INTERRUPTIONS AND UTILITY
- A. Coordinate with the Owner the interruption of services necessary to accomplish the work.
 - B. Coordinate with the campus maintenance department all work associated with power and communications distribution systems and service entrance equipment.
 - C. Electrical contractor shall supply temporary power for all trades.
- 1.11 MINIMUM SPECIFICATION REQUIREMENTS (ALL WORK OF DIVISION 260000)
- A. As a minimum Specification requirement, all materials and methods shall comply with applicable governing codes.
- 1.12 PENETRATION SEALING

- A. Seal penetration through exterior walls and fire rated walls, floors, ceilings, and roofs with 3M Firestopping materials of fire rating capacity rated per architectural plans and UBC or prevailing building code requirements.

1.13 PLACING EQUIPMENT IN SERVICE

- A. Do not energize or place electrical equipment in service until all interested parties have been duly notified and are present or have waived their rights to be present. Where equipment to be placed in service involves service or connection from another contractor of the owner, notify the owner in writing when the equipment will be ready for final testing/connection and schedule to the owner's satisfaction of this service connection. Notify the owner two weeks in advance of the date the various items of equipment will be complete.

1.14 OWNER-FURNISHED ITEMS

- A. Pick up Owner-furnished items and handle, deliver, install, and make all final connections.
 - 1. Assume responsibility for the items when consigned at the storage facility or in the field in accord with requirements of the Contract Documents.

1.15 ELECTRIC ITEM LOCATION

- A. Electrical drawings are generally diagrammatic. Verify equipment sizes with shop drawings and manufacturers' data and coordinate location layout with other trades. Notify owner and engineer of any changes of location requirements prior to installation and obtain engineer's written acceptance for all changes/revisions.

1.16 DEMOLITION

- A. Scope: Provide and perform demolition, preparatory and miscellaneous work as indicated and specified, complete.
- B. Principal Items of Work:
 - 1. Demolition and removal of existing electrical conduit, wiring and equipment required to complete the project.
 - 2. Preparation of the existing building to receive or connect the new work.
 - 3. Miscellaneous demolition, cutting, alteration, and repair work in and around the existing building necessary for the completion of the entire project.
 - 4. Disconnecting and reconnection of electrical equipment as required by the construction modifications.

- C. Existing Conditions: Make a detailed survey of the existing conditions pertaining to the work. Check the locations of all existing structures, equipment and wiring (branch circuiting and controls). Provide at bid time any exclusions for existing conditions work.
- D. Salvage and Disposal: All removed material other than items to be reused shall be returned to the owner or disposed of in accordance with instructions from the owner's representative. Disposal shall be done in accordance with EPA and governing body requirements and regulations. Contractor shall pay all fees and charges for disposal.

1.17 ELECTRICAL WORKMANSHIP REQUIREMENTS

- A. It is required that all electrical construction of this Contract be performed by journeyman electricians. All journeyman electricians shall have a minimum of 4 years of apprenticeship training and hold a valid Certificate of Completion from an apprenticeship training course approved by the State of California Department of Industrial Relations, Division of Apprenticeship Standards. This is intended to mean that a person who does not hold a valid Certificate of Completion from an apprenticeship training course approved by the State of California Department of Industrial Relations, Division of Apprenticeship Standards will not be permitted to do electrical work of any kind that involves new construction, nor make repairs, alterations, additions, or changes of any kind to any existing system of electrical wiring, apparatus, equipment, light, heat, or power.
- B. Contractor may employ electrical helpers or apprentices on any job of electrical construction, new or existing, when the work of such helpers or apprentices is performed under direct and constant personal supervision of a journeyman electrician holding a valid Certificate of Completion from an apprenticeship training course approved by the State of California Department of Industrial Relations, Division of Apprenticeship Standards.
 - 1. Each journeyman electrician will be permitted to be responsible for quality of workmanship for a maximum of eight helpers or apprentices during any same time period, provided the nature of work is such that good supervision can be maintained and quality of workmanship achieved is the best, as expected by Owner and as implied by the latest edition of the California Electrical Code (National Electrical Code with State of California amendments).
 - 2. Before each journeyman electrician commences work, deliver to Owner at project site a photocopy of journeyman's valid Certificate of Completion from an apprenticeship training course approved by the State of California Department of Industrial Relations, Division of Apprenticeship Standards.

- C. All electrical systems shall be installed in a neat and workmanlike manner per National Electrical Code requirements and ANSI approved NEIS National Electrical Installation Standards.

1.18 DESIGN CHANGES AFTER AWARD OF BID

- A. When a change in the quantity or size of conductors is made, the conduit size will remain in accordance with that indicated in the original contract drawings rather than the drawing symbol conduit table. When code permits, provide conductor insulation 'THWN' where required to maintain conduit fill conformance with the National Electrical Code.

1.19 MATERIAL AND EQUIPMENT SUBSTITUTION

- A. Where two or more trade names or manufacturers are mentioned, selection shall be made from the group listed for use in the base bid. The order in which names are listed is not intended to be any indication of preference.
- B. Where a single manufacturer, product or trade name is stated, that manufacturer, product or trade name shall be used in the base bid. The use of other manufacturers, products or trade names will be considered by the engineer of record (unless that product is indicated for no substitution) only if submitted as alternate items at the time of bidding, with evidence of equality and a statement of net price difference as compared to the specified item. After approval by the engineer of record, the architect and owner reserve the right to review such submittals and to determine the acceptability for use.
- C. Equipment other than that specified will be accepted only when written approval is given by the engineer of record and architect, in accordance with Division 1.
- D. The contractor shall be held responsible for all physical changes in piping, equipment, etc. resulting from equipment substitution and likewise bear any increased cost of other trades in making said substitution. Approval by the architect of equipment other than that specified does not relieve this contractor of this responsibility.

1.20 REQUESTS FOR INFORMATION

- A. The contractor shall submit all requests for information (RFI's) typewritten on the attached form.

PART 2 - PRODUCTS

Not Used.

150312

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 26 0030

TESTS AND IDENTIFICATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Tests and identification.

1.02 SUBMITTALS

- A. In accord with Section 260000.
- B. All test values.

1.03 DEFINITION

- A. Circuit designation: This term is construed to mean panel designation and circuit number, i.e., LA-13.

1.04 TESTS AND ADJUSTMENTS

- A. Prior to energizing, test all systems. Test to ensure systems are:
 - 1. Free from short circuits and grounds.
 - 2. Free from mechanical and electrical defects.
- B. Circuit breakers (main and feeder circuits that are adjustable only): Testing and adjustments of circuit breakers shall be made by Owner-approved independent testing firm. Testing firm shall meet the criteria for full membership of the International Electrical Testing Association (NETA).
 - 1. Visual and mechanical inspection:
 - a) Compare nameplate data with Drawings and Specifications.
 - b) Inspect circuit breaker for correct mounting.
 - c) Operate circuit breakers to ensure smooth operation.
 - d) Inspect case for cracks or other defects.
 - e) Verify tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method in accord with manufacturer's published data.
 - f) Inspect mechanism contacts and arc chutes in unsealed units.

2. Electrical tests:
 - a) Perform a contact-resistance test.
 - b) Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
 - c) Perform adjustments for final settings in accord with coordination study supplied by Owner.
 - d) Perform long-time delay time-current characteristic tests by passing 300% rated current through each pole separately with ground fault functions defeated.
 - e) Determine short-time pickup and delay by primary current injection.
 - f) Determine ground-fault pickup and time delay by primary current injection. This test shall be done after short time and instantaneous testing are complete.
 - g) Determine instantaneous pickup current by primary injection using run-up or pulse method.
 - h) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
 3. Test values:
 - a) Record all test values “as-found” and “as-left” conditions and provide certified copies to Owner.
 - b) Compare microhm or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than 25%. Investigate any value exceeding manufacturer’s recommendations.
 - c) Insulation resistance shall not be less than 100 megohms.
 - d) Trip characteristic of breakers shall fall within manufacturer’s published time-current characteristic tolerance band, including adjustment factors. Circuit breakers not within tolerance band shall be tagged defective.
- C. Adjust all installation and equipment for their intended use and rating as defined in manufacturer's specifications and test procedures.
1. Contractor recognizes and understands that the show and character lighting, electronic control equipment, special effects, etc., must have a minimum 4-week adjustment period, occurring after installation and verification of said equipment,

for each area or facility. Contractor shall provide appropriate personnel (i.e., electricians, carpenters, laborers) as necessary to support Owner during this adjustment period. Adjustment is defined as orientation of adjustable lighting fixtures, installation of color filters to any lighting fixtures requiring same, location adjustment 6 ft., control system setting including programming of control functions, system debugging (i.e., cross-wiring). Contractor shall assume day and night activities during the adjustment period.

- D. Adjust transformer taps under full load operating conditions, to provide nominal operating voltages at the loads.
- E. Hi-Pot test procedures:
 - 1. Test 25 pair, 10 pair, or 4 pair, multi-conductor cables installed in conduit, in the following manner and in presence of Owner:
 - a) Special Owner-furnished equipment: Hi-Pot Cable Tester & Adapters Model 500.
 - b) Perform visual inspection to verify:
 - 1) Proper cable identification tags are installed.
 - 2) Connector is installed properly and screws and clamps properly tightened.
 - 3) Elco connector is keyed correctly.
 - c) Continuity and Hi-Pot:
 - 1) Using the Hi-Pot cable tester and all necessary adapters:
 - (a) Set tester on 1500 VDC, S.C. (short continuity), 50 pos.
 - (b) Hook up cable to "Y" adapter if testing a cable in a conduit or tray.
 - (c) Attach turnaround Elco test plug to opposite end of cable to be tested.
 - (d) Attach ground lead of tester to center metal hold-down screw of Elco connector.
 - (e) Push reset button until tester dial points to zero. Release reset button.
 - (f) Press start button. Tester will step through all pairs and stop at bottom half of dial. This is because when using the turnaround plug, tester is checking 2-pair runs.

- d) Error indication:
 - 1) No-error dial will make 1/2 revolution and stop. Press reset button. Tester will step to top position.
 - 2) Fault lights "short" or "open" dial will stop at a pin location indicated on face plate of dial. See chart on side of unit to give correct pin assignments. Press start buttons. Tester will step on through. If another "short" or "open" is found, tester will halt again.
- e) Fault correction:
 - 1) When a fault is indicated, remove both connector shells of cable under test and check indicated pins.
 - 2) Repair fault using procedure steps as specified in Section 16121, paragraph "Repairing damaged pin-wire assembly."
- f) Marking of accepted cable:
 - 1) Record acceptance of all cables on inspection copy of cable schedule provided by Owner's representative, and submit in accord with Section 260010.
 - 2) Place inspection stamp of Owner or dot sticker with initials on either white cable tag indicating cable assembly, or on connector shell.

F. Ground systems:

- 1. Visual and mechanical inspection: Verify ground system is in compliance with Drawings and Specifications.
- 2. Electrical tests:
 - a) Perform fall-of-potential test or alternative in accord with IEEE 81 on the main ground electrode or system.
 - b) Perform point-to-point tests to determine resistance between main ground system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- 3. Test values:
 - a) Resistance between main ground electrode and ground shall be no greater than 10 ohms. Additional rods shall be installed and bonded to grounding system and driven to a depth of 50 ft. or refusal, whichever comes first.
 - b) Investigate point-to-point resistance values which exceed 0.5 ohm.

- c) Record all test values and provide certified copies to Owner.

G. Cables:

1. Make insulation resistance tests on all power cables, using a self-contained instrument such as the direct-indicating ohmmeter of the generator type, or “megger” such as manufactured by J.G. Biddle Company, or Owner-approved equivalent. Insulation resistance values shall be at least 75% of shop test records.
 - a) Apply the following test voltages for 1 minute, except where specified otherwise herein, in accord with procedure recommended by manufacturer of test equipment and as specified herein.

Minimum Rated Circuit Voltage	Megger Voltage (DC)	Megger Reading
600 volts	500 volts	600 kilohms
1000 volts	500 volts	1 megohm
15,000 volts	1000 volts	15 megohms

2. Record all test values and provide certified copies to Owner.
3. Replace cables not meeting specified resistance values.

H. Miscellaneous tests:

1. Wiring: check all control circuits for continuity and conformance with wiring diagrams furnished by Owner and manufacturers.
2. Polarity tests: Make continuity and polarity tests on all current and potential transformers to determine whether polarity is as indicated on drawings, and the circuit is continuous.
3. Phasing tests: Identify phases of all switchgear and power cables by stenciling switchgear and tagging cables with approved tags, so that phases can be identified for connecting to proper phase sequence.

1.05 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates on all electrical distribution equipment shown on single-line diagram, and on control panels, dimmer panels, terminal cabinets, and separately mounted circuit breakers, disconnects, and starters.
- B. Provide equipment and circuit designation on nameplates with minimum letter and plate sizes as indicated.
- C. Provide engraved plastic nameplates with 1/4 in. minimum height letters indicating:

1. Circuit designation at branch overcurrent devices in distribution panelboards, switchboards, and motor control centers.
 2. Circuit designation of panel, equipment-controlled or device-controlled on disconnect switches and on circuit breakers, starters, and controls which are individually enclosed.
 3. Voltage rating and circuit designation of all outlets larger than 120V, 20A rating and more than 2 poles.
 4. Designation of control and terminal cabinets including CUTC, as indicated.
 5. Designation of each contactor and relay in control cabinets.
 6. Designate area controlled for each dimmer in dimmer cabinet or rack.
 7. Circuit designation at all ground fault detectors and ground fault test receptacles.
 8. Equipment designation on front of switchboards, distribution panelboards, branch circuit panelboards, and load centers.
- D. Secure nameplates with at least two rivets. Cementing and adhesive installation is not acceptable.
- E. Provide two copies of a typewritten directory for each branch circuit panelboard, showing each circuit and its use. Attach one copy to panelboard door and deliver the other copy to Owner.
- F. Provide caution label on branch circuit panelboards with integral control compartments. Caution label shall be red with white letters reading "CAUTION, EXTERNAL CONTROL VOLTAGE CIRCUIT WITHIN THIS PANEL."
- G. Conductor identification:
1. Feeders: Identify with the corresponding circuit designation at over-current device and load ends, at all splices, and in pull boxes.
 2. Branch circuits: Identify with corresponding circuit designation at overcurrent device and at all splices.
 3. Control wires: Identify with indicated number and or letter designation at all terminal points and connections, including manufacturer pre-wired control sections and cabinets.
 4. Alarm and detection wires: Identify with indicated wire and mnemonics numbers at all connections, terminal points, and coiled conductors within cabinets for future termination by Owner.

5. For identification of conductors, use heat shrinkable white marking sleeves such as Brady Permasleeve with type written identification.

END OF SECTION

SECTION 26 0050

BASIC ELECTRICAL MATERIALS & METHODS

PART 1 - GENERAL

- 1.01 DESCRIPTION: Division 1 applies to this Section. This Section contains general requirements for the Sections in Division 26.
- A. Related Work Not in Division 26: Refer to individual Division 26 Sections.
- 1.02 QUALITY ASSURANCE:
- A. Codes: Entire installation shall comply with requirements of authorities having jurisdiction.
- B. Permits: Contractor shall pay for all permits required by work under this Division.
- C. Inspections: Contractor shall arrange for all inspections and correct non-complying installations.
- 1.03 SUBMITTALS: Refer to Division 1 for procedures.
- A. Material and Equipment: Prior to start of work, 6 copies of a list of all materials and equipment covered by Division 26 shall be submitted for approval. Contractor shall allow ample time for checking and processing and shall assume responsibility for delays incurred due to rejected items. No installation of material concerned shall be made until such written approval has been obtained. Approval of materials and equipment shall in no way obviate compliance with the Contract Documents. Each item proposed shall be referenced to the applicable Section, Page, and Paragraph of Division 26. For each item proposed, give name of manufacturer, trade name, catalog data, and performance data.
- B. Equipment Layout Drawings: Submit "Equipment Layout Drawings" for each equipment room or area containing equipment items furnished under this Division. Layout Drawings shall consist of plan view of room, to scale, showing projected outlines of all equipment, complete with dotted line indication of all required clearances including all those needed for removal or service. Location of all conduit and pull boxes shall be indicated.
- C. Service Manuals: Refer to Submittal Section. Indexed Service Manuals shall be submitted which shall include test reports, service instructions, and renewal parts lists of all equipment.
1. Submission and Information: Service Manuals shall be submitted for approval at least 30 days before final inspection. The following information together with any pertinent data, shall be included in Service Manual:
- a. Renewal part numbers of all replaceable items.
 - b. Manufacturer's cuts and rating data.
 - c. Serial numbers of all principal pieces of equipment.

- d. Supplier's name, address, and phone number.
 - e. Final settings for all breakers, relays, and control devices
 - f. Copies: Four (4) copies of approved Service Manual shall be delivered on or before date required.
- D. Record Drawings: Prepare and submit in accordance with requirements. Contractor shall make notations, neat and legible, daily as the work proceeds. Drawings shall be available for inspection at all times and kept at the job site. All buried conduit and/or indicated future connections outside any building shall be located both by depth and by accurate measurement from a permanently established landmark such as a building or structure.
- E. Seismic Calculation: Refer to Article 3.01 herein.
- F. Spare Parts: Conform to the Submittal Section. Deliver following spare parts to Owner and obtain receipts. Submit at same time as Operating Instructions:
- 1. Spare fuses; 1 set for each combination fuse breaker.
 - 2. Spare pilot light lamps of each type used on project, in quantity of 10%, but not less than 2%.
 - 3. Overload heater elements; 2 sets for each size used on project.
- G. Special Tools: If any part of the equipment furnished under Division 26 requires a special tool for assembly, adjustment, resetting, or maintenance thereof and such tool is not readily available on the commercial tool market, it shall be furnished with the equipment as a standard accessory and delivered to the Owner.
- H. Maintenance Paint: One (1) can of touch-up paint shall be delivered to Owner for each different color factory finish which is to be the final finished surfaces of the product.

1.04 DRAWINGS:

- A. Diagrammatic Drawings: For purposes of clarity and legibility, drawings are essentially diagrammatic although size and location of equipment is drawn to scale wherever possible, Contractor shall make use of data in all the Contract Documents and verify information at building site.
- B. Routing of Conduit and Piping: The drawings indicate required size and termination of conduits and raceways. It is not intent to indicate all necessary offsets and it shall be the responsibility under this Division to install conduit in such a manner as to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and make all equipment requiring inspection, maintenance and repair accessible without extra cost to the Owner.
- C. Coordination with Other Trades: Check with other Divisions of the Specifications so that no interference shall occur and in order that elevations may be established for the work. Installed work which interferes with the work of other trades shall be removed and rerouted at the discretion of the Architect.

1.05 DAMAGE AND REPAIRS:

- A. Emergency Repairs: Owner reserves the right to make temporary repairs as necessary to keep equipment in operating condition without voiding Contractor's warranty or relieving Contractor of his responsibility during warranty period.
- B. Responsibility for Damage: Contractor shall be responsible for damage to grounds, buildings, or equipment due to work furnished or installed under this Division 26.

1.06 PROTECTION, CARE, AND CLEANING:

- A. Protection: Provide adequate protection for finished parts of materials and equipment against physical damage from any cause during progress of work and until final completion. Sensitive electrical equipment shall not be installed until major construction is completed.
- B. Care: During entire construction, properly cap all lines and equipment to prevent entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint or work of other trades by covering with polyethylene sheets.
- C. Cleaning: After installation is completed, clean all systems as follows in addition to requirements specified:
 - 1. Field Painted Items: Clean exterior of conduits, raceways, piping and equipment exposed in completed structure; removing all rust, plaster, cement and dirt by wire brushing. Remove grease oil and similar materials by wiping with clean rags and suitable solvents.
 - 2. Factory Finished Items: Remove grease and oil on all factory finished items such as cabinets and controllers, and leave surfaces clean and polished.
- D. Connection: Prior to energizing, check all electrical connection hardware and torque where necessary.

PART 2- PRODUCTS

2.01 PRODUCTS: Products and materials shall be as specified in the pertinent Sections of Division 26.

2.02 MATERIALS AND EQUIPMENT: Wherever possible, all materials and equipment used in installation of this work shall be of same manufacturer throughout for each class of material or equipment. Materials shall be new and bear UL label, wherever subject to such approval. Comply with ANSI, IEEE and NEMA standards, where applicable.

PART 3 - EXECUTION

3.01 SEISMIC REQUIREMENTS: Electrical equipment for emergency systems shall be braced to withstand the lateral forces that result from earthquakes. Under Work of Division 26, submit seismic calculations stamped and signed by a registered California structural engineer confirming size, number, and location of required anchoring hardware. Electrical equipment vendors shall furnish weights together with

dimensions and the center of gravity location for all emergency electrical equipment for this purpose.

- 3.02 GENERAL LATERAL BRACING REQUIREMENTS: As shown on Drawings. Additional bracing requirements shall conform to specific requirements shown on Drawings or in other Sections of Division 26. Anchorages for equipment subject to thermal expansion and movement shall conform to manufacturer's recommendation and intent of general bracing requirements. When general and specific bracing requirements enumerated above are in conflict with referenced standards, the most stringent requirements shall govern.
- 3.03 EXCAVATION AND BACKFILL: Perform all excavation and back fill required to install Work of Division 26, both inside and outside. Perform all excavation and backfilling in accordance with Division 2.
- A. Excavation: Bury conduits outside building to a depth of not less than 24" (or as required by National Electrical Code) below finish grade, unless noted otherwise.
 - B. Backfilling: Do not backfill until after final inspection and approval of conduit installation by all legally constituted authorities and recording of the buried items on the Record Drawings.
- 3.04 CUTTING AND PATCHING:
- A. Cutting of Existing Structural Work: Holes in existing slabs and concrete walls shall be cored to the minimum size required. The Contractor shall submit Drawings showing dimensioned sizes and locations for all such holes to Architect for approval before cutting. Where required for conduit installation, slabs on grade shall be saw-cut to minimum required width; submit cutting Drawings to the Architect for approval before cutting.
 - B. Patching: Holes or chases shall be patched to match adjacent surfaces.
- 3.05 CONCRETE WORK: Concrete construction required for the Work of Division 26 shall be provided under the Work of Division 26.
- 3.06 PAINTING: Finish painting of electrical equipment will be as specified in Division 9, unless equipment is herein specified to be furnished with factory applied finish coats. Equipment to be field painted shall be furnished with a factory applied prime coat.
- A. Touch-Up: If factory finish on any equipment furnished under Division 26 is damaged in shipment or during construction of building, the equipment shall be refinished by Contractor to satisfaction of Architect.
 - B. Concealed Equipment: Uncoated cast-iron or steel that will be concealed, or will not be accessible when installations are completed, shall be given one heavy coat of black asphalt before installation.
- 3.07 OPERATING INSTRUCTIONS: Contractor to provide services of an experienced Engineer to instruct Owner in operation of entire installation. Instructional period shall be during normal work day hours. This instruction period may be simultaneous with compliance tests.

- 3.08 COMPLIANCE TESTS: Conduct such tests of all portions of installation as may be necessary to ensure full compliance with the Drawings and Specifications. Tests shall be made in the presence of the Owner. Costs of test shall be borne by Contractor and Contractor shall provide all instruments, equipment, labor and materials to complete all the tests. Tests may be required on any item between installation of Work and the end of 1 year warranty period. Should these tests develop any defective materials, poor workmanship or variance with requirements of Specifications, Contractor shall make any changes necessary and remedy any defects at his expense.
- A. All Feeders: Measure and record as follows:
1. 600-volt conductors shall be tested with 500-volt megger to ground on each phase. megger to be on test for one minute before any readings are taken. The minimum values on all feeders shall be 100,000 OHMS.
 2. Copies of the certified test readings shall be transmitted to Owner.
- 3.09 SYSTEM ACCEPTANCE:
- A. Final Review: The Contractor shall request a final review prior to system acceptance after:
1. Completion of installation of all systems required under the Contract Documents.
 2. Submission and acceptance of operating and maintenance data.
 3. Completion of identification program.
- B. Acceptance: Is contingent on:
1. Completion of final review and correction of all deficiencies.
 2. Satisfactory completion of acceptance tests demonstrating compliance with all performance and technical requirements of Contract Documents.
 3. Satisfactory completion of training program and submission of manuals and Drawings required by Contract Documents.
- 3.10 PRELIMINARY OPERATION: The Owner reserves the right to operate portions of the electrical system on a preliminary basis without voiding the warranty or relieving the Contractor of his responsibilities.
- 3.11 CLEAN-UP: Conform to the Submittal Section. Upon completion and at other times during progress or Work, when required, remove all surplus materials, rubbish, and debris resulting from Work of Division 26.

END OF SECTION

SECTION 26 0060

MINOR ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner and Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect and make safe all electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with Utility Company and Owner's representative.
- C. Provide temporary wiring and connections to maintain required existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 72 hours before partially or

completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area when outage affects business operation.

- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service and new system is accepted. Disable system only to make switchovers and connections. Notify Owner and Telephone Utility Company at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- G. Existing Security System: Maintain existing system in service until new system is complete and ready for service and new system is accepted. Disable system only to make switchovers and connections. Obtain permission from the Owner and security company at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply and re-label devices as spares.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Disconnect and remove abandoned conduit.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.

- K. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- L. Extend existing installations using materials and methods compatible with existing electrical installations, and in compliance with new project specifications.
- M. Modify existing as-built drawings to note changes.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.05 INSTALLATION

- A. Install relocated materials and as required by this section and Owner's representative.

END OF SECTION

SECTION 26 0111

CONDUITS

PART 1 - GENERAL

- A. The general provisions apply to this section.

1.1 WORK INCLUDED

- A. Conduits; including:
 - 1. Rigid steel conduit.
 - 2. Intermediate metal conduit (IMC).
 - 3. Electrical metallic tubing (EMT).
 - 4. Rigid aluminum conduit.
 - 5. Polyvinyl chloride conduit (PVC).
 - 6. Flexible metal conduit.
 - 7. Liquid-tight flexible metal conduit.

1.2 DEFINITION

- A. Conduit: This term shall be construed to mean conduit and conduit fittings; and tubing and tubing fittings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- B. Support material: Section 260190.

PART 2 - PRODUCTS

2.1 MATERIAL AND FABRICATION - ALL MATERIALS SHALL BE MANUFACTURED IN THE USA.

- A. Rigid Steel Conduit: Hot-dipped galvanized or sherardized including the threads, manufactured in accordance with ANSI C80.1 and UL6.

1. Threaded, hot-dipped galvanized or sherardized fittings manufactured in accordance with ANSI C80.4.
- B. Intermediate Metal Conduit: Hot-dipped galvanized including the threads, manufactured in accordance with UL 1242.
- C. Electrical Metallic Tubing: Manufactured in accordance with ANSI C80.3 and UL 797.
1. Provide compression fittings in walls, ceiling spaces or exposed construction areas.
 2. Provide compression (water tight) fittings in damp areas or areas exposed to weather.
- D. Rigid Aluminum Conduit: Manufactured in accordance with ANSI C80.5.
1. Threaded fittings, manufactured in accordance with ANSI C80.4.
- E. Polyvinyl Chloride Conduit: Schedule 40 and schedule 80, manufactured in accordance with ANSI C33.91, UL 651, and NEMA TC-2.
1. Cemented type fittings of the same manufacturer as the conduit.
- F. Polyvinyl Chloride Conduit: Type EB, heavy wall, manufactured in accordance with ANSI C33.91, UL651, and NEMA TC-8.
1. Cemented fittings of the same manufacturer as the conduit.
- G. Flexible Metal Conduit: Hot-dipped galvanized steel, manufacturer in accordance with UL 1.
1. Squeeze type, malleable iron, cadmium plated, straight and angle connectors for all sizes and twist-in connectors for 1/2-inch and 3/4-inch flexible metal conduit.
- H. Liquid-Tight Flexible Conduit: Hot-dipped galvanized with liquid-tight vinyl jacket.
1. Liquid-tight fittings.

PART 3 - EXECUTION

3.1 USE

- A. EMT for all exposed and concealed work except as indicated in Paragraphs B, C, D, E, F, and G.

- B. Rigid steel, IMC, or rigid aluminum conduit in areas where exposed conduit could be subject to physical damage or where conduit is exposed and conductor phase to ground voltage exceeds 300 volts.
- C. Rigid aluminum conduit may be used for all feeder runs exposed or concealed in stud walls and spaces above suspended ceilings.
- D. PVC Conduit:
 - 1. Schedule 40 for runs below grade in direct contact with earth.
 - 2. Schedule 40 in concrete floors, walls or roofs.
- E. Flexible Conduit (steel only permitted):
 - 1. For connection to equipment subject to vibration, maximum length 18 inches. In wet locations use liquid-tight flexible conduit.
 - 2. For connection to lighting fixtures above suspended ceilings. Lengths limited to 72 inches.
 - 3. Install ground conductors in all flexible conduits.
- F. Where 3/4-inch conduit runs are concealed in walls or ceilings and these runs are through wood studs and wood joists, flexible steel conduit may be used up to a maximum length of 6'0".
- G. All risers shall be PVC coated RGS with bushings.
- H. In concrete or below grade use conduit not smaller than 1 inch. Maximum size in concrete slab: 1 inch. Run larger sizes under slab.
- I. Use long sweep elbows with minimum radius 10 times nominal conduit diameter for all telephone and communication runs.

3.2 INSTALLATION

- A. Provide conduit support and bracing in accordance with the latest published SMACNA guidelines.
- B. Perform excavating, trenching, backfilling, and compacting as specified in Division 2.
- C. Minimum cover for runs below finished grade outside buildings: 24 inches except where noted or required by the serving utility. Minimum cover for conduit in concrete floors, walls or roof: 1/3 thickness of slab. Minimum cover under building slabs is 12-inches.
- D. Minimum separation from uninsulated hot water pipes, steam pipes, heater flues or vents: 6 inches. Avoid running conduit directly under water lines.

- E. Protect inside of conduit from dirt and rubbish during construction by capping all openings with plastic caps intended for the purpose.
- F. Provide conduit bodies for exposed conduit runs at junctions, bends or offsets where required. Do not use elbows or bends around outside corners of beams, walls or equipment. Make conduit body covers accessible.
- G. Make conduit field cuts square with saw and ream out to full size. Shoulder conduits in couplings.
- H. Run a minimum of one 3/4-inch empty conduit for every three single pole spare circuit breakers, spaces or fraction thereof and not less than two 3/4-inch conduits from every flush mounted panel to an accessible space above the ceiling and below the floor.
- I. Make conduit projections from covered areas to areas exposed to the weather watertight by proper flashing. Extend flashing a minimum of 6 inches in all directions from conduit.
- J. Where conduit is to remain empty, install polypropylene or nylon pull-line 3/16" minimum diameter from end to end with tag at each end designating opposite terminations.
- K. Run conduit parallel and at right angle to building lines, when visible in finished construction.
- L. Cap conduits indicated to be stubbed-out underground using glued-on PVC caps intended for this purpose.
- M. Install a coupling flush with the floor on all conduits stubbed up through floors on grade.
- N. Make no bends with a radius less than 12 times the diameter of the cable it contains nor more than 90 degrees. Make field bends with tools designed for conduit bending. Heating of metallic conduit to facilitate bending is not permitted.
- O. Where conduit installed in concrete or masonry extends across building construction joints, provide expansion fittings as manufactured by O.Z.; Crouse-Hinds; Appleton; or equal, with approved ground straps and clamps.
- P. Concrete Wall or Slab Penetrations: All core drilling, sleeves, blockouts or other penetrations must be approved by the Structural Engineer prior to installation.
 - 1. Space sleeves and core drills to insure a minimum dimension of 3 times the nominal trade diameter of the largest adjacent conduit between sleeves or core drills.
 - 2. Use block outs for concentrations of conduits in a confined area.
- Q. Do not penetrate walls with flexible conduit where subject to physical damage. Use recessed box with extension ring for transition from interior to exterior of wall.

- R. All homeruns shown shall be run to the panel indicated independently of all other homeruns. Provide pull points so as not to exceed total bends of 360 degrees between them unless otherwise indicated.
- S. At switchboards, manholes and floor standing distribution panelboards, provide insulated throat bushings or bell ends on all non-metallic conduit entries and bushings on all metallic conduit entries.
- T. Provide bushings on all conduit terminations sized 1" and larger.
- U. Provide weatherproof boxes and connectors for all exposed parking structure raceways and boxes.
- V. Provide bell ends on all conduits into pullboxes and manholes, seal all conduits after conductors are pulled.
- W. Cap all unused conduits with end cap. Do not tape.
- X. All Fire Alarm Conduits shall be painted red.

END OF SECTION

SECTION 26 0120

CONDUCTORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Conductors; for power, lighting, sound, communication and control, including conductors for general wiring, flexible cords and cables, and ground conductors.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 260000.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Conductors for General Wiring: Thermoplastic insulated rated for 600V manufactured in accordance with UL 83.
 - 1. Provide 3/4 hard drawn copper conductors. Provide solid conductor for #12 AWG and smaller. Provide stranded conductors for #10 AWG and larger.
- B. Conductor Connectors for General Wiring:
 - 1. Sizes No. 14 to No. 8: Splice with insulated spring wire connectors.
 - a) Ideal No. 451, 455 and 453.
 - b) Minnesota Mining: Types Y, R, G, and B.
 - c) Buchanan No. B1, B2 and B4.
 - 2. Size No. 6 or Larger, Copper: Splice and terminate with compression or pressure type connectors and terminal lugs.
- C. Provide connector sealing packs for all area lighting and exterior box splices which require complete protection from dampness and water.
 - 1. Scotch Lok No.'s 3576, 3577 and 3578, by 3M Company.

PART 3 - EXECUTION

3.01 USE

A. Conductors for General Wiring:

1. Minimum 75 degrees C temperature rated insulation on conductors, except use minimum 90 degrees C temperature rated insulation on conductors in conduits exposed on roof, or where required due to ambient temperature.
2. Stranded conductors at motors, audio video and other applications where subject to vibration.
3. Minimum size conductors for power and lighting #12 AWG, except where noted.
4. Minimum size conductors for control circuits #14 AWG stranded with THHN/THWN insulation.

B. Use flexible cords and cables for connection of special equipment as indicated. Length not to exceed 72 inches.

C. Ground Conductors:

1. Provide an insulated green ground conductor for all branch circuit wiring where indicated.
2. Bare copper conductor may be used.
 - a) Install ground conductors in all non-metallic conduits as required by code. Install ground conductors in all motor branch circuits and all feeders. Where ground conductor size is not indicated, provide size as required for an equipment ground conductor by the National Electrical Code.
 - b) Install ground conductors in all flexible metal conduits.

D. Install XHHW – 2, 90°C copper conductors for all underground installations unless noted otherwise on the plans.

E. Install for all dimmers, stranded THHN/THWN – 2 copper 90°C conductors with dedicated neutrals.

3.02 INSPECTION

A. Check conduit system for damage and loose connections, replace damaged sections.

B. Check for caps at conduit openings. Make sure that inside of conduit is free of dirt and moisture.

- C. Pull mandrel, one size smaller than the conduit, through entire length of all underground conduits prior to conductor installation.

3.03 INSTALLATION

A. Conductors for General Wiring:

1. Color code conductors insulation as follows:

CONDUCTOR	SYSTEM 208Y/120	VOLTAGE 480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow

2. For conductors #6 AWG or larger, permanent plastic colored tape may be used to mark conductor in lieu of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
- Provide color tape on each end and at all terminal points and splices on wire enclosed in conduit.
 - Provide color tape every 3 feet on wire not enclosed in a listed wireway.
3. When pulling conductors, do not exceed manufacturer's recommended values.
4. Use polypropylene or nylon ropes for pulling conductors.

- B. Insulate splices with plastic electrical tape: Scotch No. 33+, Tomic No. 1T, or equal.

- C. Terminate all control wires with terminal lugs on terminal boards not designed with pressure plates. If splices are needed, use same procedure, installing a terminal board in a junction box for protection.

- D. All splices or connections shall be compression type Thomas & Betts or Burndy, no split bolt connections are allowed.

3.04 IDENTIFICATION

- A. Feeders: Identify with the corresponding circuit designation at over-current device and load ends, at all splices and in pull boxes.

- B. Branch Circuits: Identify with the corresponding circuit designation at the over-current device and at all splices and devices.

- C. Control Wires: Identify with the indicated number and/or letter designation at all terminal points and connections.

- D. Alarm and Detection Wires: Identify with the indicated wire and zone numbers at all connections, terminal points, and coiled conductors within cabinets.
- E. Conductors Terminated By Others: Indicate location of opposite end of conductor, i.e., Pull Box-Room 101.
- F. For identification of conductors, use heat shrinkable white marking sleeves such as Brady Permasleeve with type written identification.
- G. Circuit designation is construed to mean panel designation and circuit number, i.e., LA-13.

END OF SECTION

SECTION 26 0130

ELECTRICAL BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Boxes; including:
 - 1. Outlet boxes.
 - 2. Pull and junction boxes.
 - 3. Cabinets.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 260000.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Outlet Boxes:
 - 1. Pressed Steel Boxes: Knockout type, hot-dipped or electro-plate galvanized.
 - 2. Cast Iron Boxes: Hot-dipped or electro-plate galvanized with threaded hubs.
 - 3. Cast Iron Conduit Bodies: Hot-dipped or electro-plate galvanized with threaded hubs.
 - 4. Cast copper free aluminum conduit bodies with threaded hubs.
 - 5. Covers for Pressed Steel Boxes: Hot dipped or electro-plate galvanized.
 - 6. Outlet boxes manufactured in accordance with UL 514.
- B. Pull and Junction Boxes:
 - 1. Sheet steel, hot-dipped or electro-plate galvanized, or prime coated and a final coat of manufacturer's standard enamel or lacquer finish. Manufactured in accordance with UL 50.

- a) Where exposed to weather, provide raintight hubs for conduits entering the boxes, top and sides only.
- 2. Floor Boxes:
 - a) Single gang, similar to Hubbell #B-2536.
 - b) Covers:
 - 1) Combination, similar to Hubbell #S-2525.
 - 2) Duplex receptacle, similar to Hubbell #S-3925.
 - c) Carpet flange, similar to Hubbell #S-3075 thru #S-3079.
 - d) Hubs: Provide hubs as required to suit the conduit arrangement.
 - 3. Pre-Cast Concrete Pull Boxes: As manufactured by Jensen Pre-Cast or Utility Vault and shown on drawings.
 - 4. High impact resistant PVC boxes: As manufactured by Carlon, Sedco, or R & G Sloan.
- C. Cabinets: Sheet metal, prime coat and final coat of manufacturer's standard enamel or lacquer finish. Manufactured in accordance with UL 50.
- 1. Control Cabinet: NEMA 1 enclosure, door with butt hinges and flush handle latches.
 - a) Provide with removable steel back panel.
 - 2. Terminal Cabinets: NEMA 1 enclosure, door with concealed hinges and spring catch type flush cylinder locks. Key locks alike, provide two keys with each lock.
 - 3. Provide engraved plastic nameplates with 1/2" minimum height letters indicating designation of control and terminal cabinets as shown on the drawings.
 - a) Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

PART 3 - EXECUTION

3.01 USE

A. Outlet Boxes:

- 1. Ceiling Outlet Boxes: Not less than 4" octagonal by 2" deep.

2. FDD cast iron or cast aluminum device boxes and conduit bodies with metal covers for exposed conduit installation. Provide gasket for covers in wet areas.
3. Intercom, Microphone and TV Outlet Boxes: Not less than 4-11/16" square x 2-1/8" deep.
4. Provide floor boxes with quantity of gangs as required for power, communication or control as indicated. Use boxes with barriers where required. Provide carpet flanges in carpeted areas.

B. Pull and Junction Boxes:

1. Use sheet steel boxes NEMA Type 1 for indoor and NEMA Type 3R for outdoor installation, except as follows.
2. Use pre-cast concrete boxes for boxes flush in finish grade where requiring a nominal capacity greater than 144 cubic inches, where located in vehicular traffic areas, or where indicated.
3. Use polyvinyl chloride (PVC) boxes flush in finish grade when the nominal internal volume is less than or equal to 144 cubic inches or where indicated.
4. Use cast iron boxes for boxes flush in slab on grade.

3.02 INSTALLATION

- A. Provide 3/8" fixture studs in wall bracket and ceiling boxes.
- B. Provide covers suitable for the fixtures or devices used.
- C. Make outlet box covers flush with finished surfaces.
- D. Close unused open knockouts with knockout seals.
- E. Provide 1" deep plaster rings on recessed outlet boxes installed in areas where concrete will be exposed after construction is complete.
- F. Where boxes are concealed in exposed concrete unit masonry, use square cornered types or boxes fitted with rings of sufficient depth for the box to be recessed completely within cavity of block or tile. Install box to insure that ring fits an opening sawed out of the masonry, so that no mortar is required to fill between ring and construction.
- G. Provide a 6" base of compacted crushed rock under pre-cast concrete pull boxes.
- H. Adjust floor boxes so they are level with top of finished floors.
- I. Provide pull boxes and junction boxes in all branch circuit and feeder runs as indicated. Do not provide pull boxes unless they are indicated or required by the Electrical Code.

3.03 IDENTIFICATION

- A. Junction Boxes: Use permanent black marker, 2” high lettering, and on each cover plate indicate the power source and circuits contained within that junction box.

END OF SECTION

SECTION 26 0140

WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Wiring devices.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Identification: Section 260030.
- B. Boxes: Section 260130.

1.03 SUBMITTALS

- A. In accord with Section 260010.

1.04 DEFINITION

- A. Wiring devices: This term includes all wall switches, pushbuttons, receptacles, and plates used for general purpose installation.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Wall switches:

Quiet toggle type, 20A – 120/277 VAC rated, with terminal screws to take up to No. 10 AWG conductors:

	SPST	DPST	3-WAY	SPST KEY SWITCH LOCK	4-WAY
Arrow-Hart	1991-I	1992-I	1993-I	1991-L	1994-I
Bryant	4901-I	4902-I	4903-I	4901-L	4904-I
General Electric	GE5951-2	GE5952-2	GE5953-2	GE5951-OL	GE5954-2
Hubbell	1221-I	1222-I	1223-I	1221-L	1224-I
Pass & Seymour/ Legrand	20AC1-I	20AC2-I	20AC3-I	20AC1-L	20AC4-I

Momentary contact type, 20A-120/277V, two-circuit, three-position, center off:

Arrow-Hart	1995-I
Bryant	4921-I
General Electric	GE5935-2
Hubbell	1557-I
Pass & Seymour/Legrand	1250-I

Passive infrared wall switch sensors: Ivory, 180° field of view, adjustable time out and ambient light, 1200 sq. ft. Coverage, 120 VAC, 60 Hz, 1500W. Maximum load, incandescent and fluorescent. As manufactured by Hubbell No. AT1201 or Owner- approved equivalent by Leviton or Pass & Seymour.

Fan speed controllers: AC unit rated 15A - 120V used to control up to twelve 56 in./52 in./48 in. ceiling fans or up to twenty 42 in. fans on a single circuit. Rinaudo's Reproductions No. 22394.

B. Passive infrared motion switching system:

1. Ceiling mount sensor, white, 500 sq. ft. coverage, requires control unit. Hubbell No. ATD500CRP.
2. Ceiling mount sensor, white, 2000 sq. ft. coverage, ceiling height dependent, requires control unit. Hubbell No. ATD2000CRP.
3. Ceiling or wall mount sensor, white, 1000 sq. ft. coverage, requires control unit. Hubbell No. ATD1000CRP.
4. Ceiling or wall mount hallway sensor, white, covers area 75 ft. long by 20 ft. wide, requires control unit. Hubbell No. PIR90HW1.
5. Low-voltage control unit, 120VAC, controls one to four sensors. Mount in 4 in. x 4in. enclosure. Hubbell No. CU120A.
6. Relay, 120VAC coil, used when load to be controlled exceeds capacity of a single circuit. Hubbell No. AAR

C. Receptacles, caps, and connectors:

1. 15A-125V, NEMA 5-15, parallel slot type with grounding pin:

	DUPLEX	SINGLE	GFI
Arrow-Hart	5252-I	5261-I	GF5242-I
Bryant	5252-I	5261-I	GFR52FT
General Electric	5252-2	5261-2	TGTR115F
Hubbell	5252-I	5251-I	GF5252-I
Pass & Seymour/Legrand	5252-I	5261-I	1591-SHG

2. 15A-250V, NEMA 6-15, straight blade grounding type:

	RECEPTACLE	CAP
Arrow-Hart	5661-I	6666
Bryant	5661-I	5666-N
General Electric	GE4069-2	GED0611
Hubbell	5661-I	5666-C
Pass & Seymour/Legrand	5662-I	5666-X

3. 15A-125V, NEMA L5-15, locking type with ground:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	4700	4721	4731
Bryant	4700	4721-NSY	4732-NSY
General Electric	GL4700	GLD0511	GLD0513
Hubbell	4700	4720-C	4729-C
Pass & Seymour/Legrand	4700	L515-P	L515-C

4. 20A-125V, NEMA 5-20, straight blade grounding type:

	RECEPTACLE	CAP
Arrow-Hart	5361-I	5362-I
Bryant	5361-I	5362-I
General Electric	GE4102-2	GE4108-2
Hubbell	5361-I	5362-I
Pass & Seymour/Legrand	5361-I	5362-I

5. 20A-125V, NEMA L5-20, two-pole, three-wire locking type, with ground:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6200	6202	6204
Bryant	70520-FR	70520-NP	70520-NC
General Electric	GL0520	GLD0521	GLD0523
Hubbell	2310-A	2311	2313
Pass & Seymour/Legrand	L520-R	L520-P	L520-C

6. 20A-125V, NEMA 5-20, two-pole, three-wire, straight blade isolated grounding type receptacle:

	DUPLEX	SINGLE
Arrow-Hart	IG5362	IG5361
Bryant	5362-IG	5361-IG
General Electric	GE8300-IG	GE8310-IG
Hubbell	IG-5362	IG-5361
Pass & Seymour/Legrand	IG-6300	IG-5361

7. 20A-125 VAC, two-pole, three-wire, NEMA 5-20, straight blade, specification grade, ivory color, ground fault circuit interrupter receptacle (GFCI), rated for feed-through wiring, with LED indicator light:

	GFCI RECEPTACLE
Hubbell	GF-5362I
Pass & Seymour	2091-S-L-I
Leviton	6898-I

8. 20A-125/250V, NEMA 14-20, three-pole, four-wire straight blade grounding type:

	RECEPTACLE	CAP
Arrow-Hart	5759	5757
Bryant	-	-
General Electric	GE1420	GED1421
Hubbell	8410	8411-C
Pass & Seymour/Legrand	L1420-R	L1420-P

9. 20A-250V, NEMA 6-20, two-pole, three-wire straight blade grounding type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	8510	6866	6869
Bryant	5461	5466N	5469N
General Electric	GE4182	GED0621	GED0623
Hubbell	5461	HBL5466-C	HBL5469-C
Pass & Seymour/Legrand	5871	5466-X	5469-X

10. 20A-120/208V, NEMA L21-20, four-pole, five-wire locking and grounding type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6470	6472	6474
Bryant	72120-FR	72120-NP	72120-NC
General Electric	GL2120	GLD2121	GLD2123
Hubbell	2510A	2511	2513
Pass & Seymour/Legrand	L2120R	L2120P	L2120C

11. 20A-250V, NEMA L6-20, two-pole, three-wire locking and grounding type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6210	6212	6214
Bryant	70620FR	70620NP	70620NC
General Electric	GL0620	GLD0621	GLD0623
Hubbell	2320A	2321	2323
Pass & Seymour/Legrand	L620-R	L620-P	L620-C

12. 20A-480V, NEMA L16-20, three-pole, four-wire locking type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6430	6432	6434
Bryant	71620-FR	71620-NP	71620-NC
General Electric	GL1620	GLD1621	GLD1623
Hubbell	2430A	2431	2433
Pass & Seymour/Legrand	L1620-R	L1620-P	L1620-C

13. 30A-125V, NEMA 5-30, two-pole, three-wire straight blade grounding type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	5716N	5717N	6716N
Bryant	9530-FR	9630-RP	-
General Electric	GE4138-3	GED0531	GED0533
Hubbell	9308	9309	-
Pass & Seymour/Legrand	3802	5921	-

14. 30A-125V, NEMA L5-30, two-pole, three-wire grounding and locking type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6330	6332	6334
Bryant	70530-FR	70530-NP	70530-NC
General Electric	GL0530	GLD0531	GLD0533
Hubbell	2610	2611	2613
Pass & Seymour/Legrand	L530-R	L530-P	L530-C

15. 30A-125/250V, NEMA 14-30, three-pole, four-wire straight blade grounding type:

	RECEPTACLE	CAP
Arrow-Hart	5744N	5746N
Bryant	9430-FR	5746
General Electric	GE4191-3	GED1431
Hubbell	9430	9431
Pass & Seymour/Legrand	5740	5741-AN

16. 30A-125/250V, NEMA L14-30, three-pole, four-wire grounding and locking type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6510	6512	6514
Bryant	71430-FR	71430-NP	71430-NC
General Electric	GL1430	GLD1431	GLD1433
Hubbell	2710-A	2711	2713
Pass & Seymour/Legrand	L1430-R	L1430-P	L1430-C

17. 30A-250V, NEMA L6-30, two-pole, three-wire locking blade grounding type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	6340	6342	6344
Bryant	70630-FR	70630-NP	70630-NC
General Electric	GL0630	GLD0631	GLD0633
Hubbell	2620-A	2621	2623
Pass & Seymour/LeGrand	L630-R	L630-P	L630-C

18. 30A-250V, NEMA 6-30, two-pole, three-wire straight blade grounding type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	5700N	5701N	6700N
Bryant	9630-FR	9630-ANP	-
General Electric	GE4139-3	GE4328-9	GE4373-9
Hubbell	9330	9331	-
Pass & Seymour/LeGrand	3801	5931	-

19. 50A-208V (50A-600V), three-pole, four-wire locking type with ground:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	3769	3765	3764
Bryant	3769	3765	3764
General Electric	LD3769	LD3765	LD3764
Hubbell	3769	3765-C	3764-C
Pass & Seymour/LeGrand	3769	3765	3764

20. 50A-125/250V, NEMA 15-50, three-pole, four-wire grounding straight blade type:

	RECEPTACLE	CAP
Arrow-Hart	5754N	5745N
Bryant	9450-FR	5745
General Electric	GE4181-3	GE4180-3
Hubbell	9450	9451
Pass & Seymour/LeGrand	5750	5751-AN

21. 50A-125/250V, three-pole, four-wire grounding locking blade type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	CS6369	CS6365	CS6364
Bryant	CS6369	CS6365	CS6364
General Electric	-	-	-
Hubbell	CS6369	CS6365	CS6364
Pass & Seymour/LeGrand	-	-	-

22. 50A-250V, NEMA 6-50, two-pole, three-wire grounding straight blade type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	5709N	5710N	6709N
Bryant	9650-FR	9650-RP	-
General Electric	GE4141-3	GED0651	GED0653
Hubbell	9367	9368	-
Pass & Seymour/Legrand	3804	3869	-

23. 60A-120/208V, three-phase, 60 Hz, five-pole, five-wire, watertight, with threaded cap:

	BOX	ANGLE ADAPTER	RECEPTACLE BODY	COMPLETE ASSEMBLY
Hubbell	26401	26404	26520	-
Crouse-Hinds	-	-	-	Area-6575
Russell Stoll	-	-	-	DS6516-FRAB-

24. 60A-480V, NEMA L16-20, three-pole, four-wire locking type:

	RECEPTACLE	CAP	CONNECTOR
Arrow-Hart	-	-	-
Bryant	-	-	-
General Electric	-	-	-
Hubbell	HBL 26410	HBL 26402	HBL 26418
Pass & Seymour/Legrand	-	-	-

- D. Safety receptacle: 15A-125V, NEMA 5-15, straight blade grounding safety receptacle, Hubbell No. SG-62H-1.

- E. Door monitoring switches:

1. General: Provide magnetic door switches (one per leaf) and key switches at specific door locations as indicated on Drawings. Refer to Electrical Drawings details for schematic installation details of door switches.
2. Magnetic contact switches: Provide concealed magnetic SPDT switches with minimum 6-ft. wire leads, Sentrol No. 1076W-06 for hollow metal doors and frames. Where necessary, provide other similar Sentrol types to suit concealed installation conditions, as approved by Owner and compatible with Owner's ride control and/or existing security system equipment. Color of switches to closely match finish or paint color of door frame.
3. Key switches: Arrow-Hart No. 1191L.

- F. Device cover plates:

1. Interior plates: Specification grade plastic, 0.1 in. thick, ivory in color, UL listed.

- a) Plates in kitchens and restrooms to be polished stainless steel, 0.040 in. thick except in kitchens use double lift lid weatherproof gasketed plates for convenience receptacles.
 - b) MATV plate: RMS No. CA-4028.
2. Exterior plates: Choose type of exterior cover plate in accord with the device location and/or manner in which device will be used. Device cover plates shall be die-cast aluminum with hinged cover, rated for respective type of use specified below, or as indicated on Drawings.
- a) Outlet box weatherproof hoods: NEMA 3R rating, gasketed, for unattended use with cover closed, padlockable latching cover to meet OSHA lockout/tagout requirements, large cord opening and UL listed. As manufactured by Hubbell, Intermatic or Leviton.
 - b) Low profile weatherproof cover: Gasketed, approved for use with cover open, self-closing hinged covers (two independent self-closing lids for duplex receptacles which are horizontally mounted), UL listed. As manufactured by Hubbell, Leviton or Pass & Seymour.
 - c) Communication outlet weatherproof hoods: NEMA 3R rating for unattended use with cover closed, two-cord openings and UL listed. As manufactured by Red Dot.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount switches and receptacles in vertical position in building interiors.
- B. Mount receptacles with weatherproof plates in horizontal position.
- C. Install receptacles mounted vertically so that the ground contact falls on the top position, and horizontally-mounted receptacles with neutral pole in top position.
- D. Use plastic blank plates on J-boxes in public areas.
- E. Use mechanical type door switches for load control.
- F. Install receptacles for plug in lighting fixtures within 36 in. of fixture location.
- G. Use safety type receptacles with low profile weatherproof metal covers for all convenience outlets in guest accessible areas (i.e., queue lines, waiting areas, etc.).
- H. All GFI type exterior receptacles shall be provided with weatherproof metal hoods.

- I. GFI type receptacles shall not be fed-through wire.

END OF SECTION

SECTION 26 0142

NAMEPLATES AND WARNING SIGNS

PART 1 - GENERAL

Not Used.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Nameplate shall be plastic laminate with 3/4" high letters in white on black background screwed onto equipment designations shall clearly state:
1. Equipment Enclosure Nameplates.
 - a) Manufacturer's nameplate including equipment design rating of current, voltage, KVA, HP, bus bracing rating, or as applicable.
 - b) Equipment nameplate designating system usage and purpose, system nominal voltage, equipment rating for KVA, amperes, HP and RPM as applicable. Designation data per drawings or to be supplied with shop drawings approval.
 2. Device nameplates: Device usage, purpose, or circuit number; manufacturer and electrical characteristic ratings including the following:
 - a) Circuit Breakers: Voltage, continuous current, maximum interrupting current and trip current.
 - b) Switches: Voltage, continuous current, horsepower or maximum current switching. If fused, include nameplate stating "Fuses must be replaced with current limiting type of identical characteristics."
 - c) Contactors: Voltage, continuous current, horsepower or interrupting current, and whether "mechanically-held" or "electrically-held".
 - d) Motors: Rated voltage, full load amperes, frequency, phases, speed, horsepower, code letter rating, time rating, type of winding, class and temperature.
 - e) Controllers: Voltage, current, horsepower and trip setting of motor running over current protection.

2.02 WARNING SIGNS

- A. Warning signs shall be minimum 18 gauge steel, white porcelain enamel finish with red lettering. Lettering to read "DANGER - HIGH VOLTAGE" in 1" letters. Warning signs to be included on door or immediately above door of all electrical equipment rooms, vaults or closets containing equipment rooms, vaults or closets containing equipment energized above 150 volts to ground, except where such spaces are accessible from public areas.

2.03 WARNING SIGN DESIGNATION

- A. Warning designation in 1" red letters shall be painted by stencil or pre-printed adhesive on each pull box, cabinet or 1-foot length of exposed conduit stating "DANGER" and giving voltage of enclosed conductors such as "DANGER - 480 VOLTS", for all systems over 150 volts to ground.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Nameplates shall be mounted by self-tapping or threaded screws and bolts or by rivets.
- B. Signs shall be permanently mounted with cadmium plated steel screws or nickel-plated brass bolts.

END OF SECTION

SECTION 26 0164

BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Branch circuit panelboards.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 260000.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Provide factory assembled, enclosed panelboards in dead front cabinets, with doors, surface mounted or recessed as indicated, not less than 20" wide and 5-3/4" deep. Height will depend on the number of breakers and spaces.
- B. Where a control compartment is indicated, provide an integral compartment with a separate hinged lockable door held with captive screws. Identify all internal control wiring with manufacturers wire numbering or control wire numbering when indicated, at all terminal points and connections.
- C. Provide feeder terminal lugs for both main lugs only and main breakers rated for use with copper conductors.
- D. Provide full length copper bussing including areas indicated as space only.
- E. Provide full size neutral bus where neutral bus is indicated. Provide equipment ground bus and bolt-on circuit breakers.
- F. Key all door locks alike.
- G. 120/208V, 3 Phase, 4 Wire Panelboards: Square-D Co. Type NQOD or Powerlink G3 NF with programmable module where designated, alternate bid for General Electric type AQ.
- H. 277/480V, 3 Phase, 4 Wire Panelboards: Square-D Co. Type NF, alternate bid for General Electric type CCB.
- I. All equipment shall be listed to meet or exceed the available fault current by 10%.

- J. Doors shall be hinged.
- K. All placards are welded steel type.
- L. Provide hinged deadfront doors to allow internal access to panel without totally rewiring cover panel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Secure panelboards to building structure to withstand wire pulling strains.
- B. Secure surface mounted panelboards to wood studs or channel material spanning metal studs.
- C. Do not use toggle bolts.
- D. Contractor shall program lighting control Powerlink panelboard per owner's requirements.

3.02 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates on all branch circuit panelboards shown on the single line diagram.
- B. Provide panelboard and source feed designation on nameplates with 3/8" minimum height lettering for the panel name and 1/4" height lettering for the source feed designation.

EXAMPLE: LA

FED FROM: DLA

- C. Secure nameplates with at least two spaces or rivets. Cementing and adhesive installation not acceptable.
- D. Provide a typewritten directory for each branch circuit panelboard, showing each circuits and its use. Provide metal directory frame with plastic window.

END OF SECTION

SECTION 26 0170

DISCONNECTS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Disconnects: Switches, fused or unfused.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 26 0000.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Square D Company
- B. General Electric

2.02 MATERIAL AND FABRICATION

- A. Provide heavy duty type, quick-make, quick-break disconnects with cover interlocks.
- B. Provide NEMA Type 1 enclosure for dry locations, provide the proper enclosure for other locations as indicated.
- C. Provide motor rated toggle switches where indicated.
- D. Provide fused disconnect for elevator drive motors.
- E. Provide rejection clips on disconnects where rejection type fuses are to be installed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Securely fasten disconnects to structure to withstand wire pulling strains.

3.02 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates on individually mounted disconnects with minimum 1/4" height letters indicating the load served and the source feed designation.

EXAMPLE: LOAD: A/C-1

FED FROM: DHA-1

- B. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

END OF SECTION

SECTION 26 0190

SUPPORT DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Support devices for conduit, boxes, lighting fixtures and equipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Hangers, Straps and Beam Clamps:
 - 1. TOLCO.
 - 5. Caddy Fastening System by ERICO Products Inc.
- B. Channels and Fittings:
 - 1. Unistrut Corp.
- C. Anchors:
 - 1. Hilti.
 - 2. Simpson.

2.02 MATERIAL AND FABRICATION

- A. Hangers: Steel cadmium plated.
- B. Straps: One-hole and two-hole malleable iron, hot-dipped galvanized or steel, cadmium or zinc plated.
- C. Beam Clamps: Malleable iron, hot-dipped galvanized or cadmium plated.
- D. Channels and Fittings:
 - 1. Channels: Hot-dipped galvanized.
 - 2. Fittings: Galvanized.
- E. Anchors: Self drilling and expansion bolt types. No wood or fiber plugs or concrete nails are acceptable.

PART 3 - EXECUTION

3.01 USE

- A. Use one-hole or two-hole straps for single conduit runs on walls or ceilings.
- B. Use hangers with solid steel rods for hanging single conduits.
- C. Use formed channel trapezes for groups of two or more conduits.
- D. To fasten boxes and supports to:
 - 1. Wood: Use wood screws or screw type nails of equal holding power.
 - 2. Brick and Concrete: Use bolts and expansion shields.
 - 3. Hollow Masonry Units: Use toggle bolts.
- E. Support sheet metal boxes from building structure directly or by bar hangers.
- F. Do not penetrate reinforced concrete beams with fastenings more than 1-1/2" or reinforced concrete joints with more than 3/4" fastenings to prevent contact with reinforcing steel.

END OF SECTION

SECTION 26 2450

GROUNDING

PART 1 - GENERAL

1.01 REFERENCES

- A. N.E.C.: Article 250 "Grounding".
- B. Underwriter's Laboratories (U.L.). Standard A67 - "Grounding and Bonding Equipment". STD 869 - Grounding and Bonding.
- C. ITEE - Standards 142 and 241.

1.02 DESCRIPTION OF SYSTEM:

- A. A permanent grounding system with methods and materials in accordance with applicable Codes and Standards, able to conduct ground fault currents to the grounded neutral of electrical distribution systems, and limit potential differences between grounding conductors, raceways and enclosures.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data on grounding systems and accessories.
- B. Shop Drawings: Submit layout drawings of grounding systems and accessories including, but not limited to, ground wiring, copper braid and bus, ground rods, and plate electrodes.

1.04 QUALITY ASSURANCE:

- A. Installer qualifies with at least 3 years of successful installation experience on projects with electrical grounding experience similar to that required for project.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Handle electrical grounding accessories and components carefully to avoid damage. Store in location that will protect from dirt and weather.

PART 2 - PRODUCTS

2.01 GROUND RODS:

- A. Copper clad steel, unless indicated otherwise. Minimum dimension of 5/8" diameter by 8' long or larger if indicated and sectional rods with couplings where lengths exceeding 12'

are specified or indicated, or where added driving depth is required to achieve a specified minimum resistance.

2.02 GROUNDING ELECTRODE:

- A. Bare stranded copper, 3/0 AWG unless indicated otherwise, for installation in soil or embedded in concrete and cable with type TW insulation when installed in raceway. Install without splice from connection to connection.

2.03 GROUNDING CONDUCTORS:

- A. Type TW insulation, unless specified or indicated otherwise with a continuous green outer insulating jacket for size #6 AWG and smaller and with green tape banding for #4 AWG and larger, marked at each access point (e.g.: Junction boxes, Enclosures).

2.04 CLAMPS AND PRESSURE CONNECTORS:

- A. Cast copper, copper alloy, or bronze alloy suitable for use with aluminum and copper. Double bolt type with formed shoe and "U" cable clamp for connection to pipe or conduit; Single bolt type with cable shoe and "U" clamp for connections to flat bar or metal; and double bolt, parallel conductor split clamp type for cable to cable connections.

2.05 WELDED CONNECTIONS:

- A. Exothermic process (Cadweld or Thermoweld).

2.06 EQUIPMENT ROOM GROUND TERMINAL BAR:

- A. Copper 1/4" X 2-1/2" X 24", unless otherwise indicated. Two rows of holes on 1-1/2" centers for 1/2" bolt, to receive cables from two directions.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Ground conductive raceways, cable trays and enclosures for electrical systems wiring. Make ground circuits complete to form permanent conductive paths. Solidly ground each low voltage electrical system unless indicated or specified as ungrounded, or grounded through an impedance of a specified value. Provide bare conductors when in open air or soil and provide 600 volt, green, insulated conductors when in raceway.

3.02 MAIN GROUNDING JUMPER:

- A. Install a main grounding jumper between the system neutral and the enclosure ground bus (or directly to enclosure where ground bus is not present) at each location where system grounding is required. Main grounding jumper:

1. Formed bus in switchboards and panelboards.
2. Formed bus or copper cable in transformers not coupled in unitized assembly with distribution equipment.

3.03 GROUND CONNECTIONS:

- A. Make grounding electrode connections electrically ahead of any overcurrent or disconnect device or tap connection such that disconnection of neutral load conductors does not interfere with or remove the system ground connection. Use separate lugs on the transformer neutral terminals for neutral and main grounding jumpers when cable is used for transformer connections.

3.04 SEPARATELY DERIVED SYSTEMS:

- A. For each separately derived system, grounded or ungrounded, install a grounding electrode conductor between each system enclosure ground bus (or bolted connection to enclosure where ground bus is not present) and a cold water pipe or building structural steel of one (1) inch size or larger near the separately derived system ground connection. Make connections to water pipes or steel accessible for easy inspection. Provide a separate ground conductor for each audio, video, isolated panels and UPS as noted on the plans.

3.05 SERVICE GROUND:

- A. For each low voltage service, install a grounding electrode conductor between the system enclosure ground bus and the water service entrance to the building and install bonding jumpers around insulating unions and removable fittings in the water pipe between the grounding electrode conductor connection to the water pipe and the water service entrance.

3.06 GROUNDING ELECTRODE SYSTEM:

- A. Install a complete grounding electrode system with interconnecting cables and terminations at the equipment room ground terminal bar. Make connections to the grounding electrode system accessible. Install the following grounding electrode systems:
 1. Metal frame of building.
 2. Grounding electrode encased by at least two inches of concrete, within and near the bottom of the building foundation or footing of the type specified in Part 2 - Products, at least 20 feet in length without splice from connection to connection.
 3. Connection of other metal piping systems as required by National Electrical Code Article 250.
 4. Driven ground rods.

5. Driven steel piles.
6. Connection to water service with bonding jumper around water meter.

3.07 GROUNDING ELECTRODE CONDUCTORS:

- A. Install grounding electrode conductor in PVC or other non-conductive, non-metallic enclosure where a raceway system is indicated or necessary for conductor installation. Install grounding electrode conductors without splice from the enclosure ground bus to the connection at the grounding electrode system.

3.08 GROUND RODS:

- A. Install a vertical position, full length below grade unless specified otherwise, and with conductor and top of rod 6" minimum below grade. Provide exothermic welds at all connections.

3.09 EQUIPMENT ROOM GROUND TERMINAL BAR:

- A. Install in equipment rooms where indicated. Mount bar by anchors and bolts using 1-1/2" long segments of 1/2" rigid conduit as spacer between bar and wall. Use a minimum of two supports, 18" on center. Connect grounding electrode system conductors, system enclosure ground bus, and other indicated electrode systems to the terminal bar. Label permanently all ground conductors as to destination location, e.g. TR1, panel IPS, etcetera.

3.10 EQUIPMENT GROUND:

- A. Form the equipment ground circuits with rigid metallic raceways (e.g., EMT, rigid steel conduit) unless indicated otherwise. Make all threaded coupling connections wrench tight. Install bonding jumpers for continuity around fittings and terminations where the conductive raceway is made non-continuous. Where indicated or specified, install ground conductors in raceways to augment the circuits formed by the metallic raceway system. Bond the conductors to boxes or enclosures in which access is possible. Size conductors as specified, indicated, or required by code, whichever is larger. Install grounding bushings and bonding jumpers to enclosures or ground bussing for the following: Service entrance feeder; each location where multiple ring knockouts are damaged during conduit installation; each location where conduits are stubbed up into floor mounted and each conduit termination at a painted enclosure where paint is not removed before installation of raceway.

3.11 FLEXIBLE RACEWAY GROUNDING:

- A. Install a ground conductor inside all flexible raceways (e.g., Flexible steel, liquid tight) regardless of length. Bond the conductor to the enclosure or ground bus in the nearest box or access on either side of the flexible section. Size conductor as specified, indicated, or required by code, whichever is larger.

3.12 NON-CONDUCTIVE RACEWAY:

- A. Install a ground conductor in raceways of non-conductive materials. Bond conductor to conductive enclosures in which access is possible. Bond non-current carrying conductive equipment contained in a non-conductive enclosure. Install insulated or bare conductors, sized as specified, indicated, or required by code, whichever is larger.

3.13 SECTIONAL RACEWAY:

- A. Install a ground conductor in sectional raceways with removable covers for access (e.g., Plug-in strips, surface raceway systems, and wireways) unless specified otherwise. Size conductor in accordance with the N.E.C. for the largest phase conductor size installed in raceway, or as indicated. Bond sections of the raceway to the ground conductor. Connect receptacle ground terminals in the raceway to the ground conductor, and make other ground connections indicated on the drawings.

3.14 CABLE SUPPORT SYSTEMS:

- A. Ground elements of the cable support system to panelboards, cabinets and switchboards from which their circuits originate. Install a ground conductor sized as required by code, as indicated, or #12 AWG, whichever is larger.

3.15 MULTI-CONDUCTOR CABLE, METALLIC SHEATH:

- A. Use multi-conductor cable with metallic sheath or armor approved for use as ground circuit conductor or install ground conductor(s). Size ground circuit conductor as required by code, as specified, or as indicated on the drawings, whichever is larger. Terminating devices for cable using the sheath or armor as the ground circuit conductor shall be approved for use as the connecting device between the cable and the enclosure. Terminate internal ground circuit conductors by lug to the interior of the enclosure or to the contained ground bus where present. Use bare or clearly identified internal grounding conductors.

3.16 MULTI-CONDUCTOR CABLE, NON-METALLIC SHEATHED:

- A. Use only non-metallic sheathed multi-conductor cables having a ground circuit conductor enclosed in the sheath the same size as the ungrounded conductors. Use bare or clearly identified internal grounding conductors. Terminate ground circuit conductor by lug to the enclosure ground bus where present or to the interior of the enclosure.

3.17 GROUND CONDUCTOR BONDING:

- A. Bond grounding conductors to boxes or enclosures at each access point. Do not use building steel as equipment grounding path. Use welded ground connections, at least where such are buried in soil, installed below slabs on grade, or embedded in concrete.

END OF SECTION

SECTION 26 2510

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Lighting fixtures, including lamps, accessories and support materials.
- B. Related work:
 - 1. Submittals: Section 26 0000.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Fixtures schedule lists one or more acceptable manufacturers for each fixture type.
- B. Provide all lighting fixtures of each type from the same manufacturer.
- C. Provide sockets for screw base lamps of plated steel, brass or bronze.
- D. All fixtures shall be LED.
- E. Flexible metal conduit systems connecting individual tandem wired lighting fixtures.
 - 1. Conductors carrying line voltage and current shall be sized in accordance with the overcurrent device protecting the circuit indicated.
 - 2. Provide a #12 AWG minimum size ground conductor.
- F. Provide electronic dimming drivers/ballasts for all fixtures.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide a lighting fixture for each lighting outlet indicated.
- B. Provide recessed and semi recessed fixtures with mounting frames compatible with the ceiling and wall systems employed and secure fixture mechanically to frame.

- C. Align rows of suspended and surface mounted fluorescent fixtures to form straight lines at uniform elevations.
- D. Provide swivel ball type hangers which will allow a minimum of 45 degrees angle for fixtures indicated as pendant mounted.
- E. Make recessed fixture fit snugly against ceiling to prevent light leakage.
- F. Support suspended and surface mounted LED fixtures as follows:
 - 1. Fixtures not over 12 inches wide and not over 50 inches long, a minimum of two fastenings.
 - 2. Fixtures not over 12 inches wide and over 50 inches long, a minimum of three fastenings.
 - 3. Fixtures over 12 inches wide and not over 50 inches long, a minimum of four fastenings.
- G. Support pendant mounted LED fixtures as follows:
 - 1. Single fixtures not over 12 inches wide, a minimum of two single pendants.
 - 2. Single fixtures over 12 inches wide, a minimum of two single pendants at each end or one double pendant at each end.
 - 3. Continuous rows of fixtures not over 12 inches wide, a minimum of one single pendant for each fixture plus one for each row.
 - 4. Continuous rows of fixtures over 12 inches wide, a minimum of two single pendants or one double pendant for each fixture plus one for each row.
 - 5. Locate pendants for continuous row fixtures at each joint and each end of row.
 - 6. Rigidly fasten continuous row fixtures together with fixtures manufacturer supplied joiner.
- H. Clean existing fixtures to be reused.
- I. EMT shall not be used to support suspended fixtures of any type. Suspension shall be by means of standard hangers, where available and applicable, by rigid threaded conduit and fittings, or by rods.
- J. Where fixtures are to be mounted on, or suspended from concrete ceiling, provide cast in place inserts.
- K. Fixtures shall not be supported by outlet box cover screws alone; provide a fixture stud or “hickey” for added support.

- L. Provide a junction box at each exit light fixture indicated.
- M. Provide weatherproof boxes and connectors and liquid tight flexible conduit to each light fixture.
- N. All suspended fixtures will be installed with 1/8-inch safety cable and four Crosby clamps (two top and two bottom) to be used as a fixture support backup.

END OF SECTION

SECTION 26 4901

GENERAL CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Pushbutton and selector switches.
 - 2. Control stations.
 - 3. Relays.
 - 4. Time delay relays.
 - 5. Control power transformers.
 - 6. Control panels.

1.02 REFERENCES

- A. NEMA ICS 1 General Standards for Industrial Control Systems.
- B. NEMA ICS 2 Standards for Industrial Control Devices, Controllers and Assemblies.
- C. NEMA ICS 6 Enclosures for Industrial Controls and Systems.
- D. NEMA ST 1 Standard for Specialty Transformers (Except General Purpose Type).
- E. NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

- A. Submit under provisions of Section 010000.
- B. Shop Drawings: Submit to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.
- C. Product Data: Provide for each component showing electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for

storage, handling, protection, examination, preparation, installation, and starting of Product.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Contactors:
 - 1. Mechanically and Electrically Held Contactors: Open type, 120V coil, number of poles and ampere rating as indicated. Factory wired and installed in lighting panelboard compartment.
 - 2. Square D Co. Class 8903.
- B. Time Switch:
 - 1. Intermatic time switch as shown on the drawings.
- C. Photo Control With Time Delay:
 - 1. Rated for 1000W load or 1800 VA, sp st, in weatherproof enclosure.
 - 2. General Electric Co. Cat. No. CR174H651, or equal.
- D. Control Relays:
 - 1. 120 VAC coil, 10A rated contacts with number of poles indicated. Square D Co. Class 8501 Type X.
 - 2. 48 VDC coil, 10A rated contacts. Square D Co. Class 8501 Type KDP 12.
 - 3. 24 VDC coil, 10A rated contacts, plug in Type 3PDT. Square D Co. Class 8501 Type KDP 13 with NR62 socket.

4. Pneumatic Time Delay Relay: Square D Co. Class 9050 Type B.
- E. Control Units, Such as Push Buttons, Pilot Lights, Selector Switches: Heavy duty, oil tight - Square D Co. Class 9001.
1. Push buttons, standard, full guard. Red for stop, green for start.
 2. Pilot lights, transformer type, with color caps as indicated.
 3. Selector switches, 3 position (Hand Off Automatic) manual return.
 4. Legend Plates: Standard, with legends as indicated.

2.02 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates with 1/4 inch minimum height letters indicating circuit designation of panel or device controlled on controls which are individually enclosed.
- B. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

END OF SECTION

SECTION 26 4920

MOTOR CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Motor control; including molded case circuit breakers or fusible disconnects, magnetic starters and other control devices.

1.02 SUBMITTALS

- A. Submit in accordance with Section 26 0000.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

A. Motor Control Centers:

1. Provide factory assembled motor control centers consisting of one or more, minimum: 19 inch wide by 16 inch deep, dead front, dead rear, vertical sections bolted together.
2. Full voltage, non-reversing starter, unless otherwise indicated.
3. Conform with NEMA Class 1, Type B wiring for starter unit control.
4. Provide two normally open and one normally closed auxiliary contacts on each except where more contacts are indicated.
5. Provide full length copper bussing including areas indicated as space only.
6. Provide a horizontal copper ground bus drilled and tapped every 10 inches for 1/4 20 machine screws.
7. Provide an individual control transformer with the secondary fused and grounded for each starter. Size as required for the control devices indicated plus 25% spare capacity minimum.
8. Provide a 3-position selector switch (hand off auto), manual return, for each starter unless otherwise indicated.

9. Provide a transformer type push to test green pilot light energized by an auxiliary contact.
10. Provide approved pull apart terminal blocks or control circuit disconnect switch for all external wiring connections.
11. Identify all internal control wiring with manufacturers wire numbering or control wire numbering when indicated, at all terminal points and connections.
12. Allen-Bradley, GE or Square D Co.

B. Combination Motor Starters:

1. Full voltage, non-reversing starters unless otherwise noted and magnetic trip only circuit breakers, or fusible disconnects in NEMA 1 enclosure for dry areas and NEMA 3R where indicated weatherproof, sized as indicated. Provide current limiters where indicated.
2. Provide two normally open and one normally closed auxiliary contacts on each starter, except where contacts are indicated.
3. Provide an individual control transformer with the secondary fused and grounded for each starter. Size as required for the control devices indicated plus 25% spare capacity minimum.
4. Provide a 3-position selector switch (hand off auto), manual return, for each starter unless otherwise indicated.
5. Provide a transformer type push to test green pilot light energized by an auxiliary contact.
6. Identify all internal control wiring with manufacturers wire numbering or control wire numbering when indicated, at all terminal points and connections.
7. Combination Starter and Circuit Breaker: Square D Co. Class 8539, GE or Allen-Bradley.
8. Combination Starter and Disconnect: Square D Co. Class 8538, GE or Allen-Bradley.

C. Motor Manual Starters:

1. Single Phase:
 - a) For fractional HP motors, single unit with toggle operator, in NEMA 1 enclosure for dry areas and NEMA 3R when indicated weatherproof.
 - b) Number of poles as indicated.

- c) Provide overload protection.
 - d) Square D Co. Class 2510, GE or Allen-Bradley.
2. Three Phase:
- a) For integral horsepower motors, single unit 3 pole with toggle operator in NEMA 1 enclosure for dry areas and NEMA 3R when indicated weatherproof.
 - b) Square D Co. Class 2510, GE or Allen-Bradley.
- D. Magnetic Motor Starters (Individually Mounted):
- 1. Non reversing, in NEMA 1 enclosure for dry areas and a NEMA 3R enclosure where indicated weatherproof.
 - 2. Provide start stop push button on door otherwise indicated.
 - 3. Square D Co. Class 8536, GE or Allen-Bradley.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Bolt all sections of the control centers together tightly and secure to floor with anchor bolts after setting assembly plumb and level.
- B. Secure units to structures to withstand wire-pulling strains.
- C. Use motor nameplates data for selection of heater elements in motor starters, except where power factor correction is used. Size heater elements accordingly.

3.02 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates on all electrical distribution equipment shown on the single line diagram.
- B. Provide motor control center and source feed designation on nameplates with 3/8" minimum lettering for the motor control center name and 1/4" height lettering for the source feed designation.

EXAMPLE: MCC A

FED FROM: DHA 1

- C. Provide engraved plastic nameplates with 1/4-inch minimum height letters indicating circuit designation at branch overcurrent devices in motor control centers.

1. Circuit designation and load served at branch overcurrent devices in motor control centers and combination starters.
 2. Circuit designation and load served at manual motor starters and individually mounted magnetic motor starters.
- D. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation is not acceptable.

END OF SECTION

SECTION 31 2326

BASE COURSE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Installation of base material.

B. Related Requirements:

1. Division 01 - General Requirements.

2. Section 32 0117 - Pavement Repair.

3. Section 32 1216 - Asphalt Paving.

4. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

A. Crushed aggregate base (CAB) shall consist of native rock without naturally occurring asbestos or recycled materials.

C. Product Data: Submit material source, technical information and test data for base materials. Gradation and quality certifications shall be dated within 30 days of the submittal.

D. Sample: Submit sample of proposed base course material.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Crushed Aggregate Base (CAB) materials shall conform to the requirements of the Standard Specifications for Public Works Construction: Section 200 - Rock Materials.

B. Crushed Miscellaneous Base (CMB) or materials generated on site shall not be used as a base course material.

2.02 MATERIAL APPROVAL

- A. Base material shall be inspected by the Project Inspector for gradation and material content prior to installation. The OWNER may choose to have additional tests performed by a geotechnical engineer, retained by the OWNER, before installation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install base course material in layers not exceeding 4 inches in thickness, unless required otherwise. Grade and compact to indicated levels or grades, cut and fill, water and roll until the surface is hard and true to line, grade and required section. Provide a relative compaction of at least 95 percent, unless otherwise required.

3.02 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 32 0117
ASPHALT PAVEMENT REPAIR

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bituminous Surfacing Repair: protruding areas, depressed areas, and raveled bituminous pavement.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 31 2326 - Base Course.
3. Section 32 1216 - Asphalt Paving.
4. Section 32 1313 - Site Concrete Work.
5. Section 32 1236 - Seal for Bituminous Surfacing.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating areas to be repaired.
- B. Product Data: Submit manufacturer's technical data for materials and products.

1.03 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Base course materials: Section 31 2326 - Base Course.
- B. Asphalt paving materials: Section 32 1216 - Asphalt Paving.
- C. Seal materials: Section 32 1236 - Seal for Bituminous Surfacing.
- D. Headers: Section 32 1216 - Asphalt Paving.

2.02 BITUMINOUS MATERIALS

- A. Provide materials and products of the class, grade or type indicated, conforming to relevant provisions of Section 203 - Bituminous Materials of the latest Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL

- A. Remove bituminous and concrete pavement in accordance with applicable provisions of Section 300 - Earthwork of the Standard Specifications for Public Works Construction.
- B. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.
- C. Remove raveled and depressed bituminous pavement to limits indicated or required.
- D. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.
- E. Remove broken concrete by saw cutting. If the required cut line is within 30 inches of a score or joint line or edge, cut and remove to the score, joint line, or edge.

3.02 EXCAVATING, BACKFILLING AND COMPACTING

- A. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of related Specification sections.

3.03 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
- B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of the adjacent undisturbed grade.
- C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid earth a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of two 12d galvanized common nails through each stake.
- D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
- F. Provide additional stakes and devices as required to fasten headers.

3.04 BASE COURSE

- A. Unless otherwise indicated, base course shall be crushed aggregate base, fine grade, 3 inches thick or equal to thickness of the existing base, whichever is greater.
- B. Fill grade and compact as specified in Section 31 2200 - Grading.

3.05 RESURFACING

- A. Holes and Trenches: Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing. Resurface flush with existing adjoining pavement installing the same type of materials and section provided in existing improvements.
- B. Other Areas: Other surface improvements damaged or removed shall be cut to a neat even line and excavated one inch below the bottom of the existing pavement. Resurface by following the original grades and installing the same type of materials provided in existing improvements.
- C. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

3.06 REPAIRING AND RESEALING EXISTING SURFACES

- A. Preparation of Surfaces: Prior to filling cracks, clean existing bituminous surfacing of loose and foreign materials and coat with a film of asphalt emulsion.
- B. Repair of Existing Surfacing:
 - 1. Fill cracks $\frac{1}{2}$ inch wide and less with RS-1 emulsion and silica sand or other required material. Cracks larger than $\frac{1}{2}$ inch wide shall be filled with Type C2 Asphalt Concrete as specified. Cracks shall be filled to the level of adjacent surfacing.
 - 2. Where low areas, holes, or depressions occur in existing surfacing, repair with emulsified asphalt. Install material, strike off the emulsified asphalt with a straightedge flush with adjoining surfacing. Finish with a steel trowel, and after dehydration, compact by rolling or tamping.
- C. Testing: Flood test entire area in presence of the Project Inspector. Entire area tested shall be free of standing water or puddles.
- D. Surface Seal: After surface has been repaired and tested, install seal coat over entire area indicated. Surface seal shall be as specified in Section 32 1236 - Seal For Bituminous Surfacing.

3.07 CLEANING

- A. Remove all stains on the Project site and adjacent properties caused by or attributed to the Work of this section.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.08 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Paving for parking areas.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 32 0117 - Pavement Repair.
 - 3. Section 31 2326 - Base Course.
 - 4. Section 32 1236 - Seal for Bituminous Surfacing.
 - 5. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

- A. Shop Drawings: Submit site plan indicating extent of paving and accessories.
- B. Product Data: Manufacturer's technical data for materials and products.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction.

1.04 PROJECT CONDITIONS

- A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.
- B. A copy of the soils report is available for examination in the office of the Architect during regular office hours of the Architect.

PART 2 - PRODUCTS

2.01 BITUMINOUS MATERIALS

- A. Provide materials of the class, grade, or type indicated on the Drawings, conforming to relevant provisions of Section 203 - Bituminous Materials of the Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

- A. Thickness of Surfacing: Unless otherwise indicated on Drawings or specified, install bituminous surfacing to a compacted thickness of 2 inches.
- B. Provide surfacing material over base course as specified in Section 31 2326 - Base Course.
- C. Surfaces of walls, concrete, masonry, or existing bituminous surfacing indicated to be in direct contact with installed bituminous surfacing shall be cleaned, dried and uniformly coated with an asphaltic emulsion film.
- D. Thicken edges of bituminous surfacing that do not abut walls, concrete, or masonry, and edges joining existing bituminous surfaces. Remove headers at existing bituminous surfacing where new bituminous surfacing is to be installed. Thicken edges an additional 2 inches and taper to the indicated or specified thickness 6 inches back from such edges.
- E. At stairways, adjust thickness of paving such that the first tread is equal in height to all other treads.
- F. Provide adequate protection for concrete, planting areas, and other finish Work adjacent to areas indicated to receive bituminous surfacing.
- G. Placing:
1. Do not install bituminous surfacing when atmospheric temperature is below 40 degrees F; or when fog or other unsuitable weather conditions are present. Temperature of mixture at time of installation shall not be lower than 260 degrees F in warm weather or higher than 320 degrees F in cold weather.
 2. Where 2-inch or 3-inch thick surfacing is indicated or specified, install surfacing in one course. Where surfacing is indicated or specified 4 inches or more in thickness, except for thickened edges, install bituminous surfacing in courses of approximately equal thickness, each course not exceeding 2 ½ inches in thickness.
- H. Stakes or Screeds: Provide grade or screed stakes spaced not more than 15 feet apart in flow lines with grades of less than one percent. Continuous screeds may be provided instead of stakes.
- I. Spreading: Install bituminous surfacing in a manner to cause least possible handling of mixture. In open areas and wherever practicable, install by mechanical means with

a self-propelled mechanical spreader. In confined or restricted areas, install mixture with hot shovels and rakes, and smooth with lutes.

J. Joints: Provide vertical joints between successive runs. Install joints true to line, grade, and cross section. Lapped joints are not permitted.

K. Rolling:

1. Finish roll with a self-propelled tandem roller weighing at least 8 tons. Break down roll with a self-propelled roller weighing between 1 ½ tons and 8 tons.
2. Roll in a manner that preserves flow lines and the established finished grades. Break down roll in areas adjacent to flow lines parallel to flow lines. Break down roll after bituminous surfacing is installed without shoving or cracking of mixture under roller. Continue finish rolling until surfacing is unyielding, true to grade, and meets requirements for specified smoothness. Areas inaccessible to finish roller may be finish rolled with breakdown roller or tamped with hot tamping irons and smoothed with hot smoothing irons or hand roller.
3. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth to properly compact.
4. Compacted bituminous surfacing shall be provided with a bulk specific gravity of at least 2.31 when tested in accordance with ASTM D1188.

3.03 TOLERANCE

- A. Smoothness: Surface of bituminous surfacing after rolling, shall be even, smooth and uniform in texture with no voids or rock pockets, free of roller marks or other irregularities, and not varying by more than 0.03 foot, except at local depressions or raised areas as indicated, when a 10-foot straightedge is placed on surface.
- B. Grade: Finished grade shall not vary more than 0.02 foot above or below required grade. Variations within prescribed tolerance shall be compensating so that average grade and cross-section are provided.

3.04 TESTING

- A. After first coat of surface seal has been installed and after a 24 hour period, the flood test shall be completed of the bituminous surfacing in presence of the Project Inspector. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.

3.05 SURFACE SEALING

- A. After bituminous surfacing has passed flood test, clear and allow to dry and provide one more coat of surface seal as specified in Section 32 1236 - Seal for Bituminous Surfacing.
- B. Where indicated, provide multiple coats of surface seal to existing bituminous surfacing.
- C. Where new bituminous surfacing joins existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.

3.06 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.07 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 32 1236

SEAL FOR BITUMINOUS SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Surface sealer over bituminous surfacing.

B. Related Requirements:

1. Division 01 - General Requirements.

4. Section 32 1723 - Pavement Marking.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product information and application procedures for bituminous surfacing.

1.03 QUALITY ASSURANCE

A. Comply with the Standard Specifications For Public Works Construction, current edition.

B. Agitate bulk materials during transport.

1.04 MAINTENANCE

A. Extra Materials: Provide 10 gallons in unopened containers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide one of the following surface seals:

	<u>Product Name</u>	<u>Manufacturer</u>
1.	Guard-Top	CALMAT / Industrial Asphalt
2.	Over Kote	Diversified Asphalt Product
3.	Park Top	Western Colloid Products
4.	Sure Seal	Asphalt Coating Engineering

- 5. Super Drive Top. SAF- T Seal. Inc.
- 6. Equal.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Thoroughly wash surfaces with water to remove dirt, debris, excessive oil and grease, or other foreign matter.

3.02 APPLICATION

- A. Install seal coat in strict accordance with manufacturer's written directions and recommendations.
- B. Install two coats of surface seal to new bituminous surfacing. First coat shall be installed before flood testing. Clean surface and allow to dry before installing second coat. Second coat shall be installed after bituminous surfacing has passed flood test.
- C. Where new bituminous surfacing is installed adjacent to existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.
- D. Where existing bituminous surfacing is indicated to be patched and sealed, install two coats of surface seal after patching. Refer to Section 32 1216 - Asphalt Paving.

3.03 PROTECTION OF SURFACES

- A. Protect sealed and unsealed surfaces from damage and traffic during performance of the Work of this section and until surface seal has thoroughly set and cured. Do not permit traffic of any kind for at least 24 hours after completion of installation.
- B. Protect the Work of this section until Substantial Completion.

3.04 TESTING

- A. Owner reserves the right to obtain samples, perform tests to ensure compliance with the Specifications, and to review weight slips and invoices of materials delivered to the Project site.

3.05 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 32 1313
SITE CONCRETE WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: On-site concrete work:

1. Portland cement concrete pavement, driveways, curbs, gutters and mowing strips.
2. Ramps and stairs on grade.
3. Footings for fence posts, bollards, flagpoles, shade structures, light standards and athletic and playground equipment.
4. Cast-in-place and surface applied Tactile Warning Pavers.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 1000 – Concrete Forming and Accessories.
3. Section 03 2000 - Concrete Reinforcement.
4. Section 03 3000 – Cast-in-Place Concrete.
5. Section 07 9200 – Joint Sealants.
6. Section 32 1723 – Pavement Markings.

1.02 REFERENCES

A. Structural work, such as retaining walls, planter walls, cast-in-place benches, equipment pads, and footings for playground equipment, fences, walls, shade structures and flagpoles shall conform to the following Sections:

1. Section 03 1000 Concrete Forming.
2. Section 03 2000 Concrete Reinforcing.
3. Section 03 3000 Cast-in-Place Concrete.

B. Flatwork, such as walkways, driveways, ramps and steps on grade, swales, curbs, mow strips and utility related concrete, conform to:

1. Standard Specifications for Public Works Construction, The “Greenbook”, except reclaimed aggregates and processed miscellaneous base are not allowed.
- C. Imported or exported earthwork shall conform to Section 01 4524 Environmental Import / Export Materials Testing.
- D. National Ready Mixed Concrete Association (NRMCA):
 1. Checklist for the Concrete Pre-Construction Conference.

1.03 QUALITY ASSURANCE

- A. Source Limitations for Exposed Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure material required for the duration of the project as needed to ensure consistent quality in appearance.
- B. Pre-Installation Conference:
 1. CONTRACTOR shall coordinate and conduct pre-installation conference in conformance to Section 01 3119 Project Meetings.
 2. CONTRACTOR shall use the NRMCA “Checklist for the Concrete Pre-Construction Conference” as the meeting agenda.
- C. Mockup:
 1. Build 8 feet by 8 feet mockups of full-thickness sections of concrete paving using processes and techniques intended for use on permanent work, including curing procedures.
 2. Build mockups to demonstrate typical joints; surface finishes and standard of workmanship.
 3. Obtain ARCHITECT’s approval of mockup before proceeding with work of this Section.
 4. Mockup shall remain through completion of the work for use as a quality standard for finished work.
 5. Remove mockup when directed by the OAR.
- D. Field applied primers, paintings, sealers, sealants, caulking, leveling and patching compounds, crack/joint repair compounds adhesives and similar products shall be approved by the OWNER’s Office of Environmental Health and Safety (OEHS).

1.04 SUBMITTALS

- A. Structural Work: Conform to the applicable requirements of Sections 03 1000 Concrete Forming, 03 2000 Concrete Reinforcing and 03 3000 Cast-in-Place Concrete.
- B. Flatwork: Submit mix design in conformance to the Greenbook.
- C. Shop Drawings: Submit drawings indicating the locations of concrete joints, including construction joints, expansion joints, isolation joints, and contraction joints.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store cement and aggregate materials so to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.
- B. Packaged materials shall bear the manufacturers and brand name label and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.
- C. Avoid exposure of reinforcing steel bars, wire, and wire fabric to dirt, moisture or conditions harmful to reinforcing.
- D. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated by size and shape.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural Work: Conform to the applicable requirements of the following Sections, except as otherwise specified:
 - 1. Section 03 1000 Concrete Forming.
 - 2. Section 03 2000 Concrete Reinforcing.
 - 3. Section 03 3000 Cast-in-Place Concrete.
 - 4. Section 07 9200 Joint Sealants.
- B. Flatwork: Conform to the applicable requirements of the Greenbook, Section 201, except as follows:
 - 1. Water/cement ratio for concrete flatwork shall be 0.50 maximum.
 - 2. Base course shall conform to Section 32 3226 Base Course.
 - 3. Reclaimed concrete material shall not be used.

C, Tactile Warning Pavers:

1. Cast-in-place detectable/warning pavers shall be Vitrified Polymer Composite (VPC) pavers by Armor-Tile (www.armor-tile.com), ADA Solutions Inc. (www.adatile.com) or equal with raised dome dimensions and patterns complying with CBC Chapter 11B.
2. Surface applied detectable/warning pavers are not acceptable

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that gradients and elevations of base are correct. Maintain subgrade clean and in a smooth, compacted condition until the concrete is placed.
- B. Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. Earth surface shall be kept moist by frequent sprinkling up to the time of placing concrete.

3.02 CONSTRUCTION OF FORMS

- A. Flatwork Forming: Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 4 stakes per form placed at intervals not to exceed two feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms.

3.03 STEEL REINFORCEMENT INSTALLATION

- A. Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted.
- B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- C. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces, and lace splices with wire.

3.04 PREPARATION FOR CONCRETE PLACEMENT

- A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.

- B. Do not place concrete until forms, reinforcement, pipe, conduits, outlet boxes, anchors, sleeves, bolts, and other embedded materials are securely fastened in place. Maintain a minimum of two inches clearance between said items and any part of the concrete reinforcement.
- C. Adjust pull boxes, meter boxes, valve covers and manholes to proposed finish grade prior to placement of concrete. Anchor bolts shall be accurately set and maintained in position by templates while being embedded in concrete.
- D. Clean thoroughly the surfaces of metalwork to be in contact with concrete, remove dirt, grease, loose scale and rust, grout, mortar, and other foreign substances before the concrete is placed.
- E. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

3.05 CONCRETE PLACEMENT

- A. Place, compact, screed, float and trowel concrete as indicated in Section 03 3000 Cast-in-Place Concrete.
- B. Finish: After straightedging, when most of the water sheen has disappeared and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.
 - 1. Provide medium broom finish on surfaces up to six percent slope by striating surface 1/32 to 3/64 inch deep with a soft bristle broom across concrete surface to provide a uniform fine line texture.
 - 2. Provide heavy broom finish on surfaces over six percent by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom.

3.06 JOINTS

- A. Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated. Align curb, gutter, and sidewalk joints.
- B. Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated on the Drawings.
 - 2. Provide tie bars at sides of paving strips where indicated on the Drawings
 - 3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated on the Drawings.
- D. Expansion Joints:
1. Provide premolded joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together. Extend expansion joint fillers full-width and depth of joint, and 1/4" below finished surface where joint filler is indicated. If no joint sealer is indicated place top of premolded joint filler flush with top of concrete or curb.
 2. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints to a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Remove grooving-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 developing random contraction cracks.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Remove edging-tool marks on concrete surfaces.
- G. Where concrete is to be cast against old concrete, (greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand-blasting, exposing the aggregate. The hardened surface shall be cleaned of latent foreign material and washed clean, prior to the application of an epoxy bonding agent.

3.07 INSTALLATION OF TACTILE WARNING TILES AND PAVERS

- A. Install detectable/warning tile and pavers in strict accordance with manufacturers printed installation instructions and project details.

3.09 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project Site.

3.10 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 1713

PRECAST CONCRETE PARKING BUMPERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Precast concrete parking bumpers.
2. Parking bumper anchors.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 3000 – Cast-in-Place Concrete.
3. Section 32 1216 - Asphalt Paving
4. Section 32 1313 – Site Concrete Work.

1.02 SUBMITTALS

- A. Shop Drawings: Submit plans of the parking areas showing the location of the bumpers and installation details.
- B. Product Data: Submit manufacturers' product data for precast bumpers and bumper anchors.
- C. Material Sample: Submit one concrete bumper and one anchor.

1.03 QUALITY ASSURANCE

- A. Precast parking bumpers shall be manufactured for the intended purpose by a company or firm specializing in the manufacture of precast concrete parking appurtenances.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Precast Concrete parking Bumper: 28 day minimum compressive strength of 3,500 psi., reinforced with two No. 4 steel reinforcing bars, minimum. Provide chamfered corners, drainage slots on underside and predrilled holes for dowel-anchoring to substrate.

1. Configuration: Half octagonal.
 2. Size: 7-1/2 inches wide by 5 inches high by 70-inches long, or as indicated on drawings.
- B. Bumper Anchors: # 6 reinforcing bar, 18 inches long, two per bumper.
- C. Adhesive and Sealant: As recommended by bumper manufacturer and approved by the OWNER's Office of Environmental Health and Safety (OEHS).
1. Epoxy adhesive for fastening bumpers to concrete or asphalt pavements.
 2. Adhesive for Bonding Dowel to Wheel Stop.
 3. Sealant for capping off and sealing the rebar at the predrilled holes.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install bumpers as indicated on the Drawings. On bituminous paving, install anchors through pavement and into the ground a minimum of 12 inches. On concrete pavement, install bumpers in a continuous bed of adhesive.
- B. Fill predrilled anchoring holes with sealant, at both concrete and asphalt pavements.

3.02 CLEAN UP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 32 1723
PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Parking stripes, markings and accessibility symbols.
2. Fire lane "No Parking."
3. Curb marking and red curbs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 32 1236 - Seal for Bituminous Surfacing.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings, indicating location, extent, color and texture of markings.
- B. Material Samples: Submit color Samples.

1.03 PROJECT CONDITIONS

- A. Do not install markings when adverse weather conditions are forecasted.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Paint: Water emulsion-based traffic paint must be approved by OEHS (LAUSD's Office of Environmental Health and Safety)
 1. Dunn Edwards: Vin-L-Stripe.
 2. Pervo Paint Company: Acrylic Traffic Paint.
 3. Sherwin Williams: Setfast Acrylic Traffic Paint.
 4. Vista Paint Corporation: Traffic Paint.

5. Equal.

PART 3 - EXECUTION

3.01 PAVEMENT MARKINGS

A. Application of Paint:

1. Prior to application of paint, allow the pavement to properly cure. Clean and prepare in accordance with paint manufacturer's written recommendations.
2. Provide mechanical equipment to apply paint in a uniform, straight or curved pattern, without gaps, holidays, runs, or other defects.
3. Do not permit traffic until paint has completely cured.
4. Apply two coats in thickness recommended by manufacturer.
5. Playground Markings: Submit Samples to Architect for review. Limited color palettes may be submitted.

B. Marking Width and Color: Unless indicated otherwise, marking width and color are as follows:

<u>Location</u>	<u>Width</u>	<u>Color</u>
Parking stall lines	4 inches	White
Traffic markings		
Striping:	4 inches	Yellow
General	4 inches	Yellow
Accessible Parking	4 inches	Blue
International Symbol of Accessibility (ISA)	2 inches	White on blue background

*Where two sets of lines overlap, one set shall be white and the other set shall be yellow.

3.02 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

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END OF SECTION