

DSA SUBMITTAL DOCUMENTS
FOR THE
INGLEWOOD UNIFIED SCHOOL DISTRICT

VOLUME 1 of 1

NEW CHILD DEVELOPMENT CENTER

AT

Child Development Center
10409 10th Ave., Inglewood, CA 90303

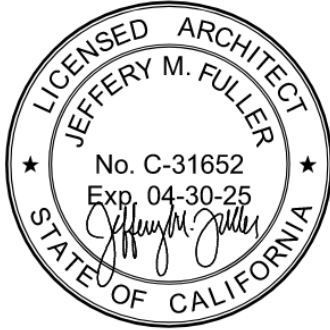
Prepared by OWNER:

INGLEWOOD UNIFIED SCHOOL DISTRICT
401 S Inglewood Ave.
Inglewood, CA 90301

For OWNER:

INGLEWOOD UNIFIED SCHOOL DISTRICT
Inglewood, California
September 18, 2024

DSA FILE #: 19-48
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SECTION 01 1100
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The furnishing of all labor, materials, equipment, services, and incidentals necessary for Work of the New Child Development Center located at 10409 10th Ave, Inglewood California 90303, as set forth in the Construction Documents which include, but are not limited to, the Drawings, Addenda and Specifications.

1.02 RELATED REQUIREMENTS:

1. Section 01 1216: Phasing of the Work.
2. Section 01 2300: Alternates (Bid Items).
3. Section 01 3113: Project Coordination.
4. Section 01 3229: Project Forms.
5. Section 01 3213: Construction Schedule.
6. Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
7. Section 01 5000: Construction Facilities and Temporary Controls.
8. Section 01 7123: Field Engineering.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.01 USE OF PREMISES

- A. CONTRACTOR shall coordinate Work of all trades, Subcontractors, utility service providers, with OWNER and/or Separate Work Contract. CONTRACTOR shall sequence, coordinate, and perform the Work to impose minimum hardship on the operation and use of the existing facilities and/or Project site. CONTRACTOR shall install all necessary protection for existing improvements, Project site, property, and

new Work against dust, dirt, weather, damage, vandalism, and maintain and relocate all protection to accommodate progression of the Work.

- B. CONTRACTOR shall confine entrance and exiting to the Project site and/or facilities to routes designated by the OAR.
- C. Within existing facilities, OWNER will remove portable equipment, furniture, and supplies from Work areas prior to the start of Work. CONTRACTOR shall cover and protect remaining items in areas of the Work.
- D. CONTRACTOR is advised school may be in session during performance of the Work. CONTRACTOR shall utilize all available means to prevent generation of unnecessary noise and maintain noise levels to a minimum. When required by the OAR, CONTRACTOR shall immediately discontinue noise-generating activities and/or provide alternative methods to minimize noise generation. CONTRACTOR shall install and maintain air compressors, tractors, cranes, hoists, vehicles, and other internal combustion engine equipment with mufflers, including unloading cycle of compressors. CONTRACTOR shall discontinue operation of equipment producing objectionable noise as required by the OAR.
- E. CONTRACTOR shall furnish, install, and maintain adequate supports, shoring, and bracing to preserve structural integrity and prevent collapse of existing improvements and/or Work modified and/or altered as part of the Work.
- F. CONTRACTOR shall secure building entrances, exits, and Work areas with locking devices as required by the OAR.
- G. CONTRACTOR assumes custody and control of OWNER property, both fixed and portable, remaining in existing facilities vacated during the Work.
- H. CONTRACTOR shall cover and protect surfaces of rooms and spaces in existing facilities turned over for the Work, including OWNER property remaining within as required to prevent soiling or damage from dust, dirt, water, and/or fumes. CONTRACTOR shall protect areas adjacent to the Work in a similar manner. Prior to OWNER occupancy, CONTRACTOR shall clean all surfaces including OWNER property.
- I. CONTRACTOR shall not use or allow anyone other than OWNER employees to use facility telephones and/or other equipment, except in an emergency. CONTRACTOR shall reimburse OWNER for telephone toll charges originating from the facility except those arising from emergencies or use by OWNER employees.
- J. CONTRACTOR shall protect all surfaces, coverings, materials, and finished Work from damage. Mobile equipment shall be provided with pneumatic tires.

- K. CONTRACTOR is advised OWNER will award Separate Work Contracts at this Project site.
- L. CONTRACTOR shall not permit the use of portable and/or fixed radio's or other types of sound producing devices including walkmans and similar devices.

3.02 PROPERTY INVENTORY

- A. Property, OWNER intends to remove; will be removed by OWNER before a room or space is vacated for the Work. Before performing Work in each room or space, OAR and CONTRACTOR shall prepare a detailed initial written inventory of OWNER property remaining within, including equipment and telephone instruments and the condition thereof. OAR and CONTRACTOR shall retain a signed copy of the inventory dated and signed by both parties. Prior to subsequent OWNER occupancy of each such room or space, OAR and CONTRACTOR shall perform a final inventory of OWNER property and all discrepancies between the initial inventory and final inventory shall be the responsibility of CONTRACTOR.

3.03 FURNITURE, FIXTURES AND EQUIPMENT (MATERIALS) OWNER FURNISHED CONTRACTOR INSTALLED (OFCI)

- A. Certain materials identified in the Contract Documents as OWNER Furnished CONTRACTOR Installed, OFCI, will be delivered to the Project site by the OWNER.
- B. If designated in the Contract Documents to be OWNER furnished CONTRACTOR installed, (OFCI), CONTRACTOR shall unload, store, uncrate, assemble, install, and connect OWNER supplied materials.
- C. One-Hundred and Twenty days before the date the CONTRACTOR needs to have the OFCI materials on site, CONTRACTOR shall notify OWNER of the scheduled date for needed OFCI materials. Upon delivery to Project site, CONTRACTOR shall store OFCI materials inside rooms and/or protected spaces and will be responsible for security of OFCI materials until Substantial Completion. OAR will sign receipt or bill of lading as applicable.
- D. CONTRACTOR shall, within ten days after delivery, uncrate and/or unpack OFCI materials in presence of OWNER who shall inspect delivered items. OWNER shall prepare an inspection report listing damaged or missing parts and accessories. OWNER shall transmit one copy of the report to CONTRACTOR. OWNER will procure and/or replace missing and or damaged OFCI materials, as indicated in inspection report.
- E. CONTRACTOR shall install OFCI materials in the locations and orientation as indicated in the Contract Documents. CONTRACTOR shall verify exact locations with OAR before final installation of OFCI materials.

- F. If required, OAR will furnish setting and or placement drawings for OFCI materials.
 - G. CONTRACTOR shall install OFCI materials by proper means and methods to ensure an installation as recommended by the manufacturer. CONTRACTOR shall furnish and install all necessary fasteners and required blocking to properly install OFCI materials.
 - H. CONTRACTOR shall install OFCI materials with manufacturer recommended fasteners for the type of construction to which the OFCI materials are being fastened and/or anchored.
 - I. CONTRACTOR shall provide final connections of any electrical, signal, gas, water, waste, venting and/or similar items to OFCI materials. CONTRACTOR shall, prior to final connection, verify the operating characteristics of OFCI materials are consistent with the designated supply.
- 3.04 FURNITURE, FIXTURES AND EQUIPMENT (Materials) - OWNER furnished, OWNER installed (OFOI)
- A. Certain materials are identified in the Contract Documents as OWNER Furnished, OWNER Installed (OFOI)
 - B. On dates and during times designated by OWNER, CONTRACTOR shall provide clear off-loading, receiving, protected storage, and OWNER'S dumpster space areas for the use of OWNER or OWNER'S third party OFOI installation contractors. At such times, CONTRACTOR shall also make clear routes and access available to all rooms and spaces to receive OFOI materials.
 - C. On dates and during times designated by OWNER, CONTRACTOR shall provide access to the elevators for use of OWNER or OWNER'S third party OFOI installation contractors.
 - D. CONTRACTOR shall cooperate fully with OWNER or OWNER'S third part OFOI installation contractors.
 - E. CONTRACTOR may be requested by OWNER to provide supplemental labor and equipment to support OFOI activities. Such requests must be submitted in accordance with the change order clauses of Contract.
 - F. Immediately prior to mobilization of OWNER or OWNER'S third party OFOI installation contractors, OWNER shall document the condition of the Work in areas to be utilized for OFOI activities.

- G. CONTRACTOR shall not be responsible for damage caused by OWNER or OWNER'S forces. OWNER shall document the condition of the Work and report to CONTRACTOR any damage in areas utilized for OFOI activities.

END OF SECTION

SECTION 01 4523
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 03 3713 - Shotcrete.
 - 4. Section 04 2200 – Concrete Unit Masonry.
 - 5. Section 05 1200 – Structural Steel Framing.
 - 6. Section 06 1000 – Rough Carpentry.
 - 7. Section 31 2319 – Excavation Fill for Structures.

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 17-8 – Sampling and Testing of High Strength Bolts, Nuts and Washers.
 - 4. DSA IR 17-9 – High Strength Bolting Inspection.
 - 5. DSA IR 17-10 – Sampling, Testing and Tagging of Reinforcing Bars.
 - 6. DSA IR 17-11 – Identification, Sampling and Testing of Threaded Steel Anchor Bolts and Anchor Rods.
 - 7. DSA IR 22-3 – Open Web Steel Joists and Joist Girders.
 - 8. DSA IR 23-4 – Metal-Plate-Connected Wood Trusses.
 - 9. DSA IR-23-8 – Manufactured Wood-Chord-Metal-Web Trusses.

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

- 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.
- 4. Retaining Walls:
 - a. Continuous inspections by Geotechnical Engineer:
 - 1) Placement, compaction and inspection of soil per CBC Section 1705A.6.1 for fills supporting foundations.
 - 2) Segmental retaining walls; inspect placement of units, dowels, connectors, etc.

- b. Concrete Retaining Walls: Provide tests and inspections as indicated on paragraphs below for concrete.
- c. Masonry Retaining Walls: Provide tests and inspections as indicated on paragraphs below for masonry.

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, 25.5.1 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 1705A.3.3.1, 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. Verify maintenance of specified curing temperature and techniques per ACI 318 sections 26.4.7 through 26.4.9 and CBC section 1908.9.
- h. 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.
- i. 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. Steel Joists and Trusses: Continuous inspection, special inspector will verify size, type and grade for all chord and web members as well as connectors and weld filler material, verify joist profile, dimensions and chamber (if applicable); verify all weld locations, lengths and profiles; mark or tag each joist, in conformance with CBC section 2207.1 and DSA IR 22-3.
- 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.
- H. Prefabricated Wood Structural Elements:
 - 1. Special inspector will continuously inspect fabrication of glued-laminated timber in accordance with CBC section 1704A2.5.

2. Special inspector will continuously inspect fabrication of manufactured open-web trusses in accordance with CBC 1704A2.5 and DSA IR 23-4.
3. Special inspector will continuously inspect fabrication of manufactured metal plate connected trusses in accordance with CBC 1704A2.5 and DSA IR 23-8.

PART 2 – PRODUCTS (Not used).

PART 3 – EXECUTION (Not used).

END OF SECTION

SECTION 01 4524
ENVIRONMENTAL IMPORT/EXPORT MATERIALS TESTING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the requirements for the sampling, testing, transportation and certification of imported fill materials or exported fill materials from school sites.
- B. This Section defines:
 - 1. CONTRACTOR requirements for use of existing, imported or generated materials on school sites.
 - 2. CONTRACTOR requirements for stockpiling materials for use on schools sites.
 - 3. CONTRACTOR requirements for exporting materials from a school site including transportation.
 - 4. Testing requirements for all materials imported, exported, stockpiled or generated for use on a school site.
 - 5. CONTRACTOR testing and reporting requirements.
 - 6. CONTRACTOR submittal requirements.
- C. Related Requirements:
 - 1. Division 1: General Requirements.
 - 2. Section 01 1100: Summary of Work.
 - 3. Section 01 3113: Project Coordination.
 - 4. Section 01 3213: Construction Schedule.
 - 5. Section 01 3300: Submittal Procedures.
 - 6. Section 01 7700: Contract Closeout.
 - 7. Section 31 2200: Grading.
 - 8. Section 31 2313: Excavation and Fill.
 - 9. Section 31 2316: Excavation and Fill. (Pavement)
 - 10. Section 31 2319: Excavation and Fill (Structures).
 - 11. Section 31 2323: Excavation and Fill (Utilities).
 - 12. Section 31 2333: Excavation and Fill for Synthetic Play Fields.
 - 13. Section 32 1100: Base Course.

1.02 OBJECTIVES

- A. Ensure that fill materials imported to school sites are safe for students, staff and visitors.
- B. Ensure that materials exported from school sites for use at school and non-school sites or offsite disposal/recycling are adequately characterized for lawful disposition.
- C. Ensure that representative data be collected so that analytical determinations can be made in regard to the first two objectives.
- D. Require CONTRACTOR to contract with and pay for the services of a licensed environmental professional (licensed State of California Professional Engineer [PE Civil] or Professional Geologist [PG]) familiar with environmental site assessment and waste classification and disposal requirements to perform such services.
- E. Require CONTRACTOR to contract with and pay for an independent, approved California Department of Health Services certified testing laboratory to perform analytical testing of imported, exported and site generated fill materials.
- F. Require CONTRACTOR to pay all fees required by authorities having jurisdiction over area.
- G. Require CONTRACTOR to post bonds required by authorities having jurisdiction over area.

1.03 DEFINITIONS

- A. Definitions not furnished in text of this section:
 - 1. CEQA: California Environmental Quality Act.
 - 2. EIR: Environmental Impact Report.
 - 3. Environmental Health Supervisor, Environmental Compliance Group: Individual at OEHS, who ensures OWNER compliance with all pertinent regulations, ordinances, codes, and/or policies.
 - 4. OEHS: OWNER's Office of Environmental Health and Safety.
 - 5. Licensed Environmental Professional: Person licensed in the State of California and with sufficient knowledge and experience to competently perform environmentally-related work, including (but necessarily limited to) environmental site investigations, remedial projects, and other tasks involving the collection of soil, soil vapor, and groundwater samples; the selection of analytical methods for said samples; the interpretation of analytical data; the preparation of work plans, reports, and other relevant documents; and the supervision and/or oversight of remedial contractors. For the purposes of this Section, a licensed environmental professional shall include a Professional Geologist or "P.G." or a Civil Professional Engineer or "P.E."
 - 6. ug/kg: micrograms/kilogram.
 - 7. mg/kg: milligrams/kilogram.
 - 8. NA: Not Applicable.
 - 9. RCRA: federal Resource Conservation and Recovery Act.

10. Soil Certification/Sample Data Report: Report documenting location, volume, sampling procedures, analytical methods, chemical test results, and recommendations for either disposing or re-using stockpiled soil excavated from OWNER sites or proposed for import to same. Preparation of report is to follow the procedures given in Article 1.04 of this Section.
11. Soil Sampling Plan (SSP): As described in Article 1.04 of this Section, a document providing sufficient guidance with which to adequately characterize soil proposed for import to, or export from, an OWNER's school Site. Guidance in this document is to be in accordance with the procedures described in Article 1.04 of this Section.
12. STLC: Soluble Threshold Limit Concentrations as defined in Tables II and III, Chapter 11, Article 3, § 66261.24-1 of Title 22 of the California Code of Regulations (CCR).
13. TCLP: Toxicity Characteristic Leaching Procedure, test Method 1311, documented in Title 40, Part 261, Subpart C, § 261.24 of the Code of Federal Regulations (CFR).
14. TPH: Total Petroleum Hydrocarbons.
15. TTLC: Total Threshold Limit Concentrations, as defined in Tables II and III, Chapter 11, Article 3, § 66261.24-1 of Title 22 of the CCR.
16. USEPA or EPA: United States Environmental Protection Agency.
17. VOCs: Volatile Organic Compounds.
18. WET: Waste Extraction Test, as defined in Appendix II-1, Chapter 11 of Title 22 of the CCR.

1.04 SUBMITTALS

A. CONTRACTOR shall submit to OAR for transmittal to the OEHS:

1. A qualifications statement for CONTRACTOR's independent California certified testing laboratory and required licensed environmental professional (California Professional Civil Engineer (PE) or Professional Geologist (PG) prior to the start of Work. CONTRACTOR's licensed environmental professional must possess recent demonstrated environmental experience in soil sampling and waste classification.
2. A draft import/export Soil Sampling Plan (SSP) prepared by CONTRACTOR's licensed environmental professional for review and concurrence by OEHS. The objective of the SSP is to obtain representative sample data. The Draft SSP or equivalent document acceptable to OEHS must be submitted at least 72 hours prior to all proposed import/export sampling activities. The consultant's proposal (with or without fees) is acceptable in lieu of a SSP.
 - a. At a minimum, the Draft SSP shall include a site map which shows the location of the proposed import/export soils and the location and number of the proposed stockpile samples. The draft SSP shall also contain information pertaining to the total volume of the stockpile proposed for

sampling and the rationale in support of the proposed sampling approach. Existing environmental documentation specific to the import/export site shall be utilized by the CONTRACTOR's environmental professional to support the proposed sampling approach and analytical method suite. It is the responsibility of the CONTRACTOR to request this information in advance from the OAR if they do not already have access to a copy at the jobsite.

- b. Lacking this information or rationale, samples shall be analyzed for all analytical methods described in paragraph 3.02 E. Guidance for the minimum number of samples per total volume of soil to be excavated is provided in Table 1. Supplemental samples may be required by OEHS if pothole sampling is utilized. In addition, the draft SSP shall contain all necessary contact information for the import/export site and a proposed schedule for the sampling activities.
- c. OEHS will either approve the document or request that revisions be made. This process shall continue until OEHS approves the draft SSP.

3. Draft Soil Certification/Sample Data Report:

- a. A draft Soil Certification/Sample Data Report prepared by CONTRACTOR's licensed environmental professional for review and concurrence. At a minimum the draft Soil Certification/Sample Data Report shall contain:
 - 1) A site map showing the location of the in situ sampling locations or the stockpile(s) and stockpile sample locations.
 - 2) A detailed discussion and evaluation of the laboratory results.
 - 3) A summary of findings and recommendations that provide a determination on the waste classification of the subject materials, based on the representative sample results.
 - 4) Recommendations for additional step-out samples, if any.
 - 5) Chain-of-custody forms and all laboratory data with respective QA/QC sheets.
- b. CONTRACTOR must allow OEHS a minimum of 72 hours to review the draft Soil Certification/Sample Data Report. OEHS will either approve the document or request that revisions be made. This shall continue until OEHS approves the draft Soil Certification/Sampling Data Report.
- c. Upon revision of the draft Soil Certification/Sample Data Report by the CONTRACTOR'S licensed environmental professional and acceptance by OEHS, the final report, signed and stamped by the licensed professional, shall be submitted to the OAR for distribution to OEHS and the project file. If the soil is to be exported to or imported from, an OWNER school site, if it satisfied the requirements of paragraphs 3.02.F and 3.02.G of this Section, then a PG or civil PE must sign and stamp the final report.
 - 1) The Environmental Health Supervisor, Environmental Compliance Group will confirm that the proposed waste classification for the

proposed import/export material is appropriate. For materials designated unacceptable for export except to a licensed facility, or for those materials sent electively by CONTRACTOR to a licensed facility, the Environmental Health Supervisor, Environmental Compliance Group will provide information on the necessary waste manifest documentation.

- 2) If an OAR/Complex Project Manager (CPM) would like OEHS to conduct the soil sampling and/or soil removal, the OAR/CPM should submit a Project Referral Form with completed COLIN funding line information to OEHS at least 3 weeks prior to when the work needs to be conducted. Submit the Project Referral Form to: environmental_review@lausd-oehs.org
4. Written documentation, e-mail is acceptable, verifying that all export soil data for any soils exported for use at a non-school site, including the final Certification Report prepared by CONTRACTOR's licensed environmental professional, were provided to the proposed recipient prior to export and delivery.
5. Prior to import/export, written documentation in the form of a letter sent by the transporter to the CONTRACTOR, who must in turn submit it to OEHS, to verify the following:
 - a. The hauling contract for each load imported to, or exported from, the school site specifies the use of "clean" trucks and/or trailer beds, in which the material will be carried;
 - b. The actual trucks and/or trailer beds utilized for import/export activities will be clear of visible contamination or deleterious materials;
 - c. The trucks will go directly from the source location to the recipient location with no detours or stops at other locations; and
 - d. Short loads will not be augmented by other materials that were not tested as part of the final SSP.
 - e. All import/export transportation activities shall be conducted in accordance with all applicable local, state and federal rules and regulations.
6. Certification, in the form of haul tickets or completed waste manifests, documenting the volume and recipient of all import/export materials and activities. This documentation shall be coordinated through the OEHS Environmental Health Supervisor, Environmental Compliance Group.
 - a. For approved import/export to unregulated facilities (landfill) or non-school sites, haul tickets may be utilized, but shall contain the following minimum information:
 - 1) Date(s) of haul activity.
 - 2) Address of source site.
 - 3) Address of recipient.
 - 4) Load volume.

- 5) Time of departure from source.
 - 6) Time of arrival at recipient site.
 - 7) Signature of recipient or recipient's agent.
 - 8) It is the CONTRACTOR's responsibility to confirm that no other trips or short-load augmentation occurred and submit documentation to the OAR and OEHS.
- b. For export to regulated facilities (landfills, recyclers, etc.), the appropriate waste manifest as determined by the OEHS Environmental Health Supervisor, Environmental Compliance Group in paragraph 1.04.A.3 must be completed and a copy of the executed manifest, signed by the receiving site, must be provided to the OAR. The waste manifest copy, signed by the receiving facility and based on the manifest address, will be sent directly to OEHS and the OEHS Environmental Health Supervisor, Environmental Compliance Group.

1.05 APPROVALS

- A. No import or export of earth or geotechnical grading or filling materials can occur at OWNER sites without prior approval by OEHS.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Imported:
1. Soils: Soils proposed for import shall be tested pursuant to the requirements of this Section (01 4524), unless a variance has been requested by CONTRACTOR and approved by OEHS prior to the import of the subject materials.
 2. Gravels: Clean gravel, consisting of native rock from a commercial source, may be granted a variance from the testing requirements of this Section provided a request for variance is submitted by CONTRACTOR for review and approval at least 72 hours prior to import. CONTRACTOR shall provide written documentation, which identifies the source, volume and proposed transport date(s) of the material for review.
 - a. Furthermore, a letter signed and stamped by either a Civil PE or PG and originating from the commercial source must state the following:
 - 1) The quarry does not mine ultramafic (i.e. natural asbestos containing) materials.
 - 2) The gravel is produced from virgin aggregate materials and does not contain any contaminated or reclaimed or recycled materials.
 - b. Additionally, a letter from the material transporter and signed by the same must state the following:

- 1) Haul truck and/or trailer beds transferring the material are clear of visible contamination and deleterious materials.
 - 2) Haul trucks will go directly from the quarry source to the site with no trips or augmentation of short loads with other materials.
 - c. The request for variance requires approval by OEHS prior to CONTRACTOR importing the materials.
3. Sands: Clean sand from a commercial source may be granted a variance from the testing requirements of this Section provided a request for variance is submitted by CONTRACTOR for review and approval at least 72 hours prior to import. CONTRACTOR shall provide written documentation, which identifies the source, volume and proposed transport date of the material for review.
 - a. Furthermore, a letter signed and stamped by either a Civil PE or PG and originating from the commercial source must state the following:
 - 1) The source does not mine ultramafic (i.e. natural asbestos containing) materials.
 - 2) The sand is produced from virgin materials and does not contain any contaminated or reclaimed or recycled materials.
 - b. Additionally, a letter from the material transporter and signed by the same must state the following:
 - 1) Haul truck and/or trailer beds transferring the material are clear of visible contamination or deleterious materials.
 - 2) Haul trucks will go directly from the commercial source to the site with no trips or augmentation of short loads with other materials.
 - c. The request for variance requires approval by OEHS prior to CONTRACTOR importing the materials.
4. Miscellaneous Material: No miscellaneous material containing crushed concrete, asphalt, construction debris, recycled, or other potential deleterious materials may be utilized or imported to an OWNER project site for use as fill or grading material.

B. Exported/Site Generated:

1. Soils: Soils proposed for export shall be tested pursuant to the requirements of the subject section, unless a variance has been requested by CONTRACTOR and approved by OEHS prior to the import of the subject materials. Once soils or other materials for export have been tested, they cannot be disturbed or reused for any purpose without prior approval by OEHS.
2. Gravels/Sands: Gravels, sands, or other natural rock materials shall not be exported from an OWNER project site without prior testing by CONTRACTOR pursuant to this Section (01 4524) and/or approval by OEHS. An exception to this provision is gravel adhering to concrete or asphalt pavement. In this instance and in consultation with OEHS, which shall make the final decision, CONTRACTOR

may dispose of said materials and construction debris without sampling and analytical testing required under this Section.

3. Miscellaneous Material. No miscellaneous material or other similar materials shall be exported from an OWNER project site without prior testing by CONTRACTOR pursuant to this Section (01 4524) and/or approval by OEHS. No crushed miscellaneous material containing concrete, asphalt, construction debris, or other potential deleterious materials that is generated onsite may be used as fill or grading material of any sort at an OWNER project site. Crushed asphalt shall be segregated and stockpiled separately. The onsite use of crushing equipment is not permitted.

PART 3 - EXECUTION

3.01 GRADING/EXCAVATION

- A. If the CONTRACTOR encounters an area with discolored, stained, and/or odorous soils or any other evidence of contamination during excavation/grading work, CONTRACTOR must immediately notify the OAR, cease work in the aforementioned area, and secure the area with fencing, tape, stakes or other suitable means to prevent entry by personnel or equipment. In turn, the OAR will immediately notify OEHS, which will initiate a construction response to address the contamination, in accordance with pertinent regulatory requirements.

3.02 SAMPLING AND TESTING

- A. CONTRACTOR shall contract with, and pay for, the services of a licensed environmental professional, licensed State of California Professional Civil Engineer (PE) or Professional Geologist (PG), to oversee or perform sampling of Materials that are subject to this Section.
- B. CONTRACTOR shall contract with, and pay for, an independent, approved California Department of Health Services certified testing laboratory to perform testing of imported, exported and site generated fill materials.
- C. All fill/grading material, unless otherwise specified in writing by OEHS, whether imported or exported, must be tested at the site of origin. Import/export testing and certification process shall include the steps listed below. OWNER retains the right to refuse any fill material proposed for use at a school site.
 1. Stockpile all materials for sampling (standard stockpile or backhoe pothole stockpile). Crushed fill materials generated by CONTRACTOR at a school site must be segregated by material.
 2. Submit draft SSP for review and concurrence by OEHS. SSP must include figures identifying the site location, the in situ sampling boundary or stockpile location, the sampling locations, and a brief site history including the type of remedial activity that occurred at the source site, if any.
 3. Collect and analyze samples (see Table 1 for number of samples per volume) per the SSP. Samples must include both discrete samples and composite samples.

- a. Discrete samples correspond to a single sample depth at a single sampling/boring location. Discrete samples are to be used for producing composite samples, as described in subparagraph b. below, and for analysis, in accordance with paragraph 3.02.E.1, which applies only to VOCs and TPH-g. For analysis of these compounds, the licensed professional shall collect one discrete sample from each sampling location and samples should be collected at different depths between these locations, so that all stockpile depths are equally represented.
 - b. Composite samples correspond to three sample depths from a single sampling location (this includes in situ samples). Each composite sample shall consist of three discrete samples collected near the top, middle, and bottom of the stockpile or in situ boring location at each sampling location. The licensed environmental professional shall then have the analytical laboratory combine the discrete samples into a single composite sample. The laboratory should be directed to retain a sufficient quantity of each discrete sample for further analysis, as necessary. The composite sample shall be analyzed, in accordance with paragraph 3.02.E.2, which describes required testing other than for VOCs and TPH-g. Once materials for export have been stockpiled and tested, they may not be used onsite for any purpose without prior approval by OEHS.
 - 1) Composite samples with analyte concentrations approximating or exceeding acceptable screening criteria, as specified below in paragraphs F through H, may be attributed to constituents within one or more discrete samples. Analyzing the discretely comprising the composite may reveal the discrete samples with elevated analyte concentrations and, thus, better isolate (and minimize) the volume of soils within the stockpile requiring removal and licensed disposal.
4. Submit draft Soil Certification/Sample Data Report for review and concurrence by OEHS.
 5. Submit final Soil Certification/Sample Data Report to the OEHS. All certified material not utilized or exported within a period of 90 days will be subject to retesting unless a variance is requested by CONTRACTOR and is approved by OEHS prior to use or import/export of the subject materials.
 6. Submit required pre import/export documentation/record to the OAR and to OEHS, e-mail is acceptable.
 7. Submit post import/export certifications to the OAR and OEHS, e-mail is acceptable.
 8. In addition to the preceding, requirements, and as necessary or as specified by OEHS, certifications and submittals as indicated in previous articles of PART 3 or in the remainder of this Section may be required.
- D. Import/export fill materials shall be samples in situ or stockpiled by CONTRACTOR (or at export site) and are deemed acceptable for import/export or reuse only when it is

demonstrated to the satisfaction of OEHS that the subject materials meet the requirements of this Section.

- E. As described in paragraph 1.04.A.2.b, lacking site-specific data or sample rationale to support a more focused analytical approach; the CONTRACTOR shall analyze all samples for the following substances according to the methods indicated below. Table 3 is a waste classification flowchart for use by CONTRACTOR's licensed environmental professional. In all cases, detection levels and quality assurance/quality control methods shall be in accordance with standard method reporting limits, best laboratory practices and the following USEPA (EPA) methods for discrete and composite samples:
1. Discrete samples shall be analyzed for Volatile Organic Compounds (VOCs), utilizing EPA Method 8260B/5035 and for Total Petroleum Hydrocarbons (TPH) gasoline (TPH-g), utilizing EPA Method 8015M [with EPA Method 5035 extraction using either volatile organic analysis (VOA) kits, EnCores®, or an equivalent soil collection device].
 2. Composite samples shall be analyzed for the following:
 - a. TPH, utilizing EPA Method 8015M, for full carbon-chain speciation (including diesel, oil, and other long-chain hydrocarbons).
 - b. Polychlorinated biphenyls, utilizing EPA Method 8082.
 - c. Semi-Volatile Compounds (SVOCs), utilizing EPA Method 8270C.
 - d. Organochlorine Pesticides (OCPs), utilizing EPA Method 8081A.
 - e. Organophosphorous Pesticides (OPPs), utilizing EPA Method 8141A.
 - f. Chlorinated Herbicides, utilizing EPA Method 8151A.
 - g. California Code of Regulations Title 22 (CAM 17) Metals, utilizing EPA Method 6010B/7470A.
 - h. Hexavalent Chromium, utilizing EPA Method 7199.
 - i. Arsenic/Thallium, utilizing EPA Method 6020.
 3. For EPA Method 8270C, a Method Detection Limit (MDL) of 250 ug/kg in addition to the Practical Quantitation Limit (PQL) or equivalent. This requirement is due to a recent DTSC directive requiring MDLs or PQLs to be sufficiently low to detect Carcinogenic Polycyclic Aromatic Hydrocarbons (CPAHs) in the composite sample, even if these compounds exceed actionable concentrations (900 ug/kg) in only one of the three discrete samples comprising the composite.
 4. The certified laboratory may also need to analyze the composite samples for polycyclic aromatic hydrocarbons (PAHs), a component of semi-volatile compounds, if the data evaluation performed in accordance with paragraph 3.02.G of this Section (01 4524) does not meet DTSC requirements. The analytical methods to be used for this purpose are EPA Method 8270 SIM, if the samples contain relatively high concentrations of hydrocarbons, or EPA Method 8310, if the samples contain low concentrations of hydrocarbons.

- F. Import/export fill material may be deemed defective for use by OEHS at a school site if any of the following results are obtained:
1. TPH are present at concentrations exceeding 100 milligrams per kilogram (mg/kg) for gasoline and/or 1,000 mg/kg for oil/diesel and long-chain hydrocarbons.
 2. Solvents and other VOCs are present at concentrations exceeding the laboratory reporting limit. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 3. PCBs are present at concentrations exceeding the laboratory reporting limit. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 4. SVOCs are present at concentrations exceeding the laboratory reporting limit. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 5. OCPs are present at concentrations exceeding the laboratory reporting limit. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 6. OPPs are present at concentrations exceeding the laboratory reporting limit. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 7. Chlorinated herbicides are present at concentrations exceeding the laboratory reporting limit. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 8. California Code of Regulations Title 22 (CAM 17) Metals at concentrations exceeding site-specific background. Detections between the laboratory reporting limit and the practical quantitation limit (J-flags) should not be reported.
 9. Hexavalent chromium is present at concentrations exceeding 300 ug/kg.
- G. As mentioned in paragraph 3.02.E, evaluate concentrations of CPAHs, a subset of SVOCs, in the import/export material by conducting the analyses set forth below.
1. Comparing CPAH concentrations with the benzo(a)pyrene [b(a)p] equivalent concentration of 900 ug/kg, the background concentration for CPAHs defined in "A Methodology For Using Background PAHs To Support Remediation Decisions," prepared by the Environ Corporation for the Southern California Gas Company and Southern California Edison, January 24, 2002 (referred to as "document"). In this document, CPAHs are defined in Table 2, and Potency Equivalency Factors (PEFs) for each CPAH are listed in Table 3. Using the correct PEF for each CPAH, the licensed environmental professional shall convert the concentration of each CPAH into its b(a)p equivalent concentration. The summation of these b(a)p equivalents for each CPAH must not exceed 900 ug/kg. If CPAHs do not exceed the laboratory reporting limit, then the licensed environmental professional must perform the procedure described above, using the PEF and the laboratory reporting limit (LRL) for each CPAH. The result will be the LRL for each CPAH converted to b(a)p equivalent concentrations. The

summation of these b(a)p equivalent concentrations (representing the LRL for each CPAH) must not exceed 900 ug/kg.

- H. Evaluate concentrations of metals in import fill by conducting the analysis set forth below.
1. Compare the maximum detected metal concentrations in import/export material samples to either DTSC or US EPA regulatory action levels for either residential or school sites, whichever is more conservative. If any metal concentration exceeds its listed regulatory action level, the fill material fails and shall be deemed defective and unacceptable for use.
 2. In addition to paragraph 3.02.G.1, import/export fill shall be deemed defective and unacceptable for use if any of the following results are obtained:
 - a. Arsenic concentrations greater than or equal to 12.0 mg/kg.
 - b. Lead concentration greater than or equal to 80 mg/kg.
 - c. Import/Export materials at school sites with total lead concentrations greater than or equal to 50 mg/kg shall be analyzed for leachability (STLC) prior to export. Materials exceeding STLC limits identified in Table 2 are deemed defective and unacceptable for use at school sites.
 - d. Import/Export materials at school sites with total chromium concentrations greater than or equal to 100 mg/kg shall be tested for hexavalent chromium.
- I. All export/import material shall be characterized, handled, and documented in accordance with applicable US EPA and State of California hazardous waste and hazardous materials regulations (See Table 2). For the purpose of this specification, “contaminated” shall mean any soil or geotechnical material with constituent concentrations, which would require disposal at a regulated facility (i.e., California hazardous waste or RCRA hazardous waste). Refer to Article 3.03 COSTS which outline the disposal fee requirements for excavated contaminated soil. OAR must be notified at least 72 hours prior to the disposal of hazardous waste or hazardous material. No material disposal or reuse can take place without prior written approval of OEHS.
- J. Specification test results and OEHS approvals are valid for a period of 90 days from the date of the subject testing unless a variance is requested by CONTRACTOR and approved by OEHS. Previously approved materials shall not be utilized or disposed offsite after the 90 day limit without prior review and approval by OEHS.
- K. Requests for variances to this Specification Section shall be submitted in writing to OEHS a minimum of two weeks in advance of need for review and approval. The request for a variance from soil sampling for export must state the following: “The soil for export is less than 10 cubic yards, has no visible staining, is not odorous, and appears native”. A photograph of the stockpiled soil must be included in the variance request. The photograph must have a representative scale within it in order for OEHS to determine the volume of soil to be exported. The request for variance must provide all available testing data, and a rationale to support the request. OEHS will review the request for variance and will provide its preliminary determination within 72 hours. Once OEHS approves the variance from sampling, the soil stockpile may be removed as “construction related debris”. Certain requests may require final approval by the DTSC.

3.03 TRANSPORTATION

- A. Details of the samples and testing must be submitted to and approved by OEHS Environmental Compliance Manager before the materials from which the samples were collected undergo transportation.
- B. Haul Routes and Regulations/Restrictions: CONTRACTOR must comply with requirements of project environmental disclosure documents (i.e., CEQA EIR) and authorities having jurisdiction over the project area and the proposed activities (e.g. Regional Water Quality Control Board, DTSC, etc.).

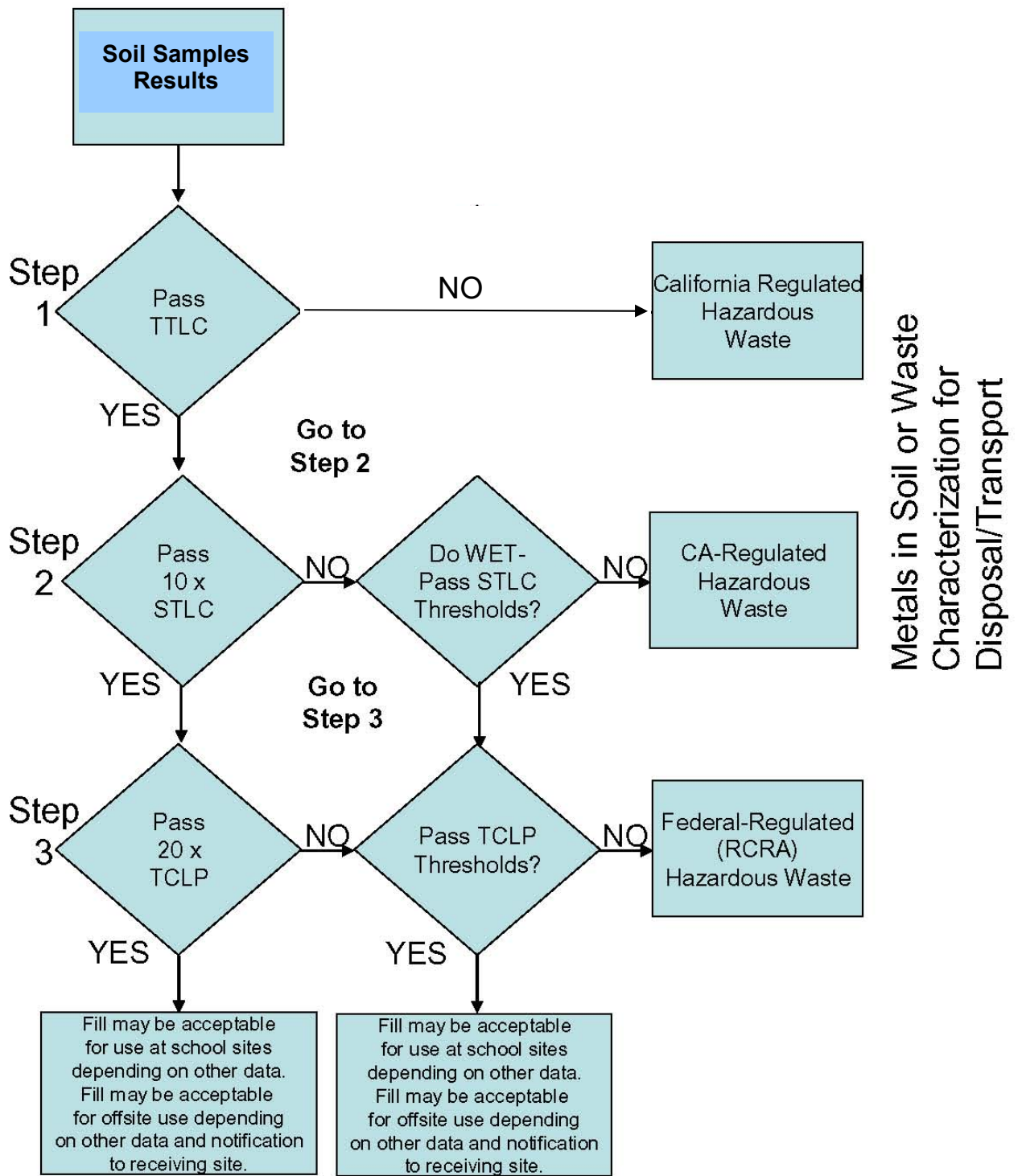
3.04 COSTS

- A. CONTRACTOR shall pay all fees required by authorities having jurisdiction over area.
- B. Contractor shall pay all fees for disposal and/or processing of impacted and/or hazardous fill materials at a regulated facility.
- C. CONTRACTOR shall post and pay for all bonds required by authorities having jurisdiction over area.

TABLE 1: MINIMUM SAMPLING FREQUENCY	
Volume (Cubic Yards)*	Sampling Frequency*
0 - 500	1 per 100 CY
501 - 1,000	1 per 250 CY
1,001 - 5,000	1 per 250 CY for first 1000 CY 1 per 500 CY thereafter
> 5,000	12 samples for first 5000 CY 1 per 1000 CY thereafter
<p>All samples are to be collected, analyzed and accepted before import/export: materials going to licensed facilities must meet sampling criteria from that facility. The rationale for sample approach should be discussed in the draft SSP.</p> <p>Pothole stockpile sampling may require discrete depth supplemental sampling in order to achieve representative results. The rationale for sample approach should be discussed in the draft SSP. In-situ (in place) sampling by mechanical boring or a hand auger method is acceptable if no space exists to store the soil stockpile at the site with prior OEHS approval.</p> <p>*Discuss alternative screening & sampling approaches with OEHS representative for project.</p>	

Chemicals of Potential Concern	TABLE 2 WASTE CHARACTERIZATION				
	Hazardous Waste if Exceed Criteria - TTLC Level* (mg/kg)	Additional WET Leaching Tests if Exceed Hazardous Waste Criteria - 10 times STLC Level** (mg/kg)	California-Regulated Hazardous Waste - Soluble Threshold Limit Concentration -STLC Level (mg/l)	Additional TCLP Leaching Tests if Exceed Hazardous Waste Criteria - 20 times TCLP Level** (mg/kg)	Federally-Regulated (RCRA) Hazardous Waste - Toxicity Characteristic Leaching Procedure - TCLP Level (mg/l)
CAM 17 Metals					
Antimony	500	150	15	NA	NA
Arsenic	500	50	5	100	5
Barium	10,000	1,000	100	2,000	100
Beryllium	75	7.5	0.75	NA	NA
Cadmium	100	10	1	20	1
Chromium	2,500	50	5	100	5
Cobalt	8,000	800	80	NA	NA
Copper	2,500	250	25	NA	NA
Lead	1,000	50	5	100	5
Mercury	20	2	0.2	4	0.2
Molybdenum	3,500	3,500	350	NA	NA
Nickel	2,000	200	20	NA	NA
Selenium	100	10	1	20	1
Silver	500	50	5	100	5
Thallium	700	70	7	NA	NA
Vanadium	2,400	240	24	NA	NA
Zinc	5,000	2,500	250	NA	NA
<i>Chromium (VI)</i>	500	50	5	NA	NA

TABLE 3 – WASTE CLASSIFICATION FLOWCHART



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.
 - 2. Section 01 1100 - Summary of Work.
 - 3. Section 01 5000 - Construction Facilities and Temporary Controls.
 - 4. Section 01 7329 - Cutting and Patching.
 - 5. Section 01 7419 - Construction and Demolition Waste Management.
 - 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 OAR. 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. Refer to Section 01 5000 - Construction Facilities and Temporary Controls.
 - 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 OAR.

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 10 00
CONCRETE FORMWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the "Standard Specifications for Public Works Construction," latest edition, Section 303, shall apply except as modified herein.

1.2 SCOPE

- A. Work of this Section includes all materials, labor and equipment necessary for and incidental to completing the Concrete Form work, as shown on the Drawings, as reasonably implied, or as specified herein, including, but not limited to, the following:
1. Forms for all concrete.
 2. Shoring and bracing.
 3. Setting of embedded items.
 4. Removal of forms.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Concrete:	Section 03 30 00
Concrete Reinforcement:	Section 03 20 00

1.4 STANDARDS

- A. Materials and workmanship shall conform to the requirements of all applicable building codes, except that requirements specified herein shall govern where they exceed those in the Building Code. Refer and comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified:

American Concrete Institute, ACT 347, "Recommended Practice for Concrete Form work."

1.5 QUALITY ASSURANCE

- A. Provide all openings in concrete Form work to accommodate work of other trades; accurately determine size and location of openings, recesses, etc., from trades providing or requiring such items; place items required for incorporating into concrete accurately and securely supported on forms.
- B. Base form and false work design on required values of live and dead loads, weight of moving equipment on Form work, height of concrete drop, foundation pressures, stresses, lateral stability and other safety factors required during construction.
- C. Materials used in Form work may not be reused except for use in other forms, without the Landscape Architect's recommended approval.

- D. Contractor shall verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces. Report to the Landscape Architect all conditions which prevent proper execution of this work.
- E. Use various form types as specified below. Refer to Concrete Section 03300 and use form materials for best results. All forms shall have a smooth straight upper edge and shall be free of any warping.

PART 2 - MATERIALS

All materials shall conform to Section 204 of the Standard Specifications except as modified herein.

2.1 FORM COATINGS

- A. Non-grain-rising and non-staining type that will not leave residue on surface of concrete or adversely affect bonding to concrete of paint, plaster, mortar or other applied materials. Coatings containing mineral oils or other non-drying ingredients will not be permitted. Submit manufacturer's data.

2.2 LUMBER

- A. Lumber shall be "Construction Grade" Douglas Fir.

2.3 PLYWOOD

- A. Plywood shall be of grade Exterior B-B. All plywood shall be at least 5/8" thick, and edge sealed. Plywood for forming exposed concrete shall be Plyform.

2.4 METAL FORMS

- A. Removable metal forms shall be of proper gauges and sizes, carefully aligned and fitted. Removable metal forms shall be properly reconditioned for use, clean, free from dents, bends, rust, oil or other coatings, and shall receive the recommended approval of the Landscape Architect prior to installation.

2.5 FORM TIES

- A. Prefabricated rod, flat band or wire type, or threaded internal disconnecting type of sufficient tensile strength to resist all imposed loads of fresh concrete and with external holding devices of adequate bearing area. Ties shall permit tightening and spreading of forms and leave no metal closer than one and one-half inches (1-1/2") from surfaces.

2.6 FORM TYPES

- A. Use Plywood or Metal Forms as specified above for exposed surfaces.
- B. Use Boards or Plywood as specified above for concealed surfaces.

PART 3 - EXECUTION

3.1 GENERAL

- A. Build forms to exact shapes, sizes, lines and dimensions as required to obtain accurate alignment, locations and grades, and level and plumb work. Provide for openings, offsets, keyways, recesses, chamfers, blocking, joint screeds, anchorages and other required features.
- B. Use metal spreaders to provide accurate spreading of forms and positive tying of forms together.
- C. Provide for recesses, rebates, drips and profiles as detailed.
- D. Forms shall be of materials and construction adequate to safely support all loads, so that no sagging, leakage or displacement occurs during and after pouring of concrete.
- E. Form joints shall not show in exposed concrete.
- F. Clean-outs and Cleaning - Provide temporary openings in wall and column forms for cleaning and inspection. Prior to pouring, clean all forms and surfaces to receive concrete.
- G. Provide 3/8" x 3/8" chamfer strips for exposed corners unless otherwise indicated. Use eight feet (8') long plywood for exposed surfaces.
- H. Fabricate form for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
- I. Forms shall be set with the upper edge of the board true to line and grade and shall be staked rigidly in place with stakes set not more than four feet (4') apart.
- J. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and all other debris just before concrete is placed. Re-tighten forms during and after concrete placement if required to eliminate mortar leaks.
- K. Clean and repair surfaces for forms to be reused in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form-coating compound material to concrete contact form surfaces.
- L. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove pins and tighten form to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces. Forms are to be inspected prior to pouring concrete.

3.2 FORM COATINGS

- A. Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound.
- B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.3 REGRETS & REBATES

- A. Each affected trade required to fasten work to the structure, or to insert therein any piping, conduit, duct, box bolt, anchor, insert or other rough hardware, shall set such items securely and accurately in the forms. Be responsible for any and all changes in such piping, box, bolt, anchor, inserts and other rough hardware after they have been set in the forms.
- B. Conduits and pipes in concrete slabs will be permitted to be embedded therein under the following conditions:
 - 1. Conduit or pipe diameter shall not exceed one-third (1/3) of the slab thickness
 - 2. Minimum spacing of conduit or pipe shall be three (3) diameters
 - 3. There shall be a minimum separation of one inch (1") from parallel reinforcing steel and conduit
 - 4. Minimum concrete coverage over conduits and pipes shall be one inch (1")
 - 5. No crossovers will be permitted except as specifically detailed
 - 6. No reinforcing steel shall be bent or displaced to permit passage of conduit or pipe
 - 7. No conduit or pipe shall be placed in slabs four and one-half inches (4-1/2") and less in thickness, unless specifically detailed or specifically authorized by the Landscape Architect
- C. Build into forms special features as the character and requirements of work dictate.
- D. Place pouring strips in the forms wherever horizontal construction joints are made in exposed concrete. Place pouring strips level and place concrete flush with the top of the pouring strip. After cleaning concrete surfaces and just ahead of placing of subsequent concrete, tighten form ties to conceal shrinkage.
- E. Carefully check with other trades before completing forms and placing concrete to determine all embedded items are in place in the forms. Set miscellaneous anchors, bolts, ties, dowels, plates, etc. necessary to complete the work as detailed. Embed no wood blocks other than treated built-in blocks or nailing blocks in concrete.

3.4 FORM REMOVAL

- A. Remove forms only when concrete has developed sufficient strength to sustain its own weight and super-imposed loads.

3.5 PAYMENT TERMS

- A. Payment for concrete formwork will be at the lump sum price bid for concrete. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in concrete formwork as herein specified. A 5% retention shall apply to all concrete work.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the "Standard Specifications for Public Works Construction," latest edition, Section 303, shall apply except as modified herein.

1.2 SCOPE OF WORK

- A. Work of this Section includes all material, equipment, and labor necessary for and incidental to completing all Concrete Reinforcement, as shown on the Drawings as reasonably implied, or as specified herein, including, but not limited to, the following:
 - 1. Reinforcing steel.
 - 2. Control during concrete placement.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: Section 03 30 00

1.4 STANDARDS

- A. Materials and workmanship shall conform to the requirements of all applicable building codes, except that requirements specified herein shall govern where they exceed those in the Building Code. Refer and comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.
 - 1. American Concrete Institute, ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 2. Concrete Reinforcing Institute, "Manual of Standard Practice."
 - 3. American Concrete Institute, ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
 - 4. American Welding Society, AWS D12.1, "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."

1.5 INSPECTION

- A. Contractor shall notify the District and Landscape Architect prior to pouring of concrete in order to inspect placement of all reinforcement.

1.6 TESTING

- A. Tests will be conducted as required by the District and in accordance with Section 303 of the Standard Specifications.

PART 2 - MATERIALS

2.1 REINFORCING STEEL BARS

- A. Shall be deformed steel bars conforming to ASTM A-615 and UBC Standard 26-4, and shall be Grade 40 or Grade 60. Refer to Section 303 of the Standard Specifications.

2.2 WELDED WIRE FABRIC

- A. Conform to ASTM A 185 and Standard Specifications, Section 303.

2.3 TIE WIRE

- A. Annealed steel, 16-gauge minimum, galvanized where concrete is exposed.

2.4 SUPPORTS FOR REINFORCING

- A. All supports for work exposed to view or weather shall be galvanized steel, or plastic-coated units so that finished surfaces will not be marred nor stained; supports shall be suitably sized and spaced for proper load distribution on earth or membrane so that membrane is not perforated and rebar does not set. Use no supports of wood or other cellulose material.

PART 3 - EXECUTION

- A. All work shall conform to the requirements of Section 303 of the Standard Specifications.

3.1 GENERAL

- A. Coordinate with other trades and expedite materials and labor to avoid omissions and delay in job progress.
- B. Clean reinforcement of loose mill scale, oil or other foreign coatings that might destroy or reduce bond prior to placement of concrete or grout.

3.2 FABRICATION AND DELIVERY

- A. Fabricate bars of indicated size and accurately form to shapes and lengths indicated and required, by methods not injurious to materials. Do not heat reinforcement for bending. Bars with bends or offsets not conforming to Drawings will be rejected.
- B. Bundle reinforcement and tag with suitable identification to facilitate sorting and placing and sufficient supply of proper reinforcement at site to avoid delays; transport and store at site so as not to damage material.

3.3 SECURING IN PLACE

- A. Accurately place reinforcement and securely wire tie in precise position at points where bars cross. Tie stirrups to bars at both top and bottom. Bend wire ties away from forms. Use galvanized wire ties in exterior walls, beams, columns, and slabs. Support horizontal bars in strict accordance with the "Manual of Standard Practice," latest edition, published by Concrete Reinforcing Steel Institute.

- B. Maintain proper placement of all reinforcement during entire pouring or grouting operation.

3.4 PLACING REINFORCING BARS

- A. Splice reinforcement as indicated on the Drawings and as specified herein. Avoid splices at critical connection and stress points. Lap as indicated or necessary to develop full strength or stress of bars. Stagger top splices and in horizontal wall reinforcement separate at least ten feet (10') longitudinally in alternate bars of opposite tiers. Extend stubs and dowel required to receive and engage subsequent work as sufficient length to develop full strength of bar or as indicated. Place dowel and stub bar in forms, and maintain placement during pouring of concrete or grout.
- B. Where reinforcement is interrupted by sleeves and openings, provide additional bars as indicated on the Drawings.
- C. When necessary, perform welding of reinforcing bars in accordance with "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections for Reinforced Concrete Construction" (AWS D12.1).

3.5 PLACING FABRIC REINFORCEMENT

- A. Roll out, straighten, cut to required size, and lay reasonably flat in place. Lap fabric one full mesh at sides and ends; securely wire together and to other reinforcement at frequent intervals.

3.6 CLEARANCES

- A. Exercise particular care to maintain proper distance and clearance between parallel bars and between bars and forms. Provide metal spreaders and spacers to hold steel in position as necessary. Use metal or plastic chairs to support reinforcing steel and mesh in concrete placed on earth and in footings. Transverse steel bars with hangers, or in another manner, as necessary.
- B. Minimum clear distances between reinforcing steel and face of concrete shall be as indicated on the Drawings, or as follows:
 - 1. Concrete footings formed against earth 3"
 - 2. Concrete in forms with exposed face in contact with earth 2"
 - 3. Walls As detailed
 - 4. Slabs Centered

3.7 PAYMENT TERMS

- A. Payment for concrete reinforcement will be at the lump sum price bid for concrete. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in concrete reinforcement as herein specified. A 5% retention shall apply to all concrete work.

END OF SECTION

SECTION 03 30 00

CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the "Standard Specifications for Public Works Construction," latest edition, shall apply except as modified herein.

1.2 SCOPE OF WORK

- A. Work of this Section includes all material, equipment, and labor necessary for and incidental to completing all Concrete Work, as shown on the Drawings, as reasonably implied, or as specified herein, including, but not limited to, the following:
 - Exterior walks and slabs as shown on Drawings.
 - Curbs, gutters, and mowing curbs.
 - Cast-in-place concrete.
 - Miscellaneous concrete items.
 - Setting of items to be inserted into concrete.
 - Cement, finish, joints, saw cutting, and patching.
 - Curing.
 - Testing.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Irrigation:	Section 32 80 00
Site Furnishings:	Section 32 33 00
Site Water Distribution Utilities:	Section 33 11 00
Concrete Form work:	Section 03 10 00
Concrete Reinforcement:	Section 03 20 00

1.4 STANDARDS

- A. Testing, materials and workmanship shall conform to the requirements of all applicable building codes, except that requirements specified herein shall govern where they exceed those in the Building Code.

1.5 SMOOTHNESS TOLERANCE

- A. Cement finish surfaces shall be of such smoothness and evenness that they shall contact the entire length of a ten foot (10') straight edge laid in any direction, with an allowable tolerance of one-eighth inch (1/8"). Any operations necessary to achieve this result shall be performed by the Contractor at no additional cost to the District.
- B. No patching will be permitted to correct defective work; defective Sections shall be removed to the nearest score line or construction joint and replaced. No extension of time will be allowed for correcting defective work.

1.6 INSPECTIONS

- A. Inspections will be required. Contractor shall call for inspection a minimum of forty-eight (48) hours (two working days) prior to need.
 - 1. The Contractor shall call for inspection upon completion of each of the following specific phases of construction, each prior to pour:
 - a. All form work placement/construction.
 - b. All footing excavation.
 - c. Sub-grade preparation.
 - d. Steel reinforcing placement.
- B. Any work covered prior to inspection shall be opened to view by the Contractor at his expense.

1.7 TESTING

- A. All testing shall be as required by the "Standard Specifications."

PART 2 - MATERIALS

- A. All materials shall conform to Section 201 of the "Standard Specifications."

2.1 "OR APPROVED EQUIVALENT" PRODUCTS

- A. This project is a Public Works project. Sole sourcing of material is not allowed. Any reference or call out on the plans and/or in the specifications to a specific manufacturer shall be interpreted as "or approved equivalent". The District Engineer's and Landscape Architect's approval is required as to whether or not a product meets the District's standard to be an approved equivalent. Bidders shall use the pricing for the products as specified to avoid risks of disapproval. No substitutions will be considered prior to the award of the contract.

2.2 CONCRETE

- A. Concrete shall be a minimum five (5) sack mix, with a maximum four inch (4") slump, 3,000 pounds per square inch ultimate compressive strength at twenty-eight (28) days and shall conform to Concrete Class Use Table, Section 201-1, of the Standard Specifications.

2.3 ADMIXTURE:

- A. Admixture shall be WRDA® 64, a polymer based aqueous solution which produces a concrete with lower water content, greater plasticity and higher strength, as manufactured by Grace Construction Products, or equal. The admixture shall not contain calcium chloride and shall comply with ASTM Designation C494, Type A water-reducing (or Type D water-reducing and retarding) admixtures.

2.4 REINFORCING STEEL

- A. Shall be in accordance with Section 03 20 00, Concrete Reinforcement and per Section 201-2 of the "Standard Specifications."

2.5 EXPANSION JOINTS

- A. Expansion joint material shall be foam material "Flexcell" as manufactured by Celotex Corporation, conforming with ASTM Standard D1751-61, "Fleximastic," conforming to ASTM D1190, or approved equal. Only one type of material to be used throughout the job. Submit samples of preformed materials for approval of the District.

2.6 SCORE JOINTS

- A. Shall be as shown on the plans and details.

2.7 CONCRETE CURING COMPOUND

- A. Shall be Type 1 - in conformance with Section 201-4 of the "Standard Specifications."

2.8 FORM LUMBER

- A. Shall be Douglas Fir, construction grade or better, in conformance with Section 303-1.3 of the "Standard Specifications."

PART 3 - EXECUTION

- A. All work shall conform to the requirements of Section 303 of the "Standard Specifications."

3.1 GENERAL

- A. The Contractor shall provide copies of all load tickets for all transit-mixed concrete delivered to the site.
- B. All concrete slabs shall slope to drain. Depressions in the slab surface that hold water ("bird baths") will not be acceptable.
- C. Install concrete and cement finish work true to lines, dimensions and grades.
- D. Protect all finished concrete from graffiti. The Contractor shall provide watchmen as required to insure a graffiti-free surface. Stoning and/or patching of concrete surfaces will not be permitted. Whole sections must be removed and replaced. A graffitied finish will not be acceptable.
- E. Remove and replace all defective concrete and defective cement finish work. All concrete with cracks shall be deemed unacceptable and the full panel shall be removed and replaced at the Contractor's sole expense. Permission to patch any defective area shall not be a waiver of the District's right to require complete removal of defective work if patching does not restore quality and appearance of work.
- F. No advertising impression, stamp, or mark of any description will be permitted on surface of concrete or cement finish.
- G. Concrete shall be poured prior to 11:00 a.m. Contractor is to guarantee curing of concrete free of graffiti.

3.2 PLACING CONCRETE

- A. Before placing of any concrete, thoroughly clean all forms, washout with water and make tight. Transport, place and spread concrete in a manner to prevent segregation of aggregate. Reinforcing shall be supported by metal or plastic chairs; concrete supports shall not be used. Refer to Sections 303-1.7 and 303-1.8 of the "Standard Specifications."

3.3 CEMENT FINISH

- A. Exterior slabs and walks-non-slip, uniform light broom surface, transverse to direction of slab, unless otherwise shown on the plans. Finish cast-in-place walls as designated on details.

3.4 CURING

- A. Initial curing shall be moist curing or moisture cover curing, and shall continue for at least 168 cumulative hours (not necessarily consecutive), during which the concrete has been exposed to air temperatures above 50 Degrees F. Avoid rapid drying at the end of the curing period.
- B. Use water that is free of impurities which could etch or discolor concrete surfaces.

Do not use liquid membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete, such as other concrete, liquid floor hardener, water-proofing, damp-proof flooring, painting, court surfacing materials and other coatings and finish materials, unless otherwise acceptable to the inspector.

3.5 COORDINATION

- A. All site furnishings, benches, drinking fountains, light poles, etc. shall be set in cured footings prior to placing concrete slabs. All foundations shall cure at least fourteen (14) days prior to placing concrete slabs.

3.6 PAYMENT TERMS

- A. Payment for concrete work will be at the lump sum price bid for concrete. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in concrete as herein specified. A 10% retention shall apply to all concrete work.

END OF SECTION

SECTION 05 0513
HOT-DIP GALVANIZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hot-dip galvanizing of structural steel articles.
2. Hot-dip galvanizing of steel stairs and railings.
3. Hot-dip galvanizing of fabricated steel assemblies.
4. Preparation of galvanized steel fabrications for painting.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 05 1200: Structural Steel Framing.
3. Section 05 5000: Metal Fabrications.
4. Section 05 5100: Metal Stairs and Railings.
5. Section 09 9000: Painting and Coating.

1.02 REFERENCES

A. American Galvanizers Association (AGA):

1. Inspection of Products Hot-dip Galvanized after Fabrication.
2. The Design of Products to be Hot-dip Galvanized after Fabrication.
3. Recommended Details of Galvanized Structures.
4. Suggested Specifications for Paint Preparation Galvanized Structures.
5. Preparing Hot Dip Galvanizing for Paint.
6. Preparing Hot-Dip Galvanized Steel for Powder Coating.
7. Wet Storage Stain.

B. ASTM International (ASTM):

1. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
2. ASTM A143 – Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A384 – Standard Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies.
5. ASTM A385 – Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
6. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
7. ASTM B6 – Standard Specification for Zinc.
8. ASTM B201 – Standard Practice for Testing Chromate Coatings on Zinc and Cadmium Surfaces.
9. ASTM D6386 – Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
10. ASTM D7803 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating.
11. ASTM E376 - Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.

C. The Society for Protective Coatings (SSPC):

1. SSPC-SP1 – Solvent Cleaning.
2. SSPC-SP2 – Hand Tool Cleaning.
3. SSPC-SP3 – Power Tool Cleaning, for surfaces to receive paint or powder coating.
4. SSPC-SP5 – White Metal Blast Cleaning.
5. SSPC-SP10 – Near White Blast Cleaning.
6. SSPC-SP16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.

1.03 COORDINATION WITH STEEL FABRICATOR

- A. Prior to fabrication, steel fabricators shall submit approved fabrication shop drawings to the galvanizer. The Galvanizer shall review fabricator shop drawings for suitability of materials for galvanizing and coatings and coordinate required fabrication modifications.
- B. Steel Fabricator shall notify the galvanizer of steel fabrications that exceed the ASTM A385 recommended percentages for carbon, phosphorus, manganese and silicon, so special galvanizing processing techniques are used. Galvanizer may request material test reports (MTRs) or metallurgical assays from fabricator.
- C. Coordinate with steel fabricator appropriate marking and masking materials.
- D. Coordinate modifications needed to the fabrications to accommodate lifting and handling during galvanizing.

1.04 QUALITY ASSURANCE

- A. Coating Applicator: Company specializing in hot-dip galvanizing after fabrication following the procedures in the Quality Assurance Manual of the American Galvanizers Association.
- B. Galvanizer shall have an in-plant inspection program designed to maintain the coating thickness, finish, and appearance within the requirements of this Section.

1.05 SUBMITTALS

- A. Galvanizing Certificate of Compliance: Submit to OAR notarized Certificate of Compliance with ASTM standards and specifications herein listed, noting exception for intentional bare areas. The Certificate shall be signed by the galvanizer and contain a detailed description of the material processed.
- B. When galvanizer prepares the surfaces of fabrications that will receive paint or powder coating over galvanizing provide statement indicating conformance with ASTM D6386 or D7803, as applicable.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Package and handle galvanized material in a manner which will avoid damage to the zinc coating.
- B. Store in dry, well-ventilated conditions until shipping.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel for Galvanizing: As specified in Sections:
 - 1. Section 05 1200: Structural Steel Framing.

2. Section 05 5000: Metal Fabrications.
 3. Section 05 5100: Metal Stairs and Railings.
- B. Zinc for Galvanizing: Conform to ASTM B6, as specified in ASTM A123.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Remove welding slag, splatter, anti-splatter compounds and burrs remaining in steel articles. If anti-splatter sprays are utilized, they shall be water-soluble or solvent-based.
- B. Provide drainage and venting holes in tubular assemblies. In thicker material drill holes in place of punching. Holes shall have a relatively uniform circumference. Punched holes or burned holes with a plasma torch shall be treated with a drill to even the diameter to appropriate size.
- C. Masking installed by steel fabricator shall remain in place through galvanizing process completion.
- D. Provide lifting holes or lugs to allow for handling during galvanizing. Avoid the use of chains or wires directly connected to steel articles to be duplexed or architecturally exposed.
- E. Safeguard against warpage or distortion of steel members in accordance with ASTM A384.
- F. Pre-clean steel work in accordance with accepted methods to produce an acceptable surface for quality hot-dip galvanizing. Remove surface contaminants and coatings that are not removable by the normal chemical cleaning process in the galvanizing operation by grit-blasting, sand-blasting, or other mechanical means.
- G. Markings and stickers from fabrication or shipping that will interfere with galvanizing adhesion shall be removed prior to beginning the galvanizing process.

3.02 COATING APPLICATION

- A. Galvanize steel articles, fabrications and assemblies by the hot-dip process in accordance with ASTM A123. The zinc used in the galvanizing bath shall conform to ASTM Specification B6. The molten metal in the working volume of the galvanizing bath shall contain at least 98.0 % zinc by weight.
- B. Galvanize bolts, nuts, washers and iron and steel hardware components in accordance with ASTM A153.
- C. Safeguard products against steel embrittlement in conformance with ASTM A143.

- D. Surface preparation requirements shall be performed in accordance to ASTM D7803 or D6386 but also in accordance with the paint manufacturer's requirements and recommendations.

3.03 COATING REQUIREMENTS

- A. Conform to paragraph 6.1 of ASTM A123, or Table 1 of ASTM A153, as applicable.
- B. Surface Finish: Conform to paragraph 6.2 of ASTM A123, or Paragraph 5 of ASTM A153, as applicable.
- C. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

3.04 TESTS

- A. Inspection and testing of hot-dip galvanized coatings shall be done under the guidelines provided in the AGA publication Inspection of Products Hot-dip Galvanized after Fabrication.
- B. Test in accordance with ASTM A123, or A153, as applicable, to determine the thickness of the zinc coating on the metal surface.
- C. During the visual inspection, if adhesion concerns are suspected, such as peeling or flaking of the galvanized coating, then adhesion testing using the stout knife method shall be conducted. Embrittlement testing is required when there is evidence of embrittlement and shall be conducted per the requirements of ASTM A143.
- D. Upon completion of tests furnish notarized Certificate of Compliance with ASTM standards and specifications as indicated in Article 1.05 Submittals.

3.05 REPAIR OF DAMAGED COATINGS

- A. Smooth out icicles by hand filing or power sanding the area without removing any more zinc coating than necessary. Smooth out rough and bumpy surface of fabrications to be painted, powder coated or are indicated as architecturally exposed.
- B. Remove lifting lugs and repair coating as indicated below.
- C. Repair areas damaged at the galvanizing facility using zinc rich paints, zinc-based solders or metalizing methods in accordance with ASTM A780, and meeting the minimum repair thickness in accordance with ASTM A123 and ASTM A153.

3.06 PREPARATION FOR TOP COATING

- A. Galvanized fabrications indicated on the drawings to be painted shall be prepared in accordance with ASTM D6386 and the American Galvanizers Association (AGA)

Suggested Specifications for Paint Preparation Galvanized Structures. For field painting refer to Section 09 9000, Painting and Coating.

- B. Galvanized fabrications indicated on the drawings to be powder coated shall be prepared in accordance with ASTM D7803.
- C. Galvanizer shall ensure water quenching and chromate passivation are not performed for fabrications scheduled for duplex coatings.

END OF SECTION

SECTION 05 05 19
POST-INSTALLED CONCRETE ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for materials and equipment for post-installed mechanical and adhesive anchors in concrete.

1.02 RELATED REQUIREMENTS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Section 01 45 33 - Code-Required Special Inspections: Test reporting.
- C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.
- D. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- E. Section 05 50 00 - Metal Fabrications.
- F. Divisions 10 - Specialties, 22 - Plumbing, and 26 - Electrical: Mounting of equipment and components.
- G. Other miscellaneous sections, where indicated.

1.03 REFERENCE STANDARDS

- A. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- E. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
- F. ASTM F594 - Standard Specification for Stainless Steel Nuts.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: If requested, manufacturer's product literature and installation instructions for each type of anchor indicated.
- C. Samples: If requested, representative length and diameters of each type of anchor shown on the drawings.

- D. ICC ES Reports: If requested, ICC Evaluation Service report indicating conformance with ICC-ES Acceptance Criteria.
- E. Field quality-control test and inspection reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 and Section 01 45 33 for testing indicated.
- B. Installer Training: Prior to beginning the work, manufacturer or manufacturer's representative shall provide on-site training for all contractor's personnel who will be installing anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in manufacturer's or distributor's original packaging undamaged, and with printed installation instructions.
- B. Store and handle all materials in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Provide products as indicated on the approved Structural Drawings.
- B. Substitutions: Substitutions of products from manufacturer's not listed are not permitted.
 - 1. Substitution of structural anchors requires structural calculations and DSA approval.

2.02 MATERIALS

- A. Interior Use: For use in conditioned environments free from potential moisture, provide zinc plated carbon steel anchors.
- B. Exterior Use:
 - 1. In exposed or potentially wet environments, and for attachment of exterior cladding materials, provide stainless steel anchors.
 - 2. Stainless steel nuts and washers shall be of matching alloy group of equal or greater strength than the rod.
 - 3. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
- C. Deformed Reinforcing Bars: Deformed steel rebar conforming to ASTM A615/A615M Grade 60. Permissible sizes as described in each adhesive products ICC report.

2.03 MECHANICAL ANCHORS

- A. Expansion, screw or undercut anchors having current ICC approval for use in cracked and uncracked concrete, with a published ICC Evaluation Service report.
 - 1. Type and size as indicated on drawings.

- B. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as indicated on Drawings:
 - 1. Hilti, Inc. Tulsa, OK; Hilti Kwik Bolt TZ Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete (ICC Report ESR-1917); www.us.hilti.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as follows:
 - 1. Simpson Wedge-All Wedge Anchor (ICC-ES ESR-1396)
 - 2. Hilti Kwik Bolt 3 Expansion Anchor (ICC-ES ESR-1385)
 - 3. Hilti Kwik Bolt TZ Expansion Anchor (ICC-ES ESR-3785)
 - 4. Simpson Titen HD Screw Anchor (ICC-ES ESR-1056)
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ADHESIVE ANCHORS

- A. Cartridge Injection Adhesive Anchors: Threaded carbon steel rod, inserts, or reinforcing dowels complete with required nuts, washers, adhesive system and manufacturer's installation instructions.
 - 1. Type and size as indicated on drawings.
 - 2. Current ICC approval for use in cracked and uncracked concrete with a published ICC Evaluation Service report required.
- B. Interior Use: Unless otherwise indicated on the Drawings, provide:
 - 1. Carbon steel threaded rods conforming to specification as indicated on structural drawings. Where no specification and grade are indicated, provide: ASTM A193/A193M Type B7 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
- C. Exterior Use: As indicated on the Drawings, provide stainless steel anchors.
 - 1. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.
 - 2. All nuts shall conform to ASTM F594, unless otherwise specified.
- D. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as indicated on Drawings:
- E. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:

2.05 CONCRETE SCREW ANCHORS

- A. Anchors shall be manufactured from carbon steel which is then heat-treated.
 - 1. Anchors shall be zinc-plated in accordance with ASTM B633, Class SC1, Type III.

2. Current ICC approval for use in cracked and uncracked concrete with a published ICC Evaluation Service report required.
 3. Provide anchors with a diameter and anchor length marking on the head.
- B. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as follows:
1. Simpson Strong-Tie Company, Inc.; Simpson Titen HD anchor, (ICC Report ER-2713) heavy duty screw anchor for concrete; www.simpsonanchors.com.
 2. Hilti, Inc.; Hilti KWIK HUS-EZ (KH-EZ) and KWIK HUS-EZ I (KH-EZ I) Carbon Steel Screw Anchors For Use In Cracked and Uncracked Concrete (ICC Report ESR-3027); www.hilti.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 POWER-DRIVEN/POWDER ACTUATED FASTENERS

- A. Use only if approved by Architect, generally not permitted where not specifically indicated or in load-bearing installations; as follows.
1. Hilti, Inc.; Hilti Low Velocity Power Driven Fasteners (ICC Report ESR-1663); www.us.hilti.com.
 2. Simpson Strong-Tie Company, Inc.; Simpson Strong-Tie® Powder-Actuated Fasteners, Threaded Studs and Assemblies (ICC Report ESR-2138); www.strongtie.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions
1. Base Material Strength: Unless otherwise specified, do not drill holes in concrete until concrete has achieved full design strength.
 - a. Adhesive anchors shall be installed in concrete having a minimum concrete compressive strength equal to or greater than the specified minimum 28-day compressive strength or a minimum age of 21 days at time of anchor installation. Whichever are more restrictive.
 2. Temperature of concrete surface and ambient air temperature must meet manufacturer's requirements prior to use of adhesive anchor products.
 3. Embedded Items:
 - a. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors.
 - b. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items.
 - c. Take precautions as necessary to avoid damaging anything embedded in the concrete including electrical/telecommunications conduit, gas pipes, and plumbing pipes.

- d. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling.
- 4. Beginning of installation indicates acceptance of existing conditions.

3.02 INSTALLATION

- A. Installation shall comply with all manufacturer's instructions and current ICC ESR report.
- B. Post-Installed Anchors in Hardened Concrete.
 - 1. Drilled-in anchors and/or powder driven pins in existing non-prestressed reinforced concrete: use care and caution to avoid cutting or damaging the existing reinforcing bars.
 - 2. Maintain a minimum clearance of one inch between the reinforcement and the drilled-in anchor and/or pin.
- C. Manufacturer shall provide on-site training for all personnel who will be installing post-installed adhesive anchors at the beginning of the work. Installation of anchors must be performed by a certified installer.
- D. Where manufacturer recommends use of special tools for installation of anchors, such tools shall be used, unless otherwise permitted specifically by the Engineer.
- E. Drill holes with rotary impact hammer drills using carbide-tipped bits. Bits must be of type required and permitted by ICC ESR report.
 - 1. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits.
 - 2. Drill bits shall be of diameters as specified by the anchor manufacturer.
 - 3. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - 4. Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer.
 - 5. Cored holes may only be used if acceptable to the Engineer and in compliance with ICC ESR report.
- F. Holes shall be cleared of debris after holes are drilled per manufacturer's instructions.
 - 1. For adhesive installations, at a minimum, holes shall be blown out with oil-free compressed air and shall be brushed with a wire or nylon brush.
 - 2. Holes shall then be blown out one additional time with oil-free compressed air.
 - 3. Additional hole cleaning requirements may be required by manufacturer and ICC ESR Report.
- G. During adhesive curing time period, the temperature of the substrate shall be kept above the minimum substrate temperature as defined by the manufacturer. Contractor shall determine the appropriate means and methods to ensure that the temperature is kept above the required minimum temperature required before adhesive installation is begun.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 33 - Code-Required Special Inspections.
- B. Inspection: Special inspection of post-installed anchors shall be provided as required by the ICC-ES report for that anchor and not less than the requirements of the Structural Drawings and the following (whichever is the most restrictive):
 - 1. Continuously observe the installation of all anchors, or as specified in the ICC report.
 - a. Minimum anchor embedments, proof loads and torques shall be as shown on the Drawings.
 - b. Load Testing: Per Structural General Notes on Drawings.
 - c. Post-Installed Anchor Load Testing: CBC Section 1910A.5.
 - 1) As indicated on Structural Drawings, minimum 10 % of drilled-in sill plate bolting anchor applications shall be proof loaded by the independent testing laboratory.
 - 2) 100 % of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory.
 - 3) Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Architect.
 - 4) Tension testing should be performed in accordance with ASTM E488/E488M.
 - 5) Torque shall be applied with a calibrated torque wrench.
 - 6) Proof loads shall be applied with a calibrated hydraulic ram, as required and indicated on the Structural Drawings. Comply with CBC 1910A.5.
 - 7) If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Architect.
 - d. Verify anchor type, anchor dimensions, hole dimensions, anchor spacing, edge distances, anchor embedment and adherence to the manufacturer's published installation instructions.
 - e. For adhesive anchors also verify hole cleaning technique, adhesive expiration date and proper mixing and dispensing.
 - 2. Subsequent inspection of installation will be required when there is a change of personnel doing the installation. Change is defined as any one or more persons drilling or preparing holes, or installing anchors.
 - 3. Visually inspect 100% of all installed anchors.
- C. Reporting:
 - 1. Daily reports shall reference the applicable ICC-ES report number, indicate that all specified criteria were complied with and provide itemized verification of all inspected items.
 - 2. Special Inspector shall immediately report any deviations from the requirements to the Architect.

D. Defective Work:

1. Installations that are not accepted by the Special Inspector shall be considered defective.
2. Provide additional testing and inspection to determine acceptability of defective work, as directed by the Architect at Contractor's expense.

3.04 REPAIR OF DEFECTIVE WORK

- A. Remove and replace misplaced, defective or malfunctioning anchors at Contractor's expense. Replacement of anchors requires signed structural detail, unless otherwise noted.
- B. Fill empty anchor holes and patch failed anchor locations with high-strength, non-shrink non-metallic grout.

END OF SECTION

SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal fabrications:

1. Steel thresholds.
2. Steel ladders and ladder safety cages.
3. Ramp and concrete stair railings.
4. Steel framing and supports for countertops.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel Gates.
8. Gratings, frames and covers.
9. Steel bollards.
10. Embedded edge angles in concrete.
11. Steel framing and supports for operable partitions.
12. Miscellaneous steel framing, supporting angles, plates, brackets, clips, anchors and bolts for equipment, and other work which is not specifically included in Section 05 1200, Structural Steel Framing.
13. Miscellaneous fabrications, as indicated on the Drawings.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 03 3000 – Cast-in-Place Concrete.
4. Section 04 2200: Concrete Unit Masonry.
5. Section 05 5013: Hot-Dip Galvanizing.

6. Section 05 1200: Structural Steel Framing.
7. Section 05 3000: Metal Decking.
8. Section 05 4100 Structural Cold Rolled Metal Framing.
9. Section 05 5100: Metal Stairs and Railings.

1.02

REFERENCES

A. ASTM International (ASTM):

1. ASTM A27 – Standard Specification for Steel Castings, Carbon, for General Application.
2. ASTM A36 – [Standard Specification for Carbon Structural Steel](#).
3. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
4. ASTM A53 - [Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless](#).
5. ASTM A123 - Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A283 - [Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates](#).
8. ASTM A307 - [Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength](#).
9. ASTM A500 - [Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes](#).
10. ASTM A501 - [Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing](#).
11. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
12. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
13. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
14. ASTM C1107 - [Standard Specification for Packaged Dry, Hydraulic-Cement Grout \(Nonshrink\)](#).

15. ASTM D1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
16. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
17. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

B. American Welding Society (AWS):

1. AWS D1.1 Structural Welding Code - Steel.
2. AWS D1.3 Structural Welding Code - Sheet Steel.
3. AWS D-19.0 Welding Zinc Coated Steel.

1.03 COORDINATION

A. Coordination between Steel Fabricator and Galvanizer:

1. Prior to fabrication, submit approved fabrication shop drawings to the galvanizer. Indicate fabrications to be painted or powder coated.
2. Notify galvanizer of steel fabrications that exceed the ASTM A385 recommended percentages for carbon, phosphorus, manganese and silicon, so special galvanizing processing techniques are used.
3. Coordinate modifications needed to the fabrications to accommodate lifting and handling during galvanizing.

B. Coordinate installation of metal fabrications that are anchored to concrete or masonry, or that receive work specified by other Sections. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

C. Field Measurements: Field verify dimensions prior to fabrication.

D. Coordinate selection of shop primers with galvanizing, and with paintings to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and paintings are compatible with one another.

1.04 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating provided materials, grade, dimensions, anchoring detail, and details of termination or connection to adjacent construction. Indicate items that are purchased from a manufacturer and items that are shop fabricated. Indicate component parts requiring Project site fabrication or assembly.

- B. Product Data: Submit Product Data for manufactured items. Submit Product Data for primers and finishes.
- C. Material Samples: Submit Samples of primers and finishes on fabricated items.
- D. Fabricator qualifications per Article “Quality Assurance”.
- E. Welding:
 - 1. Welder’s Certificates: Field welders shall be Project certified in accordance with AWS D1.1.
 - 2. Welding Material Certification: Provide certificate that welding material complies with specifications.
- F. Research/Evaluation Reports: ICC-ES for post-installed anchors.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm with a minimum five year experience in successfully producing metal fabrications similar to that shown on the drawings.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D-1.1– Structural Welding Code – Steel.
 - 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- C. Inspection of Welding: Refer to Section 01 4523: Testing and Inspection.
- D. Field applied primers, paintings, sealers and adhesives shall be approved by the OWNER’s Office of Environmental Health and Safety (OEHS).
- E. Preassemble items in shop to greatest extent possible to minimize field welding. Mark units for reassembly and coordination of installation. Use marking method compatible with galvanizing.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store miscellaneous metal items above grade on platforms, skids, or other required supports.
- B. Protect from damage and from corrosion, dirt, grease and other foreign matter.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural Steel Shapes: ASTM A36.

- B. Rolled Steel Plates: ASTM A36. Plates to be bent or cold-formed shall conform to ASTM A283, Grade C.
- C. Round HSS: ASTM A500 Grade B or C.
- D. Square and Rectangular HSS: ASTM A500 Grade B or C.
- E. Steel Pipe: ASTM A53 Type E or S, Grade B, standard weight (Schedule 40) minimum, unless otherwise noted or required to satisfy the performance requirements. Black finish.
- F. Steel Sheet: ASTM A1008 or ASTM A1011.
- G. Steel Bolts: ASTM A307, Grade A, or F3125 with hex steel nuts per ASTM A563 and washers. Galvanized in accordance with ASTM A153 for exterior locations.
- H. Steel Bars: Conforming to ASTM A108 or ASTM A575.
- I. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers, and shims, hot-dip galvanized per ASTM A153.
- J. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- K. Welding Rods and Bare Electrodes: In conformance with AWS specifications.
- L. Concrete Materials:
 - 1. Concrete per Section 03 3000, Cast-in-Place Concrete.
 - 2. Welded wire fabric and reinforcing per section 03 2000, Concrete Reinforcing.
- M. Galvanizing Repair Materials:
 - 1. Carbomastic 15 by Carboline, or OEHS approved zinc paints conforming with ASTM A780.
 - 2. Galva-Guard Galvanizing Repair Solder by San Diego Galvanizing Inc. or zinc-based solders conforming with ASTM A780.
 - 3. Metalizing methods in accordance with ASTM A780.

2.02 FABRICATION

- A. General:
 - 1. Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces. Mark units for reassembly and installation.
 - 2. Cut, drill, and punch metals cleanly and accurately. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated or specified. Remove sharp

and rough areas on exposed surfaces. Form exposed work with accurate angles and surfaces and straight edges. Form exposed connections with hairline joints, flush and smooth. Locate joints where least conspicuous.

B. Welding:

1. Weld connections unless otherwise indicated.
2. Weld corners and seams continuously and in accordance with requirements of AWS D1.1 Structural Welding Code. Welds shall be inspected as required in Section 05 1200: Structural Steel Framing.
3. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

2.03 RAILING FABRICATION

- A. Pipe Railing: Handrails, posts and pickets shall be fabricated of black ASTM A53 Type E or S, Grade B standard weight steel pipe.
- B. Handrail Brackets: Wagner cast iron bracket Style D, or equal.
- C. Form elbow bends and wall returns to uniform radius, free from buckles and twists. Close exposed ends of pipe and tubing by welding metal closure in place or by use of pre cased fittings.
- D. Accurately miter and cope intersections of posts, pickets and rails and weld all around, grind welds smooth.
- E. Connect posts to stair framing by direct welding, unless otherwise indicated.

2.04 PREPARATION FOR GALVANIZING

- A. Fabricate to the largest size possible and whenever possible use slip joints to minimize field welding.
- B. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's Recommended Details for Galvanized Structures, to facilitate galvanizing process. Corners of gussets, stiffeners, and bracing shall be cropped to allow free flow of zinc during galvanizing process.
- C. Remove welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
- D. Marking for Identification: Avoid unsuitable marking paints for identification, such as oil based paints and markers and crayon markers. Use water soluble paints or markers acceptable to galvanizer or steel tags wired to the work.
- E. Masking: Use masking materials recommended by the American Galvanizers Association (AGA) to produce ungalvanized areas for field welding and at slip critical bolts.

- F. Galvanize fabrications per Section 05 5013, Hot-Dip Galvanizing, in accordance with ASTM A123 and ASTM A153.

2.05 SHOP FINISH

- A. Metal fabrications shall be provided with a coat of primer, except those indicated to be hot-dip galvanized.
- B. Primers:
 - 1. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
 - 2. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - 3. Minimum dry film thickness of primer shall be 2.0 mils.
- C. Preparation for Primer Painting: Miscellaneous ferrous metal, except items specified galvanized, shall be thoroughly cleaned and prepared for painting, including removal of shipping oils or protective coatings, mill scale, grease, dirt and rust. Prepare in accordance with SSPC recommendations. Deliver to Project site primed or galvanized as indicated, and ready to receive Project site applied finishes.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the areas where metal fabrications are to be installed. Notify the OAR in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide anchorage devices and fasteners as indicated in the drawings and where necessary for securing miscellaneous metal fabrications to in-place construction.
- B. Cut, drill, and fit as required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of hot-dip galvanized fabrications intended for bolted or screwed field connections.
- D. Alignment: Verify alignment of items with adjacent construction. Coordinate related work.
- E. Grout: Follow manufacturer's recommendations for substrate preparation and application.

- F. Corrosion Protection: Coat concealed surfaces of metals that will come into contact with grout, concrete, masonry, or wood, with a heavy coat of bituminous paint or zinc chromate primer. Protect dissimilar metals from galvanic corrosion by pressure tapes, coating, or isolators.

3.03 FIELD WELDING

- A. Preparation of Weld Area of Galvanized Fabrications: Remove masking from fabrications. Remove remaining zinc coating between one inch and four inches from both sides of members to be welded, by grinding back the zinc coating, burning the zinc away or pushing back the molten zinc from the weld area.
- B. Welding: Comply with AWS Code for procedures of manual shielded metal-arch welding, appearance and quality of welds made, methods used in correcting welding work.
 - 1. Weld in accordance to AWS D-1.1.
 - 2. Weld galvanized fabrications in accordance to AWS D-19.0.
- C. Remove welding flux immediately. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surfaces matches those adjacent.
- D. Upon completion of welding plug vent, drainage and lifting holes of galvanized fabrications with appropriate diameter zinc plugs. Push in about half way by hand, and hammer to a tight fit. With a hand file or an abrasive tool, file away excess material. Repair scratches with a zinc rich coating.
 - 1. Plug railing holes.
 - 2. Plug visible holes of HSS members.

3.04 ADJUSTING AND CLEANING

- 1. Touch Up Damaged Painted Finishes: Comply with SSPC-PA-1 for touch-up; apply with brush to produce a minimum 2.0 mil dry film thickness.
- A. Galvanized Surfaces: Clean field welds, connections and damaged areas.
 - 1. Apply two coats of Carbomastic 15 or a zinc rich coating in conformance with ASTM A780 and approved by OWNER's OEHS. Brush or roll to a 4 to 6 mil thickness.
 - 2. Apply Galva-Guard Galvanizing Repair Solder or other zinc-based solders in conformance with ASTM A780.
 - 3. Apply metalizing methods in accordance with ASTM A780.

3.05 CLEAN UP

- A. Remove rubbish, debris, and waste materials 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 06 2000

FINISH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Finish carpentry.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 06 1000: Rough Carpentry.
3. Section 06 4000: Architectural Woodwork.
4. Section 08 1416: Flush Wood Doors.
5. Section 08 7100: Door Hardware.
6. Section 08 8000: Glazing.
7. Section 09 2900: Gypsum Board.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings of each item of finish carpentry and millwork, indicating materials, dimensions, construction, and anchorage details.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Douglas fir finish lumber shall be manufactured and graded in accordance with WCLIB - Standard Grading and Dressing Rule No. 17.
2. Redwood finish lumber shall be manufactured and graded in accordance with RIS - Standard Specifications for Grades of California Redwood Lumber.
3. Hardwood finish lumber shall be manufactured and graded in accordance with NHLA - Rules for the Measurement and Inspection of Hardwood and Cypress Lumber.

4. Softwood Plywood: Plywood shall comply with APA - Product Standard PS 1. Plywood shall be grade marked by APA.
 5. Products and installation shall comply with the North American Architectural Woodwork Standards (NAAWS) for the Grade or Grades specified.
- B. Finish lumber shall be kiln-dried according to recognized methods for the thickness and species. Lumber one inch thick or less shall be dried to an average moisture content of not more than 13 percent. Lumber 1-1/4 inches to 2 inches in thickness shall be dried to an average moisture content of not more than 15 percent.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in undamaged condition, stored in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.
- B. Interior millwork and finish carpentry shall not be installed unless interior building temperature and humidity levels are within the ranges recommended by the manufacturer and/or recognized standards.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Douglas Fir: Interior trim, solid lumber shelves, partitions, door frames and other concealed members of interior finish; NAAWS Economy Grade.
- B. Hardwood: Birch, maple firsts and seconds.
1. Birch: NAAWS Custom Grade.
 2. Maple: NAAWS Custom Grade.
- C. Softwood Plywood: Except where otherwise specified, AWI Custom Grade, Douglas fir unless otherwise indicated.
- D. Hardwood Plywood: NAAWS Premium Grade, species as indicated.
- E. Redwood: Exterior millwork, except framing lumber, shall be clear heartwood redwood. Where installed in direct contact with earth or provided for exterior storage units, install Foundation Grade.
- F. Perforated Hardboard Panels: Panels shall be 1/4 inch thick tempered hardboard, SIS with 1/4 inch diameter holes spaced one inch on center.

2.02 FABRICATION

- A. The means of fastening various parts together shall be concealed in finished Work. Work which is curved shall be fabricated from solid stock, or if veneered, shall be bent to a uniform radius.

PART 3 - EXECUTION

3.01 GENERAL

- A. Interior and exterior wood, millwork, blocking, and lumber shall be installed level, plumb, and true to line. Members shall be neatly and accurately scribed in place, maintaining full widths of end members, wherever possible. Trim shall be installed in full lengths, without piecing, except where use of single lengths is not required. Butt joints, if necessary, shall be beveled. Exterior angles shall be mitered, and interior angles of molding parts coped. Nails shall be set for putty. Grain and color of adjoining interior finish shall match adjacent finishes. Where Work specified in this section adjoins other Work, provide a neat tight joint.
- B. Interior and exterior finish carpentry and other fixed wooden equipment having hammer marks or other visible damage will be deemed defective Work.
- C. Staff or brick moulds of exterior wood doorframes shall be attached to frames after frames have been set and caulked. Moulds shall be mitered at corners and coped to sills, accurately secured in place with finish nails, and nails set.

3.02 INSTALLATION

- A. Install Work of this section as specified in the North American Architectural Woodwork Standards.
- B. Wood shoe base shall be fitted and temporarily tacked in place until floor covering is installed. Provide and install corner fillets, same contour and materials as shoe base, in corners where shoe base is installed.
- C. Platform Front: Plywood at platform front and adjoining steps in Multi-Purpose Building shall be provided with face veneers of unselect birch. Trim and frames shall match face veneer of panels. Joints shall be V-shaped where indicated.
- D. Door Frames: Frames shall be installed plumb and true, solidly blocked, reinforced for butts and hardware, and shall be fastened to structural frame with 16d set finish nails at not more than 24 inches on centers. Nails securing exterior door and window frames shall be cement coated. Doorframes shall be dadoed together at the head.
- E. Sealing of Joints: Joints between exterior frames and adjoining surfaces shall be primed before sealing.

3.03 CLEAN UP

- A. Remove debris, rubbish and waste material 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 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 06 2000 - Finish Carpentry.
3. Section 07 0800 Commissioning of Thermal and Moisture Protection.
4. Section 07 6000 - Flashing and Sheet Metal.
5. Section 07 8413 - Penetration Firestopping.
6. Division 08 - Openings.
7. Division 09 - Finishes.

1.02 REFERENCES

A. ASTM Standards:

1. ASTM C834 - Standard Specification for Latex Sealants.
2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
3. ASTM-C1193 - Standard Guide for Use of Joint Sealants.
4. ASTM C1311 - Standard Specification for Solvent Release Sealants.
5. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
6. ASTM D2377 - Standard Test Method for Tack-Free Time of Caulking Compounds and Sealants
7. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

1.03 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 C1521 for each substrate.
- G. CxSP will review the Submittals of this Section as part of the Commissioning of Thermal and Moisture Protection.

1.04 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.
- B. Commissioning of Thermal and Moisture Protection: Refer to Field Quality Control article for testing of sealants.

1.05 DELIVERY, STORAGE AND HANDLING

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

1.06 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 50.
 - a. Dow Corning Corp., Dow Corning 791, 795.
 - b. General Electric Co., Silpruf SCS 2000, SCS 9000 NB.
 - c. Tremco, Inc., Spectrem 2.
 - 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 D2377.
 - 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 C1193.
- 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	Sealant 1	To Match Adjacent

not otherwise scheduled

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 FIELD QUALITY CONTROL

- A. Commissioning of Thermal and Moisture Protection: CONTRACTOR shall perform field adhesion tests of sealants of the work of the Sections listed below in accordance with manufacturer's instructions and ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken. Number of tests shall be per ASTM C1521, Destructive Procedure.
 - 1. Section 08 4113 – Aluminum Entrances and Storefronts.
 - 2. Section 08 4413 – Glazed Aluminum Curtain Walls.
 - 3. Section 08 5113 – Aluminum Windows.
 - 4. Section 08 6323 – Metal-Framed Skylights and Sloped Glazing.

3.07 CLEANING

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

3.08 CURING

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

3.09 PROTECTION

- 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 08 8000 - Glazing.
6. Section 09 9000 - Painting and Coating.
7. Section 28 1600 - Intrusion Detection Systems.

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 3/4 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.

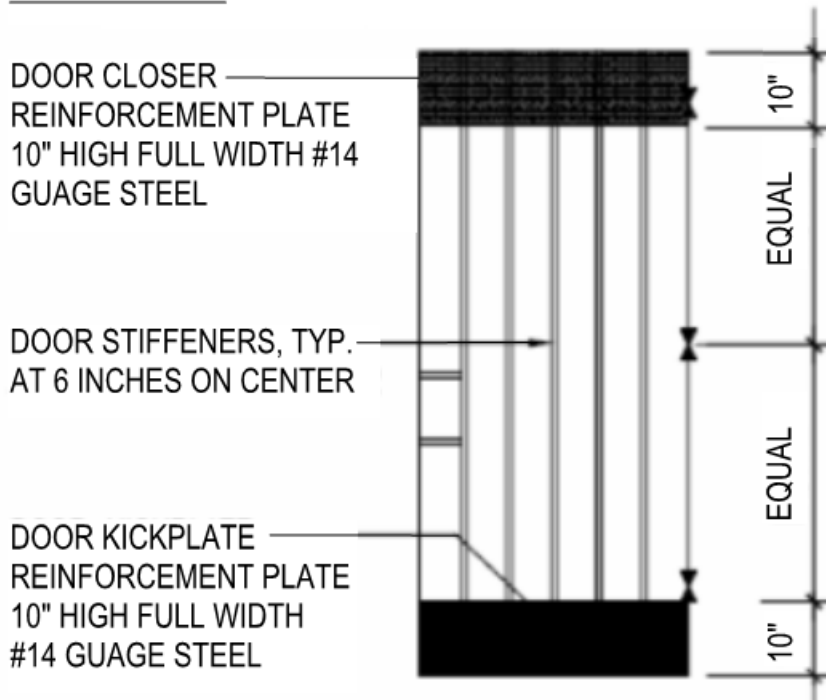
3.05 PROTECTION

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

END OF SECTION

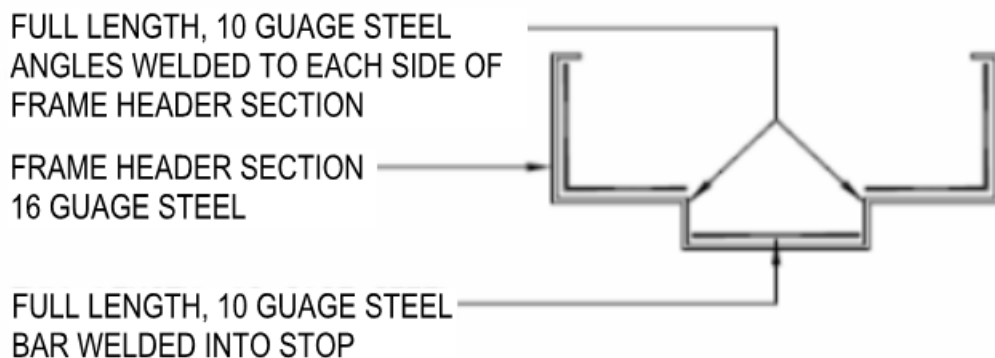
DETAIL #1 - DOOR REINFORCEMENT

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 13 13

HOLLOW METAL DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes the following:
 - 1. Non-rated and Fire-rated rolled-steel doors.
 - 2. Glass stops.
- B. Related sections described elsewhere:
 - 1. Section 08 12 13: Hollow Metal Frames
 - 2. Section 08 80 00: Glazing

1.02 REFERENCES

- A. SDI - Steel Door Institute.
- B. ANSI A250.8/SDI 100 - Recommended Specifications for Standard Steel Doors and Frames.
- C. SDI 118 – Basic Fire Door Requirements.
- D. SDI 111 – Standard Details Steel Doors and Frames.
- E. SDI 117 - Manufacturing Tolerances Standard Steel Doors and Frames.
- F. ANSI A250.4 - Test Procedures and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing's.
- G. ANSI A250.5 - Accelerated Physical Endurance Test Procedure for Steel Doors, Frames, and Frame Anchors.
- H. ASTM A653/A653M-98 - Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM A924/A 924M - General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- J. ASTM A1008/A1008M - Standard Specifications for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- K. ASTM A568/A568M - General Requirements for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- L. UL - Underwriters Laboratory.

- M. WH - Warnock-Hersey Laboratory.
- N. NFPA 80, Fire Doors and Fire Windows.
- O. 2022 California Building Code (CBC).

1.03 SUBMITTALS

- A. Shop drawings indicating core material, location of cutouts for hardware, reinforcement and finish.
- B. Product data.
- C. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Manufacture doors to conform to SDI standards except where exceeded by this Specification.
- B. Comply with ANSI/SDI A250.4 Test Procedure and Acceptance Criteria for –Physical Endurance for Steel Doors and Hardware Reinforcings. Level A, one million cycle swing test performance.

1.05 DELIVERY, STORAGE AND PROTECTION

- A. Deliver and protect doors with manufacturer's shipping safeguards.
- B. Storage: Store in dry secure location. Place units on minimum 4 inch high wood blocking. Avoid non-vented plastic or canvas shelters. Provide 1/4 inch wide spaces between stacked doors.

1.06 WARRANTY

- A. One year warranty against defects in materials and workmanship. Warranty to commence at Date of Certified Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products of following manufacturers form the basis for design and quality intended.
 - 1. Amweld Building Products LLC
 - 2. Benchmark
 - 3. Ceco
 - 4. Curries
 - 5. Firedoor
 - 6. Steelcraft
 - 7. Windsor Republic Doors

- B. Or equal in accordance with Division 01, General Requirements for Substitutions.

2.02 DOORS

- A. Exterior Doors: ANSI A250.8/SDI-100, Level 4, maximum duty, 1-3/4 inches thick, Model 2 seamless, 14 gauge cold-rolled face sheets, ASTM A653/A-653M, seamless, continuously welded seam dressed smooth, hollow-steel construction, sizes as scheduled on drawings. Close top and bottom with flush channel.
- B. Interior Doors: Cold-rolled steel sheets Level 2, Commercial quality heavy-duty, 18 gauge, carbon steel ASTM A 1008.
- C. End Closures: Minimum 18-gauge.
- D. Fire Rated Doors: Label "S" for smoke assembly requirements, NFPA 80.

2.03 DOOR CORE

- A. Performance Test Procedures Requirements: Conform to ANSI A250.4
- B. Core for non-fire-rated doors:
 - 1. Core for exterior doors and Thermal-Rated (Insulated) Doors: vertical stiffeners 6 inches o.c., 22 gauge steel, spot welded to face sheets 6 inches o.c. with minimum 1 lb/cu.ft. density insulation U-factor 0.29 minimum and R-factor of 3 min. or with min. polystyrene 1 lb/cu ft. density of U-factor 0.21 min. and R-factor of 5 min., full thickness of cavities.
 - 2. Core construction shall conform to requirements of the grade of door specified in accordance with ANSI A250.8/SDI-100, Sections 2.3.2 and 1.4.
- C. Core for Fire-Rated Doors: polystyrene or mineral-core 16-20 lb. density (incombustible) for temperature-rise doors, rating; 250 degrees. Conform to Door Schedule for fire rating required.
- D. Frames for Fire-Rated Doors: Conform to NFPA 80 and Section 08 12 13.

2.04 ACCESSORIES

- A. Glass Stop: Unit frame, model FGS-75 manufactured by Anemostat Products Division, Carson, CA, or an approved equal, for fire-rated and non-fire rated doors.
 - 1. Frame: 18 gauge.
 - 2. Baked-Enamel or Powder-Coat Finish: AAMA 2605 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: to match 08 43 00 Aluminum Storefront finish.
 - 3. Unit shall have UL or WH label and State Fire Marshal approval number.
 - 4. Fire Rated Glass: As specified in Section 08 80 00.
 - a. Wire glass is prohibited in all doors and lights within safety glazing required locations.
 - 5. Mounting: Countersunk, one-way vandal-resistant heads, through-bolts or one side mounting sheet metal screws from inside.

6. Exterior Doors: Unit shall be hot-dip galvanized after fabrication.

2.05 PROTECTIVE COATINGS

- A. Exterior Doors:
 1. Metallic coating protection required, types permitted: ASTM A653/A-653M, hot-dip galvanized, zinc-coated Commercial Steel, G60 coating designation.
 2. Baked-Enamel or Powder-Coat Finish: AAMA 2605 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color and Gloss: to match 08 43 00 Aluminum Storefront finish.
- B. On surfaces where zinc has been damaged or removed during fabrication, doors shall be touched-up with factory-applied power coat.

2.06 FABRICATION

- A. Fabricate doors from cold-rolled steel conforming to ASTM A1008/A1008M or ASTM A924. Stretcher-leveled standard of flatness for face sheets.
- B. Fabricate doors with cutouts sized for hardware and openings as indicated. Non-handed doors using hinge fillers are not permitted.
- C. Reinforce, drill and tap doors to receive mortise hinges, locks, latches, flush bolts and closer. Use reinforcing gauges as listed in Table 4 of ANSI A250.8/SDI-100. Channel or plate reinforcing only.
- D. Locate hardware according to Table 5, ANSI A250.8/SDI-100, CBC 11B-404.
- E. Attach fire-rated label to hinge-stile of each fire-rated door unit and frames.
- F. Hardware Enclosures: Provide enclosures and junction boxes within doors for electrically operated door hardware, interconnected with UL-approved, 1/2-inch diameter conduit and connectors.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install doors under Section 06 10 00.
 1. Doors shall be adjusted to proper clearances using shims (not by binding the hinges).
 2. Provide continuous hinges.
- B. Fire doors and frames shall be installed in accordance with their listing, NFPA No. 80 and the manufacturer's instructions.
- C. Factory Finish Power Coat to match 08 43 00 Aluminum Storefront selected color.

END OF SECTION

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 06 2000 - Finish Carpentry.
3. Section 08 1113 - Hollow Metal Doors and Frames
4. Section 08 7100 - Door Hardware.
5. Section 08 8000 - Glazing.
6. 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 Institute 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. Exterior Flush Doors:
 - 1. Exterior doors shall be furnished as follows:
 - a. Transparent Finished (Stained): NAAWS Custom grade, extra heavy duty grade, solid wood core, 5 ply, veneer faces, fully bonded to core.
 - b. Opaque Finished (Painted): NAAWS Custom grade extra heavy duty grade, solid wood core, 5 ply, medium density overlay faces, bonded to core.
 - 2. Staved Lumber Core shall be low density, thoroughly kiln-dried wood blocks not more than 2 ½-inches wide, with joints staggered, and random lengths.
 - 3. Edge strips: Shall be kiln-dried birch or maple
 - a. Transparent Finished Doors: Same species as face veneer or similar in overall color, grain, character and contrast as the face veneer.
 - b. Opaque Finished Doors: Close grain hardwood.

4. Full stile edge strip shall be not less than 2 inches wide. Stiles shall be fully bonded to the core. The outer face stiles shall be full length $\frac{3}{4}$ inch birch or maple. The inner back stile shall be 1 $\frac{1}{4}$ -inch, 2 ply of similar species which may have four finger joints well staggered or be full lengths.
5. Top rail shall be a minimum of 2 inches with a maximum of three plies. Bottom rail shall be a minimum of 5 inches with a maximum of 6 plies. The outer rail faces shall be full length $\frac{7}{8}$ inch of same species as edge strips. The inner rails shall be full length of similar species. Rails shall be fully bonded to core.
6. Crossbanding: Doors shall be furnished with full width crossbanding of properly dried hardwood, $\frac{1}{16}$ inch thick, with a density of 52 pounds or higher per cubic foot.
7. Face Veneer for Transparent Finished Doors: NAAWS Custom grade, veneer shall be Grade "A". Minimum thickness shall be 0.0277 inches before sanding and 0.020 inches after sanding of specified face veneer.
 - a. Veneer Species:
 - b. Veneer Cut: [Rotary] [Plain] [Quarter]
 - c. [Rift-cut]
 - d. Veneer Match: [Book] [Slip] [Random]
 - e. [Running] [Balance] [Center]
 - f. Pairs: [Matched] [Not Matched]
8. Opaque Finished Doors: Custom grade medium density overlay hardboard.
9. Adhesive and Bonding: Bonding between veneer plies of wood face panels, and between door faces, frame and core unit shall be fabricated with type I waterproof cross-linking emulsion PVA adhesive.
10. Openings: Openings for lights, louvers and grilles, shall be fabricated by manufacturer, or in a certified door service mill in accordance with manufacturer's details, and in compliance with approved testing agency.
11. Louvers:
 - a. Louvers for exterior doors shall be furnished with at least 12 gage frame and security grill 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.
 - b. Light-proof louvers (at Dark Rooms): Type DRDL by Anemostat, Air Louver Model 1000, L & L Louvers, or equal.

- c. Louvers shall be furnished with factory primer.
- 12. Vision Panels: Vision panels in exterior doors shall be framed with Security Grille Glass Stop: Anemostat SI-IS, Air Louvers Inc. VLF-SG, L & L Louvers, or equal. Install vision panels with tamperproof-head through bolts. Security Grille shall be supplied with manufacturer's standard baked-on enamel finish.
- 13. Security Grilles: Refer to Section 08 5656.

B. Interior Flush Doors:

- 1. Interior doors shall be furnished as follows:
 - a. Transparent Finished (Stained): NAAWS Custom grade. Solid wood core, 5 ply, veneer faced, fully bonded to core.
 - b. 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. Transparent Finished Doors: Same species as face veneer or similar in overall color, grain, character and contrast as the face veneer.
 - b. 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. Face Veneer for Transparent Finished Doors: Custom grade, veneer shall be Grade "A". Minimum thickness shall be 0.0277 inches before sanding and 0.020 inches after sanding of specified face veneer.
 - a. Veneer Species:
 - b. Veneer Cut: [Rotary] [Plain] [Quarter]
 - c. [Rift-cut]
 - d. Veneer Match: [Book] [Slip] [Random]

- e. [Running] [Balance] [Center]
- f. Pairs: [Matched] [Not Matched]
- 7. Opaque Finished Doors: Custom grade medium density overlay hardboard.
- 8. 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.
- 9. 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.
- 10. Louvers:
 - a. Louvers for interior doors shall be furnished with at least 12 gage cold rolled steel frames and security grill welded to 18 gage blades: Anemostat PLSL, Air Louvers Inc. Model 1500-A, L & L Louvers, or equal.
 - b. For fire rated doors: Anemostat FLDL-UL-SG2, Air Louvers Inc. Model 1900-ASG, L & L Louvers, or equal.
 - c. Light Proof Louvers (at Dark Rooms): Anemostat Model DRDL, Air Louvers Inc. Model 1000, L & L Louvers, or equal.
 - d. Install louvers with tamperproof-head through bolts.
- 11. 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.

C. 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. FACTORY FINISHING:

1. Factory finishing shall be NAAWSI Custom Grade and include all necessary preparation, materials and labor to provide an [Opaque] [Clear Transparent] [Stained Transparent] finish.
2. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
3. Finish: NAAWS [System 5, conversion varnish] [System 9, UV curable, acrylated epoxy, polyester, or urethane] [System 10, UV curable, water based] [or] [System 11, catalyzed polyurethane].
4. Staining: [Match Architect's sample] [As selected by Architect from manufacturer's full range] [None required].
5. Effect: [Open-grain finish] [Filled finish] [Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores].
6. Sheen: [Satin] [Semigloss].

B. 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.
 - b. Doors Scheduled for Transparent Finish: Prime with stain and first coat of finish as indicated in 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 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware.
2. Battery-powered electronic credential access control locks and panic hardware lever trim.
3. Cylinders for doors fabricated with locking hardware.
4. Stainless steel guard rails between pairs of exterior doors.

B. Related Divisions:

1. Division 06 – door hardware installation
2. Division 07 – Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
3. Division 08 – metal doors and frames, wood doors

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

1. Windows.
2. Cabinets, including open wall shelving and locks.
3. Signs.
4. Toilet accessories, including grab bars.
5. Installation.
6. Rough hardware.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute
 - a) ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties.
2. BHMA – Builders Hardware Manufacturers Association
3. 2022 California Building Code.
 - a) Chapter 11B – Accessibility To Public Buildings, Public Accommodations, Commercial Buildings and Public Housing.
4. DHI – Door and Hardware Institute.
5. UL – Underwriters Laboratories
 - a) UL 305 – Panic Hardware
6. WHI – Warnock Hersey Incorporated State of California Building Code
7. Local applicable codes
8. SDI – Steel Door Institute
9. WI – Woodwork Institute
10. AWI – Architectural Woodwork Institute
11. NAAMM – National Association of Architectural Metal Manufacturers

B. Abbreviations

1. Manufacturers: see table at 2.1.A of this section.
2. Finishes: see 2.7 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

- A. SUBMITTALS: Submit electronic copy of schedule. Organize vertically formatted schedule into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt font size. Include following information:
1. Type, style, function, size, quantity, and finish of hardware items.
 2. Use BHMA Finish codes per ANSI A156.18.
 3. Name, part number and manufacturer of each item.
 4. Fastenings and other pertinent information.
 5. Location of hardware set coordinated with floor plans and door schedule.
 6. Explanation of abbreviations, symbols, and codes contained in schedule.
 7. Mounting locations for hardware.
 8. Door and frame sizes, materials, and degrees of swing.
 9. List of manufacturers used and their nearest representative with address and phone number.
 10. Catalog cuts.
 11. Manufacturer's technical data and installation instructions for electronic hardware.
- B. Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.
- C. Deviations: Highlight, encircle or otherwise identify deviations from "Schedule of Finish Hardware" on submittal with notations clearly designating those portions as deviating from this section.
- D. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.
- E. Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.
- F. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.
- G. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE:

- A. Qualifications:
1. Hardware supplier: direct factory contract supplier who employs a hardware consultant, available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.
 - a) Responsible for detailing, scheduling, and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

- B. **Hardware:** Free of defects, blemishes, and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges, and closers) from one manufacturer.
- C. **Exit Doors:** Operable from inside with single motion without the use of a key or special knowledge or effort.
- D. **Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions and code requirements.**

1.5 DELIVERY, STORAGE AND HANDLING:

- A. **Delivery:** coordinate delivery to appropriate locations (shop or field).
 - 1. **Permanent keys and cores:** secured delivery direct to Owner's representative.
- B. **Acceptance at Site:** Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.
- C. **Storage:** Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION:

- A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.
- B. **Coordination:** Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information:
 - 1. Location of embedded and attached items to concrete.
 - 2. Location of wall-mounted hardware, including wall stops. Note: Careful coordination required for reinforcement/blocking for wall stop support. If random inspection yields an unsupported wall stop, all locations will be rebuilt at no expense to the Owner or Architect.
 - 3. Location of finish floor materials and floor-mounted hardware.
 - 4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits.
 - 5. Coordinate: flush top rails of doors at out swinging exteriors, and throughout where adhesive-mounted seals occur.
 - 6. Manufacturers' templates to door and frame fabricators.
- C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.
- D. **Environmental considerations:** segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

1.7 WARRANTY:

- A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties.
- B. Include factory order numbers with close-out documents to validate warranty information, required for Owner in making future warranty claims:
- C. Minimum warranties:
 - 1. Mortise Locksets: Ten years mechanical
 - 2. Stand Alone Electric Locks One year
 - 3. Exit Devices: Ten years mechanical
 - 4. Closers: Thirty years mechanical
 - 5. Hinges: One year
 - 6. Other Hardware Two years

1.8 COMMISSIONING:

- A. Conduct these tests prior to request for certificate of substantial completion:
 - 1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.

1.9 REGULATORY REQUIREMENTS:

- A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2022 California Building Code, Section 11B-404.2.7.
 - 1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.
- B. Handles, pull, latches, locks, other operable parts:
 - 1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2022 California Building Code Section 11B-309.4.
 - 2. Force required to activate the operable parts: 5.0 pounds maximum, per 2022 California Building Code Section 11B-309.4.
- C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2022 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
 - 1. Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
- D. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2022 California Building Code Section 11B-404.2.8.
- E. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2022 California Building Code Section 11B-404.2.10.

1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges. Cavities created by kickplates to be capped per 2022 California Building Code Section 11B-404.2.10.
 2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.
- F. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and below 80 inches, and the hardware projects no more than 4 inches. 2022 California Building Code Section 11B-404.2.3.
1. Exception: In alterations, a projection of 5/8 inch (15.9 mm) maximum into the required clear width shall be permitted for the latch side stop.
 2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2022 California Building Code 11B-307.4.
- G. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2022 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). 2022 California Building Code Section 11B-303.2 & ~.3.
- H. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from wall.
- I. Pairs of doors with independently activated hardware both leafs: limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2022 California Building Code Section 11B-703.4.2.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Listed acceptable alternate manufacturers: these will be considered; submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE ALTERNATE:
Hinges	(IVE) Ives	Bommer
Key System	(SCH) Schlage	Owner standard
Mechanical Locks	(SCH) Schlage	Owner standard
Electronic Locks	(SCE) Schlage Electronics	Owner standard
Exit Devices	(VON) Von Duprin	Owner standard
Closers	(LCN) LCN	Owner standard
Auto Flush Bolts	(IVE) Ives	DCI
Coordinators	(IVE) Ives	DCI
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Thresholds	(ZER) Zero	NGP, Pemko
Seals & Bottoms	(ZER) Zero	NGP, Pemko

2.2 HINGING METHODS:

- A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.
- B. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.
- C. Conventional Hinges: Steel or stainless-steel pins and approved bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
1. Out-swinging exterior doors: non-ferrous with non-removable (NRP) pins and security studs.
 2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Mortise Locksets and Latchsets: as scheduled.

1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
2. Universal lock case – 10 functions in one case.
3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
 - a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
 - b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
 - c) Levers rotate up or down for ease of use.
6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
7. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.
8. Strikes: 16 gage curved steel, bronze or brass with 1-inch-deep box construction, lips of sufficient length to clear trim and protect clothing.
9. Scheduled Lock Series and Design: Schlage L series, 06A design.
10. Certifications:
 - a) ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
 - b) ANSI/ASTM F476-84 Grade 31 UL Listed.
11. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC 2022 11B-404.2.7 and 11B-309.4.
12. Accepted substitutions: None.

2.4 EXIT DEVICES / PANIC HARDWARE

A. General features:

1. Independent lab-tested 1,000,000 cycles.
2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. Deadlocking latchbolts, 0.75-inch projection.
4. End caps: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.
5. No exposed screws to show through glass doors.
6. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
7. Accessibility: Require not more than 5 lb. to retract the latchbolt, per CBC 2022 11B-404.2.7 and 11B-309.4.
 - a) Mechanical method: Von Duprin "AX - feature", where touchpad directly retracts the latchbolt with 5 lb. or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb. requirement.

B. Specific features:

1. **Non-Fire Rated Devices:** cylinder dogging with Security indicators.
2. **Lever Trim:** breakaway type, forged brass or bronze escutcheon min. 0.130-inch thickness, compression spring drive, match lockset lever design.
3. **Accepted substitutions:** None.

2.5 CLOSERS

A. Surface Closers: 4040XP

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast-iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2022 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
 - a) Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.
13. **Accepted substitutions:** None.

2.6 OTHER HARDWARE

- A. Automatic Flush Bolts:** Low operating force design.
- B. Kick Plates:** Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.
- C. Door Stops:** Provide stops to protect walls, casework, or other hardware.
1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.

- D. **Seals:** Four-fingered type at head & jambs. Inelastic, rigid back, not subject to stretching. Self-compensating for warp, thermal bow, door settling, and out-of-plumb. Adhesive warranted for life of installation.
 - 1. Proposed substitutions: submit for approval.
 - 2. Three-fingered type at hinge jambs of doors fitted with continuous hinges where jamb leaf of hinge is fastened to the frame reveal.
- E. **Automatic door bottoms:** low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.
 - 1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.
- F. **Thresholds:** As scheduled and per details. Comply with CBC 2022 11B-404.2.5. **Substitute products:** certify that the products equal or exceed specified material's thickness. **Proposed substitutions:** submit for approval.
 - 1. Saddle thresholds: 0.125 inches minimum thickness.
 - 2. Exteriors: Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Minimum 0.25-inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors. National Guard Products' "COMBO" or Pemko Manufacturing's "FHSL".
 - 3. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
 - 4. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.
 - 5. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full thread. Sleeve nuts: full length to prevent door compression.
- G. **Through-bolts:** Do not use. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.
 - 1. Exception: surface-mounted overhead stops, holders, and friction stays.

2.7 **FINISH:**

- A. **Generally:** BHMA 626 Satin Chromium.
 - 1. Areas using BHMA 626: furnish push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise scheduled.
- B. **Door closers:** factory powder coated to match other hardware, unless otherwise noted.

2.8 KEYING REQUIREMENTS:

- A. Key System: (Verify with Owner)Schlage Everest utility-patented keyway, interchangeable core. Utility patent protection to extend at least until 2029. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers. For estimate use factory GMK charge. Initiate and conduct meeting(s) with Owner and Allegion representatives to determine system keyway(s), keybow styles, structure and degree of geographic exclusivity. Furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the Owner. Contractor will install permanent cylinders/cores.
- B. Keys
 - 1. Existing factory registered master key system.
 - 2. Construction keying: furnish temporary keyed-alike cores. Remove at substantial completion and install permanent cylinders/cores in Owner's presence. Demonstrate that construction key no longer operates.
 - 3. Furnish 10 construction keys.
 - 4. Furnish 2 construction control keys.
 - 5. Furnish 2 Emergency keys per each L9485 Faculty Restroom Lock
- C. Key Cylinders: furnish utility patented, 6-pin solid brass construction.
- D. Cylinder cores: furnish keyed at factory of lock manufacturer where permanent records are maintained. Locks and cylinders same manufacturer.
- E. Permanent keys: use secured shipment direct from point of origination to Owner.
 - 1. For estimate: 3 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.
 - 2. For estimate: VKC stamping plus "DO NOT DUPLICATE".
 - 3. Bitting List: use secured shipment direct from point of origination to Owner upon completion.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

- A. Can read and understand manufacturers' templates, suppliers' hardware schedule and printed installation instructions. Can readily distinguish drywall screws from manufacturers' furnished fasteners. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

3.2 PREPARATION:

- A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.
- B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
 - 1. Notify Architect of code conflicts before ordering material.
 - 1. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1008.1.9.2 and 11B-404.2.7.

2. Locate panic hardware between 36 inches to 44 inches above the finished floor.

3.3 INSTALLATION

- A. Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.
 1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
 2. Use manufacturers' fasteners furnished with hardware items or submit Request for Substitution with Architect.
 3. Replace fasteners damaged by power-driven tools.
- B. Locate floor stops no more than 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.
- C. Drill pilot holes for fasteners in wood doors and/or frames.

3.4. ADJUSTING

- A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.
 1. Hardware damaged by improper installation or adjustment methods: repair or replace to Owner's satisfaction.
 2. Adjust doors to fully latch with no more than 1 pound of pressure.
 - a) Door closer valves: turn valves clockwise until at bottom – do not force. Turn valves back out one and one-half turns and begin adjustment process from that point. Do not force valves beyond three full turns counterclockwise.
 3. Adjust door closers per 1.9 this section.
- B. Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:
 1. Has re-adjusted hardware.
 2. Has evaluated maintenance procedures and recommend changes or additions and instructed Owner's personnel.
 3. Has identified items that have deteriorated or failed.
 4. Has submitted written report identifying problems.

3.5 DEMONSTRATION:

- A. Demonstrate mechanical hardware and electrical, electronic, and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING:

- A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.
- B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

- A. See door schedule in drawings for hardware set assignments.
- B. Do not order material until submittal has been reviewed, stamped, and signed by Architect's door hardware consultant.
- C. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.












Opt. #: OPT0384424-V2

Hardware Group No. 01

For use on Door #(s):

A1-1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HW HINGE	5BB1HW SH 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-J-RHR		626	SCE
			4AA BATTERY			
1	EA	FSIC CORE	23-030		626	SCH
1	EA	CONST. CORE	23-030 ICX		ORG	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)		AA	ZER
1	SET	SET SEAL	429AA-S (@ HEAD & JAMBS)		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	103A-223 (OR AS REQ'D. OR PER		A	ZER
			DETAILS/CONDITIONS)			

ELEC CLASSROOM LOCK TO BE PROVIDED BY DIVISION 28. LISTED FOR TEMPLATING PURPOSES ONLY.













MOUNT HEAD SEAL BEFORE CLOSER ARM(S).

Hardware Group No. 02

For use on Door #(s):

A1-2	A10-1	A12-1	A14-1	A16-1	A18-1
A18-2	B1-1	B6-1	B10-1	B10-2	B12-1
B14-1					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HW HINGE	5BB1HW SH 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-L-NL-06		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	MORTISE CYLINDER	20-061 ICX X XQ11-948 36-083		626	SCH
2	EA	FSIC CORE	23-030		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/L AS REQ'D		BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)		AA	ZER
1	SET	SET SEAL	429AA-S (@ HEAD & JAMBS)		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	103A-223 (OR AS REQ'D. OR PER DETAILS/CONDITIONS)		A	ZER

MOUNT HEAD SEAL BEFORE CLOSER ARM(S).








USE SCUSH ARM(S) ON CLOSER IF FLOOR STOP(S) CANNOT BE USED.

Hardware Group No. 03

For use on Door #(s):

A3-1	A5-1
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Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 06A L583-363 OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV AS REQ'D		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 04

For use on Door #(s):

A4-1 A6-1 A7-1 A8-1 A9-1 B4-1
B5-1

Provide each SGL door(s) with the following:











QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK W/ INSIDE INDICATOR	L9050T 06A L583-363 IS-LOC		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV AS REQ'D		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 05

For use on Door #(s):

A10-2 A14-2 B12-2

Provide each DE door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
2	EA	PANIC HARDWARE	LD-PA-AX-9827-EO-LBR		626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
2	EA	DOOR BOTTOM	369AA-Z49		AA	ZER
1	EA	MEETING STILE	383AA		AA	ZER
1	EA	THRESHOLD	164A-223		A	ZER

Hardware Group No. 06

For use on Door #(s):

A11-1 A13-1 A15-1 A17-1 A19-1 B7-1
B11-1 B13-1 B15-1

Provide each SGL door(s) with the following:












QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8302 10" 6" X 16" G		630	IVE
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV AS REQ'D		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 07

For use on Door #(s):

B2-1 B3-1

Provide each PR door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	AUTO FLUSH BOLT	FB41P/FB31P AS REQ'D		630	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D		626	IVE
1	EA	STOREROOM LOCK	L9080T 06A		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB AS REQ'D		689	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	ASTRAGAL	383AA		AA	ZER

Hardware Group No. 08

For use on Door #(s):

B6-2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	OFFICE/ENTRY LOCK W/ INSIDE INDICATOR	L9050T 06A L583-363 IS-LOC		626	SCH
1	EA	FSIC CORE	23-030		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

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.
2. Lath and scratch coat of Portland cement plaster as a substrate for ceramic wall tile.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 3000 – Cast-in-Place Concrete.
3. Section 04 2200 – Concrete Unit Masonry.
4. Section 05 4100 - Structural Metal Stud Framing.
5. Section 06 1000 - Rough Carpentry.
6. Section 06 1643 – Gypsum Sheathing.
7. Section 07 2100 – Thermal Insulation.
8. Section 07 2719 – Plastic Sheet Air Barriers.
9. Section 09 2216 - Non-Structural Metal Framing.
10. Section 09 2427 – Smooth Cement Plaster for Murals.
11. Section 09 3013 - Ceramic Tiling.

1.02 SYSTEM DESCRIPTION

- A. Three coat 7/8" cement plaster with a fiberglass reinforcing mesh embedded into a polymer-modified base coat over the cured brown coat on metal lath over water resistive barrier over plastic sheet air barrier over sheathing over wood or metal studs.
- B. Two coat 1/2" to 5/8" cement plaster on metal lath over CMU or concrete with a fiberglass reinforcing mesh embedded into a polymer-modified base coat over the cured brown coat.

- C. Soffits and ceilings: Three coat 7/8" cement plaster on metal lath with a fiberglass reinforcing mesh embedded into a polymer-modified base coat over the cured brown coat over suspended metal framing.
- D. One coat cement plaster base for ceramic tile installation.

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.
 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.
- 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. 3.4 Expanded Metal Lath 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 open stud 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 and ASTM E2556 Type II, manufactured by Fortifiber, Davis Wire, GMC Paper Products, 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 repellant 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: M-Slide Expansion Joint 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.
12. Foundation Casing at Walls with Continuous Insulation: Custom shaped galvanized steel "J" mold with weep holes. Width shall be sized to accommodate insulation thickness plus 7/8 inch plaster.

2.03 LATH FASTENERS

- A. Fasteners through Continuous Insulation: Fastener spacing as indicated on drawings.
 1. Wood Studs: Fasteners shall be corrosion resistant screws in conformance to CBC Chapter 26.
 2. Metal Studs: Corrosion resistant coated wafer head steel #8 screws with length that penetrates framing steel thickness plus three threads minimum.
- B. Fasteners at Locations with no Continuous Insulation:
 1. Wood Studs: Fasteners shall be corrosion resistant.
 - a. Nails: In accordance to FS FF-N-105, 0.113 with a 3/8 inch diameter head with length that penetrates wood framing (exclusive of sheathing) 3/4 inch minimum.
 - b. Screws: Type A, in accordance to ASTM C1002, length that penetrates wood framing (exclusive of sheathing) 3/4 inch minimum.
 - c. Staples: In accordance to FS FF-N-105. Minimum 3/4 inch crown, 0.053 inch steel. Staples shall have sufficient length to penetrate studs at least 3/4 inch.
 2. 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.
- C. Fasteners for Concrete and CMU Substrates: Power Actuated Fasteners: For attachment of lath to concrete and concrete masonry, recommended by manufacturer for the specific use intended. Minimum 3/4 inch long hardened drive style pin with a 1/2 inch diameter style washer. Fasteners shall be corrosion resistant and provide minimum withdrawal resistance of 50 pounds minimum.

- D. 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 MATERIALS FOR SUSPENDED CEILLINGS

- A. Main Runners and Cross Furring Channels: Cold-formed channels made from steel with minimum 33,000 psi yield strength 0.0538 inch minimum bare steel thickness. Channel shall have a protective G60 galvanized coating conforming to ASTM A653.
 - 1. Main Runners: in depth indicated
 - 2. Cross Furring: 3/4 inch deep.
- B. Wire: Galvanized soft-annealed mild steel wire in conformance to ASTM A641, Class 1 coating. Ultimate stress value of 60,000 psi and design value not to exceed 24,000 psi per DSA IR 25-1.
 - 1. Hanger wire for suspended ceilings, minimum 0.1620 (8 gauge), 0.135 inch diameter (10 gauge), and 0.106 (12 gauge).
 - 2. Wire for saddle-tying cross furring to main runners, 0.0625 inch diameter (16 gauge) for single strand tying and 0.0475 (18 gauge) for double strand tying.
- C. Hangers:
 - 1. Rod Hangers: ASTM A510, mild carbon steel, hot-dip galvanized per ASTM A153.
 - 2. Flat Hangers: Commercial-steel sheet, 1 by 3/16 inch with G60, hot-dip galvanized zinc coating per ASTM A653.
 - 3. Ceiling Clips: Commercial steel sheet, 3/4 inch wide minimum by 12 gauge minimum, with G60, hot-dip galvanized zinc coating per ASTM A653.
- D. Hanger Attachments to Concrete: Power-actuated fasteners that use explosive powder, gas combustion, or compressed air or other gas to embed fasteners in concrete and that are suitable for application indicated. Fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers. Capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E1190 by a qualified independent testing agency.

2.05 PLASTER MATERIALS

- A. Factory Blended Portland Cement Plaster Basecoats and Finish: Products as fabricated by California Stucco, La Habra, Parex, Shamrock Stucco, Merlex, Omega Stucco, Inc., , Spec Mix, Quikrete, CTS, Sika, or other manufacturer member of the Stucco Manufacturer's Association (SMA).
 - 1. Material Standards: Shall conform to ASTM C926.

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: Sand Float 20/30
 - 2) Color: As selected by ARCHITECT.

3. Two Coat Systems:

- a. Brown Coat: Factory blended fiber reinforced plaster and pre-mixed with sand 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: Sand Float 20/30
 - 2) Color: As selected by ARCHITECT.

4. Crack Isolation System:

- a. Fiberglass Reinforcing Mesh (Lamina): 4.5 oz. Mesh, alkali resistant, compatible with plaster finish.
- b. Base Coat: Polymer-modified cement base/skim coat, compatible and approved by plaster finish coat manufacturer.

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. Bonding Agent: 100% acrylic emulsion additive, Parex USA Adacryl Admix & Bonder or equal.

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. Continuous Insulation: Refer to Section 07 2100, Thermal Insulation.

- G. 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 SUSPENDED CEILING METAL FURRING

- A. Install ceiling metal furring in conformance to drawings and ASTM C1063.
- B. Space hangers as indicated on drawings along carrying channels and within 6 inches of ends of carrying channel run. Connect to underside of structure as indicated on drawings.
- C. Install 1-1/2 inch carrying channels at spacing indicated on drawings and within 6 inches of walls, positioned for proper ceiling height. Level and secure with hanger wire saddle-tied along channel. Provide one inch clearance between runners and abutting walls. At channel splices interlock flanges, overlap ends 12 inches and secure each end with 16 gauge tie wire or double-strand 18 gauge tie wire.
- D. When flat hangers are used, bend tightly hanger around main runners and carried up and above the runners and fasten through with 3/8 inch round-head stove bolts. Nuts of bolts shall be drawn up tight. Smooth or threaded rod hangers shall be fastened to the runners with special attachments appropriate to the design.
- E. Erect 3/4 inch cold-rolled furring channels at right angles to 1-1/2 inch carrying channels, and secure to furring channels by wire-tying with double-strand 18 gauge wire. At splices nest furring channels eight inches and securely wire-tie each end with single strand 16 gauge wire or double-strand 18 gauge wire.
- F. Fasten wires with four (4) tight turns. Make all tight turns within a distance of one and one-half (1-1/2) inches.

3.04 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.

3.05 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 Sand Float 20/30 finish coats, as specified.
- B. Preparation of Concrete and Masonry Surfaces:
 - 1. Exterior concrete and masonry surfaces to be plastered shall be free of oily or waxy substances, and loose or foreign material. Uniformly spray with nozzle-type water spray at least 12 hours before installation of plaster or as required to control suction.
 - 2. Concrete and masonry surfaces to receive two coat application of 5/8 inch thick Portland cement plaster shall be treated with bonding agent. This surface preparation shall not be installed instead of a brown coat of plaster.
 - 3. Concrete surfaces to receive stucco dash finish shall be lightly sandblasted to provide a roughened surface.
 - 4. Verify that lath has been installed securely and that grounds, screeds, casing beads and other accessories are straight, in correct position, and securely fastened in place.
- C. 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.
- D. Application:
 - 1. Sand Bond Coat: on concrete or masonry surfaces, leave undisturbed, and maintain damp for at least 24 hours following installation. Dash bond coat may be omitted when liquid bonding agent is used.

2. Scratch Coat: Install with sufficient material to completely cover laths and scratch across supports.
 3. 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.
 4. 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 finish 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.
- E. Curing Exterior Plaster: Adhere to current edition of CBC for curing requirements.
- F. 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.

3.07 INTERIOR PLASTERING

- A. Portland Cement Plaster, Scratch Coat: Install to vertical lathed surfaces where ceramic tile is indicated, and install Portland cement plaster finishes where indicated.
- B. Preparation for Plastering:
 - 1. Verify that lath has been installed securely and that grounds, screeds, casing beads and other accessories are straight, in correct position, and securely fastened in place.
 - 2. Bonding Agent: Install to vertical concrete or masonry surfaces to receive ceramic tile.
 - 3. Concrete and masonry surfaces on which suction must be reduced shall be sufficiently moistened before plastering operations start.
 - 4. Install galvanized expanded metal lath on supports in conformance with requirements of ASTM C1063 and CBC.
- C. Number of Coats and Thickness: Interior plastering to receive paint shall consist of the following, with thickness measured from face of supports or surface:
 - 1. On Concrete or Masonry: two coats, brown and finish, 5/8 inch thick.
 - 2. On Metal Lath: three coats, scratch, brown and finish 7/8 inch thick.
- D. Proportions for Interior Plaster: Adhere to current edition of CBC for proportions and curing requirements.
 - 1. Admixtures shall be proportioned, mixed and installed in accordance with printed directions of manufacturer.
- E. Mix factory blended plaster using only sufficient water to obtain proper consistency before installation. Do not mix any more material at any time than can be installed within ½ hour after mixing. Do not allow material to remain in mixer or mixing boxes overnight.
- F. Application:
 - 1. Dash Bond Coat: Dash on surface, leave undisturbed, and maintain damp at least 24 hours following installation. Omit Dash bond coat when liquid bonding agent is used.
 - 2. Scratch Coat: Install with sufficient material to form good keys, thoroughly cover lath, and cross scratch.
 - 3. Brown Coat: Rod to a straight, true and even surface. Brown coat must be 1/16 inch below face of grounds to provide adequate space for finish coat. Float surface to increase density.

4. Smooth Finishes: Install two coats for a thickness of 1/8 inch. Install second coat after finish coat begins to set. Install to a true, even plane and trowel to a smooth finish, free from blemishes.
 5. Float Finishes: Install to a thickness between 1/16 inch to 1/8 inch, install and uniformly float to true planes.
 6. Plaster Screeds: On metal lath or wire fabric lath, install plaster screeds wherever permanent grounds are too far apart to serve as guides for rodding.
- G. Curing Interior Plaster: Adhere to requirements of CBC.

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. Underwriters Laboratories (ULI) requirements and listings for fire-rated materials and products classification.
 11. GA-214 - Gypsum board finish shall conform to requirements of GA 214, Application and Finishing of Gypsum Panel Products, published by the Gypsum Association, and as specified herein.
 12. GA-216 – Application and Finishing of Gypsum Panel Products.
 13. GA 600 - Gypsum board 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 A118.11 – Test Methods and Specification for Cementitious Backer Units.
 16. The Interior Guide, published by the Wall and Ceiling Conference (WWC).
- B. Qualifications: Installer shall have a minimum 5 years experience in installing and finishing gypsum board.

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. Gypsum board 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 board showing any evidence of water damage shall not be installed. Gypsum board showing evidence of water damage after installation shall be removed and replaced.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840, GA 216 requirements or gypsum board manufacturer's written instructions, whichever is more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet moisture damaged and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but not limited to, fuzzy or splotchy surface contamination and discoloration.

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.
- C. Mold and Moisture Resistant Gypsum Board, Type X (fire-resistant): (Use at elevator shaft interior), 5/8 inch thick 4-foot wide, up to 16-foot long conforming to ASTM C1396 with long edges tapered.
 1. Resistance to Mold Growth: Minimum score of “10” when tested in accordance to ASTM D3273 and evaluated in accordance with ASTM D3274.
- D. Gypsum Liner, Type X (fire-resistant): 1 inch thick 24-inch wide, up to 14-foot long, conforming to ASTM C1396 or C1658.
 1. Resistance to Mold Growth: Minimum score of “10” when tested in accordance to ASTM D3273.
- E. Glass Matt Gypsum Tile Backer: Fully embedded glass mat gypsum tile backer meeting the requirements of ASTM C 1178.
 1. Type and Thickness: Type X, 5/8 inch and as otherwise required to meet fire rating for specific element.
 2. Flame spread: ASTM E 84: Class A.
 3. Smoke developed: ASTM E 84: Class A.
 4. Standard Size: 4 feet by 8 feet.
 5. Glass-Fiber Mesh Tape: Alkali-resistant self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch.

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. Joint mortar and Tape for Cement board: Meet ANSI 118.4.

- E. Finishing Materials: Texture coat finish material shall be manufactured by U.S. Gypsum, Hamilton, Murlux, Parex, Rapid Set-Cement, Eisenwall, Mortar Mix, Stucco Mix, Stucco Patch, One Pass, Westpac or equal.
- F. 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.
- G. Fasteners:
 - 1. Self-drilling, 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 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.
6. Install gypsum board to ceiling framing with long dimension at right angles to furring channels, or wood framing members, and fasten with specified 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.

C. Cement Board Backer System:

1. In shower areas, install water barrier in shingle-like manner to prevent water infiltration into stud cavity. Pre-cut all board to required sizes and make necessary cut-outs.
2. Install in accordance with UL Design and SA-932. Install tile backer board plumb and flat. Shim behind board as required.
3. Fasten to steel studs spaced max. 16" o.c. and bottom runners with fasteners spaced 8" o.c. maximum with perimeter fasteners at least 3/8" and less than 5/8" from ends and edges. Studs shall be not less than 20 gage.

3.02 TOLERANCES

- A. System shall appear smooth 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 joint compound, tape, and finishing compound on joints in wall gypsum board as required for specified levels of finish.
- C. Levels 2 through 5:
1. Install joint compound and finishing compound over screw heads. Treat all inside corners with joint compound, tape, and finishing compound. Treat outside corners with corner beads and finishing compound.
 2. Provide metal casing beads at all edges of gypsum board, 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. All cut edges and openings around pipes and fixtures shall be sealed with a water-resistant flexible sealant.
 4. When entire installation is completed, correct and repair broken, dented, scratched or damaged gypsum board before installation of finish materials by other trades.
- D. Levels 3 and 4: Install one coat of high solids tinted topcoat primer over entire surface, Westpac Prep Coat, Tuff Hide Primer, and Hamilton Smooth Coat.
- E. Level 5: Apply a skim coat over entire surface Westpac topping, USG topping, and Hamilton topping.

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 gypsum board 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 gypsum board in classrooms, utility rooms, and similar spaces not requiring Level 5 finish. To be painted per Section 09 9000, Painting and Coating, with a paint sheen shall not be greater than a "flat" finish.
 5. Level 5: Exposed, painted gypsum board in offices and corridors. To be painted per Section 09 9000, Painting and Coating, with a "non-flat paint" - a paint material specifically manufactured to produce greater than 10 gloss units (GU) at an 60° and greater than 35 gloss units (GU) at an 85° angle when measured using a gloss meter.

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 (100) 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 5113
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lay-in acoustical ceiling systems and metal suspension systems.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 09 2216 - Non-Structural Metal Framing.
3. Section 09 2900 - Gypsum Board.
4. Section 09 5115 - Vinyl-Faced Acoustical Ceilings.
5. Section 11 5215 – Video/Multimedia Projector Mounting Plate.
6. Division 23 - HVAC.
7. Division 26 - Electrical.

1.02 QUALITY ASSURANCE

A. Ceiling systems shall consist of lay-in acoustical ceiling panels by a single manufacturer and suspension systems by a single manufacturer for the entire project.

B. Qualifications of Installer: Minimum five years experience in installing acoustical ceiling systems of the types specified.

C. Design Criteria:

1. Deflection of finished surface to 1/360 of span or less.
2. 1/8 inch maximum permissible variation from true plane measured from 10 foot straightedge placed on surface of finished acoustical fiber units.

D. Requirements of Regulatory Agencies:

1. Conform to CBC requirements and UL - Tunnel Test for Fire Hazard Classification of Building Materials.
2. Cisca: Acoustical Ceilings Use and Practice.
3. Division of the State Architect: Comply with requirements of IR 25-2.13.

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

1. ASTM A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 4. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 5. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 7. ASTM E580 – Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
 8. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
 9. ASTM E1414 - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
 10. ASTM E1477 - Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- F. American Society of Civil Engineers (ASCE):
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures, as amended by CBC 1615A.1.16.
- G. CHPS Low-Emitting Materials Table: Materials submitted must be listed as low emitting on the CHPS website, www.CHPS.net.

1.03 SUBMITTALS

- A. Samples:
1. Lay-in panels of each specified type, 6-inch by 6-inch minimum size.
 2. Suspension System: 12-inch long samples of suspension system members, connections, moldings and wall angles, for each color specified.
- B. Shop Drawings:
1. Indicate complete plan layouts and installation details.
 2. Indicate related Work of other sections which is installed in, attached to, or penetrates ceiling areas, such as air distribution and electrical devices.
- C. Product Data:
1. Suspension System for Lay-in Ceiling: Printed data for suspension system components, including load tests, indicating conformance to specified tests and standards.

- 2. Acoustical units: Printed data indicating conformance to specified tests and standards.
 - D. Maintenance Materials: Provide extra panels equal to 1 percent of the area of each typical module size of acoustical panel, but not less than 8 of each specified size, style and color.
- 1.04 DELIVERY, STORAGE AND HANDLING
- A. Deliver materials to the Project site in original sealed packages.
 - B. Storage: Store materials in building area where they will be installed, in original package. Keep clean and free from damage due to water or deteriorating elements.
 - C. Handle in a manner to prevent damage during storage and installation.
- 1.05 PROJECT CONDITIONS
- A. Installation of acoustical ceiling system shall not begin until the building is enclosed, permanent heating and cooling is in operation, and residual moisture from plaster and concrete work has dissipated. Building areas to receive ceilings shall be free of construction dust and debris.
 - B. Environmental Requirements: Maintain temperature in space at 55 degrees F or above for 24 hours before, during, and after installation of materials.
 - C. Scheduling:
 - 1. Before concealing Work of other sections, verify required tests and inspections have been completed.
 - 2. Coordinate with related Work of other sections. Coordinate location and symmetrical placement of air distribution devices, electrical devices, and penetrations with related Work section.
- 1.06 WARRANTY
- A. Manufacturer shall provide a 10 year material warranty.
 - B. Installer shall provide a two year fabrication and installation warranty.

PART 2 - PRODUCTS

- 2.01 ACCEPTABLE MANUFACTURERS
- A. USG Corporation.
 - B. Armstrong World Industries.
 - C. CertainTeed Saint-Gobain.
 - D. Equal.
- 2.02 SUSPENSION SYSTEM

- A. Metal suspension system for acoustical lay-in tile shall be hot-dipped galvanized steel conforming to ASTM A653. Main beams and cross tees shall be double-web steel construction with exposed flange design, with factory punched cross tee slots, hanger holes and integral couplings.
- B. Metal suspension system for acoustical lay-in tile shall conform with ASTM C635, C636 and E580 and section 13.5.6 of ASCE 7, as amended by CBC Section 1615A.1.16, for installation in high seismic areas.
- C. Structural classification of suspension systems shall be heavy-duty in conformance to ASTM C635.
- D. Vertical Strut: USG Donn Compression Post, or equal, or as indicated; types and designs complying with requirements of authorities having jurisdiction and seismic Zones D, E and F requirements. Provide base attachment clip for connection of vertical strut to main beams.
- E. Wall Molding: Fabricated from galvanized steel with 2-inch horizontal leg and hemmed edges, same finish as main and cross tees.
- F. Spacer/Stabilizer Bars: Provide for tying together the ends of main runners and cross tees that are not attached to wall molding.
- G. Hanger Wire: 0.106 inch diameter (0.144 inch diameter for pendant fixtures), galvanized soft annealed mild steel wire as defined in ASTM A641, Class 1 coating.
- H. Provide attachment devices and any other required accessories for a complete suspended ceiling system installation.

2.03 ACOUSTICAL CEILING PANELS

- A. Acoustical ceiling panels shall be class A in accordance with ASTM E1264.
- B. Acoustical panels shall meet the following surface-burning characteristics when tested in accordance with ASTM E84 for Class A materials:
 - 1. Maximum Flame Spread: 25.
 - 2. Maximum Smoke Developed: 50.
- C. Mold and Mildew Resistance: Panels and faces shall be treated with a biocide paint additive or an antimicrobial solution to inhibit mold and mildew.

2.04 CEILING TYPES

- A. ACT 1 - Classrooms:
 - 1. Acoustical Ceiling Panels:
 - a. Panel Name: Armstrong Fine Fissured High NRC 1811, USG Radar Climaplus HiNRC 22311, CertainTeed Fine Fissured HHF 497 HNRC, or equal.
 - b. Panel Size: 2-foot by 4-foot.
 - c. Panel Thickness: 3/4 inch.

- d. Edge Detail: Lay-in.
 - e. Light Reflectance: 0.83 minimum, complying with ASTM E1477.
 - f. CAC: Minimum 35 - 39, UL Classified, complying with ASTM E1414.
 - g. NRC: Minimum 0.70, UL Classified, complying with ASTM C423.
 - h. Color: White.
 - i. Recycled Content: Minimum 37 percent.
 - 2. Suspension System:
 - a. Suspension System Name: Prelude XL by Armstrong, Donn DX by USG, 1200 Seismic Series by Chicago Metallic Corporation, or equal.
 - b. Color: White.
- B. ACT 2 - Administration:
 - 1. Acoustical Ceiling Panels:
 - a. Panel Name: Armstrong Ultima 1912, USG Mars ClimaPlus 86985, CertainTeed Symphony M #1222BF-OVT-1, or equal.
 - b. Panel Size: 2-foot by 2-foot.
 - c. Panel Thickness: 3/4 inch.
 - d. Edge Detail: Beveled tegular.
 - e. Light Reflectance: 0.89 minimum, in accordance with ASTM E1477.
 - f. CAC: Minimum 35, UL Classified, complying with ASTM E1414.
 - g. NRC: Minimum 0.70, UL Classified, complying with ASTM C423.
 - h. Color: White.
 - i. Recycled Content: 74 percent minimum.
 - 2. Suspension System:
 - a. Suspension System Name: Silhouette XL by Armstrong, Fineline by USG, 4500 Ultraline Series by Chicago Metallic Corporation, or equal.
 - b. Color: White.
- C. ACT 3 - Cafeteria:
 - 1. Acoustical Ceiling Panel:
 - a. Panel Name: Armstrong Optima Open Plan 3250, USG Halcyon #98223, CertainTeed Symphony F 1342B-OVT-1, or equal.
 - b. Panel Size: 2-foot by 2-foot.
 - c. Panel Thickness: 1 inch.
 - d. Edge Detail: Tegular.
 - e. Light Reflectance: 0.88 minimum, complying with ASTM E1477.

- f. NRC: Minimum 0.95, UL Classified, complying with ASTM C423.
 - g. Color: White.
 - h. Recycled Content: Minimum 28 percent.
 - 2. Suspension System:
 - a. Suspension System Name: Prelude XL by Armstrong, Donn DX by USG, 1200 Seismic Series by Chicago Metallic Corporation, or equal.
 - b. Color: White.
- D. ACT 4 – Other areas:
 - 1. Acoustical Ceiling Panel:
 - a. Panel Name: Armstrong Fine Fissured 1729, USG Radar Climaplus 2410, CertainTeed Hytone Fine Fissured HHF 197, or equal.
 - b. Panel Size: 2-foot by 4-foot.
 - c. Panel Thickness: 5/8 inch.
 - d. Edge Detail: Lay-in.
 - e. Light Reflectance: 0.82 minimum, complying with ASTM E1477.
 - f. CAC: Minimum 35, UL Classified, complying with ASTM E1414.
 - g. NRC: Minimum 0.55, UL Classified; complying with ASTM C423.
 - h. Color: White.
 - i. Recycled Content: Minimum 37 percent.
 - 2. Suspension System:
 - a. Suspension System Name: Prelude XL by Armstrong, Donn DX by USG, 1200 Seismic Series by Chicago Metallic Corporation, or equal.
 - b. Color: White.
- E. ACT 5 – Specialty Acoustic Spaces:
 - 1. Acoustical Ceiling Panel:
 - a. Spaces with specialty acoustical requirements such as Music Classrooms, Multi-Purpose Room, shall be provided with the NRC and CAC performance requirements indicated on drawings. b. Ceiling tiles in control rooms in Multi-Purpose Rooms and Auditoriums shall be black in color.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Furnish layouts for inserts, clips or other supports and struts required to be installed by the Work of other trades that depend on the suspended ceiling system for support.

- B. Coordinate related Work to ensure completion prior to installation of clips or fasteners.
- C. Compare layouts with construction conditions. Tile shall be spaced symmetrically about the centerlines of the room or space and shall start with a tile or joint line as required to avoid narrow tiles at the finish edges unless indicated otherwise. Joints shall be tight with joint lines straight and aligned with the walls. Ceiling moldings shall be provided where tile abuts wall with matching caulking to eliminate any space.

3.02 INSTALLATION OF SUSPENSION SYSTEMS

A. General:

1. Install suspension system in accordance with ASTM C636 and ASTM E580.
2. System shall be complete; with joints neatly and tightly joined and securely fastened; suspension members shall be installed in a true, flat, level plane.
3. Hanger Wires: 0.106 inch diameter minimum; larger sizes as indicated or required.
 - a. Fasten wires to panel points and structure above per most stringent requirements of fabricator and CBC and as indicated on Drawings.
 - b. Wires exceeding 1:6 out-of-plumb shall be braced with counter-sloping wires.
 - c. Maintain wires at least 6 inches from non-braced ducts, pipes, conduits, and other items.
 - d. Install wire along main runners at 4 feet on center. Terminal ends of each main runner and cross tee must be supported within 8 inches of each wall with a perimeter wire or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area.
 - e. Where obstructions prevent direct suspension, provide trapezes or equivalent devices; 1 ½-inch minimum cold rolled channels back to back may be installed for spans to 6 feet maximum.
 - f. Wire shall be straight, without extraneous kinks or bend. Hanger wire connections must be capable of carrying a 200 - pound pull without stretching or shifting the suspension clip.
4. Bracing Wires to Resist Seismic Forces: 0.106 inch diameter minimum, larger sizes as indicated or required.
 - a. System for Bracing Ceilings: Lay-In Ceiling Systems: Install one four-wire set of sway-bracing wires and a vertical strut for each 144 square feet maximum of ceiling area. Locate wire-sets and struts at 12 feet maximum on center. At ceiling perimeters, wire-sets shall be installed within 6 feet of walls.
 - b. Install four-wire sets and struts within 2 inches of cross-runner intersection with main runner; space wires 90 degrees from each other.

- c. Do not install sway bracing wires at an angle greater than 45 degrees with the ceiling plane.
 - d. Wires shall be tight, without causing ceiling to lift.
 - e. Fasten struts in accordance with CBC requirements.
 - f. Maintain wires at least 6 inches from non-braced ducts, pipes, conduit, and other items.
 - 5. Provide additional wires, 0.106 inch diameter minimum, necessary to properly support suspension at electrical devices, air distribution devices, vertical soffits, and other concentrated loads.
 - 6. Suspension:
 - a. Suspension members shall be fastened to two adjacent walls per ASTM 580; but shall be at least 3/4 inches minimum clear of other walls.
 - b. Any suspension members not fastened to walls shall be interconnected to prevent spreading, near their free end, with a horizontal metal strut or stabilizer bar or 0.064 inch diameter taut tie wire.
 - c. Provide additional tees or sub-tees to frame openings for lights, air distribution devices, electrical devices, and other items penetrating through ceiling, which do not have an integral flange to support and conceal cut edges of acoustic panels. Provide cross bracing necessary to securely support any surface mounted fixtures or other items.
 - 7. Attachment of Wires:
 - a. To Metal Deck or Steel Framing Members: Install as required by current code.
 - b. To Suspension Members: Insert through holes in members or supporting clips.
 - c. Wires shall be fastened with three tight turns minimum for hanger wires and four tight turns minimum bracing wires. Turns shall be made in a 1 1/2-inch maximum distance.
- B. Suspension System for 2-foot by 4-foot Lay-in Acoustical Ceilings:
- 1. Main Runners: Install main runners 48 inches apart; 0.106 inch diameter hanger wires space 48 inches on center maximum along runners, and within 8 inches of ends.
 - 2. Install wall moldings with fasteners to studs. Install corner caps at molding intersections.
 - 3. Cross-Tees: Install between main runners in a repetitive pattern of 2-foot spacings.
 - 4. Sub-Tees: Install at edges of penetrations.

3.03 INSTALLATION OF ACOUSTICAL PANELS

- A. Install panels into suspension system. Partial panels shall be neatly cut and fitted to suspension and around penetrations and/or obstructions. Duplicate tegular edges at partial panels; cuts to be straight. Repaint cut tiles to match color or as directed by manufacturer for mylar facing at visually exposed conditions or as required by the ARCHITECT.
- B. Penetrations through the ceilings for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a 2 inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of one inch in horizontal directions. Alternatively per ASTM E580, a flexible sprinkler hose fitting that can accommodate one inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve or adapter.

3.04 AIR DISTRIBUTION DEVICES

- A. Refer to and coordinate with Division 23 - HVAC.
- B. Install air distribution grilles and other devices into suspension system. Install 4 taut wires, each 0.106 inch diameter minimum, to each device within 3 inches of device corners, to support their weight independent of the suspension system.

3.05 LIGHT FIXTURES

- A. Refer to and coordinate with Division 26 - Electrical.
- B. Fixtures weighing less than 56 pounds: Install fixtures into suspension systems and fasten earthquake clips to suspension members. Install minimum 2 slack safety wires, each 0.106 inch diameter minimum, to each fixture at diagonally opposite corners, to support their weight independent of the system.
- C. Fixtures weighing 56 Pounds or more: Install fixtures into suspension system and fasten earthquake clips to suspension system members as required by the Drawings and/or code. Install not less than 4 taut 0.106 inch diameter wires capable of supporting four times the fixture load.
- D. Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two times the weight of the fixture. Brace the pendant-mounted light fixtures by either a bracing assembly at the ceiling penetration or below the ceiling to the walls, as indicated in the drawings.

3.06 CLEANING

- A. General: After installation of acoustical material has been completed, clean surfaces of the material, removing any dirt or discolorations. Replace panels as required.
- B. Acoustical Panels: Minor abraded spots and cut edges shall be touched up with the same paint as was used for factory applied finish of the lay-in panels.
- C. Remove and replace work that can not be successfully cleaned and repaired to eliminate evidence of damage.

3.07 CLEAN UP

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

3.08 PROTECTION

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

END OF SECTION

SECTION 09 65 13
RUBBER WALL BASE

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
 - 1. Topset coved rubber base for installation with surface flooring.
- C. Related Sections:
 - 1. Section 09 65 43: LINOLEUM COMPOSITE TILE
 - 2. Section 09 68 13: CARPET TILE

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 top set 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 5 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 5 years experience in successfully installing the same or similar flooring materials.
- B. Comply with the following as a minimum requirement:
 - 1. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM F 1861: Standard Specification for Resilient Wall Base.

3. CHPS Low-Emitting Materials Table: Materials submitted for rubber base assemblies must be listed as low emitting on the CHPS website, www.CHPS.net, or must be tested by an independent laboratory to meet CHPS Section 01350. All components of an assembly must meet Section 01350 individually or in an assembly. Rubber assemblies include tile and adhesive.
4. All 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 5-year material warranty.
- B. Installer shall provide a 2-year labor warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Roppe, Pinnacle Rubber Wall Base.
- B. Burke Wall Base.
- C. Johnsonite Rubber Wall Base.
- D. Flexco Company, Wallflower Premium Rubber Wall Base.

2.02 MATERIALS

- A. Rubber base: Conform to ASTM F 1861; Group 2, solid (homogeneous); Type 1, TS, (thermoset) vulcanized rubber, Style A, 4-inch-high unless otherwise indicated, integral colors as selected, non-shrinking, 1/8 inch thick

- 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 top set base at all hard floors, including resilient flooring, concrete and wood, carpet and other soft floors, unless otherwise indicated on drawings.
- B. Securely fasten cement base to backing in long lengths in accordance with manufacturer's recommendations. Lay out lengths so that not less than 18 inches long filler pieces are provided. Assure that top and toe continuously contact the wall and floor, and that all joints are tight. Install matching factory formed external corners at all offsets. All inside corners shall be coped; wrapped 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 65 19.19

Resilient Tile Flooring

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

B. Related Documents

1. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

C. Related Sections:

1. Other Division 9 sections for floor finishes related to this section but not the work of this section
2. Division 3 Concrete; not the work of this section
3. Division 6 Wood and Plastics; not the work of this section
4. Division 7 Thermal and Moisture Protection; not the work of this section

1.02 REFERENCES

A. ASTM International:

1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
4. ASTM F 1066 Standard Specification for Vinyl Composition Tile
5. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
6. ASTM F 1861 Standard Specification for Resilient Wall Base
7. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

B. National Fire Protection Association (NFPA):

1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials

C. Canadian Standards

1. CAN/ULC-S102.2 Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.

B. Administrative Requirements

1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
2. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e., moisture tests, bond test, pH test, etc)]

- C. Test Installations/Mock-ups: Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.

1. Mock-Up Size: [Specify mock-up size.]
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into the final construction with Owner's approval.

D. Sequencing and Scheduling

1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.04 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. Submit Safety Data Sheets (SDS) available for adhesives, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
- D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- E. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty: Warranty documents specified herein

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
- B. Select an installer who is experienced and competent in the installation of Armstrong resilient vinyl composition tile flooring and the use of Armstrong Flooring subfloor preparation products.
 - 1. Engage installers certified as Armstrong Commercial Flooring Certified Installers
 - 2. Confirm installer's certification by requesting their credentials
- C. Fire Performance Characteristics: Provide resilient vinyl composition tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
 - 1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
 - 2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
 - 3. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Comply with Division 1 Product Requirements Sections
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.07 PROJECT CONDITIONS

- A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65° F (18° C) and a maximum temperature of [100° F (38° C)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55° F (13° C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to product installation recommendations for a complete guide on project conditions.

1.08 LIMITED WARRANTY

- A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- B. Limited Warranty Period: 5 years
- C. Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
- D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.09 EXTENDED SYSTEM LIMITED WARRANTY

- A. Resilient Flooring System: Submit a written warranty executed by the manufacturer, agreeing to repair or replace system (subfloor preparation products, adhesive, and floor covering) that fails within the warranty period.
- B. Limited Warranty Period: 10 years on top of the Resilient Flooring Limited Warranty.
- C. [S-463 Level Strong™ cement based self-leveling compound] [S-466 Patch Strong™ flexible patching and smoothing compound] [S-464 Prime Strong™ acrylic primer for porous substrates]

[S-465 NP Prime Strong™ epoxy primer for non-porous substrates] [S-462 Seal Strong™ two-part moisture mitigation system].

- D. The installation of an Armstrong Flooring product along with the recommended Armstrong Flooring adhesive, as well as any one of the Strong System subfloor preparation products listed above, provides 10 additional years of limited warranty coverage. The Strong System limited warranty covers the installation integrity for the length of the flooring product warranty plus 10 years. To qualify for the Strong System Warranty, any subfloor preparation product needed for an installation must be an Armstrong Flooring product.
- E. For the System Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.
- F. When Armstrong Flooring Strong System subfloor preparation products are used with other manufacturers' floor coverings, adhesives, or other subfloor preparation products, Armstrong Flooring warrants our products to be free from manufacturing defects from the date of purchase through the limited warranty period of 15 years.

1.10 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Quantity: Furnish quantity of flooring units equal to 10 % of amount installed.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage, and protection of extra material.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Resilient tile flooring, wall base, adhesives and subfloor preparation products and accessories:

Armstrong Flooring Inc., 1770 Hempstead Road, Lancaster, PA 17605,
www.armstrongflooring.com/commercial

1. Manufacturer must have a headquarters in the United States of America.

2.02 RESILIENT TILE FLOORING MATERIALS

A. Provide Vinyl Composition Tile

1. Description: Tile composed of polyvinyl chloride resin, plasticizers, fillers, stabilizers and pigments with colors and texture dispersed uniformly throughout its entire thickness.
2. Vinyl composition tile shall conform to the requirements of ASTM F 1066, "Standard Specification Vinyl Composition Floor Tile", Class 2, through-pattern
3. Pattern and Color: per Finish Schedule
4. Size: 12 in. x 12 in. (305 mm x 305 mm)
5. Thickness: [1/8 in./0.125 in. (3.2 mm)] [3/32 in./0.095 in. (2.4 mm)]

2.05 ADHESIVES

- A. For Tile Installation System, Full Spread: Provide adhesive as recommended by the flooring manufacturer.

2.06 ACCESSORIES

- A. For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide cement based self-leveling compound.
- B. For priming porous substrates to aid in adhesive bond strength and reducing subfloor porosity, provide acrylic primer for porous substrates. For non-porous substrates, provide epoxy primer for non-porous substrates.
- C. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- D. Provide transition/reducing strips tapered to meet abutting materials.
- E. Provide threshold of thickness and width as shown on the drawings.
- F. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl, or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- G. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap-type metal edge

strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e., moisture tests, bond test, pH test, etc.).
- B. Visually inspect flooring materials, adhesives, and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates regarding conditions existing at the time of installation.

3.03 PREPARATION

- A. Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with cement based self-leveling compound patching and smoothing compound as recommended by the flooring manufacturer.
- B. Subfloor Preparation Moisture Mitigation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, mitigate moisture and other defects with cement based self-leveling compound as recommended by the flooring manufacturer.
- C. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers, and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the

flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate, they must be mechanically removed prior to the installation of the flooring material.

- D. Perform subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes" to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Internal relative humidity of the concrete shall not exceed 100%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.
- E. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

3.04 INSTALLATION OF FLOORING

- A. Install flooring in strict accordance with the latest edition of Armstrong Flooring Guaranteed Installation Systems. Failure to comply may result in voiding the manufacturer's warranty listed in Section 1.08.
- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

3.05 INSTALLATION OF ACCESSORIES

- A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths if practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.

- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
- D. Apply butt-type metal edge strips where shown on the drawings, after flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

3.06 CLEANING

- A. Perform initial and on-going maintenance according to the latest edition of the Maintenance Instructions for Vinyl Composition & Bio-Based Tile.

3.07 PROTECTION

- A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION

SECTION 09 67 23-
RESINOUS FLOORING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Resinous flooring system as shown on the drawings and in schedules.
- B. Related sections include the following:
 - 1. Cast-in-Place Concrete, section 03 30 00
 - 2. Concrete Curing, section 03 39 00

1.3 SYSTEM DESCRIPTION

- A. The work shall consist of preparation of the substrate, the furnishing and application of a squeegee-applied resinous flooring system with Micro or Macro colored decorative chips and topcoat. The system shall have the color and texture as specified by the Owner with a nominal thickness of 50 mils. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.
- B. Cove base (if required) to be applied where noted on plans and per manufacturers standard details unless otherwise noted.

1.4 SUBMITTALS

- A. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
- B. Manufacturer's Safety Data Sheet (SDS) for each product being used.
- C. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

1.5 QUALITY ASSURANCE

- A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.
- B. The Applicator shall have experience in installation of the flooring system as confirmed by the

manufacturer in

all phases of surface preparation and application of the product specified.

- C. No requests for substitutions shall be considered that would change the generic type of the specified System.
- D. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.
- E. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.
- F. System shall be in compliance with the Indoor Air Quality requirements of California section 01350 as verified by a qualified independent testing laboratory.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

- 1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

B. Storage and Protection

- 1. The Applicator shall be provided with a storage area for all components. The area shall be between 60 F and 85 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
- 2. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.

C. Waste Disposal

- 1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.7 PROJECT CONDITIONS

A. Site Requirements

- 1. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
- 2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
- 3. The application of resin flooring where jobsite relative humidity is less than 30% is not recommended.
- 4. Use resin where jobsite relative humidity is between 10% and 30%.
- 5. The Applicator shall ensure that adequate ventilation is available for the work area.

6. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with material.

1. Concrete shall be moisture cured for a minimum of 7 days and have fully cured a minimum of twenty eight days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).
3. Sealers and curing agents should not to be used.
4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements

1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
2. "No Smoking" signs shall be posted at the entrances to the work area.
3. The Owner shall be responsible for the removal of foodstuffs from the work area.
4. Non-related personnel in the work area shall be kept to a minimum.

1.8 WARRANTY

- A. Dur-A-Flex, Inc. warrants that material shipped to buyers at the time of shipment substantially free from material defects and will perform substantially to Dur-A-Flex, Inc. published literature if used in accordance with the latest prescribed procedures and prior to the expiration date.
- B. Dur-A-Flex, Inc. liability with respect to this warranty is strictly limited to the value of the material purchase.

PART 2 – PRODUCTS

2.1 FLOORING

A. Dur-A-Flex, Inc, ACCELER A C seamless flooring system

1. System Materials:
 - a. Primer: Dur-A-Flex, Inc, ACCELER A (EXT, LH, or Standard) pigmented resin and hardener.
 - b. Broadcast Coat: Dur-A-Flex, Inc, ACCELER A (EXT, LH, or Standard) resin and hardener.
 - c. Chips: Dur-A-Flex, Inc. Macro or Micro Decorative Colored Chips.
 - d. Topcoat: Dur-A-Flex, Inc. ACCELER A (EXT, LH, or Standard) resin and hardener.
2. Patch Materials
 - a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Dur-A-Glaze #4 Cove-Rez.
 - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Poly-Crete WR.

2.2 MANUFACTURER

- A. Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802
- B. Manufacturer of Approved System shall be single source.

2.3 PRODUCT REQUIREMENTS

A. Primer, Broadcast and Topcoat

1. Percent Solids	100 %
2. VOC	0 g/L (Satin topcoat 42 g/L)
3. Bond Strength to Concrete ASTM D 4541	400 psi, substrates fails
4. Hardness, Shore D ASTM D2240	70
5. Compressive Strength, ASTM C579	18,000 psi
6. Tensile Strength, ASTM D638	2,600 psi
7. Abrasion Resistance, ASTM D4060	27 mg loss (Satin topcoat 22 mg. loss)
C-17 Wheel, 1,000 gm load, 1,000 cycles	
8. Potlife @ 70 F	7 – 10 minutes
9. Gloss (ASTM D523) 60°	90 (Satin topcoat 50 – 55)
10. Coefficient of Friction (ASTM D2047)	0.6

A. Primer and Topcoat

1. Percent Solids	96 %
2. VOC	33 g/L
3. Bond Strength to Concrete ASTM D 4541	400 psi, substrates fails
4. Hardness, Shore D ASTM D2240	70
5. Compressive Strength, ASTM C579	18,000 psi
6. Tensile Strength, ASTM D638	2,600 psi
7. Abrasion Resistance, ASTM D4060	27 mg loss
C-17 Wheel, 1,000 gm load, 1,000 cycles	
8. Potlife @ 70 F	10 – 15 minutes
9. Gloss (ASTM D523) 60°	90
10. Coefficient of Friction (ASTM D2047)	>0.6

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.2 PREPARATION

A. General

1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
2. Moisture Testing: Perform tests recommended by manufacturer and as follows.
 - a. Perform relative humidity test using is situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
 - b. If the relative humidity exceeds 75% then Dur-A-Flex, Inc Dur-A-Glaze MVP Primer moisture mitigation system must be installed prior to resinous flooring installation. Slab-on grade substrates without a vapor barrier may also require the moisture mitigation system.
3. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
4. Mechanical surface preparation
 - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 3-4 as described by the International Concrete Repair Institute.
 - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
 - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
 - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations. Refer to Dur-A-Flex Joint Guidelines.
5. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.3 APPLICATION

A. General

1. The system shall be applied in four distinct steps as listed below:
 - a. Substrate preparation
 - b. Priming
 - c. Broadcast coat application with chip broadcast
 - d. Topcoat application
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
3. The handling, mixing and addition of components shall be performed in a safe manner to achieve

the desired results in accordance with the Manufacturer's recommendations.

4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the

Applicator.

B. Primer

1. The primer shall be pigmented ACCELERA mixed per the manufacturer's instructions.
2. The primer shall be applied by 1/8" V-notched squeegee and cross rolled with a 3/8" nap roller at the rate of 115 SF/kit.

C. Broadcast Coat

1. The broadcast coat shall be applied as a single broadcast system as specified by the Architect.
2. The broadcast coat shall be comprised of two components: a resin, and hardener as supplied by the Manufacturer and mixed per manufacturer instructions.
3. The hardener shall be added to the resin and thoroughly mixed by suitably approved mechanical means.
4. The broadcast coat shall be applied over horizontal surfaces using a 3/16" V-notched squeegee and cross rolled with a 3/8" nap roller at the rate of 75 SF/kit.
5. Chips shall be broadcast to excess into the wet material, Macro chips at the rate of 0.1 lbs/sf, and Micro chips at the rate of 0.15 lbs/sf.
6. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
7. Scrape the floor with a trowel or floor scraper. Sweep and vacuum the floor again.

D. Topcoat

1. The grout coat shall be comprised of ACCELERA resin and hardener mixed per the manufacturer's instructions.
2. The grout coat shall be flat squeegee applied and cross rolled with a 3/8" nap roller with a coverage rate of 65 SF/kit.
3. The finished floor will have a nominal thickness of 44 mils.

3.4 FIELD QUALITY CONTROL

A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
 - a. Temperature
 1. Air, substrate temperatures and, if applicable, dew point.
 - b. Coverage Rates
 1. Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.5 CLEANING AND PROTECTION

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

SECTION 09 7720

DECORATIVE FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum wallboard.
- B. Products Not Furnished or Installed under This Section:
Gypsum substrate board.

1.2 RELATED SECTIONS

- A. Section 09 29 00 - Gypsum [Cementitious] substrate board.
- B. Section 09 90 00 - Painting & Transparent Finishes.
- C. Section 09 65 13 - Resilient Base.

1.3 REFERENCES

- A. American Society for Testing and Materials: Standard Specifications (ASTM)
 - ASTM D 790 – Flexural Strengths (psi)
 - ASTM D 790 – Flexural Modulus (psi)
 - ASTM D 638 – Tensile Strengths (psi)
 - ASTM D 638 – Tensile Modulus (psi)
 - ASTM D 2583 – Barcol Hardness
 - ASTM D 256 - Izod Impact Strengths (ft #/in)
 - ASTM D 696 – Thermal Coefficient of Lineal Expansion (in/in/F)
 - ASTM D 570 – Water Absorption (%)
 - ASTM D 792 – Specific Gravity
 - ASTM D 3359 – Cross-cut Adhesion
 - ASTM D 3273 – Mold & Mildew
 - ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data to indicate compliance with these specifications, including:
 - Storage, handling and preparation instructions and recommendations.
 - Installation instructions.

- B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.
- C. Selection Samples: Submit manufacturer's standard color pattern selection samples representing manufacturer's full range of available colors and patterns.
- D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
Submit complete with specified applied finish.
For selected patterns show complete pattern repeat.
Exposed Trim Molding: Provide samples of each type, finish, and color.
- E. Manufacturers Safety Data Sheets (SDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site.

1.5 QUALITY ASSURANCE

- A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
ASTM E 84 (Method of test for surface burning characteristics of building Materials)
Wall Required Rating – Class C.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials factory packaged on strong pallets.
- B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels and adhesive to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Building are to be fully enclosed prior to installation with heat (70° or similar room temperature) and ventilation consistent with good working conditions for finish work.
- B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

- A. Furnish one-year guarantee against defects in material.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.
- B. Product:
Symmetrix™ SmartSeam FRP Panels with Sani-coat Sealer

2.2 PANELS

- A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
Finishing: BlueSky™ Advanced Finishing System: Spray-applied Sani-coat Sealer covers entire panel including grooves and features water-based coatings and controlled, low-temperature inline curing.
Dimensions:
 Thickness – 0.090” (2.29mm) nominal
 Width – [4'-0” (1.22m)] nominal
 Length – [4'-0” (1.22m)] [8'-0” (2.44m)] [As indicated on the drawings] nominal
Tolerance:
 Length and Width: +/-1/8” (3.175mm)
 Square - Not to exceed 1/8” for 4' (1.2m) panels, 8' (2.4m) panels or 5/32” (3.96mm) for 10' (3.0m) panels
- B. Properties: Resistant to rot, corrosion, denting, peeling, and splintering.
1. Flexural Strength – 0.9×10^4 psi per ASTM D 790.
 2. Flexural Modulus – 6.0×10^6 psi per ASTM D 790.
 3. Tensile Strength – 11.5×10^3 psi per ASTM D 638.
 4. Tensile Modulus – 0.45×10^6 psi per ASTM D 638.
 5. Barcol Hardness (scratch resistance) – 28 per ASTM D 2583.
 6. Izod Impact Strength – 6.0 ft. lbs./in ASTM D 256
 7. Thermal Coefficient of Lineal Expansion – 2.22×10^{-5} in/in/F per ASTM D 696
 8. Water Absorption – 0.15% per ASTM D 570.
 9. Specific Gravity – 1.8 per ASTM D 792.
 10. Cross-cut Adhesion – 0 removed per ASTM D 3359
 11. Mold & Mildew – Pass per ASTM D 3273.
- Standard Specification for FRP Wall Panels – per ASTM D 5319
Standard Test Method Surface Burning Characteristics of Building Materials – Class C per ASTM E 84.
- C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
- D. Front Surface: Smooth
- E. Panel Color and Groove Color:
1. SYM SS5461Loggia Panel and White Grooves

- F. Finish Gloss Level:
 - 1. High Gloss
- G. Tile Pattern, Groove Direction, Tile Size & Panel Size:
 - 1. Subway Horizontal Direction
 - a) 6" x 3" tiles, panel size 4' x 4' nominal
- H. Fire Rating: Class C (III) Fire Rating.

2.3 TRIM MOLDING

- A. PVC Trim: Thin-wall semi-rigid extruded PVC. Use only as needed.
 - M 350 Inside Corner, 8' length
 - M 360 Outside Corner, 8' length
 - M 370 Edge, 8' length
 - V 177 135° Inside Corner [8' length]
 - V 179 135° Outside Corner [8' length]
 - Color: White

2.4 ACCESSORIES

- A. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
 - Water- resistant, non-flammable adhesive. Use over porous subwall only, such as unfinished drywall.
 - Titebond Advanced Polymer Panel Adhesive – VOC compliant, non-flammable, environmentally safe adhesive. [3.5 gallon can]. Use over non-porous subwall.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine sub wall to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
 - Verify that stud spacing does not exceed 24" (61cm) on-center.
- B. Repair defects prior to installation.
 - Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

- A. Comply with manufacturer's recommended procedures and installation sequence.
- B. Cut panels to meet supports allowing 1/8" (3 mm) clearance for every 8 feet (2.4m) of panel.
 - Cut and drill with carbide tipped saw blades or drill bits or cut with shears.

- C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.

Install panels with manufacturer's recommended gap for panel field and corner joints.

Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.

For interlocking SmartSeam Panels (non-continuous vertical joints, i.e. subway groove configuration), apply Marlite C-109 Low VOC Cartridge adhesive using swirl technique at jagged panel edges.

- D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.

All moldings must provide for a minimum 1/8" (3mm) of panel expansion at joints and edges, to insure proper installation.

Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

- A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
- B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 09 7720

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED

The work includes furnishing of materials and equipment, preparation of surfaces and completion of the painting and finishing of all surfaces as required by the drawings and specified herein.

1.02 RELATED WORK

- A. Factory, pre-finished items as specified in various sections.
- B. Shop painting specified in respective sections.
- C. Architectural woodwork.
- D. Surfaces not to be painted:
 - a. Pre-finished wall, ceiling and floor coverings.
 - b. Items with factory-applied final finish.
 - c. Concealed ducts, pipes and conduit.
 - d. Surfaces specifically scheduled or noted on the drawings not to be painted.

1.03 SUBMITTALS

- A. Product data:
 - a. Not less than thirty (30) days before beginning work, submit a complete list of materials proposed for use, together with manufacturer's specifications.
 - b. Paint materials and products shall be subject to the Architect's approval.
- B. Color samples:
 - a. Prepare all color and finishes on samples, 8-1/2" x 11" in size.
 - b. Samples shall be submitted as requested until required sheen, color and texture is achieved.
 - c. Prepare wood samples on type and quality of wood specified for use on project.
 - d. Label and identify each sample as to location and application.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver paint materials in sealed original labeled containers bearing manufacturer's name, type of paint, stock number, color and instructions for reducing or mixing where applicable.
- B. Paint materials and equipment
 - a. Store only acceptable project materials on site.
 - b. Store in a suitable location.
 - c. Restrict storage to paint materials and related materials.
 - d. Comply with health and fire regulations.

1.05 PROJECT CONDITIONS

- A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied. Do not apply varnish or paint when temperature is below 45 degrees F. Do not apply exterior paint in damp or rainy weather; ensure that the surface has dried thoroughly before proceeding.
- B. Do not apply finish in areas where dust is being generated.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Vista Paint corporation (Basis of Design)
- B. Dunn Edwards
- C. PPG Pure Performance
- D. Sherwin Williams Company Harmony Low Odor

2.02 MATERIALS

- A. Materials selected for coating systems for each type surface shall be the product of a single manufacturer.
- B. Accessory materials such as turpentine, thinner, linseed oil, putty and shellac shall be of the highest quality and by approved manufacturer.
- C. All paints shall be ready-mixed except field-catalyzed coatings. Mix only in metal pails.
- D. Finish coats shall not be thinned without Architect's approval.
- E. Number of coats scheduled is minimum. Additional coats shall be applied at no additional cost if necessary to completely hide base materials, produce uniform color and provide satisfactory finish result.
- F. All submitted paint products to be in compliance with all local, state and federal air quality mandates.

2.03 COLORS

- A. All colors are to be selected or approved by the Architect and actual color chips shall be supplied to the Contractor for matching. All undercoats shall be tinted to approximate the finish coat.
- B. Approval of final colors: Final coat of paint shall not be applied until the Architect has approved colors.
- C. The number of colors to be used shall be as determined by the Architect. Architect reserves the right to vary colors throughout the project.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into acceptable condition through preparatory work as included in Article 3.02 "Preparation of Surfaces". The Contractor shall notify the General Contractor and Architect in writing of any defects or conditions which will prevent a satisfactory installation.

- B. Do not proceed with surface preparation or coating application until conditions are suitable. Special attention should be made to all smooth and especially Level 5 Drywall Finish. In those instances a test patch to ensure proper surface adhesion should be undertaken.
- C. Commencement of installation will be construed as acceptance of surfaces.

3.02 PREPARATION OF SURFACE

- A. All surfaces to receive paint shall be clean, dry, smooth and dust free before application of any materials. Prepare surfaces as follows:
 - a. WOOD: Sand smooth and remove dust. Fill open joints, cracks, nail holes and other pits or depressions flush and smooth with putty or wood dough after priming. Putty color to match finish paint coat. Touch up knots or sap streaks with shellac or other approved sealer before priming.
 - b. CONCRETE: Remove all foreign matter, efflorescence and encrustations. Use a stiff fiber brush to remove loose particles. Fill all depressions and remove all fins and projections not inherent in the base material.
 - c. PRIMED FERROUS METAL: Remove all foreign matter. Touch up abrasions with ferrous metal primer.
 - d. UNPRIMED FERROUS METAL: Remove all rust, mill scale and foreign matter by wire brushing, scraping, sandblasting or solvent as required to provide a clean, smooth surface.
 - e. GALVANIZED METAL: Remove all foreign matter and clean entire surface with mineral spirits. Pre-treat with phosphoric acid, etch or wash primer. Apply primer the same day as pretreatment is applied.
 - f. GYPSUM BOARD: Remove all foreign matter. Finish all pits flush and smooth with approved gypsum board filler material.
 - g. PLASTER: Fill hairline cracks, small holes and imperfections on plaster surfaces with patching plaster. Smooth off to match adjacent surfaces. Wash and neutralize high alkali surfaces where they occur.
- B. Surfaces that cannot be prepared or painted as specified shall be immediately brought to the attention of the Architect in writing.
 - a. Starting of work without such notification will be considered acceptance by the Contractor of surfaces involved.
 - b. The Contractor shall replace unsatisfactory work caused by improper or defective surfaces as directed by the Architect at no additional cost to the Owner.

C. 3.03 APPLICATION

- a. Do not apply initial coating until moisture content of surface is within limitations recommended by the paint manufacturer.
- b. Application:
 - i. Apply paint with suitable brushes, rollers or spraying equipment.
 - ii. Apply stain in accordance with manufacturer's recommendations.
 - iii. Rate of application shall not exceed that as recommended by the paint manufacturer for surface involved.
- c. Comply with recommendations of product manufacturer for drying time between succeeding coats.
- d. Leave all parts of molding and ornaments clean and true to details with no undue amount of paint in corners and depressions.

- e. Make edges of paint adjoining other material or color clean and sharp with no overlapping.
- f. Refinish whole wall where portion of finish is not acceptable.
- g. All materials shall be applied evenly with proper film thickness and free of runs, sags, skips and other defects. Enamel and varnishes shall be sanded lightly between coats, dusted and cleaned before recoating.
- h. Hardware, hardware accessories, plates, lighting fixtures and similar items in place shall be removed prior to painting and replaced upon completion of each space.
- i. Heating and other equipment adjacent to walls shall be disconnected, using workmen skilled in appropriate trades, and moved to permit wall surfaces to be painted. Following completion of painting, they shall be expertly replaced and reconnected.
- j. Paint visible surfaces behind vents, registers or grilles flat black.
 - i. Wash exposed metal with solvent then prime and paint as scheduled.
 - ii. Spray paint wherever practical.
- k. Do not paint over Underwriters' labels, fusible links or sprinkler heads.
- l. Exposed plumbing and mechanical items without a factory finish such as conduits, pipes, access panels and items of similar nature be finished to match adjacent wall and ceiling surfaces unless otherwise directed.

3.04 CLEAN-UP

Upon completion of the work, the Contractor will remove all equipment, excess material and debris and leave the area in a neat and orderly condition.

3.05 PAINT FINISH SCHEDULE

- 1. Stucco (exterior):
 - a. Step 1 (Primer) - 4700 Tilt-Up Primer
 - b. Step 2 (First Coat) - 7500 Acriglo Eggshell
 - c. Step 3 (Second Coat) - 7500 Acriglo Eggshell
- 2. Wood Exterior:
 - a. Step 1 (Primer) - 863 Production AquaLac
 - b. Step 2 (First Coat) - 1300 Coverall Semi-Gloss
 - c. Step 2 (Second Coat) - 1300 Coverall Semi-Gloss
- 3. Ferrous Metal (Exterior):
 - a. Color: Film Noir 0144
 - b. Step 1 (Primer) - 4800 Metal Pro Prime
 - c. Step 2 (First Coat) - 7000 Acriglo Semi-Gloss
 - d. Step 3 (Second Coat) - 7000 Acriglo Semi-Gloss
- 4. Non-Ferrous Metal (Exterior):
 - a. Color: Film Noir 0144
 - b. Step 1 (Primer) - 4800 Metal Pro Prime
 - c. Step 2 (First Coat) - 7000 Acriglo Semi-Gloss
 - d. Step 3 (Second Coat) - 7000 Acriglo Semi-Gloss

5. Gypsum Board (Interior) Walls:
 - a. Color: Herare White 0215
 - b. Step 1 (Primer) - 155 Seal Kote
 - c. Step 2 (First Coat) - 7500 Acriglo Eggshell
 - d. Step 3 (Second Coat) - 7500 Acriglo Eggshell
6. Wood Trim:
 - a. Step 1 (Primer) - 863 Production AquaLac
 - b. Step 2 (First Coat) - 1300 Coverall Semi-Gloss
 - c. Step 2 (Second Coat) - 1300 Coverall Semi-Gloss

END OF SECTION

SECTION 09 9623

GRAFFITI-RESISTANT COATINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work includes anti-graffiti coating.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 09 9000: Painting and Coating.

1.02 SUBMITTALS

- A. Provide submittals in accordance with Division 01.
- B. Samples: Submit Samples of coating system.
- C. Product Data: Submit anti-graffiti coating manufacturer's technical data and installation instructions, recommended coverage rates for types of surfaces to be treated, and evidence that coatings conform to requirements specified. Submit evidence of code approvals.
- D. Furnish Samples on the same materials to which coating will be applied on. Indicate satin or flat finish. Coat one-half of each Sample, with the other half non-coated.
- E. Installer: Submit written evidence the installer for the Work of this section has completed at least five projects of similar complexity within the past five years.
- F. Certificate and Summary Statement: Before Substantial Completion, submit a certificate stating that coatings applied conform to reviewed submittals and specified requirements. Provide a summary statement setting forth the following:
 - 1. Number of square feet of each surface treated with coating, classified as to the kind of material treated, open pore or closed pore type, and whether vertical or horizontal.
 - 2. The number of gallons of each type, class, or grade of coating required to treat involved surfaces, based on the number of square feet of each type and orientation of the material the coating was installed on.
 - 3. Total gallons of each coating type, class, or grade installed.
- G. Maintenance Instructions: Furnish manufacturer's recommended graffiti removal instructions, and recommendations for recoating. Furnish names and addresses of cleaning firms and of suppliers of maintenance materials.
- H. Maintenance Material: Furnish five gallons of each product specified.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Observation: Start coating application under the observation of the coating manufacturer's technical representative. Notify Project Inspector and coating manufacturer at least 72 hours before starting installation.
- B. Preliminary Tests: Perform tests on each kind of surface to be treated to establish the actual application rates required to provide the surfaces resistant to defacing and meet warranty requirements. Tests shall demonstrate the coating does not yellow, darken, mottle, or discolor any treated surface and those surfaces to be treated are dry. Established application rates shall not be less than those recommended in the coating manufacturer's technical data for the kind and surface orientation of the material.
- C. Compliance with Regulations: Materials shall comply with the current rules and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous materials in coatings.
- D. Materials shall meet requirements of SCAQMD regarding emission of solvents and other pollutants.
- E. Qualifications:
 - 1. Manufacturer: Anti-graffiti coating shall be product of a manufacturer who has been regularly engaged in manufacturing anti-graffiti coatings for at least 5 years. Manufacturer shall supply references of at least five satisfactory installations in which anti-graffiti coating has been in service for at least five years.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver coating materials to the Project site in containers bearing name and batch number of manufacturer, with seals intact.

1.05 PROJECT CONDITIONS

- A. Protection: Install temporary coverings and protection, and do not allow coating to contact plastic, planting soil, plants, asphaltic paving, roofing membranes, or other materials that are likely to be damaged by coating.
- B. Weather Conditions: Do not install coating during windy, wet, or excessively hot or dry weather conditions.

1.06 WARRANTY

- 1. Manufacturer shall provide a five year material warranty.
- 2. Installer shall provide a one year application warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Permashield, by Monopole Inc.:

1. Permashield Premium 5650 over Aquaseal ME12, Permanent Graffiti Control, Monopole Inc., ND Graffiti Shield System, Rainguard VandlGuard System, or equal. High gloss finish.
- B. Coval Anti-Graffiti coating by Coval Molecular Coatings.

2.02 PROPERTIES

- A. Coatings shall not darken or discolor the treated surfaces and shall be non-toxic, compatible with standard polymer type sealing materials, conforming to AQMD 1113, and certified by manufacturer as suitable over paint finish.
- B. Colors of opaque materials shall match adjoining colors, or shall be selected from manufacturer's custom colors.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not start installation of coating if conditions are present that prevent or interfere with the correct preparation of surfaces or installation of coating system.

3.02 PREPARATION

- A. Remove dust, dirt, oil, grease, other deleterious substances and stain, and efflorescence and laitance from surfaces. Repair cracks and holes over 1/16 inch size. Spot prime cracks and holes 1/16 inch size and smaller and prime horizontal surfaces other than soffits with a heavy duty coating supplied by same coating manufacturer. Mask and protect adjoining surfaces and glass, unless coating is harmless and easily removed.

3.03 APPLICATION

- A. Install the anti-graffiti coating to surfaces indicated on drawings.
- B. Test graffiti resistant coating in an inconspicuous location to ensure adhesion and performance.
- C. Apply the anti-graffiti coating to surfaces indicated on drawings per manufacturer's recommended application methods and thicknesses.

3.04 CLEANING

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

3.05 PROTECTION

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

END OF SECTION

SECTION 10 1100
VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall mounted marker boards.
2. Horizontal sliding marker boards and map rail at media wall cabinets.
3. Horizontal sliding marker boards and map rail at science classrooms.
4. Tack boards.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 06 1000 - Rough Carpentry.
3. Section 06 4000 - Architectural Woodwork: Media wall cabinets at classrooms.
4. Section 09 9000 - Painting and Coating.

1.02 SUBMITTALS

A. Shop Drawings: Shop Drawings to indicate gages, profiles, sections of materials, details of construction, hardware, methods of attachment and/or anchoring, as applicable for specified materials.

B. Samples: Submit the following:

1. Three- inch by 5-inch marker board Samples, provide manufacturer's full range of colors.
2. Three- inch by 5-inch sliding tack board Samples, provide manufacturer's full range of colors and patterns.
3. Three- inch by 5-inch sliding bulletin board Samples, provide manufacturer's full range of colors.

C. Product Data: Submit manufacturer's technical data, product specifications, installation instructions, and other pertinent information as applicable for each product or material specified.

D. Test Reports: Submit certified laboratory test reports as applicable to indicate compliance with specified requirements.

1.03 QUALITY ASSURANCE

- A. Manufacturer shall have been regularly engaged in the business of manufacturing markerboards for at least five years.
- B. Comply with requirements and recommendations of applicable portions of Porcelain Enamel Institute - PEI 2.

1.04 PRODUCT HANDLING

- A. Deliver materials to the Project site with manufacturer's labels intact and legible.
- B. Protect marker boards before, during and after installation.

1.05 JOB CONDITIONS

- A. Sequencing, Scheduling:
 - 1. Coordinate with related Work of other sections including gypsum board and tackboards.
 - 2. Do not install markerboards until paint is installed to surfaces concealed behind them.

1.06 SPECIAL PROJECT WARRANTY

- A. Manufacturer shall provide a 50 year material warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. W.E. Neal Slate Co.
- B. ABC School Equipment.
- C. Claridge Inc.
- D. Equal.

2.02 SYSTEM PERFORMANCE

- A. System shall be comprised of factory assembled markerboards, in configurations and sizes indicated on the Drawings or as specified herein.
- B. Laminations of panel components shall be by face sheet manufacturer.

2.03 MATERIALS

- A. Wall-Mounted Marker boards
 - 1. Dry marker boards shall be porcelain enamel steel manufactured to exceed the performance specifications for porcelain enamel S104 of the Porcelain Institute. Markerboards shall be capable of supporting papers by means of

magnets. The writing surface shall resist wear and damage from shock and abrasion and shall not dent, shatter or crack. The surfaces shall retain original color, writing, and erasing qualities and shall not become glossy or shiny in normal use. The gloss variation of a surface shall not exceed three units when measured by a 45 degree gloss meter in accordance with the Porcelain Enamel Institute Bulletin 1-18 Gloss Test for Porcelain Enamels and ASTM C346.

2. Steel: Base metal shall be high quality enameling iron or steel of low metalloid and copper content, especially manufactured and processed for temperatures over 1,400 degrees F. used in coating porcelain on steel units for Architectural purposes; minimum 24 gage.
3. Facing Surfaces:
 - a. Board surfaces shall consist of the following:
 - 1) Primer coat, 0.0025 inch minimum thickness.
 - 2) Vitreous-porcelain writing surface coating of 0.0025 inch minimum thickness.
 - 3) The reverse side of the steel base sheet shall receive a ground coat of 0.0005 inch thickness and a spray coat of silicon.
 - 4) The panel edges at butt joints shall be porcelain enamel.
 - 5) Fuse cover and ground coats to the steel at the manufacturer's standard firing temperature, but at least 1,250 degrees F.
4. The dry marker board surfaced steel shall be factory laminated to 7/16 inch thick fiberboard core. A moisture blocking backing sheet shall be provided.
 - a. Fiberboard Core shall be #45 pound particle board.
 - b. Moisture Barrier Backer Sheet shall be minimum .015 aluminum or 28 gauge galvanized steel. Backer sheet shall be factory laminated to the core under pressure.
5. Lamination: The surface facing and the backing shall be bonded to the core material by means of a special flexible adhesive developed for this purpose with no unbonded area. The face and back shall not be removable without rupturing the core material. Panels shall not delaminate under normal use.
6. Joints: Where vertical joints occur, a 14 gage continuous concealed steel spline shall be fitted tightly into grooves in the core material. Factory rabbet to produce a smooth butt joint. Do not furnish exposed trim.
7. Edge Trim:
 - a) Alloy 6063-T5, extruded, anodized satin finish aluminum.
8. Chalktray: Furnish manufacturer's standard continuous flat-ribbed or box-type aluminum chalktray with stained front and cast plastic end closures for each chalkboard and markerboard.

- a. Extend chalk tray to end of both vertical edges of the board.
 - b. On flat-rib tray, provide 3/4 inch radius on corners and polish at ends.
- 9. Map Rail: Furnish map rail at the top of each unit, complete with the following accessories:
 - a. Display rail: Provide continuous cork display rail 2-inch wide, as indicated, integral with the map rail. Extend display rail to end of both vertical edges.
 - b. End stops: Provide one end stop at each end of the map rail.
 - c. Map hooks: Provide two map hooks with flexible paper holder clips for each 8 feet of map rail or fraction thereof.
 - d. Roller Map Bracket: Provide two for each 8 feet of map rail or fraction thereof.
- B. Soffit Mounted Horizontal Sliding Marker boards (at Media Walls).
 - 1. Frame: Heavy-duty aluminum.
 - a. Top Supported Trolley System.
 - b. Top Track/Carrier: Five adjustable ball bearing carriers per panel. Provide rubber bumpers at ends of track.
 - c. Bottom Guide Channel: Manufacturer's standard.
 - 2. Marker board: 24 gage porcelain enamel steel laminated to 7/8 inch thick honeycomb core with moisture barrier backing sheet of 0.015 aluminum and aluminum trim at perimeter and nylon guides at guide channel edge.
 - a. Marker board facing color: White, unless otherwise indicated on Drawings.
 - b. Pulls: Provide two recessed pulls per panel at jambs.
 - 3. Map Rail, surface mounted 2-inch width, with insert and end stops, or equal.
 - a. Combination Maphook/Clip. Provide two for each eight feet of map rail or fraction thereof.
 - b. Roller Map Bracket. Provide two for each eight feet of map rail or fraction thereof.
 - 4. Chalk Tray: Manufacturer's standard.
- C. Wall Mounted Horizontal Sliding Marker boards – Double Panel (at Science and Laboratory Classrooms):

1. Frame and Track and Chalk tray: Heavy-duty aluminum wall frame fabricated with 3-inch by 1 ½-inch frame channels and interior fitting C-clip wall channels.
 - a. Top Roller Supported Trolley System and Top Carrier: Guide track with five adjustable ball bearing carriers per panel.
 - b. Bottom Guide: Inner and Outer Boards with rubber bumpers at ends.
 - c. Chalk tray attached to bottom horizontal frame.
2. Sliding Marker Board: 24 gage porcelain enamel steel on 7/8 inch thick paper honeycomb with 0.015 aluminum backing and trim at perimeter and nylon guides at guide channel edge.
 - a. Marker board facing color: White, unless otherwise indicated.
 - b. Pulls: Provide two per panel at jambs.
3. Fixed (Wall Mounted) Marker Board: 24 gage porcelain enamel steel on either 7/16 inch fiberboard core or 7/8 inch thick paper honeycomb with 0.015 aluminum backing and trim
4. Map Rail, surface mounted 2-inch width, with insert and end stops.
 - a. Combination Maphook/Clip. Provide two for each eight feet of map rail or fraction thereof.
 - b. Roller Map Bracket. Provide two for each eight feet of map rail or fraction thereof.

D. Tack boards:

1. Tackwall panels shall consist of single-face layer of cloth-backed vinyl film, factory-bonded to 1/2 inch wood fiberboard backing; weight of vinyl film to be 20 ounces per lineal yard. Panel edges shall be beveled and wrapped; ends shall be square and unwrapped. Color as selected by Architect.
 - a. Vinyl film shall comply with FS CCC-W-408 A, Type 1; backing shall comply with FS LLL-1-535B, Class A. Finished panel shall have a Fire Hazard Classification of Class II in accordance with ASTM E84 tunnel test, as administered by California State Fire Marshal approved testing laboratory.
2. Adhesive shall be as recommended by manufacturer.

E. Flagpole Holder: Provide one per classroom where marker boards are provided.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install markerboard, trim, map rail and marker tray in accordance with manufacturer's directions. Fasteners for assembly of trim and frame units shall be truss head aluminum or stainless steel self-tapping screws with double cadmium-plated finish.
- B. Install panels after finish painting of wall surfaces has been completed and paint is cured. Install panels level, plumb and neatly assembled. Before Substantial Completion, trim shall be cleaned of dirt, finger-marks, and other foreign material.
- C. Install panel guides, spacers, and panels at media wall cabinets.

3.02 CLEANUP

- 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 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.
3. School Name and Address Sign.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 08 1113: Hollow Metal Doors, Windows and Frames.
3. Section 08 1416: Wood Doors.
4. Division 09: Finishes.
5. Section 13 4216: Wheelchair Lifts.
6. Section 14 2423: Hydraulic Elevators.
7. 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. 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 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.
 - c. Adhesives and sealants shall comply with the limits for VOC content and shall be approved by OWNER's Office of Environmental Health Services (OEHS).

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 with 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 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 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 with 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 degrees 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 righthand 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, one 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.
 - 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.
- D. Room Identification for Single-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. Text descriptor shall be “All Gender Restroom”. 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 STAIR DOWN".
3. "EXIT RAMP DOWN".
4. "EXIT STAIR UP".
5. "EXIT RAMP UP".
6. "EXIT ROUTE".
7. "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 DIRECTIONAL EXIT SIGNAGE

A. At exits serving a required accessible space but not providing an approved accessible means of egress, at elevator landings and within areas of refuge, provide signage indicating the location of accessible means of egress.

1. Finish and Contrast: Refer to paragraph 2.03.B.
2. Character Height and Proportions: Refer to paragraph 2.03.B.
3. Symbol of Accessibility: Refer to paragraph 2.03.E.

2.08 ASSISTIVE LISTENING DEVICE SIGN

A. Include International Symbol of Access for Hearing Loss, CBC Figure 11B-703.7.2.4, with text "Assistive-Listening System Available". Use upper and lower case characters. Sign shall comply with the following requirements:

1. Finish and Contrast: Refer to paragraph 2.03.B.
2. Character Height and Proportions: Refer to paragraph 2.03.B.

3. Symbol of Accessibility: Refer to paragraph 2.03.E.

2.09 PUBLIC TELEPHONE WITH VOLUME CONTROL SIGN

- A. Sign shall contain a depiction of a telephone handset with radiating sound waves. Symbol shall be white on a blue background. The blue shall be equal to Color No. 15090 in Federal Standard 595B. Symbol shall comply with CBC Figure 11B-703.7.2.3.

2.10 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.

2.11 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 AT [Insert location] OR BY TELEPHONING (213) 625-6631".
- 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.

2.12 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.

2.13 OWNER FURNISHED / CONTRACTOR INSTALLED SIGNS

- A. Locate at the main entry and at pedestrian and vehicular entrances to the school site.
 1. Welcome to Our School Sign: Sign size is 24 inches by 36 inches.
 2. Safe School Zone Sign: Sign size is 18 inches by 24 inches.

2.14 SCHOOL NAME AND ADDRESS SIGN

- A. Sign, indicating school name and address, shall be furnished with cast aluminum letters as manufactured by Andco Industries Corp., or equal.
- B. Style: Helvetica Medium, Futura 444, Ribbon 555, 556 or 557 as selected.
- C. Material: 0.064 inch aluminum construction, unless indicated otherwise.
- D. Letter Size: School name shall be 10 inches high and address shall be 4 inches high, unless indicated otherwise.
- E. Letter Copy and Design: As indicated on Drawings.
- F. Finish: Finish shall be type H anodic clear or black, as selected by ARCHITECT.

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.
- E. Exterior Building Sign:
 - 1. Each letter shall be furnished with a minimum of three cast mounting lugs on backside, drilled and tapped to receive installation bolts.
 - 2. Letters shall be installed according to manufacturer's method PMC-1. Letters shall be installed $\frac{3}{4}$ inch away from wall surface, by an aluminum sleeve spacer.

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 10 2113
PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Solid phenolic toilet compartments, urinal screens, and vision screens.

B. Related Requirements:

- 1 Division 01 - General Requirements.
- 2 Section 05 4100 - Structural Metal Stud Framing.
- 3 Section 06 1000 - Rough Carpentry.
- 4 Section 10 2813 - Toilet Accessories.
- 5 Section 10 2815 – Hand and Hair Dryers.

1.02 DESIGN REQUIREMENTS

- A. Design and fabrication shall conform to requirements of ADAAG and CBC Chapter 11B.
- B. Toilet Compartments: Floor supported overhead braced type units consisting of solid phenolic pilasters, panels and doors; plated steel leveling devices with stainless steel covers; and stainless steel fittings, hardware and fastenings.
- C. Urinal Screens: Floor supported and wall hung type consisting of solid phenolic screen panels and plated steel leveling devices with stainless steel covers, stainless steel fittings and fastening.
- D. Vision Panels: Floor- and wall-mounted solid phenolic type.

1.03 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating complete layout, elevations of partitions, thickness of solid phenolic panels, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, hardware, fittings, mountings, method of assembly, other related items, and installation details.
- B. Product Data: Submit manufacturer's technical data for materials, fabrication, finishing, fastenings, hardware, and installation details.
- C. Material Samples:
 1. Submit full range of Samples of phenolic chips for initial color selection. Chips shall be at least 2-inch by 3-inch.

2. Submit Samples of hardware and fasteners.
- D. Certificates: Furnish manufacturer's certification that materials meet or exceed Specification requirements.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 1. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
 2. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 3. Underwriters Laboratories Inc. (UL):
 - a. UL Fire Resistance Directory; applicable UL Design Numbers for application of fireproofing and conditions as indicated.
 4. Chemical Resistance: Panels to meet or exceed Scientific Equipment Furniture Association's (S.E.F.A.) list of 49 standard chemicals.
 5. Consistency:
 - a. Panels to have uniform thickness (+0.03 inch).
 - b. Panels to have uniform flatness (maximum difference of 0.03 inch) for a 10-foot span.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site with manufacturer's labels intact and legible, in sealed containers. Materials shall be kept dry.
- B. Protect compartments and screens.

1.06 COORDINATION

- A. Field Measurements: Secure field measurements prior to fabrication, for proper and adequate fabrication and installation of the Work of this section.
- B. Furnish inserts and anchorage built into other construction for installation of toilet compartments, urinal screens and vision panels.

1.07 WARRANTY

- A. Toilet Compartment Manufacturer shall provide a 25 year material warranty for solid phenolic panels and hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer:

1. Qualifications of Toilet Compartment Manufacturer: Partition Manufacturer shall have been regularly engaged in the construction of Phenolic Toilet Compartments of the type specified for a minimum of five years.

B. Solid Phenolic Panels:

1. Formica Solid Phenolic panels with -692 Folkstone Celesta, 689 Stellar, Formica Corporation.
2. Wilsonart.
3. Nevamar Surface Systems.
4. Equal.

C. Hardware:

1. Galaxy Hardware, Series 8033.
2. Jacknob Corporation.
3. Equal.

2.02 MATERIALS

A. Toilet compartments panels, doors and pilasters; urinal screens and visual screens.

1. Core: Phenolic impregnated Kraft papers. Panel shall be at least 93 pounds per cubic foot to ensure full saturation of Kraft core.
2. Face Sheet: Over decorative papers impregnated with melamine resin and integrally compression molded with the core.
3. Fire Resistance: The panels shall have the following surface burning characteristics and smoke generation values in accordance with UL 723 classification and labeling in accordance with ASTM E84 Class A tests and shall be self-extinguishing.
 - a. Flame spread: Maximum 30 for $\frac{3}{4}$ inch thick panels; 30 for $\frac{1}{2}$ inch thick panels.
 - b. Smoke developed: Maximum 70 for $\frac{3}{4}$ inch thick panels; 85 for $\frac{1}{2}$ inch thick panels.
4. Panels shall be UL registered and labeled.
5. Panel shall be resistant to cleaning solvents and uric acid.
6. Product/Material Specification:
 - a. Modulus of Elasticity: 1.5 million psi minimum.

- b. Shear Strength: 2,000 psi minimum.
- c. Compressive strength: 24,000 psi minimum.
- d. Water Absorption: 3 percent maximum.
- e. Use Temperature: 350 degrees F maximum.
- f. Surface and Edges: Non-porous.
- g. Material Resistance: Will not support fungus or bacteria.
- h. Uniform Load Deflection: ¼ inch maximum per Table A:

Table A: Uniform Load (lbs) which causes ¼ inch deflection at Center				
(Shelves not fixed at either end, static load on E modulus of 2.0 by 106)*				
Uniform Load in pounds:				
Thickness	12 by 24-inch	12 by 36-inch	12 by 48-inch	24 by 36-inch
½ inch	370	110	45	220
¼ inch	1,400	400	170	800
*Loads can be affected by temperature, humidity, time, and other environmental factors. Users should test shelves in appropriate environment. It is assumed that deflection greater than ¼ inch is undesirable aesthetically, even though rupture has not occurred.				

- B. Stainless Steel: ASTM A167, Type 304.
- C. Concealed Fasteners and Leveling Devices:
 - 1. Concealed Fasteners: Stainless steel.
 - 2. Leveling Devices: Zinc or cadmium coated steel, Stainless steel.

2.03 FABRICATION

- A. Doors shall be ¾ inch thick, panels ½ inch thick, pilasters ¾ inch thick and screens ½ inch thick. Edges shall be machined to a radius of 3/16 inch; exposed surfaces shall be free of fabrication marks.
- B. Pilasters: Flush, formed of ¾ inch thick solid phenolic panels. Edges shall be machined to a radius of 3/16 inch.
 - 1. Door Dimensions: Unless otherwise indicated, furnish 24-inch wide in-swinging doors for standard toilet compartments, 36-inch wide clear opening out-swinging doors when located at the end, and 36-inch wide clear opening out-swinging doors when located at the side for stalls equipped for use by the physically disabled
 - 2. Anchorage: Provide stainless steel anchorage, complete and threaded rods, washers, and leveling adjustment nuts at pilasters, to permit connection to floor slab. Furnish devices, which are designed to support pilasters from structure without transmitting load to floor fill.

3. Overhead Bracing: Provide anti-grip, decorative, heavy duty, extruded aluminum head rail with clear anodized finish.
- C. Panels and Urinal Screens: Flush, formed of ½ inch thick solid phenolic panels with a one inch corner radius. Height and width as indicated in drawings.

2.04 HARDWARE

A. Door hardware shall be cast Type 304 stainless steel, as follows:

1. Hinges: 11 gage Cast Stainless Steel Hinge. Hinge shall be cast of type 304 stainless steel and shall have a Satin finish. Hinge shall be gravity type for self-closing action and shall be fully adjustable up to 360 degrees. Pivot pin shall be made of type 304 stainless steel. Only stainless steel components shall be used in the construction of the Hinge. Plastic inserts are unacceptable. Hinges shall provide emergency access by lifting the door. Hinges shall be pre-drilled for mounting to door and pilaster with Stainless Steel through-bolts. Stamped stainless steel is not acceptable.
 - a. Galaxy Hardware: CS-560 (LeftHand IN/RightHand OUT) or CS-561 (RightHand IN/LeftHand OUT).
 - b. Jacknob Corporation: 7273 (RightHand IN/LeftHand OUT) or 7283 (LeftHand IN/RightHand OUT).
 - c. Equal.
2. Continuous Hinge: Continuous 14 gauge stainless steel hinge (48.5") shall be made of Type 302/304 Stainless Steel and shall have a Satin Finish. Hinge shall be 3" wide and shall have four (4) Stainless Steel wire springs for self-closing action. Pivot pin shall be .250" in diameter, and shall be made of Type 304 Stainless Steel. Hinges shall provide emergency access by lifting the door. Hinges shall be pre-drilled for mounting to door and pilaster with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Brass inserts are unacceptable. Each Hinge Set is to be packaged in a separate carton, and is to be labeled by stock number, manufacturer, and left or right hand. Furnish one per door.
 - a. Galaxy Hardware: SS-953 (LeftHand IN/RightHand OUT) or SS-954 (RightHand IN/LeftHand OUT).
 - b. Jacknob Corporation: 7339 (RightHand IN/LeftHand OUT) or 7349 (LeftHand IN/RightHand OUT).
 - c. Equal.
2. Strike and Keeper with Emergency Access: Refer to Detail #1 of this section. Strike and keeper shall be heavy duty ASTM A167, Type 304 cast stainless steel with a polished satin finish. All outside corners and edges shall be rounded to ensure there are no sharp edges. The strike and keeper shall provide emergency egress by lifting of the door. The strike and keeper shall be 2.50" high, with the mounting holes at 1.50" O.C. The wall thickness shall be a minimum of .125". The keeper shall have a minimum 7/8 inch tab to prevent impaling injuries. The strike and keeper shall be mounted to the pilaster with theft proof stainless steel Torx Head with pin through-bolts. Strike and keeper shall have an integral rubber bumper door stop rated and able to withstand a sudden impact of 350 lbs. Stamped stainless steel strike and keepers are

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unacceptable. Extra door stops that encumber the door opening and create a hazard are unacceptable. The stock number shall be molded into the back of strike and keeper for ease in identification. Furnish one per door.

- a. Galaxy Hardware: CS-458 (inswing strike & keeper), or CS-456 (outswing strike & keeper).
 - b. Jacknob Corporation 6283 (inswing strike & keeper), or 4913 (outswing strike & keeper).
 - c. Equal.
3. Slide Latch: Heavy duty cast stainless steel with satin finish. Slide latch shall be surface mounted. The slide bar shall be .150 inch thick, 1.020 inch wide and 3.720 inch long. Latch shall have an internal stainless steel buffering spring to prevent damage when door is inadvertently slammed against the latch. Mounting holes are to be spaced at 3.50 inch on center. Latch knob shall be riveted to the slide bar and welded to insure that the knob will not come off. Stock number shall be molded into the back of the slide latch for ease identification. Furnish one per door. Stamped stainless steel is not acceptable.
 - a. Galaxy Hardware: CS-233.
 - b. Jacknob Corporation: 5053
 - c. Equal.
4. Coat Hook: Heavy duty cast stainless steel with satin finish. Coat hook and bumper shall be 2.340 inch high, 1.230 inch wide and shall protrude out from the door 3.05 inch. The hook portion shall have a finished diameter of .250 inch thick. The stock number shall be molded into the back of the Coat Hook and Bumper for ease in identification. Furnish one per door. Stamped stainless steel is not acceptable. Mount at 48 inches maximum above finished floor in accessible toilet compartments.
 - a. Galaxy Hardware: CS-274.
 - b. Jacknob Corporation.
 - c. Bobrick: B-212.
 - d. Equal.
5. Door Stop: Heavy duty cast stainless steel with satin finish. Plated Zarnac Door stops are unacceptable. Door Stop shall have a 2.125 inch base diameter and shall protrude 1.80 inch from the Wall. The bumper at the end of the Door Stop shall be .250 inch thick. The diameter of the shaft shall be .6875 inch. The stock number shall be molded into the back of the Door Stop for ease in identification. Stamped stainless steel is not acceptable.
 - a. Galaxy Hardware: CS-276.
 - b. Jacknob Corporation: 4123.
 - c. Equal.

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6. Pull Handle:
- a. Heavy duty cast stainless steel with satin finish. Plated Zamac Door pulls are unacceptable. Pull Handle shall protrude from the face of the door .940 inch and shall be 4.735 inch long. The Pull Handle shall have mounting holes drilled and tapped for 10/24 threads at 3.50 inch on center. The Pull Handle shall be .655 inch wide and shall be mounted back to back with the slide latch. The stock number shall be molded into the back of the pull handle for ease in identification. Stamped stainless steel is not acceptable. Provide u-pull shape handle on each side of accessible toilet compartment doors.
 - 1) Galaxy Hardware: CS-277.
 - 2) Jacknob Corporation: 6253.
 - 3) Equal.
 - b. Accessible Door Pull: 5-1/8 inch by 3 inch high stainless steel pull:
 - 1) Galaxy Hardware: PH-200.
 - 2) Jacknob Corporation: 6253.
 - 3) All Partitions A0625.
 - 4) Equal.
- B. Pilaster Shoes: ASTM A167, Type 302/304 Stainless Steel, minimum 3-inch high, 18 gauge, finish with #3 Directional polish, attached with stainless steel through bolts.
- C. Brackets: One piece double ear bracket or single ear bracket (at end partition) extending within 3 inches of top and bottom panel edges. Extruded 6063-T5 Aluminum with a satin anodized finish or 304 stainless steel. The minimum weight shall be 1.685 pounds per lineal foot. Inside opening of Bracket shall be .50 inch for panels, .75 inch for pilasters. Holes for mounting to wall and panel/pilaster shall be pre-drilled. Holes are to be spaced at 9 inches on center along the full length of the bracket for a total of twelve holes (double ear) for mounting to the wall and six holes (single ear) for mounting to the panel/pilaster. Each bracket is to have a minimum wall thickness of .125 inch.
- D. Overhead Bracing (Headrail): Continuous heavy duty extruded 6063-T5 Aluminum Headrail with anti-grip profile. Head rail shall have integral reinforcing channel and curtain track. Head rail shall have Satin Anodized finish. Provide headrail corner brackets, wall brackets, and headrail end caps as required. The headrail and headrail brackets shall have a minimum wall height of 2 inch. The minimum wall thickness of the headrail and head rail brackets shall be .125 inch.
- 1. Galaxy: AL-115 (16' antigrip headrail), EC-120 (3/4" END CAP), HP-132 (Headrail to wall bracket pack), HP-970 (Corner headrail bracket pack).
 - 2. Jacknob Corporation: 80188 – Extruded Aluminum Headrail, 2109 Headrail Wall Brackets, 6672 Headrail End Caps.
 - 3. Equal.
- E. Chrome-plated, non-ferrous cast alloy material shall not be furnished for hinges, brackets, locks, latches and other fittings and accessories.

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PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Before covering wall framing with finish materials, examine framing to ensure that backing plates and structural framing have been installed in such position as to receive all attachment screws.
- B. Verify spacing of plumbing fixtures to ensure compatibility with installation of compartments.
- C. Do not start the Work of this section until all deficiencies have been corrected.

3.02 INSTALLATION

- A. Install partitions and screens as shown in the Shop Drawings and in accordance with manufacturer's instructions and as specified. Install straight, level and plumb.
- B. No evidence of drilling, cutting or patching shall be visible in finished Work.
- C. Fasten panel brackets securely to walls and ceilings with recommended anchoring devices.
- D. Fasten panels and pilasters to brackets with through bolts and nuts.
- E. Fasten urinal screen panels to walls with a continuous bracket.
- F. Provide ½ inch spaces between wall surface and panels or pilasters.
- G. Provide for adjustment of floor variations with non-breakable plastic shoes on pilasters. Conceal floor fastenings in pilaster shoes.
- H. Furnish each toilet compartment door with top and bottom hinges, and door latch.
- I. Install door strike keeper on each pilaster in alignment with door latch.
- J. Furnish each toilet compartment door with one coat hook and bumper.

3.03 TOLERANCES OF INSTALLED WORK

- A. Maximum Variation from Plumb or Level: 1/8 inch.
- B. Maximum Misplacement from Intended Position: 1/8 inch.

3.03 ADJUSTING AND CLEANING

- A. Hardware Adjustment: After installation, adjust hardware for proper operation. Install hinges on in-swinging doors to hold open approximately 30 degrees from the closed position when unlatched. Install hinges on out-swinging doors to return to the fully closed position. Door shall be plumb with pilasters when door is closed.
- B. Adjust and align door hardware to uniform clearance at vertical edges of doors. Clearance space shall not exceed ¼ inch.
- C. Cleaning: Clean compartments, hardware, and doors before Substantial Completion and leave free from imperfections. Remove protective coverings.

3.04 CLEANUP

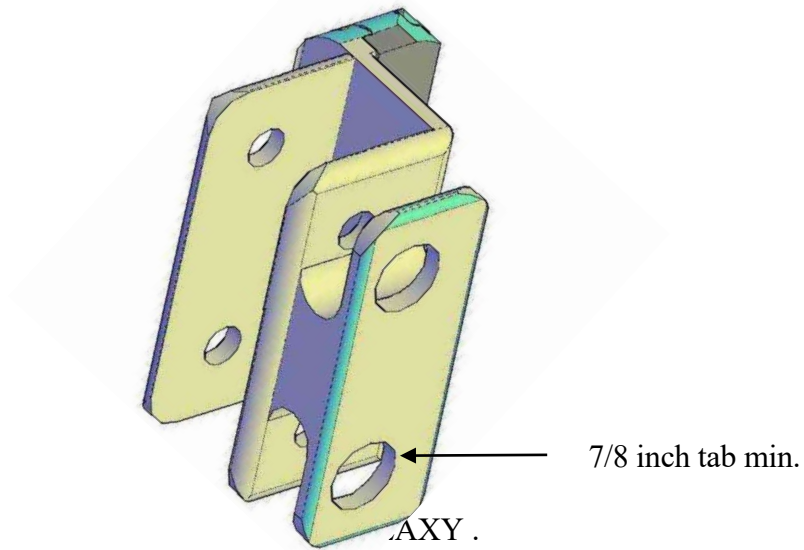
- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.05 PROTECTION

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

END OF SECTION

DETAIL #1 – STRIKE AND KEEPER



SECTION 10 2813
TOILET ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Toilet accessories.
2. Changing tables.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 06 1000- Rough Carpentry.
3. Section 05 4100 - Structural Metal Stud Framing.
4. Section 10 2113 - Plastic Toilet Compartments.
5. Section 10 2815 – Hand and Hair Dryers.

1.02 REGULATORY REQUIREMENTS

- A. Comply with CBC Chapter 11B requirements and ADAAG recommendations for accessibility.**

1.03 SUBMITTALS

- A. Shop Drawings: Submit a schedule of accessories and Shop Drawings indicating installation methods and fasteners.**
- B. Changing Tables: Submit conformance to specified standards.**

1.04 QUALITY ASSURANCE

- A. Coordinate related Work as required to ensure proper and adequate provision in framing of backing and wall finish for installation of accessories.**
- B. Coordinate requirements of Section 10 2113 - Plastic Toilet Compartments to ensure that correct openings are provided in partitions for toilet accessories where required.**

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protect accessories from damage.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Accessories shall be provided with necessary anchoring devices and fasteners appropriate for surfaces on which items are to be fastened.

2.02 TOILET ACCESSORIES

- A. Liquid Soap Dispenser: 20 gage stainless steel, 40-ounce. capacity, tamper-proof cap and concealed vandal-proof mounting. Continental V 444SS, ASI 0347, Bobrick B-2111, or equal.

- B. Toilet Paper Boxes:

1. For Student and Public Restrooms:

- a. Non-accessible toilet compartments: Surface mounted, JR Billington JRB-016, or equal.
- b. Accessible adult toilet rooms or compartments: semi-recessed Bobrick B-3888, ASI-0031, Bradley 5412 (double roll tissue holder without paper roll spindle stops), or equal.
- c. Accessible elementary or kindergarten toilet rooms or compartments: semi-recessed with theft resistant toilet tissue spindles Bobrick B-6977, include part number 283-604, Bradley 5124-52, or equal

2. For Faculty and Staff Restrooms:

- a. Non-accessible toilet compartments: ASI 0264-1A2, Bobrick B-27460 (double roll tissue holder), Bradley, or equal.
- b. Accessible toilet rooms or compartments:
 - 1) Semi-recessed Bobrick B4388 or 3888, ASI 0031, Bradley 5412 (double roll tissue holder without paper roll spindle stops), or equal.
 - 2) Surface mounted ASI 0264-1A2, Bobrick B-27460 (double roll tissue holder), Bradley, or equal.

- C. Paper Towel Boxes: Type 304 stainless steel, satin finish. Door with tumbler lock and piano hinge.
1. Surface mounted: ASI 0245-SS, Bobrick B-263, Bradley 252, or equal.
 2. Semi-recessed: ASI 0457-2, Bradley 247-10, or equal.
 3. Recessed: ASI 0457, Bobrick B-35903, Bradley 247, or equal.
- D. Grab Bars: 1-1/4 inches diameter by 18 gage stainless steel tubing, of size and configuration indicated. Ends shall be screwed to 11 gage stainless steel wall plate, with snaplock cover flanges. Grab bars over 36 inches in length shall be furnished with stainless steel support at mid point. Exposed stainless steel to be 180 grit satin finish. ASI 3700 series, Tubular Specialties Manufacturing, Inc. series Q-CS-1, Bobrick, or equal.
- E. Shower Seat: Folding shower seat with frames and supports constructed entirely of stainless steel tubing. Slats shall be phenolic. Mounting hardware shall consist of stainless steel screws with plastic plugs. Tubular Specialties Manufacturing Inc., Model No. 731-PH, ASI, Bobrick, or equal.
- F. Mirrors: Framed mirror, with one piece roll-formed 3/4 inch by 3/4 inch Type 304 stainless steel angle frame, with satin finish. Corners shall be heliarc welded, ground and polished smooth. Glass shall be No. 1 quality 1/4 inch float glass, electrolytically copper-plated. Frame shall be furnished with a continuous integral stiffener on sides. Back of mirror shall be protected by 1/8 inch thick, waterproof, shock-absorbing polyethylene padding and 20 gage galvanized steel back attached to frame with concealed screws. Mirror shall be provided with a 20 gage wall hanger. ASI 0600, Bobrick B-290 series, Bradley, or equal. Size as indicated on Drawings.
- G. Mirror with Shelf: Frame and mirror as described above, with Type 304 stainless steel shelf, 5 inches deep with 3/4 inch return edges on 4 sides, front and side return edges shall be hemmed. ASI 0605, Bobrick B-292, Bradley, or equal. Size as indicated on Drawings.
- H. Medicine Cabinet (Nurse's Office Restroom): Recessed-mounted, one-piece seamless construction of Type 304 stainless steel, satin finish. Cabinet door with No.1 quality 1/8 inch float glass. Provide 4 adjustable stainless steel shelves. ASI 0952, Bobrick B-398, Bradley, or equal.
- I. Toilet Seat Cover Dispensers (Faculty and Staff Toilet Rooms only): Surface-mounted, Type 304 stainless steel, satin finish. ASI 0477SM, Bobrick B-221, Bradley, or equal.
- J. Sanitary Napkin Vendors and Disposals:
1. Vendors (In Nurse's Office Restrooms only): Surface mounted, Type 304 stainless steel, satin finish, tumbler lock, single 25 cent coin operation. ASI

0864, Bobrick B-2706 surface mounted, Bobrick B-3706 recessed/semi-recessed, Bradley, napkin/tampon dispenser, or equal.

2. Disposals in non-accessible toilet compartments Surface-mounted, Type 304 stainless steel, satin finish, ASI 0473-A, Bobrick B-270, Bradley, or equal.
 3. Disposals in accessible toilet rooms or compartments: recessed, semi-recessed or 3-inch maximum projection from wall surface; Bobrick B 353 (recessed), ASI 0473 (recessed), Bradley, or equal.
- K. Mop and Broom Holder Rack: Provide two 24-inch long minimum, stainless steel mop and broom holder racks at each janitor room. ASI 8215-3, Bobrick B223 by 24, Bradley, or equal.
- L. Coat Hook Strip: Hook strip shall be type-304 stainless steel with satin finish. Hooks shall be 14 gauge and mounting strip shall be 20 gauge. ASI 1307, Bobrick B-232 x 24, Bradley 9943, or equal.

2.03 CHANGING TABLES

- A. Horizontal, wall mounted, stainless steel finish, baby changing station. Koala Kare Products KB110-SSWM, or equal.
- B. Unit shall conform to:
1. California Code of Regulations Title 24 and ADA regulations.
 2. ICC A117.1, Standard for Accessible and Usable Buildings and Facilities.
 3. ASTM F2285, Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.
 4. ANSI Z535.4 Product Safety Signs and Labels.
 5. ASTM G21, Standard Practice for Determining Resistance of Polymeric Materials to Fungi.
- C. 18 gage type 304 satin stainless steel exterior finish with FDA approved blow molded high-density grey polyethylene with antimicrobial interior. Reinforced full-length steel-on-steel hinge mechanism with 11 gage steel mounting plates and mounting hardware. Pneumatic cylinder shall provide controlled, slow opening and closing of bed. Provide molded-in graphics and safety messages in six languages. Provide safety straps and bag hooks.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check openings in substrates to receive accessories. Verify openings are correctly located and sized to receive accessories, and that locations will comply with disability access requirements. Confirm that blocking, backing or support is properly located and adequate for the accessory installation.
- B. Verify spacing of plumbing fixtures and toilet partitions. Confirm spacing and locations are compatible with proposed accessory locations and will allow compliance with disability access requirements.

3.02 INSTALLATION

- A. Install toilet accessories in accordance with manufacturer's written recommendations and accessibility requirements. Fasten components firmly in place.
- B. Drill holes to correct size and application that is concealed by item with ¼ inch tolerance.
- C. Install recessed accessories into wall openings with sheet metal screws into metal frames.
- D. Install surface-mounted accessories to backing plates with machine screws, plumb, and aligned.
- E. Grab Bars:
 - 1. Fasten to toilet partition with 3-inch diameter stainless steel back plates with studs, couplings, and stainless steel machine screws.
 - 2. At wood stud walls, fasten wood blocking with threaded stainless steel wood screws of sufficient length to penetrate blocking 1 ¼-inch minimum.
 - 3. At metal stud walls, provide 1/8 inch cold-rolled steel plate, drilled and tapped for machine screws, or 16 gage cold-rolled steel plate complete with threaded sleeves for stainless steel machine screws. Weld plates to studs.
 - 4. At concrete or masonry walls, install bars with sheet metal screws and expansion anchors.
 - 5. At plaster or gypsum board walls, provide spacers of same thickness as wall material to prevent crushing of wall material.
- F. Mirrors: Install mirror on manufacturer supplied concealed wall hanger and fasten with two theft-resistant locking screws.
- G. Stainless Steel Medicine Cabinet: Fasten cabinet to wall.
- H. Before Substantial Completion, deliver keys and maintenance instructions and product data to OAR.

3.03 ADJUSTING AND CLEANUP

- A. Adjust accessories for proper operation.
- B. Remove rubbish, debris, and waste material 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 10 4413

FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire Extinguishers and Cabinets.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 04 2200 - Concrete Unit Masonry.
3. Section 06 1000 - Rough Carpentry.
4. Section 09 2900 - Gypsum Board.

1.02 SUBMITTALS

A. Shop Drawings: Indicate materials, sizes, anchorage, and installation details.

B. Product Data: Submit manufacturer's product literature, indicating product characteristics.

C. Material Samples: Submit manufacturer's standard cabinet color Samples for selection by Architect.

1.03 QUALITY ASSURANCE

A. Installer shall be manufacturer trained and certified to install the Work of this section.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's wrapping to protect items.

B. Store items in a dry, enclosed area.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS AND CABINETS

- A. Location: Fire extinguisher cabinets and fire extinguishers shall be installed where indicated on Drawings or as required by authorities having jurisdiction.
- B. Manufacturer: Fire extinguishers and cabinets shall be manufactured by one of the following:
 - 1. Potter-Roemer.
 - 2. J. L. Industries.
 - 3. Larsen's Manufacturing.
 - 4. Modern Metal Products.
 - 5. Waltrous.
 - 6. Amerex (fire extinguishers).
 - 7. Equal.
- C. Fire Extinguisher Type: Provide a legally appropriate rechargeable fire extinguisher for every fire extinguisher cabinet and as otherwise indicated.
 - 1. Classrooms, Corridors, Administration and Special Use Rooms, Cabinet mounted:
 - a. Type ABC multi-purpose dry chemical with UL rating 2A:10B:C, 5 pound size, also with red glossy polyester coated steel cylinder, pressure gage, hose and horn. Maximum Height: 15 ¼-inch. Maximum Cylinder Diameter: 4 ½-inch.
 - 2. Underground Parking Structures, Cabinet mounted:
 - a. Type ABC multi-purpose dry chemical with UL rating 2A:20B:C, 10 pound. size, with red glossy polyester coated steel cylinder, pressure gage, hose and horn. Maximum Height: 20-inch. Maximum Cylinder Diameter: 5-inch.
 - 3. Kitchens, Cabinet mounted:
 - a. Type BC multi-purpose dry chemical with UL rating 40B:C, 5 pound size, with red glossy polyester coated steel cylinder, pressure gage, hose and horn, Maximum Height: 15 ¼-inch, Maximum Cylinder Diameter: 4 ½-inch . K type (wet chemical) for suppression system back-up. UL Rating 2A:K, 6 liters, 2 ½ gallons, with heavy duty stainless steel cylinder, internal diameter not to exceed 7 inches.
 - 4. LAN Rooms, Bracket mounted:

- a. Type Halotron 1, EPA approved “Clean Agent” with UL rating 5B:C, 5 pounds size, with red glossy polyester coated steel cylinder, discharge nozzle and bracket. Maximum Height: 15 ¼-inch. Maximum Cylinder Diameter: 6-inch. Provide 16 gage steel bracket by same manufacturer as extinguisher.
5. Electrical, Science Rooms, Boiler, Fan, Heating Rooms, bracket mount:
 - a. Type CO₂, carbon dioxide gas, with UL rating 5B:C. 10B:C, (5 pounds with red glossy polyester coated aluminum cylinder, hose and horn. Maximum Height, (not exceed): 17 ¾-inch. Maximum Cylinder Diameter, (not to exceed): 5 ¼-inch.

D. Fire Extinguisher Requirements:

1. Design Specification:
 - a. Finish: Corrosion and impact resistant red epoxy.
 - b. Valve Stem Assembly: Metal, reusable, connects to cylinder by threaded pipefitting, aluminum or steel siphon tube, and shatter resistant plastic face gage.
 - c. Gage (if applicable) to Indicate: “Recharge,” “fully charged (195 PSI),” and “over charge.”
 - d. Pull Pin: Metal, reusable and securely fastened to unit with metal, aluminum chain or very heavy plastic line approximately 4 ½-inch long.
 - e. Mechanical Operation: Pistol grip, heavy duty metal handle (plastic not permitted), and shall be operated by a grip and squeeze lever.
2. Manufacturer Identification/Information: Manufacturer’s name, date manufactured, model number, U.L. approval seal and number, contents operating instructions, Fire Marshall approval, etcetera shall be identified on the Fire Extinguisher.
3. Warning and First Aid Label: Fire extinguisher must indicate all standard warnings concerning breathing, eyes, skin and ingestion. Provide emergency and first aid procedures.
4. Property Identification: Label affixed at front of unit, size 2-inch by 4-inch, shall read “PROPERTY OF LOS ANGELES UNIFIED SCHOOL DISTRICT”.
5. Repair Parts: The manufacturer and/or their representative shall maintain within the Los Angeles Metropolitan Area an adequate stock of replacement parts, available for immediate delivery.

6. Warranty:
 - a. Manufacturer shall provide a five year material warranty.
 - b. Installer shall provide a five year installation warranty.
 7. Material Safety Data Sheet: Provide an MSDS sheet with every shipment.
- E. Fire Extinguisher Cabinet: Potter-Roemer cabinets are listed as the standard of quality, products by other listed manufacturers are acceptable.
1. Semi-recessed cabinet: Provide semi-recessed, square trim edge cabinet with 1 1/4 inch to 2-inch projection:
 - a. Potter-Roemer Fire Extinguisher Cabinet 7022:
 - 1) Door Style: either DVL (Duo Vertical Panel with lock) or E (Center Break Glass with lock), glass to be clear tempered safety glass.
 - 2) Cabinet Door and Frame: Cold rolled steel with electrostatically applied, thermally fused polyester coating with recoatable white finish.
 - 3) Identification Lettering: Cabinet door to be furnished with die cut lettering indicating "FIRE EXTINGUISHERS" in contrasting color to cabinet finish, and either vertical or horizontal lettering depending upon door style.
 2. Surface mounted cabinet: Provide surface mounted, square trim edge cabinet:
 - a. Potter-Roemer Fire Extinguisher Cabinet 7024:
 - 1) Door Style: either DVL (Duo Vertical Panel with lock) or E (Center Break Glass with lock), glass to be clear tempered safety glass.
 - 2) Cabinet Door and Frame: Cold rolled steel with electrostatically applied, thermally fused polyester coating with re-coatable white finish.
 - 3) Identification Lettering: Cabinet door to be furnished with die cut lettering indicating "FIRE EXTINGUISHERS" in contrasting color to cabinet finish, and either vertical or horizontal lettering depending upon door style.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with manufacturer's recommendations.
- B. Cabinets shall be installed plumb and level, where indicated on Drawings, at heights required by authorities having jurisdiction.

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 Project site.

END OF SECTION

SECTION 11 68 00
PLAY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the Standard Specifications for Public Works Construction shall also apply to this Section.

1.2 SCOPE OF WORK

- A. The work under this section shall include all labor, materials, and equipment required to provide and install the play equipment complete as specified. The equipment shall be assembled on site as per manufacturing recommendations and this section. All work and equipment provided shall be subject to approval of the District Inspector.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: Section 03 30 00

1.4 GUARANTEE & LIABILITY INSURANCES

- A. Manufacturer shall guarantee all materials and workmanship for a period of one (1) year exclusive of vandalism. Manufacturer will be required to provide product liability insurance coverage in the minimum amounts of \$10,000,000.00 per incident.
1. The Manufacturer will be required to provide complete installation drawings including specifications and a replacement parts list for all products.
- B. Contractor shall provide a written guarantee on their firm's letterhead for all materials and workmanship for a period of one (1) year exclusive of vandalism. Written guarantee shall be submitted to the District at the final inspection prior to final acceptance of the work.

1.5 LOCATION INSPECTION

- A. No equipment or apparatus or foundations for same shall be placed until location stakes have been inspected by the District and Landscape Architect.

PART 2 - MATERIALS

2.1 "OR APPROVED EQUIVALENT" PRODUCTS

- A. This project is a Public Works project. Sole sourcing of material is not allowed. Any reference or call out on the plans and/or in the specifications to a specific manufacturer shall be interpreted as "or approved equivalent". The District Engineer's and Landscape Architect's approval is required as to whether or not a product meets the District's standard to be an approved equivalent. **Bidders shall use the pricing for the products as specified to avoid risks of disapproval. No substitutions will be considered prior to the award of the contract.**

2.2 PLAY STRUCTURES

- A. Shall be as called for on plans.

2.3 GROUND LEVEL COMPONENTS

- A. Shall be as called for on plans.

2.4 SITE FURNISHINGS

- A. Shall be as called for on plans.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall be in the approximate location shown on the drawings. Final approval of precise location by the District and Landscape Architect is required. In case of conflict between construction plans and manufacturer's requirements, the more stringent shall apply.
- B. Ground surfaces on accessible routes, clear floor or ground spaces, and turning spaces shall comply with CBC Section 11B-1008.2.6: For accessibility; ground surfaces shall comply with ASTM F 1951 and shall be inspected and maintained regularly and frequently to ensure continued compliance. Ground surfaces within use zones shall comply with ASTM F 1292

3.2 EQUIPMENT INSTALLER

- A. All play equipment shall be installed by a NPSI certified installer.

3.3 VANDAL RESISTANCE

- A. All fasteners shall be either deformed or tack welded together to prevent unauthorized removal of the fasteners. Paint with galvi-con after deformation/welding.

3.4 CONCRETE WORK

- A. All concrete foundation work shall be performed in accordance with the Standard Specifications, Concrete Section.

3.5 CLEAN-UP

- A. Project area shall be left clean and orderly upon completion.

3.6 PAYMENT TERMS

- A. Payment for play equipment work will be at the lump sum price bid for play equipment. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in play equipment as herein specified. A 10% retention shall apply to all play equipment work.

SECTION 12 2113
WINDOW BLINDS
(ADMINISTRATION/SUPPORT AREAS)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Window blinds and accessories.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 08 4113 - Aluminum Entrances and Storefront.
3. Section 08 4116 - Glazed Aluminum Curtain Wall.
4. Section 08 5113 - Aluminum Windows.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings including plans, elevations, and fastening details.
- B. Product Data: Submit manufacturer's data and catalog cuts.
- C. Material Samples: Submit manufacturers color Samples and catalog cuts.

1.03 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Manufacturer shall have been regularly engaged in the business of manufacturing venetian blinds for five years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. MechoShade Systems LLC
- B. Levolor Contract.
- C. Hunter Douglas Contract.
- D. Superior Shade & Blind Co. Inc.
- E. Equal.

2.02 WINDOW BLINDS

- A. Horizontal blinds; aluminum slats supported by braided ladders; pull cords to raise and lower slats; crash-proof cord locks to set slats at selected heights; tilters to tilt slats to desired angles; include valances.
- B. Slat supports shall be of braided polyester yarn and dimensionally stabilized. Vertical components shall furnish maximum strength and flexibility with minimum stretch. Braided ladders shall support slats parallel, straight, and equally spaced to ensure proper tilt control and closure of slats. Distance between end ladder and end of slats shall not exceed 7 inches. Distance between braided ladders shall not exceed 23 inches. Horizontal component, or rungs, shall consist of not less than two crossed cables interbraided with vertical components.
- C. Slats shall be aluminum alloy, one inch wide (0.984 inch plus 0.003 or minus 0.300 inch). They shall be furnished with undercoat and baked-on enamel finish, in selected color. Slats shall be formed to concave/convex shape.
- D. Head channels shall be 0.025 inch thick galvanized steel, U-shaped, one inch high by 1-9/16-inch wide with flanged edges and shall be furnished with a baked-on enamel finish. Hardware shall be enclosed in metal head. Both end braces shall be furnished with adjustable tabs. Operating hardware shall be machine-clinched to head to ensure perfect alignment.
- E. Galvanized steel end brackets with riveted locking covers shall be finished to match head channels. Intermediate support brackets shall be furnished where required.
- F. Tilt controls shall consist of enclosed worms and gear tilting mechanisms, which prevent slat-drift from selected angle.
- G. Bottom rail shall be of 0.031 inch galvanized steel formed after coating and shall be provided with color compatible molded plastic end caps.
- H. Cords shall be of adequate diameter, braided of high-strength synthetic fibers, and with cores to provide minimum stretch, maximum strength, abrasion resistance and flexibility. Cord shall be as a minimum 1.8 mm and shall meet or exceed Commercial Item Specification 1029.86.
- I. Bottom of cord shall extend to 36" above finish floor.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that openings are ready to receive Work.
- B. Ensure that structural blocking and supports are installed and suitable for attachment and support of Work.

3.02 INSTALLATION

- A. Install blinds as detailed in locations indicated. Furnish and install necessary parts and perform adjustments required to provide a complete, rigid and properly operating installation. Corners and surfaces shall be free from burrs and sharp edges.

- B. Unless otherwise indicated, blinds shall be top-suspended, installed singly over each sash and between jambs or mullions, heads set flush with wall or trim, and shall not interfere with operation of sash or sash hardware. Where recessed installation is not indicated, blinds shall be installed over the casing, overlapping casings not less than 1 3/8-inch at sill, 1 3/4-inch at jambs and one inch at top.
- C. Brackets shall securely fasten head rails and shall provide for easy removal of head rails. Blinds shall be securely fastened by sheet metal screws through back into head rails at side channels.
- D. Brackets shall be fastened with galvanized or cadmium-plated pan-head all-purpose screws, oval-head wood screws, toggle bolts or appropriate fasteners.

3.03 INSTALLATION TOLERANCES

- A. Maximum Variation of Gap at Perimeter: 1/4 inch.
- B. Maximum Offset from Level: 1/8 inch.

3.04 ADJUSTMENT AND CLEANUP

- A. Adjust for smooth operation.
- B. Before Substantial Completion, clean the blinds, including tapes, cords, and tassels in accordance with manufacturer's recommendations.
- C. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.05 PROTECTION

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

END OF SECTION

SECTION 12 2116

WINDOW BLINDS (INSTRUCTIONAL SPACES)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Window darkening horizontal blinds.

A. Related Sections:

1. Division 01 - General Requirements.
2. Section 08 4113 - Aluminum Entrances and Storefront.
3. Section 08 4116 - Glazed Aluminum Curtain Wall.
4. Section 08 5200: Aluminum Windows.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings including plans, elevations, and installation details.
- B. Product Data: Submit manufacturer's data and catalog cuts.
- C. Material Samples: Submit manufacturers color Samples.

1.03 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Manufacturer shall have been regularly engaged in the business of manufacturing products of this section for five years.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver in manufacturer's sealed and labeled containers. Store in a clean dry area.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Products of Levolor Lorentzen Inc., Hunter Douglas Inc., Springs Window Fashions LP, or equal.

2.02 MATERIALS

- A. Provide the following:
 - 1. MechoShade Systems LLC
 - 2. Levolor Contract, Riviera 2.
 - 3. Hunter Douglas Inc., Flexalum.
 - 4. Springs Window Fashions LP, Bali.
 - 5. Equal.
- B. Slats: Aluminum; 2-inch wide; .008 inch minimum thickness; elliptical crown approximately 3/16 inch high; rounded corners. Slats shall be formed to concave/convex shape.
- C. Head Rails and Bottom Rails: Steel, 0.022 plus or minus .003 inch thick; underside of bottom rail shall be flat with no outside clips, tape holders, end caps or other fittings which create light gaps at sill. Molded plastic end pieces, tape and cord holders shall be provided and located inside or on top of bottom rail. Provide light seal at underside of headrail.
- D. Tapes: Manufacturer's standard A-V tapes, vinyl, 1 ½-inches wide, with ladders uniformly spaced every 46 inches. Tapes shall be not more than 34 inches on center, and shall be not less than 4 ½ inches nor more than 7 ½ inches from slat ends.
- E. Color: Visible parts shall be of color as selected by the Architect from manufacturer's standard color selection.
- F. Finish: Metal parts shall be furnished with factory-applied baked-on enamel or plastic finish.
- G. Tilt Controls: Shall consist of enclosed worms and gear tilting mechanisms, which prevent slat-drift from selected angle.
- H. Bottom Rails: Shall be provided with color-compatible molded plastic end caps. Cords: Braided of high-strength synthetic fibers, and with cores to provide minimum stretch, maximum strength, abrasion resistance and flexibility.
- I. Cord shall be as a minimum 1.8 mm, and shall meet or exceed Commercial Item Specification 1029.86.

- J. Safety Cleat for Cords: Provide one safety cleat per cord to secure any loose cord.
- K. Bottom of cord shall extend to 36" above finish floor.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that openings are ready to receive Work.
- B. Ensure that structural blocking and supports are installed and suitable for fastening and support of Work.

3.02 INSTALLATION

- A. Install blinds as detailed in locations indicated. Furnish and install necessary parts and perform adjustments required to provide a complete, rigid and properly operating installation. Corners and surfaces shall be free from burrs and sharp edges.
- B. Length of blind shall be at least 1 3/8 inches longer than height of window opening.
- C. Unless otherwise indicated, blinds shall be top-suspended, installed singly over each sash and between jambs or mullions, heads set flush with wall or trim, and shall not interfere with operation of sash or sash hardware. Where recessed installation is not indicated, blinds shall be installed over the casing, overlapping the casing not less than 1 3/8-inch at sill, 1 3/4-inch at jambs and one inch at top.
- D. Brackets shall securely fasten headrails in place and shall provide for easy removal of headrails. Blinds shall be securely fastened with sheet metal screws through back into headrails.
- E. Brackets shall be fastened with galvanized or cadmium-plated pan-head all-purpose screws oval-head wood screws, toggle bolts or other fasteners.
- F. Upon completion of installation, test and adjust blinds and operating hardware to verify proper operation.

3.03 INSTALLATION TOLERANCES

- A. Maximum Variation of Gap at Perimeter: 1/4-inch.
- B. Maximum Offset from Level: 1/8-inch.

3.04 ADJUSTMENT AND CLEANUP

- A. Adjust for smooth operation.
- B. Before Substantial Completion, clean the blinds, including tapes, cords and tassels, in accordance with manufacturer's recommendations.
- C. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.05 PROTECTION

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

END OF SECTION

END OF SECTION

SECTION 13 31 23

PRE-ENGINEERED FABRIC SHADE STRUCTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. A single, State of California-licensed fabric shade structure contractor shall be responsible for the design, wet-stamped engineering drawings, fabrication, supply, and erection of the work specified herein, including foundations. The intent of this specification is to have only one shade contractor be responsible for all of the functions listed above.

1.3 SUBMITTALS

1.3.1 With Bid Submittals:

- A. Provide proof of existing reference sites with structures of similar project scope and scale, and that are engineered to and approved to DSA specifications and hold a current PC number.
- B. Provide a minimum of 7 fabric samples to demonstrate fabric color range, and a digital (PDF) or paper document showing a minimum of 9 powder coat color choices. Also, provide a letter of authorization from the fabric manufacturer delineating authorized use of the specified fabric.
- C. Provide proof of all quality assurance items including:
 - 1. Approved DSA PC engineering with a current site specific approved “A” number.
 - 2. A list of at least 3 reference projects in California that have been installed a minimum of 12 years.
 - 3. Proof of General Liability, Professional Liability, and Umbrella insurance, as per Section 1.4B.
 - 4. Proof of current State of California Contractor’s License, Class A or Class B.
 - 5. Proof of current City of Los Angeles Approved Fabricator license.
 - 6. Proof of a minimum of \$15,000,000 aggregate bonding capacity.
 - 7. Proof of current IAS certification, as per Section 1.4D.
 - 8. Proof of an Annual Maintenance Inspection Program.
 - 9. Proof of a Corporate Safety and/or Injury & Illness Prevention Program.

1.4 QUALITY ASSURANCE

Fabrication and erection are limited to firms with proven experience in the design, fabrication, and erection of fabric shade structures, and such firms shall meet the following minimum requirements. No substitutions shall be allowed for the following:

- A. A single shade structure contractor shall design, engineer, manufacture, and erect the fabric shade structures, including the foundations, and shall provide a dedicated Project Manager throughout the entire Scope of Work related to the shade structure(s).
- B. All bidders shall have at least 15 years' experience in the design, engineering, manufacture, and erection of fabric shade structures, engineered to California Building Code requirements with similar scope, and a successful construction record of in-service performance.
- C. All bidders shall provide proof with bid submittal of a minimum of \$1,000,000 General/Public Liability insurance, \$3,000,000 Professional Liability (PL) insurance, and additional \$5,000,000 Umbrella/Excess Liability insurance.
- D. All bidders shall be a currently licensed contractor in the State of California and shall provide proof of a minimum aggregate bonding capacity of \$15,000,000 with bid.
- E. Manufacturer shall have a City of Los Angeles Approved Fabricator license and be accredited by the IAS (International Accreditation Service) for Structural Steel Fabrication.
- F. The fabric shade structure contractor shall have a Corporate Quality Control program/manual, which describes their complete quality assurance program.
- G. All bidders must be a current Member Contractor with ISNetwork, which confirms the bidder's strict adherence to Safety, Insurance, Quality, and Regulatory standards.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fabric shade structure(s) shown on the drawings in relation to the property survey and existing structures and verify locations by field measurements prior to erection of the fabric shade structure(s).

1.6 WARRANTY

- A. The successful bidder shall provide a 12-month warranty on all labor and materials.
- B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years (pro-rated) on fabric and 10 years on the structural integrity of the steel, from date of substantial completion.
- C. The warranty shall not deprive the Owner of other rights the Owner may have under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The structures shall consist of: two (2) ~12'x12'x10' Single Post Pyramid shade structures with HSS 5.0x0.375 structural steel columns per DSA Pre-Approved PC engineering drawings.

- B. The structures shall be manufactured by Shade Structures, Inc., d/b/a USA SHADE & Fabric Structures, or approved equal with valid DSA approval at time of bid that includes the engineering drawings, fabric roof, steel cables, all fasteners, and erection of structure(s), including foundations.
- C. Contact: USA SHADE & Fabric Structures
1085 N. Main Street, Suite C
Orange, CA 92867
Phone: 714.427.6981 Fax: 714.538.2440
Attn: Patti Abrecht
patti.abrecht@usa-shade.com
- D. To qualify as an approved equal, please submit product documentation, fabric samples, and all quality assurance criteria, as per Section 1.4, at least 10 days prior to bid in order to be considered. No substitutions will be allowed after the deadline. Any approval of alternate manufacturers shall be by addendum prior to the bid date and shall not be allowed without written notification.
- E. The fabric shade structure(s) shall conform to the current adopted version of the California Building Code.
- F. All fabric shade structures are designed and engineered to meet the minimum of 115mph Wind Load, Risk Category II, Exposure C, and Seismic (earthquake) Load based on Seismic Design Category D, Seismic Risk Category II, and a Live Load of 5psf. All fabric shade structures shall be engineered with a zero wind pass-through factor on the fabric. When ASD Steel Design Method is used based on CBC Section 1605A.3.1, the load combinations Dead Load + 0.75 Live load + 0.75 Wind Load, and 0.6 Dead Load + Wind Load must be analyzed. NO EXCEPTIONS.
- G. Steel:
1. All steel members of the fabric shade structure shall be designed in strict accordance with the requirements of the "American Institute of Steel Construction" (AISC) Specifications and the "American Iron and Steel Institute" (AISI) Specifications for Cold-Formed Members and manufactured in a IAS- (International Accreditation Service) accredited facility for Structural Steel Fabrication under CBC Section 1704.2.5.2.
 2. All connections shall have a maximum internal sleeving tolerance of .0625" using high-tensile strength steel sections with a minimum sleeve length of 6".
 3. All non-hollow structural steel members shall comply to ASTM A-36. All hollow structural steel members shall be cold-formed, high-strength steel and comply with ASTM A-500-10, Grade B. All steel plates shall comply with ASTM A-572, Grade 50. All galvanized steel tubing shall be triple-coated for rust protection using an in-line electroplating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.
- H. Bolts:
1. All structural field connections of the shade structure shall be designed and made with high-strength bolted connections using ASTM A-325, Grade B.
 2. Where applicable, all stainless steel bolts shall comply with ASTM F-593, Alloy Group 1 or 2. All bolt fittings shall include rubber washers for water-tight seal at the joints. All nuts shall comply with ASTM F-594, Alloy Group 1 or 2.
- I. Welding:
1. All shop-welded connections of the fabric shade structure shall be designed and performed in strict accordance with the requirements of the "American Welding Society" (AWS) Specifications. Structural welds shall be made in compliance with the requirements of the "pre-qualified" welded joints, where

applicable and by certified welders. No onsite or field welding shall be permitted.

2. All full penetration welds shall be continuously inspected by an independent inspection agency and shall be tested to the requirement of the 2016 CBC.

J. Powder Coating:

1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance with solvent cleaning SSPC-SP1. Solvents such as water, mineral spirits, xylol, and toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning, and prior to surface preparation, shall be executed according to Power Tool Cleaning SSPC-SP3, utilizing wire brushes, abrasive wheels, needle gun, etc.
2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance with commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, and other foreign material.
3. Powder coating shall be sufficiently applied (minimum 3 mils thickness) and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests, as defined by the American Society of Testing Materials.
4. Raw powder used in the powder coat process shall have the following characteristics:
 - a. Specific gravity: 1.68 +/- 0.05
 - b. Theoretical coverage: 114 +/- 4ft²/mil
 - c. Mass loss during cure: <1%
 - d. Maximum storage temperature: 80°F
 - e. Interpon[®] 800 is a high-durability TGIC powder coating designed for exterior exposure. Tested against the most severe specifications, Interpon 800 gives significantly improved gloss retention and resistance to color change.
5. When the fabric shade structure(s) will be located within 15 miles of the ocean or standing body of water, rust protection undercoat primer will be required on all structures. Sherwin-Williams[®] POWDURA[®] epoxy powder coating Z.R Primer shall be applied in accordance with the manufacturer's specifications. Primer should be fused only and then top coated with the selected powder coat to ensure proper inter-coat adhesion.
 - a. The primer's attributes shall be:
 - a. Specific gravity (g/ml): 2.37
 - b. Coverage at 1.0 mil (ft²/lb): 81.6
 - c. Adhesion: ASTM D-3359 5B
 - d. Flexibility: ASTM D-552 Pass 1/8"
 - e. Pencil hardness: ASTM D-3363 H-2H
 - f. Impact resistance (in.lb): ASTM D-2794 Dir & Rev, 120 in-lbs
 - g. Salt spray resistance: ASTM B-117 2000 hours
 - h. Humidity resistance: ASTM D-4585 2000 hours
 - i. 60° Gloss: ASTM D-523 50 ~ 70
 - j. Cure schedule (metal temp): 10min @ 200°C (390°F)
25min @ 135°C (275°F)
 - k. Film thickness tange (mils): 2.0 ~ 3.0

K. Tension Cable: Steel wire rope cable is determined based on calculated engineering loads.

1. 0.25" (nominal) galvanized 7x19 strand core wire rope shall be used for tension loads up to 4,500 lbs.

2. 0.375" (nominal) galvanized 7x19 strand core wire rope shall be used for tension loads up to 9,000 lbs.
3. 0.5" (nominal) galvanized 6x19 strand core wire rope shall be used for tension loads up to 13,500 lbs.

L. Fabric Roof Systems:

1. UV Shade Fabric:

- a. Colourshade® FR shade fabric is made of a UV-stabilized, high-density polyethylene (HDPE), as manufactured by Multiknit® (Pty) Ltd. HDPE mesh shall be a heat-stentered, three bar Rachel-knitted, lockstitch fabric with one monofilament and two tape yarns to ensure that the material will not unravel if cut. Raw fabric rolls shall be 9.8425 feet wide.

b. Fabric Properties:

- ~ Life Expectancy: minimum 8 years with continuous exposure to the sun
- ~ Fading: minimum fading after 5 years (3 years for Red)
- ~ Fabric Mass: 5.31 oz/yd² ~ 5.6 oz/yd² (180gsm ~ 190gsm)
- ~ Fabric Width: 9.8425 feet (3m)
- ~ Roll Length: 164.04 feet (50m)
- ~ Roll Dimensions: 62.99 inches x 16.5354 inches (160cm x 42cm)
- ~ Roll Weight +/- 66 lbs (+/- 30kg)
- ~ Minimum Temp: -13°F (-25°C)
- ~ Maximum Temp: +176°F (80°C)

c. Fabric shall meet the following flame spread and fire propagation tests:

- 1) ASTM E-84
- 2) NFPA 701 Test Method 2
- 3) California's Office of the State Fire Marshal, Registered Flame Resistant Product

2. Stitching & Thread:

- a. All sewing seams are to be double-stitched.
- b. The thread shall be GORE® TENARA® mildew-resistant sewing thread, manufactured from 100% expanded PTFE (Teflon™). Thread shall meet or exceed the following:
 - 1) Flexible temperature range
 - 2) Very low shrinkage factor
 - 3) Extremely high strength, durable in outdoor climates
 - 4) Resists flex and abrasion of fabric
 - 5) Unaffected by cleaning agents, acid rain, mildew, salt water, and is unaffected by most industrial pollutants
 - 6) Treated for prolonged exposure to the sun
 - 7) Rot resistant

3. Shade and UV Factors:

- a. Shade protection and UV screen protection factors shall be as follows:

Color	UV Block %	Shade %
Pacific Blue	85%	80%~86%
Rain Forest Green	85%	79%~86%
Red	86%	80%~83%
Silver	81%	80%~85%
Desert Sand	92%	80%~84%
Terracotta	82%	80%~83%
Yellow	89%	80%~82%

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The installation of fabric shade structures shall be performed by manufacturer or manufacturer-approved and certified contractor, which shall be bonded and holding a current contractor's license with the State of California's Contractors State License Board. All installation personnel must have experience in the erection of tensioned fabric structures.
- B. The installation shall comply with the manufacturer's instructions for assembly, installation, and erection, per DSA approved drawings.
- C. Concrete:
 - 1. Unless noted otherwise for footings and piers by the Project Engineer, the concrete specification for footings, piers, slabs, curbs, and walkways shall meet a minimum 3,000psi at 28-day strength.
 - 2. Concrete work shall be executed in accordance with the latest edition of American Concrete Building Code ACI 318-14.
 - 3. Concrete specifications shall comply in accordance with the Section 03300 Cast-in-Place Concrete, detailed as per plans, and shall be as follows:
 - a. 28 Days Strength $F'_c = 3000$ psi
 - b. Aggregate: HR
 - c. Slump: 3 ~ 5 inch
 - d. Portland Cement shall conform to C-150
 - e. Aggregate shall conform to ASTM C-33
 - 4. All reinforcement shall conform to ASTM A-615 grade 60.
 - 5. Reinforcing steel shall be detailed, fabricated, and placed in accordance with the latest ACI Detailing Manual and Manual of Standard Practice.
 - 6. Whenever daily ambient temperatures are below 80 degrees Fahrenheit, the contractor may have mix accelerators and hot water added at the batch plant (See Table 1).
 - 7. The contractor shall not pour any concrete when the daily ambient temperature is to be below 55 degrees Fahrenheit.

TABLE 1

Temperature Range	% Accelerator	Type Accelerator
75~80 degrees F	1%	High Early (non calcium)
70~75 degrees F	2%	High Early (non calcium)
Below 70 degrees F	3%	High Early (non calcium)

- D. Foundations:
 - 1. All anchor bolts set in new concrete shall comply with ASTM F1554 GR 55.
 - 2. All anchor bolts shall be Hot-Dip Galvanized.
 - 3. Footings and full rebar cages shall be drilled, set and poured as per manufacturer's specifications. The Single Post Pyramid shall have a minimum recessed base plated footing of 9'0" deep x 24" diameter with full rebar cage. All foundations shall be installed per final DSA approved manufacturer's engineered specifications and drawings.

END OF SECTION

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.
- B. Related Requirements:
 - 1. Division 01 – General Requirements.
 - 2. Division 23 – HVAC.
 - 3. Division 26 – Electrical.
 - 4. Division 27 – Communications.
 - 5. Division 28 – Electronic Safety and Security.
- C. Related Industry Standards: The most current version of the following industry standards.
 - 1. ASTM D 709 – Laminated Thermosetting materials.
 - 2. ANSI/NEMA FB-1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 - 3. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 4. California Electrical Code (CEC).
 - 5. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 - 6. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
 - 7. UL/ANSI 1 – Standard for Flexible Metal Conduit.
 - 8. UL/ANSI 1242 – Standard for Electrical Intermediate Metal Conduit.
 - 9. UL/ANSI 506 – Standard for Specialty Transformers.
 - 10. UL/ANSI 6 – Electrical Rigid Metal Conduit-Steel.

11. UL/ANSI 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.
12. UL 797 – Electrical Metallic Tubing-Steel.
13. UL/ANSI 870 – Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
14. UL/ANSI 891 – Standard for Safety Switchboards.

1.02 BASIC ELECTRICAL REQUIREMENTS

A. Quality Assurance:

1. Work shall be performed by CONTRACTOR'S personnel possessing the skills and experience obtained in performing work of similar scope and complexity.
2. Refer to related division(s) specifications for other requirements.

B. Drawings and Specifications Coordination:

1. For purposes of clearness and legibility, Drawings are essentially diagrammatic, and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.
2. Verify final locations for rough ins with field measurements and with the requirements of the equipment to be connected.
3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduits. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.
5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity; CONTRACTOR shall coordinate in the field prior to rough-in work.
6. Coordinate electrical equipment and materials installation with building components and the Work of other trades.
7. Equipment disconnects shall be readily accessible and free of obstructions.

8. When extending or intercepting existing electrical facilities, CONTRACTOR shall Coordinate and verify existing conditions.

C. Terminology:

1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.
2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.

D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.

E. Structural Considerations for Conduit Routing:

1. CONTRACTOR shall provide DSA approved calculations and drawings as necessary for any construction and/or alterations requiring conduits to pass through or interfere with any structural members, or where notching, boring or cutting of the structure is necessary, or where special openings through walls, floors, footings, or other buildings elements, or where notches and bored holes in wood or steel are required. All work shall conform to CBC, Part 2, Title 24 requirements.
2. Concrete encasement for underground conduits that abuts a foundation wall or underground structure shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.

F. Electrically Operated Equipment and Appliances:

1. Furnished Equipment and Appliances:
 - a. Work shall include furnishing and installing wiring enclosures and complete connections of electrically operated equipment, appliances and electrical control devices, which are specified to be furnished and installed in this or other sections of the Specifications. Wiring enclosures shall be concealed except where exposed work is indicated on the drawings.

- b. Provide all connections necessary for installation of equipment.
 - 1) Equipment shall be tested for proper operation, including proper rotation of motorized equipment.
 - 2) If outlets are of incorrect electrical characteristics, or any specified equipment fails to operate properly, CONTRACTOR shall repair and/or replace the outlet and/or equipment.
 - 3) Utility connections (electrical, controls, gas, etc.) to roof mounted mechanical equipment shall be made through the side of the equipment and not from beneath the unit to facilitate future replacement.

2. Equipment and Appliances Furnished by Others:

- a. Equipment and appliances indicated on Drawings as "not in contract" (NIC), "furnished by others," or "furnished by the OWNER," will be delivered to the Project site. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
- b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems, furnished under Division 23. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.
- c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
- d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
- e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of

damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.

G. Power Distribution System Reports: For fault current, coordinatization and Arc-Flash system report requirements refer to applicable electrical distribution equipment sections. for specific requirements.

H. Protection of Materials:

1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.

I. Cleaning:

1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped, and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

J. WARRANTIES

1. Provide one-year warranty on all material and labor performed, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Advise the Inspector before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.

- D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the Inspector. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be three inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. CONTRACTOR to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- F. Electrical equipment shall be braced and anchored for CBC Seismic Design requirements, or as otherwise indicated on the Drawings.

3.02 DELIVERY STORAGE AND HANDLING

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

3.03 CUTTING AND PATCHING

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work or surfaces damaged as a result of the work performed under this contract.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.
- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the OWNER Authorized Representative.

3.05 PROTECTION

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

END OF SECTION

SECTION 26 0513

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Boxes, enclosures, keys and locks.
2. Receptacles and switches.
3. Identifications and signs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 – Electrical.
3. Division 27 – Communications.
4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.01 BOXES, ENCLOSURES, KEYS AND LOCKS

A. Outlet Boxes and Fittings:

1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.

5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.
6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Racor, Appleton, Cooper, Bowers, or equal.
10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with enough machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.
4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.

- b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.
5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.
6. Underground Concrete Pull Boxes:
- a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inches by 10 inches in each 3 feet side, and one 20 inches by 20 inches knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one-inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4-inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required.
 - b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.
 - e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.

- h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
 - j. Approved Products: Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or OWNER approved equal.
- 7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.
 - 8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.

C. Keys and Locks:

- 1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
- 2. Special keys and locks shall only be provided where specified. Locks shall be keyed to Corbin No. 60 or 70 as follows:
 - a. Access to operate equipment shall be keyed to Corbin 60.
 - b. Access to service areas shall be keyed to Corbin 70.

2.02 RECEPTACLES AND SWITCHES

A. Receptacles:

- 1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be wired on the side and back with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

Equal products approved by OWNER may be acceptable.

2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15-amps, 120-volts, or OWNER approved equal.

3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

Equal products approved by OWNER may be acceptable.

4. Single 15 and 20-amps receptacles on circuits supplied by panel boards with integral surge suppression shall be blue in color.

- a. Approved products: Pass & Seymour NEMA 5-20R model number 5361-BL (blue), NEMA 5-15R model number 5261-BL (blue), or OWNER approved equal.

5. Kiln and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps or as indicated on plans. Receptacle shall be rated 125/250 volts NEMA 14-50R. Provide 2-gang, stainless steel plates.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE	SS703	S703	84026

Equal products approved by OWNER may be acceptable.

6. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

Equal products approved by OWNER may be acceptable.

7. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

Tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body.

- a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Arrow Hart</u>	<u>Leviton</u>
NEMA 5-20R	TR63-I	TR8300V	8300SGI
NEMA 5-15R	TR62-I	TR8200V	8200SGI

Equal products approved by OWNER may be acceptable.

B. Switches

1. Local Switches:

- a. Local switches shall be high strength thermoplastic toggle, industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three-way	PS20AC3I	HBL1223I	1223-2I
Four-way	PS20AC4I	HBL1224I	1224-2I

Equal products approved by OWNER may be acceptable.

- b. Lock type switches shall be specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

- 1) Approved products:

	<u>Pass & Seymour</u>	<u>Arrow Hart</u>
Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key
Three-way	PS20AC3L w/#500 Key	1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key	1224L w/1201LK Key

Equal products approved by OWNER may be acceptable.

- c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-volt or 277-volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

1) Approved products:

	<u>Arrow Hart</u>
Single pole	AH1191N
Double pole	AH1192N
Three-way	AH1193N

Equal products approved by OWNER may be acceptable.

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by LED lamps. Pilot light shall light when load is on. Pilot light 120-volt switches

1) Approved products:

	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three-way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Equal products approved by OWNER may be acceptable.

- 2) 20 amps, 277 volts rated pilot light switches shall be single pole and shall conform to specifications for local switches, and the requirements of paragraph d above.

a) Approved Products:

<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
PS20AC1-RPL	1221-7PR	HBL1221-PL7

- e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles.

1) Approved products:

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1251-I	HBL1557-I	1285-I

Equal products approved by OWNER may be acceptable.

- f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC

only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

1) Approved products:

<u>Pass and Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1225-I	HBL 1385	1285-I

Equal products approved by OWNER may be acceptable.

- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.

1) Approved products:

Arrow Hart AH1995L w/ AH2000 key

Equal products approved by OWNER may be acceptable.

- h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

1) Approved products:

Pass and Seymour Toggle 1081I, Locking 1081KGRY w/#500 Key

Equal products approved by OWNER may be acceptable.

2. Time Switches and Photoelectric Controls for existing construction.

- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Resistive or inductive contacts rated for 25-amps, each pole 240-VAC; 5-amps tungsten or 277-VAC pilot duty, each pole 240-VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one-minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation.

b. Required :

- 1) Liquid crystal display panel.

- 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.

- 3) Automatically adjusts to and from daylight savings time and for leap year.
 - 4) Contact ratings: 10 amp at 240 VAC.
 - 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.
 - 6) Selective review: All or part of schedule shall be displayed at touch of a key.
 - 7) Super Capacitor for power carry-over system.
 - 8) Supply voltage: 120/277-Volt.
 - 9) 365-day advance scheduling.
- c. Approved products: Tork Model EW 101B series, Intermatic ET90000 series, or OWNER approved equal.
 - d. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2-inch conduit fitting,
 - 1) Approved products: Tork series 2100, or OWNER approved equal.

3. Emergency Lighting Control Unit

- a. The Emergency Lighting Control Unit shall provide all required functionality to allow a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
- b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
- c. The device shall have normally closed dry contacts capable of switching 10-amp emergency ballast loads at 120-277 VAC, 60 Hz., 2-amp tungsten loads at 120 VAC, 60Hz., LED loads at 120-277V VAC, 60 Hz
- d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
- e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)

- f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
 - g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
 - h. Approved products: WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series, or OWNER approved equal.
4. School Main Entrance Intercom Station: Refer to specification section 28 1000 – Access Control System.

2.03 IDENTIFICATION AND SIGNS

A. Identification Plates:

- 1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
- 2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
- 3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

- 1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
- 2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be

marked "WARNING-HIGH VOLTAGE – ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.

C. Warning Signs:

1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2-inch-high lettering.
3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.01 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or OWNER approved equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or OWNER approved equal; nut and a Tomic No. 711-B Adapta-Stud, or OWNER approved equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.
- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
 1. Install wall-mounted switches at 48 inches above finished floor.

2. Outlet boxes for fire alarm pull stations shall be mounted at a mounting height above finished floor that ensures that the operating handle of the initiating device is no higher than 48 inches from finished floor.
3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or other OWNER approved protective covers as required in plans.
5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
6. Install clocks and speakers, in classrooms and offices, 8 feet above finished floor. Unless otherwise indicated.
7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.
8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.
10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.
11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
12. Install television outlets at a height corresponding to location of television monitor, or as indicated on plans.
13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.02 COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.

- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:
 - 1. Three-gang and larger gang switches in locations other than classrooms.
 - 2. Lock switches.
 - 3. Pilot switches.
 - 4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
 - 5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
 - 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 - 7. Switches operating on 277 V shall be identified with the operating voltage.
 - 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.
- E. Standard GFI cover plates shall be Pass & Seymour 4600, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.03 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be

manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.

- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit's area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.04 PROTECTION

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

3.05 CLEANUP

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

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. List of Materials: Submit a complete list of proposed materials.
- C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, insulation type, resistivity, conductivity, impedance, and conductance. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- D. Prior to start of construction; provide letter from wiring and electrical cables manufacturer certifying that the products are qualified/ listed as low electromagnetic field products.

1.03 SUBSTITUTIONS

- A. Deviations/Substitutions from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating are proposed the following information shall be submitted:
 - 1. Substitution request form stating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. Proposed substitutions requests shall provide proof of compliance with OWNER'S requirements and applicable standards.
- B. Submittals must comply with contract general provisions.

1.04 QUALITY ASSURANCE

- A. Components and materials shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes.
- B. Wiring installation shall be performed under the supervision of state certified electricians. Contractor or Installer's electricians shall be certified in accordance with Labor Code sections 3099, and 3099.2 and section 209.0 of the California Code of Regulations.
- C. Contractor shall have adequate experience installing systems of similar size and complexity.
 - 1. Qualifications of Installer: Minimum five years of experience installing products and systems of similar scope and complexity.
 - 2. Installer shall have completed at least five projects of equivalent scope and complexity.
 - 3. Contractor shall have completed and commissioned a minimum of five service agreements that provide similar support services to those needed for this project.
 - 4. System startup and testing shall be performed under direct observation of the Project Inspector and OAR.
- D. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.

1.05 WARRANTY

- A. Provide a one year labor warranty.
- B. Provide material warranty of no less than 10 years.
- C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.
- D. CONTRACTOR shall warranty all products and materials. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.01 WIRES

- A. Pressure cable connectors shall be pre-insulated 3M Scotchlok, Ideal Wing Nut, O-Z/Gedney or equal.
- B. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at a maximum continuous conductor temperature in dry locations of 90 degrees C. and 75 degrees C. in wet locations. Wires and cables shall be listed by Underwriter's Laboratories (UL) Standard 83 for thermoplastic insulated wires, and listed for installation in accordance with Article 310 of the California Electrical Code (CEC).
- C. Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors.
- D. Conductors shall be insulated with PVC and sheathed with nylon.
- E. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted.
- F. Wires shall be tested in accordance with the requirements of UL standard for types THWN and THHN.
- G. Conductors shall be solid Class B or stranded Class C annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

2.02 STANDARDS

- A. THWN/THHN wires shall comply with the following standards:
 - 1. UL 83 for thermoplastic insulated wires.
 - 2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values

- C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- D. Pressure cable connectors, Yellow, Red, or Blue spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems. Listed Push-in spring clamp wire connectors, Ideal In-Sure, or equal may be used in luminaires for fixture wiring.
- E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- F. Connections to any bussing and high-pressure cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.
- I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- J. Maintain the conductor required bending radius.
- K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.
- L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.
- M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch

circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.

1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform megger time-resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.
3. Tests shall be performed in the presence of the Project Inspector.
4. Insulation resistance shall not be less than 100 mega-ohms.

3.02 COLOR CODES

A. General Wiring:

1. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.
2. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

3. Where two voltage systems are combined in an enclosure; CONTRACTOR shall apply a permanent color code label where the circuits originate.

B. Signal Systems: Wires for signal systems shall be color-coded and installed under observation of the Project Inspector. Except where otherwise specified, color-coding shall be as follows:

<u>SYSTEM</u>	<u>COLOR CODE</u>
Clocks	Pink, Gray and Orange
Program Bells (some existing elementary schools)	White (Common)Black
Initiating Devices (Non-Addressable)	Red (+) and Black (-)
Program Bells (some existing secondary schools)	White (120 volt, common) Black (C.R. program) Blue (Shop program) Brown (Gym program) Yellow (Auditorium fire alarm)
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct	Brown (+) and White (-) Note: A single white wire may be common to both

detectors)	
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

3.03 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.04 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

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 26 0526
GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide and install an effective grounding and bonding system.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 26 – Electrical.
 - 4. Division 27 – Communications.
 - 5. Division 28 - Electronic Safety and Security.

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. IEEE 142 Green Book.
 - 2. Underwriter's Laboratories (UL).
 - 3. California Electrical Code.
 - 4. Building Industry Consultant Services International (BICSI).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL).

1.03 SYSTEM DESCRIPTION

- A. Equipment, components, or materials that enclose electrical conductors, or are likely to be energized by electrical currents shall be effectively grounded.
- B. Metal equipment parts such as switchboards, panelboards, metal enclosures, raceways, equipment grounding conductors, and earth grounding electrodes shall be effectively bonded into a continuous grounding path.
- C. Metallic systems or electrically conductive materials shall be effectively bonded to the building's grounding electrode system.

- D. A separately derived AC system shall be grounded to the equipment grounding conductor and to a separate “made” electrode of building grounding electrode system.
- E. Provide effective electrical equipment bond continuity to all metal raceways and enclosures. Grounding shall be achieved through a code sized green insulated grounding conductor provided within each raceway.
 - 1. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.
 - 2. Provide code sized equipment grounding conductor in all flexible conduits as required by CEC.
 - 3. The length of flexible conduit installations shall not be less than six feet.
 - 4. Effectively ground metal raceways and enclosures at each end.
- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:
 - 1. A dedicated “made” electrode, fabricated of at least 20 feet of uncoated galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth. A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 exothermic welded bare copper cable, or be welded directly to the bus. The exothermic weld shall be at least four inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
 - 3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors.
 - 4. An external grounding electrode, as specified hereafter or as required by the CEC shall be installed and connected to foundation or footing rebar.
- G. Non-current carrying metal parts of high-voltage (1000 Volts or more) equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively bonded to the grounding system. Provide a CEC sized equipment grounding conductor in every raceway.

- H. Metallic or semi-conducting shields and lead sheaths of cables operating above 1000 Volts shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
 - 1. Neutral shall be solidly grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
 - 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 - 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.
 - 4. Equipment grounding conductor shall be installed from switchboard to each individual building. At building, grounding conductor shall be bonded with power equipment enclosures, metal frames of building, etc., to “made” electrode for that building.
 - 5. Feeder neutrals shall be bonded at service entrance point only; neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to “made” electrode serving the building.
- K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.04 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger.
 - a. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast-iron frames cast into the yard boxes.
 - b. Yard boxes shall comply with LAUSD standard detail E-102.
 - c. Provide yard boxes with hinged Frame Locking Cover.

- d. Approved products include Brooks No. 36 HFL, Jensen Precast, Oldcastle Precast, Western Precast, Kistner, or equal.
- B. External ground electrodes shall be copper-clad steel ground rods, minimum 3/4-inch diameter by ten feet long.
- C. Clamps and fittings used in ground boxes below grade shall be listed for direct burial.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box.
- C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet CEC grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be bonded together with listed fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.02 TESTING

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of “made” electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
 - 1. Visually and mechanically examine ground system connections for completeness and adequacy.

2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
 3. Perform the two-point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal hand railings at building entrances and at handicapped ramps shall also be tested.
 4. Test shall be performed in the presence of the Inspector.
- B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.
- 3.03 PROTECTION
- A. Protect the Work of this section until Substantial Completion.
- 3.04 CLEANUP
- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 0533
RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Raceways and wire ways.
 - 2. Conduit installation.
 - 3. Underground requirements.
- B. Related Requirements:
 - 1. Section 26 0500: Common Work Results for Electrical.
 - 2. Section 26 0513: Basic Electrical Materials and Methods.
 - 3. Division 27: Communications.
 - 4. Division 28 - Electronic Safety and Security.
- C. Applicable Standards and Codes.
 - 1. EIA/TIA 569 Standards.
 - 2. National American Standards Institute (ANSI).
 - 3. National Electrical Manufacturer's Association (NEMA).
 - 4. Nationally Recognized Testing Laboratory (NRTL).
 - 5. California Electrical Code (CEC).
 - 6. Uniform Building Code (UBC).
 - 7. Underwriters Laboratory (UL).

1.02 SUBMITTALS

- A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Conduit Materials:
 - 1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name.

2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.
 3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings, and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application.
 4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1.
 - a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.
 5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
 6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking.
 7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or District approved equal.
 8. Metal Clad (MC) cable system is not allowed.
- B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal.
- C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal.

D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:

1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture's internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations.
2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal.

E. Conduit Seal Fittings:

1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC.
2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area.

F. Surface Steel Raceway:

1. The surface steel raceway system for branch circuit wiring, data network, voice, video, and other low voltage wiring shall be as manufactured by the Wiremold Company, Hubbell, or Mono-Systems, Inc. or equal. The raceway system may be supplied pre-wired in accordance with all sections of these specifications and requirements herein, and shall be UL or another NRTL listed. Computer data installation shall be as required by other sections of this Division.
 - a. If furnished pre-wired, the system must be listed in accordance with UL or another NRTL for "Multiple Outlet Assemblies" and so labeled on interior of the assembly. The pre-wired installation must contain no extra wire splices in the raceway as compared to a contractor assembled installation assembled from components. The pre-wired steel raceway

shall be Hi-Pot tested at the factory to prevent any potential bare wire or short circuit defects.

2. The raceway base, cover, and device bracket shall be manufactured of steel and finished in ivory, gray enamel or custom colors suitable for field painting to match adjacent finishes.
3. The raceway shall be a two-piece design with a metal base and snap-on metal cover, except for the Wiremold V700 system, Hubbell HBL750 series and Mono-Systems Inc. S145-700 series that shall be a one-piece design. The base and cover sections shall be a minimum of 0.040 inch wall thickness. The base section shall be available in ten-foot lengths. A hand-operated cutting tool shall be available for the base and cover to ensure clean, square cuts. Wiremold V500, Hubbell V500, and Mono Systems inc. SM500 series are not permitted.
4. A full complement of fittings shall be furnished, including but not limited to, flat internal and external elbows, tees, entrance fittings, wire clips, cover clips, couplings, support clips, C-hangers and end caps. The fitting color shall match the raceway color. Fittings shall be supplied with a base where indicated and/or required. A take-off fitting shall be furnished as required to adapt to existing flush wall boxes.
5. Device brackets shall be furnished for mounting single or two-gang devices within the raceway. Devices shall be provided with the ability of mounting flush or in conjunction with standard steel, stainless steel, or manufacturer's metal faceplates.
6. The raceway shall be furnished with a complete line of connectivity outlets and modular inserts for unshielded twisted pair including category 5, fiber-optic, coaxial, and other cabling types with face plates and bezels to facilitate installation. Computer data installation shall be as required by other sections of this Division, and Division 27.
7. Raceway shall be furnished with corner elbows and tee fittings to maintain a cable bend radius which meets the requirements of fiber-optic and copper cables under EIA/TIA 569 for communications pathways.

G. Factory Pre-Wired Surface Metal Raceway:

1. Furnish and install pre-wired surface metal raceways as indicated on Drawings and as specified.
2. Metal Raceway shall be galvanized steel Wiremold V4000, Hubbell 4000 series, or Mono-Systems Inc. SMS-4000 series complete with raceway base, cover, fittings, receptacles and mounting plates required for a complete assembly. Raceway shall have two wiring compartments with integral dividing barrier for isolating the wiring compartments.
3. Pre-wired assembly shall be UL, or another NRTL listed as a multi-outlet assembly and surface raceway as labeled on interior of assembly.

4. Wiring devices and other components shall be factory installed, electrically wired and covers labeled as indicated on drawings. Each receptacle shall be identified with panelboard and circuit number from which it was fed. Grounding shall be maintained by means of factory installed grounding conductors.
 5. Where shown on Drawings, Raceway covers shall have provisions for mounting computer data outlets.
 6. Complete assembly is to consist of required fittings such as elbows, slide couplings for joining raceway sections, blank end caps and flat tees.
 7. Prewired assembly must contain no wire splices.
 8. Receptacles and wiring shall be as indicated on drawings and as specified.
 9. Where raceway is used for power and computer data outlets, installation of data outlets shall be as required by other sections of this specification.
 10. Prior and during installation, verify and comply with manufacturer's installation instructions.
 11. Entire assembly shall be tested for shorts, opens, ground faults, and wire insulation at factory and certified. Raceways shall be electrically continuous and bonded in accordance with California Electrical Code.
 12. Submit shop drawings for approval showing the complete layout of all components of each raceway, raceway lengths, each component description, location and circuit identification.
 13. All wiring devices shall be removable without requiring disassembly of wireway.
 14. Standard non OEM wiring devices shall be used as specified in District's specifications.
- H. Wireways shall be 16 gage galvanized steel enclosed hinge/screw wiring troughs, surface metal raceway, wireway, and auxiliary gutter designed to enclose electrical wiring. Wireway fittings shall be furnished with removable covers and sides to permit complete installation of conductors throughout the entire wireway run. Cover shall be furnished with keyhole slots to accept captive screws locking the cover securely closed. Wireways shall be UL or another NRTL listed, and shall be Square D Type LDB NEMA-1 enclosure for interior applications, or Type RDB NEMA-3R enclosure for exterior applications, or equal by Cooper B-line, Hoffman, Wire Guard, or Circle AW.
- I. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.
- J. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. General Requirements:

1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
2. EMT may be installed in interior concealed applications and in areas approved by owner. EMT shall not be installed in concrete, directly buried underground, outdoors, in boiler rooms, elevator pits, or where subject to damage.
3. Within buildings, flexible steel conduit may be installed instead of rigid steel conduit where permitted by code. Flexible steel conduit shall be installed:
 - a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).
 - b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations.
4. Flexible Steel conduit shall not exceed 1-1/2 inches in size.
5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.
6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection.
7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap.
8. If connection is from a flush wall-mounted junction box, install an approved extension box.
9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated.
10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings.

11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not permitted. Public telephone conduit bends and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation, specified in this section, for radius of bends and offsets required for underground installations.
12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems.
13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps. Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations.
14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:
 - a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet.
 - b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet.
 - c. Conduits shall not be spaced closer than three inches on centers.
15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall fasten conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel.
16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached.

17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or two-inch x four-inch headers fitted between joists or wall studs.
18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support.
19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks.
20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 1/2-inch conduit hangers and larger.
21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review.
22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements.
23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified.
24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work.
25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole

malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits.

26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements.
27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted.
28. Flex conduits shall be cut square and not at an angle.
29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings.

B. Underground Requirements:

1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides , except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts.
2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified.
3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible.
4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines.
5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested.
6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical

code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 1/2-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted.

7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".
 8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service.
 9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings.
 10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing.
 11. Underground conduit for systems operating above 600 volts shall be a minimum size of four inches.
 12. At portable classroom all stub ups shall be installed with a coupling flush to finish grade.
 13. Underground conduits and raceways shall be swabbed prior to wire pull.
- C. Rooftop conduit shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Blok, or equal. Roller type supports shall be provided below and above conduit to prevent its dislodgement. Bottom of conduits shall clear the roof surface by 10 inches.
1. At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.
 - a. Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
 - b. Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
 2. Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the

block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.

D. General Installation Requirements for Computer Network System Conduits:

1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work.
2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained.
3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet.
4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes.
5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit.
6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard.
7. Splicing or terminating cables in pull boxes is not permitted.
8. For indoor application, a pull box shall be provided in conduit run where:
 - a. The length is over 100 feet.
 - b. There are more than two bends of 90 degrees.
 - c. There is a reverse bend in the run.
9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes.
10. Where a pull box is provided with raceways, pull box shall comply with the following:
 - a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway.
 - b. For angle and U-pulls:
 - 1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased

by the sum of the trade-size diameters of the other raceways on the same wall of the box.

- 2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least:
 - a) Six times the trade-size diameter of the raceway; or
 - b) Six times the trade-size diameter of the larger raceway if they are of different size.
 - c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor.

11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings.

E. Slabs on Grade:

1. Unless specifically reviewed by the Architect and DSA, conduits 1 1/4-inches and larger are not permitted to be installed in structural concrete slabs. Where conduits are permitted, and are installed in concrete slabs on grade, slabs shall be thickened at bottom where conduits occur to provide three inches of concrete between conduit and earth. Required excavation shall be part of the Work of this section.
2. If concrete slab is five inches or more in thickness with a moisture barrier plastic sheet between earth and slab, one inch and smaller conduits shall be installed in the slab with a minimum of one inch concrete between earth and conduit.

- F. Concrete Walls, Beams, and Floors: Provide sleeves where conduits pierce concrete walls, beams, and floors, except floor slabs on grade. Sleeves shall provide 1/2 inch clearance around conduits. Sleeves shall not extend beyond exposed surfaces of concrete and shall be securely fastened to forms. Where conduits pass through walls below grade, seal with required sealant and backer materials between conduit and sleeve to provide a watertight joint. Sealant shall be as indicated in Section 07 9200: Joint Sealants.

3.02 STUBS

- A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps.
- B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where

capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.

C. Underground:

1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.
2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.03 PROTECTION

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

3.04 CLEANUP

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

END OF SECTION

SECTION 26 1000

SERVICE ENTRANCE

PART 1 - GENERAL

1.01 SUMMARY Furnish all labor, material and equipment necessary for the complete installation of the Service Entrance Electrical System as shown on the Drawings, including final connections as specified herein. Work shall be performed in accordance with the the requirements of the local Utility Company, codes and regulations, and applicable industry standards.

B. Section Includes: Underground power service conduits from utility company service pole, transformer, vault or other designated service point to OWNER'S service equipment.

C. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 3000 – Cast-In-Place Concrete.
3. Section 26 0500 – Common Work Results for Electrical.
4. Section 26 0513 – Basic Electrical Materials and Methods.
5. Section 26 0533 – Raceways, Boxes Fittings, and Supports.
6. Section 26 0526 – Grounding and Bonding.
7. Section 26 0519 – Low-Voltage Wires (<600 Volt AC).
8. Section 26 2413 – Switchboards.
9. Section 31 2313 – Excavation, and Fill.

1.02 REFERENCES

- A. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. California Electrical Code (CEC).
- C. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.

- D. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
- E. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
- F. Los Angeles Department of Water and Power Electrical Service Requirements.
- G. Southern California Edison ESR – Electrical Service Requirements.
- H. UL 891-Switchboards.
- I. UL/ANSI 891 – Standard for Safety Switchboards.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size, capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.
- C. Submit Fault Current, Coordination and Arc-Flash reports based on installed conditions and equipment.
 - 1. Provide installation and seismic anchorage details.

1.04 SYSTEM REQUIREMENTS

- A. Where required and indicated on Drawings, install transformer vault, outdoor transformer enclosure, pad and slab box, manholes or other equipment in accordance with utility company drawings and standards.
- B. Coordinate all work with the utility company electrical service requirements.
- C. Consult utility company to determine exact location of serving point, service poles, quadrants on poles for service risers, transformer location(s), underground work, and work and materials. Service installation shall be complete and ready for cable installation. Service cable shall be provided by utility company and paid for by OWNER.
- D. Reports: Provide short-circuit, coordination and arc-flash reports signed and stamp by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines and applicable codes. Submit two copies of each study for Engineer of Record review.

1. Provide a system coordination report based on approved equipment and installed equipment for all main and branch circuit protective devices including transformers secondary protective devices. Study report shall be in accordance with IEEE 242 and recorded on log paper. The circuit protective devices shall be set based on the coordination study. Submit a written record of protective device settings.
 2. Provide a complete arch-flash report in accordance with code and IEEE 1584. The report shall be based on installed equipment, and feeders' sizes and lengths. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.
 3. Provide a short circuit withstand capacity/ Interrupting capacity of main and distribution equipment and circuit breakers in accordance with IEEE 551.
- D. Equipment shall be labeled with Short Circuit Current Rating (SCCR), and in compliance with UL 891 requirements.
- E. All work shall be done in compliance with California Electrical Code and authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Transformer Pads: Concrete transformer pads shall be provided as indicated on Drawings and shall meet requirements of serving electric utility company.
- B. Service Conduits: As described under Section 26 0533: Raceways, Boxes Fittings, and Supports. For utility portion of wiring and conduit runs, comply with utility company requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Service conduits shall terminate at service poles or other service point, as indicated on Drawings and shall extend underground to main service terminating pull section as indicated on drawings. Bends in conduits shall be long radius type and sweeps shall have a radius of not less than 12 times conduit trade size for conduits up to 5" diameter, and 10 times for conduits with a diameter greater than 5". Underground conduits shall be encased in concrete three inches thick on all sides with multiple conduits spaced not less than 1-1/2 inches apart, or utility company recommended

spacing, whichever is more stringent. Provide support for conduits to prevent floating when encased.

B. Service Cables:

1. Overhead: Shall be connected to metering compartment of switchboards.
2. Underground: Shall be in service terminating pull section as required and directed by utility company.

3.02 CONDUITS CROSSING PUBLIC DEDICATED PROPERTY

- A. Where service or other conduits cross a street, alley, highway, or other public dedicated property, provide necessary arrangements to open and close public property and pay costs in connection with required licenses, permits, fees and deposits. Conduits shall be installed in a manner required by utility company and authorities having jurisdiction.

3.03 STRUCTURAL CONDITIONS

- E. Where conduits are to pass through or interfere with structural members, or where notching, boring or cutting of structure is necessary, or where special openings are required through walls, floors, footings, or other building elements to accommodate electrical Work, such Work shall be performed as required by the Architect and DSA.
- F. Placement of conduits in concrete slabs and structural members shall comply with requirements of applicable section of CCR, Title 24, Public Works and shall be as required by Architect and DSA.
- G. Where a concrete encasement for underground conduits abuts a foundation wall or underground structure which conduits enter, encasement shall be maintained in position in relation to structure as indicated on Drawings, or rest on a haunch integral with wall or structure, or shall extend down to footing projection, or shall be doweled into structure. Underground structures shall include manholes, pull boxes, vaults, and buildings.
- H. Cutting and patching of rough and finish Work shall be performed as required for installation of Work under this section. Patching shall be of same materials, workmanship and finish and shall accurately match surrounding Work.

3.04 PROTECTION

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

3.05 CLEANUP

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

END OF SECTION

SECTION 26 2413
SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Main switchboard, including metering facilities required by the utility company.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 3000: Cast-In-Place Concrete.
 - 3. Section 26 0500: Common Work Results for Electrical.
 - 4. Section 26 0513: Basic Electrical Materials and Methods.
 - 5. Section 26 0526: Grounding and Bonding.
 - 6. Section 26 0519: Low-Voltage Wires (600 Volt AC).
 - 7. Section 26 1000: Service Entrance.
 - 8. Division 27: Communications.
 - 9. Division 28: Electronic Safety and Security.
- C. Related Industry Standards: The most current version of the following industry standards.
 - 1. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. California Electrical Code (CEC).
 - 3. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 - 4. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
 - 5. IEEE 1584 – Performing Arc-Flash Hazard Calculations.

6. UL/ANSI 891 – Standard for Safety Switchboards.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Shop Drawings:

1. Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size or capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.

C. Fault Current, Coordination and Arc-Flash Reports: the following reports shall be prepared using SKM Systems Analysis, ETAP Powering Success, EasyPower, or equal.

1. Provide a short-circuit and coordination report signed and stamped by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.

2. Provide a system coordination report for main and branch circuit protective devices including transformers secondary protective devices. Study shall be recorded on log paper. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted.

3. Provide a complete arc-flash report based on installed equipment, and feeders' sizes and lengths. Prepare the report in accordance with code requirements and IEEE 1584 standard. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.

4. Provide installation detail and seismic anchorage notes for switchboards.

D. Provide a connection schematic diagram.

1.02 SUBSTITUTIONS

A. Switchboards that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards and Maintenance and Operations Technical Units. When deviating or proposing substitutions the following information shall be submitted:

1. Substitution request form substantiating reasons for the deviation and benefits to the OWNER.
 2. Proposed substitutions requests shall provide proof of compliance with transformers characteristics indicated in this specifications section.
- B. Documentation must comply with contract general provisions.

1.03 QUALITY ASSURANCE

- A. Installation shall be performed by State approved/ certified electricians.
- B. Switchboards shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under REFERENCES.
- C. Provide labor, engineering, design, testing, supervision, material and equipment required.
- D. Equipment shall be new and high quality. Manufacturer shall have been continuously manufacturing distribution transformers for at least 10 years.

1.04 COMMISSIONING

- A. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of power distribution systems and assemblies, including submittal review, installation, testing, documentation, and training as indicated in section 26 0800 – Electrical Systems Commissioning.
- B. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 9113, General Commissioning Requirements.
- C. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER's Commissioning Services Provider.

1.05 WARRANTY

- A. Provide a one-year labor warranty.
- B. Switchboards shall be warranted to be free from defects in materials and fabrication for a period of three years from the date of substantial completion.
- C. Warranty period begins at project acceptance for beneficial occupancy.

- D. Warranty exclusions for third party components is not acceptable.

PART 2 - PRODUCTS

2.01 SWITCHBOARDS

- A. General Description: Switchboards shall be product of W.A. Benjamin Electric, Eaton, General Electric, Siemens, or equal, and shall conform to the following requirements:
1. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.
 2. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.
 3. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that cabinet can be located in any position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.
 4. Main circuit breaker or main fusible switch shall be as follows:
 - a. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips, bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as determined by utility company. Provide shunt-trip and integral ground fault devices, as indicated on drawings. Breakers shall be furnished with lockout provisions.

- b. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Where required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.
- 5. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid-state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
- 6. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept three industrial type heavy-duty padlocks. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.
- 7. Utility metering provisions shall meet requirements of serving utility and shall be furnished with necessary fittings.
- 8. Provide switchboard silver-plated copper bus bars of same capacity as main breaker, or as indicated on Drawings, between current transformer and main section and distribution sections; also, full height of breaker space in distribution portions. Copper bus shall have current density of 1000A per square inch of cross section. Bus structure shall be free-fitted and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as

required by utility company. Cables and internal wiring shall be supported with suitable cleats.

9. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.
10. Provide a large nameplate identifying switchboard, indicating service voltage, originating power source, function and current rating. Nameplate shall be furnished with 3/16-inch engraved black letters on white background. Name plate shall be mechanically fastened to switchboard.
11. Provide labels for circuit breakers, disconnect switches, and or other disconnecting means in switchboards. Labels shall be a P-Touch type or equal, with a minimum width of 3/8 inch with black letters on white background. Label shall indicate name of load served, name or room number and if in different building, name of building. If equipment is installed in same room as source, label should indicate source name and "in this room".
12. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.
13. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.
14. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, three-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to Corbin No. 60 keys. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.
15. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an independent recognized testing laboratory. Testing lab shall

provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the Project Inspector. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step-down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.

16. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be GE Multiline PQMII with BACnet translator capabilities; equal or better meters will be acceptable with District's approval only. Contractor shall supply the metering software and electronic key to owner.
17. Connections to bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Switchboards shall be located so that they are readily accessible and not exposed to physical damage.
- E. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.
- F. Switchboards shall be securely fastened to the mounting surface.
- G. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- H. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- I. Lugs shall be suitable and as required for installation with the conductor being connected.

- J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside the cabinet.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Tightening the wire lugs or conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
- N. Remove shipping blocks from component devices.
- O. Manually exercise circuit breakers to verify they operate freely.
- P. Remove debris from switchboard interior.
- Q. Follow manufacturer's instructions for installation.
- R. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.
- S. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.
- T. Switchboard equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, and perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the switchgear during testing.
 - a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).

- b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
- c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
- 1. Perform tests in the presence of the Project Inspector.
- 2. During testing, provisions shall be made to prevent damage to solid state components, or electronic equipment such as TVSS equipment that may be tied onto switchboard bussing.
- 3. Test results shall meet manufacturer's recommendations or NETA ATS-2007 recommendations, whichever is more stringent.

3.02 PADS AND ANCHORING

- A. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 03 3000: Cast-In-Place Concrete.
- B. Where a utility meter is installed in a switchboard, concrete pad shall extend three feet from face of switchboard door or board, whichever is greater. Concrete pad installation shall comply with electric utility company requirements.
- C. Anchor bolts for freestanding equipment shall meet CBC Seismic design requirements, and manufacturer's installation recommendations. The more stringent requirements will be enforced.

- D. Project Record Documents: Provide project record drawings of switchboards as installed, indicating main and branch circuit ratings, circuit numbers and part numbers.
- E. For ground fault relays and sensors, the following information shall be provided:
 - 1. Certified Calibration and Acceptance Test.
 - 2. Installation Instructions.
 - 3. Operating Instructions.
 - 4. Maintenance Instructions.
 - 5. Replacement Parts List.
 - 6. Final Test Report.
- F. Test information shall be submitted to the Architect. Nameplates may be fabricated of engraved laminated plastic or etched metal and shall be permanently attached with escutcheon pins or screws.

3.03 PROTECTION

- A. Protect the 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 26 2416
PANELBOARDS AND SIGNAL TERMINAL CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting and power distribution facilities, including panelboards.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 6. Division 27: Communications.
 - 7. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- C. Installation Instructions: Submit manufacturer's written installation instructions.

1.03 DESIGN REQUIREMENTS

- A. Panelboards:
 - 1. Panelboards shall be wall-mounted, enclosed safety type with 120/240 volt, three-wire solid neutral 277/480 volt, four-wire or 120/208 volt, four-wire solid neutral mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.
 - 2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They

shall be listed by UL, or other NRTL as ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.

3. Two- and three-pole branches shall be enclosed, and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.
 4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225 amperes shall be furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.
 5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
 6. Internal connections shall be fabricated with plated copper bus bars and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Copper bussing shall be fully rated. Heat rated bussing is not acceptable.
 7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.
 8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.
 9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.
- B. Surge Suppressors: Where indicated on Drawings, provide transient voltage surge suppressors as an integral part of panelboards. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section. Surge suppressors shall be as follows:
1. Surge Capacity:

- a. Line-to-neutral for wye systems: 80 KA.
 - b. Line-to-ground: 80 KA.
 - c. Neutral-to-ground: 80 KA, three-phase wye.
 - d. Line-to-neutral plus line-to-ground: 160 KA.
2. UL 1449 2nd Edition Suppressed Voltage Rating for 208/120 Wye System:
- a. Line-to-neutral: 400 volts.
 - b. Line-to-ground: 400 volts.
 - c. Neutral-to-ground: 400 volts.
 - d. Maximum continuous over-voltage: 150 volts.
3. EMI/RFI High-Frequency Noise Power Filter (Characteristics):
- a. 100 KHz at 44 dB.
 - b. 100 MHz at 44 dB.
 - c. 10 MHz at 44 dB.
 - d. 100 MHz at 444 dB.
4. MOVs shall be thermally protected for low current faults and shall be fused with surge-rated fuses. The surge-rated surge current passes and clears the circuit safely if the surge capacity is exceeded. Enhanced diagnostics shall continuously monitor the unit's status and shall include LEDs to signal a reduction in surge capacity or the loss of a suppression circuit. An audible alarm, with test and silence features, shall be furnished in diagnostic package.
5. Each phase or the entire unit shall be replaceable and have bolted-on, tin-plated copper connections. Unit to have UL witnessed fault current rating of 65,000 symmetrical amperes.
6. Surge suppression units shall comply with the following:
- a. UL certified.
 - b. UL 1283.
 - c. UL 1449.
 - d. IEEE C 62.45.
 - e. IEEE C 62.41.

f. Nationally Recognized Testing Laboratory (NRTL) or equal.

C. Panelboard Cabinets:

1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.
2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys.
3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 60 keys.
4. Provide and install panelboard manufacturer's permanent circuit number kit option.
5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.
6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 60 keys.
7. Self-tapping screws and bolts not permitted.

D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or switchboard from which it is fed. Schedule shall be installed in

a frame under transparent plastic 1/32 inch thick on inside of each panelboard cabinet door.

- E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.
- F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"
- G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:
 - 1. California Electric Code, Article 384.
 - 2. UL 67, Panelboards.
 - 3. UL 50, Cabinets and Boxes.
 - 4. UL 943, GFCI.
 - 5. UL 489, Molded Case Circuit Breakers.
 - 6. NEMA PB1.
 - 7. Federal Specifications W-P- 115C and WC-375B.
- H. Signal Terminal Cabinets:
 - 1. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.
 - 2. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 3/4-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
 - 3. Terminal cabinets shall be furnished with 3/4 inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.

4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards shall be manufactured by Siemens, W.A. Benjamin, General Electric, Cutler Hammer, Square D or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be located so they are readily accessible and not exposed to physical damage.
- B. Panelboards installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.
- C. Panelboard locations shall provide sufficient working space around panels to comply with the California Electrical Code.
- D. Panelboards shall be securely fastened to structure and mounted on surface by at least four points.
- E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.
- F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and listed for installation with the conductor being connected.
- I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Clean the cabinet of foreign material such as cement, plaster, and paint.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Use the manufacturer's torque values to tighten lugs.

- N. Before energizing panelboards, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.
 - 2. Remove shipping blocks from component devices and panelboard interiors.
 - 3. Manually exercise circuit breakers to verify they operate freely.
 - 4. Remove debris from panelboard interior.
- O. Follow manufacturer's instructions for installation.
- P. Do not install in highly corrosive environments, unless rated for the application.

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 26 2419

MOTOR CONTROL CENTER AND MOTOR CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Disconnect switches and motor starters for motors or equipment and connections to the motors.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electric Materials and Methods.
 - 4. Section 26 0519: Low Voltage Wires.
 - 5. Section 26 0526: Grounding and Bonding.
 - 6. Section 26 0533: Raceways, Boxes, Fittings and Supports.
 - 7. Section 26 2413: Switchboards.
 - 8. Section 26 2416: Panelboards and Signal Terminal Cabinets.
- C. Related Industry Standards: The most current version of the following industry standards.
 - 1. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. California Electrical Code (CEC).
 - 3. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 - 4. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
 - 5. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
 - 6. NEMA KS-1 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)

7. NEMA publication ICS 2.3 – Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
8. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
9. UL/ANSI 891 – Standard for Safety Switchboards.
10. UL-845 – Motor Control Centers.

1.02 SUBMITTALS

- A. Shop Drawings: Include a front elevation indicating dimensions, make, location and capacity of equipment, type of wiring, equipment ratings, bussing, gutters, type of mounting, anchoring bolts requirements and finish. Installation shall be in comply with CBC seismic design requirements.
- B. Product Data: Submit equipment engineering data indicating make, ratings, dimensions, and catalog number for disconnect switches, motor starters, control and meter devices.
- C. Fault Current, Coordination and Arc-Flash Reports: the following reports shall be prepared using SKM Systems Analysis, ETAP Powering Success, EasyPower, or equal.
 1. Provide a short-circuit and coordination report signed and stamp by a California registered professional electrical engineer. Studies shall be in accordance with applicable IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.
 2. Provide a system coordination report for main and branch circuit protective devices including transformers secondary protective devices. Study shall be recorded on log paper. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted.
 3. Provide a complete arch-flash report based on installed equipment, and feeders' sizes and lengths. Prepare the report in accordance with code requirements and IEEE 1584 standard. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.
 4. Provide installation details and seismic anchorage notes.
- D. Submit manufacturer's written installation instructions, including recommendations for handling, protection and storage.

- E. Submit project record drawings indicating the motor control center exactly as it was installed, including wiring diagrams of components.

1.03 TECHNICAL REQUIREMENTS

- A. Motor overload protection shall be manual reset type as part of a motor starter and shall be set at not to exceed 125 percent of motor full load current rating.
- B. Overload protection shall be provided for each motor exceeding 1/8 horsepower, except where indicated otherwise.
 - 1. Overload Protection is not required when motors are of sufficient impedance to prevent overheating on failure to start (such as clock motors), and for motors provided with an approved built-in manual reset type device that is responsive to motor current and set at not to exceed 125 percent of the motor full load current rating.
- C. Motor Control Center components shall be provided with nameplates. Plates shall be black and white plastic stock, with characters cut thorough black exposing white, and shall bear designation of service, feeders controlled, and fuse and/or breaker sizes.
- D. Design, construction, and testing shall comply with requirements of latest CEC, UL publication UL-845, NEMA publication ICS 2.3 and applicable standards of ASA, AIEE, and NEMA.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Motor Control Centers (MCC):
 - 1. Motor control centers shall be of metal-clad, free floor-standing dead-front type, totally enclosed with one or more vertical sections. Arrangement and construction shall be as indicated on Drawings.
 - 2. Motor control center shall be braced for the available symmetrical and asymmetrical fault currents at the MCC location.
 - 3. Equipment shall be completely fabricated, wired and tested at factory, and shall be shipped in sections ready for installation, complete with required assembly bolts and mounting channels. General construction shall consist of modular vertical sectioned cubicles, approximately 90 inches high and 20 inches wide. Sectional cubicles shall be bolted together to form required arrangement having the appearance of a single assembly. Cubicle sections shall be fabricated from a minimum of 12 gage P & O Mill prime sheet steel, shaped, reinforced, and welded to form a rigid structure. Sections shall contain required number of modular spaces for various starter units.

4. Wiring gutters shall extend through cubicles with front accessible bolted filler plate covers. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted.
5. Bus bars and connections shall be copper. Vertical buses shall be rated at not less than 300 amperes and shall be placed to allow starter units to be connected by pushing into place. Bus connections shall be free fitting and bolted, with silver plated connecting areas rated at 200 amperes per square inch.
6. Bus work bracing and support shall withstand the short circuit stresses indicated on Drawings without damage to buses or structure. Connections shall be secured bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted
7. Main horizontal and vertical buses shall be made of copper and entire length shall be electrolytically silver-plated.
 - a. Copper ground lugs shall be provided in incoming line vertical sections.
 - b. Horizontal tin-plated copper ground buses shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout control center, drilled and tapped every ten inches for $\frac{1}{4}$ - 20 machine screws. RMS amperes symmetrical bus bracing shall be as indicated on Drawings.
 - c. Vertical sections shall support horizontal and vertical buses, combination started units, covers and doors. Vertical sections shall be furnished with structural supporting members formed of a minimum of 13 gage hot-rolled steel.
 - d. Reinforcement for structural parts shall be of ten gage steel to provide a strong, rigid assembly.
 - e. Vertical sections shall be designed to accommodate bolts on units 20 inches wide and 20 inches deep.
 - f. Vertical sections shall be provided with 12 inches high horizontal wireway located at bottom of sections and a six-inch horizontal wireway at top of sections in addition to the vertical wireways for each section.
 - g. Busing components shall be secured bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted

8. Separate control cell compartments of sizes indicated on Drawings shall be provided for future interlocking relays and transducers.
9. Starters shall be of the bolt-on combination magnetic type, as indicated on Drawings, each with a separate hinged door. Starters shall be provided with separate overloads in each phase.
 - a. Combination magnetic starters shall be circuit breaker magnetic across-the-line type, or as indicated on Drawings, and shall be furnished with suitable thermal overload elements for controlled motor.
 - b. Breaker shall be bussed with copper bus bars. Covers shall be mechanically interlocked with circuit breakers to prevent opening when energized.
 - c. Circuit breaker handles shall be capable of being padlocked in the off position with one to three padlocks.
 - d. Each motor starter shall be furnished with a red pilot light, HOA selector switch or pushbutton station, and a control circuit transformer, unless otherwise indicated on Drawings. Control circuit transformer shall be fused.
10. Units shall be provided with unit doors, unit support pans, unit saddles, and unit disconnect operators. Units shall be designed and constructed so that faults will be localized within compartment.
11. Control devices and wiring of motor control centers shall be in accordance with functional wiring diagrams indicated on Drawings and requirements of controlled equipment.
12. Motor control center wiring shall be NEMA Class 1, Type B.
13. Motor control center shall be as manufactured by Cutler Hammer, W.A. Benjamin Electric, Square D, General Electric, or equal.

B. Disconnect Switches:

1. Heavy duty type switches shall be 240 volts or 480 volts as required, totally enclosed, externally operated, with quick-make, quick-break operating mechanism, interlock cover, and provisions for locking cover in closed position and locking switch in on and off positions. Switches shall be single throw, unless otherwise indicated or specified. Switches controlling direct current loads shall be DC rated.
2. Switches shall be furnished with switch blades, which are fully visible in off position when switch door is open. Current carrying parts shall be plated to resist corrosion and promote cool operation.

3. Switches shall be furnished with removable arch suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL, or other Nationally Recognized Testing Lab listed for 75 degrees C. copper wires.
4. Switch enclosure shall be NEMA Type 1 for indoor locations and rain tight, NEMA Type 3R, rainproof for outdoor locations. NEMA Type 3R enclosures shall be manufactured from galvanized steel with gray baked enamel and shall be furnished complete with rainproof bolt on hubs. Covers shall be attached with pin type hinges. Removable closing cap types are not permitted. In kitchen area, provide disconnect switchers in a NEMA type 4 stainless steel enclosure.
5. Quick release latches shall be permitted only when switches are furnished tamper resistant.
6. Switches shall be furnished with Corbin 66 locks keyed to Corbin 60 key.
7. Switches shall be fusible or non-fusible as indicated on Drawings. Fusible switches shall accept cartridge fuses.
8. Current rating of switches, number of poles, solid neutral facilities, and current rating of fuses shall be as indicated on Drawings.
9. Switches shall have proper horsepower rating equal to or greater than horsepower of motor controlled. Only lower horsepower rating of dual rated switches will be permitted as a switch rating. Switches shall accept Class H, Class J, and Class R fuses.
10. Padlocking device shall lock operating handle and cover with one padlock regardless of on or off position. Furnish a minimum of two padlocks and two keys with each switch. Padlocks shall be Corbin No. 66 keyed to Corbin No. 60 keys.
11. Furnish one spare fuse for each fusible disconnect switch installed. Spare fuses shall be same type and rating as those installed.
12. Switches shall be heavy duty type, as manufactured by Square D, General Electric, Cutler Hammer or equal. Switches shall be UL listed and shall comply with NEMA Standard KS-1.

C. Motor Starters:

1. Motor starters shall be AC magnetic across-line starters unless otherwise indicated on Drawings.
 - a. Motor starters shall be furnished with manual reset thermal overload protective devices including heating elements.

- b. Starters shall be furnished in a NEMA Type 1, NEMA Type 3R or other type of enclosure as indicated on Drawings.
 - c. Starters shall be furnished with HOA selector switches or pushbuttons, as indicated on Drawings.
 - d. NEMA size, voltage rating, number of poles, and special features shall be as indicated on Drawings.
 - e. Horsepower rating of each starter shall be equal to or greater than motor horsepower.
 - f. Starters for motor circuits rated at 208 volts and above shall be provided with a control circuit transformer, having a 120-volt secondary.
 - g. Combination magnetic starters are permitted.
 - h. Three-phase starters shall be furnished with three-element protection.
2. Manual across-line starters shall be furnished with manual reset thermal overload protective devices, including heating elements, start-stop-reset device or H.O.A. switch as indicated on Drawings, operable from front.
- a. Enclosure shall be NEMA Type 1 for indoor installation and NEMA Type 3R for outdoor installation or as indicated on the Drawings.
 - b. NEMA size, voltage rating and number of poles shall be determined by motor horsepower, voltage and phase indicated on Drawings.
 - c. Horsepower rating of each starter shall be equal to or greater than motor horsepower.
 - d. Combination manual starters are permitted.
3. Thermal switch starters shall be tumbler type with plaster ears, binding screws for wiring, standard size composition cups with fully enclose mechanism, and designed to fit standard outlet boxes.
- a. Thermal switches shall be fractional horsepower motor starters with thermal overload protective devices including heating elements, and with handle providing on-off-reset control.
 - b. Horsepower rating, voltage rating, and number of poles shall be determined from motor horsepower and voltage indicated on Drawings.
 - c. Switches shall be key operated where so indicated on Drawings.
 - d. Furnish one key with each key type switch.

- e. Horsepower rating of each switch shall be equal to or greater than motor horsepower.
- 4. Relays furnished for directly controlling motors shall be installed in NEMA Type 1 enclosure for indoor installations and NEMA Type 3R for outdoor installations, unless otherwise indicated on drawings.
 - a. Relays shall be horsepower rated.
 - b. Relay size, voltage rating and number of poles shall be determined from motor horsepower and voltage indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Motor control centers installed outdoors, or below grade, shall be installed on a concrete pad as specified in Section 03 3000 – Cast-In-Place Concrete, and as indicated on Drawings.
- B. Motor control centers shall be anchored to concrete slab. Anchor bolts for freestanding equipment shall be designed to meet CBC seismic requirements. Provide structural drawings for Architect review prior to start of construction.
- C. Equipment shall be securely fastened to the mounting surface.
- D. Equipment shall be located so that it is readily accessible and not exposed to physical damage.
- E. Provide code required working space around the equipment.
- F. Equipment installed outdoors shall be specifically approved for wet locations and shall be installed in a weatherproof NEMA–3R enclosure.
- G. Equipment enclosure shall be grounded to comply with Article 250 of the California Electrical Code.
- H. Conduits shall be installed in a manner that prevents moisture or water from entering and accumulating within the equipment enclosure.
- I. Lugs shall be suitable and permitted for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside the cabinet.

- L. Distribute and arrange conductors neatly within the equipment space.
- M. Tightening of wire lugs or any conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
- N. Remove shipment blocks from component devices.
- O. Manually exercise switches and circuit breakers to verify they operate freely.
- P. Remove debris from equipment interior.
- Q. Follow manufacturer's instructions for installation.
- R. Installation in corrosive environments such as boiler rooms, pool equipment, and other similar spaces is not allowed.
- S. The contractor shall be responsible for the testing of bolted electrical connections, perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. or latest version, test shall be performed in the following manner:
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the motor control center during testing.
 - a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.

- 6) Description of equipment being tested.
- 7) Description of tests.
- 8) Test results.
- 9) Analysis, interpretation and recommendations.

2. Perform test in the presence of the Project Inspector.
3. During testing, provisions shall be made to prevent damage to any solid-state components, or electronic equipment such as TVSS equipment that may be tied onto panel bussing.

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 26 5010
SOLID STATE (LED) LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: LED Luminaires, LED modules, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires (<600 Volt AC).
 - 6. Section 26 5200: - Emergency Power Systems.

1.02 REFERENCES

The latest version of the following industry standards applies:

- A. American National Standards Institute/American National Standard Lighting Group ANSI/ANSLG – C78.377-2008 Specifications for the Chromaticity of Solid-State Lighting Products.
- B. American National Standards Institute/American National Standard Lighting Group ANSI/ANSLG – C82.77-2002 Harmonics Emission Limits.
- C. Federal Communication Commission (FCC) 47 CFR Part 15 – Radio Frequency Devices.
- D. Illuminating Engineering Society of North America (IESNA) LM-79-, LM-80-15, and TM-21.
- E. National Electrical Manufacturers Association (NEMA) SSL-1-2010 Electronic Drivers for LED Devices, Arrays, or Systems.

- F. SSL-3-2010 Solid State Lighting High Power LED Binning for General Illumination.
- G. SSL-4-2012 Solid State Lighting Retrofit Lamps.
- H. National Fire Protection Association (NFPA) NEC-70-2011
- I. Underwriters Laboratories (UL) 8750-Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- J. Underwriters Laboratories (UL) 1598C- Light Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

1.03 SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Prior to start of construction; provide photometric calculations with graphic of lighting foot-candle levels at work plane, ceiling and walls. Calculations shall comply with IESNA recommendations.
- D. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.04 SUBSTITUTIONS

- A. Luminaires that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating or substituting luminaires, the following information shall be submitted:
 - 1. Substitution request form with clear indication of reasons and benefits to OWNER.
 - 2. Provide substantiating evidence of benefits and pros and cons on favor of the proposed material/equipment/components substitution.
 - 3. OWNER'S approval shall be obtained for any equipment or materials substitutions.

4. Fixtures manufacturer LM-79 and LM-80 test reports shall be from a third-party testing lab.

1.05 QUALITY ASSURANCE

- A. Design of lighting luminaires, accessories, supports, and method of luminaire installation shall comply with requirements for earthquake-resistant construction of the State of California.
- B. Provide suspension points at no more than two feet from luminaire ends. Spacing between supports shall not exceed eight feet.
- C. Components and luminaires shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under article 1.02 – References.

1.06 WARRANTY

- A. Provide the following warranties:
 1. One-year labor warranty.
 2. Material warranty:
 - a. LED modules: five years minimum.
 - b. Drivers: five years minimum.
 - c. Lighting Pole (Standards): five year minimum.
- B. Warranty period shall begin at substantial completion or at project acceptance for beneficial occupancy, whichever occurs first.
- C. CONTRACTOR shall warranty Luminaires, including drivers, LED modules and ancillary components via a single warranty source. Multiple warranty sources are not acceptable.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Luminaires of same type shall be of one manufacturer.

- B. Manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers' models may be submitted for review, provided the product meets or exceeds the product's specified requirements.
- C. Conductors that pass over edges or through metal opening(s) shall be secured from contacting the edges and be protected from cutting and abrasion. This requirement shall be met through one of the following:
 - 1. Rolling the edge of the metal not less than 120 degrees.
 - 2. A bushing or grommet of a material other than rubber at least 1.2 mm (0.047") thick.
 - 3. Glass sleeving at least 0.025 mm (0.010") thick.
- D. Lighting luminaires shall meet the following requirements:
 - 1. Industry standards as indicated under Article 1.02.
 - 2. Luminaire shall be from a manufacturer who has been in the business of manufacturing LED lighting luminaires for interior and exterior applications for a minimum of 5 years.
 - 3. Luminaires shall comply with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act or follow the European Restriction of Hazardous Substances (RoHS), whichever is more stringent.
 - 4. Luminaires shall be baked-on enamel or powder-coated, unless otherwise specified in this section.
 - 5. The luminaire(s) lens, including end caps shall be 0.187 nominal thickness.
 - 6. Drivers shall be easily accessible without the use of special tools.
 - 7. Wiring cavity shall be field accessible for service or repairs.
 - 8. Luminaires shall be capable of being operated by standard motion/ vacancy sensors, daylight sensors, and dimmers.
 - 9. Luminaires shall be provided with a manufacturer's stencil or permanent legible sticker that states manufacturer business information and date of delivery.
 - 10. Temperature rating; -20 degrees Celsius minimum starting temperature. Luminaire accessories including LEDs and drivers shall be able to withstand temperatures in excess of 110 Fahrenheit degrees.

11. Color Rendering Index (CRI):
 - 1) Interior Applications: +85 CRI.
 - 2) Exterior Applications: +70 CRI
12. Power factor: Greater than 0.9 at 120V and 277V.
13. Total Harmonic Distortion: Less than 20% at 120V and 277V.
14. Color Correlated Temperature (CCT): 4000K minimum \pm 275K degrees.
15. LEDs and drivers' life expectancy: 50,000 minimum projected hours at 6,000 hours testing for both LEDs and drivers.
16. Luminaires in contact with insulation materials shall be IC rated.

2.02 DRIVERS and LED MODULES

A. Drivers:

1. Approved Drivers Manufacturers:
 - a. Osram – Optotronic.
 - b. Signify – Advance and Xitanium.
 - c. Universal Lighting Technologies – Everline.
 - d. General Electric – Lightech.
 - e. Thomas Research Products
 - f. Kenall – Low Profile LED Driver
 - g. EldoLED
2. Driver Type and Characteristics:
 - a. Comply with the state of California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act, or be RoHS compliant, whichever is more stringent.
 - b. Dimming for 0-10-volt DC control circuits. Drivers shall be specifically compatible with the lighting control system being provided.

- c. Comply with applicable state, federal, and industry standards listed under References article.
- d. Wattage as stated in Luminaire's LM-79 test report.
- e. Driver performance requirements: Refer to Attachment A.

B. Light Emitting Diodes (LEDs):

1. Approved Manufacturers:

- a. General Electric.
- b. Signify.
- c. NICHIA
- d. Samsung LED Co.
- e. CREE
- f. Equal. With OWNER's approval.

2. LEDs Characteristics:

- a. Color Correlated Temperature (CCT):
 - 1) Chromaticity target Duv and tolerance 0.001 plus/minus 0.006.
 - 2) Nominal CCT for 4000K, target CCT 3985K \pm 275K.
 - 3) CCT measurements in compliance with ANSI C78.377-2008.
- b. Lumen Maintenance: Greater than 90% at 50⁰ C degrees.
- c. LEDs must be from same manufacturer and batch.
- d. TM-21 and LM-80 reported hours of no less than 50,000 at minimum of 6000 hours testing.
- e. LM-79 reported CCT and CRI in compliance with articles 2.01.D.11 and 14.

2.03 LUMINAIRES

- A. Luminaires types and minimum requirements are indicated on the Fixture Schedule. All luminaires shall comply with information contained on the Fixture Schedule.

2.04 LIGHT POLES (STANDARDS)

- A. Standards shall be as noted on the Fixture Schedule, tapered galvanized steel. Starting at the base, a minimum of 12 inches of the light standards interior and exterior surfaces shall be treated with water repellent or barrier coatings to prevent moisture contact with galvanized surface.
- B. Aluminum poles are not acceptable.
- C. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one-piece construction with a full length longitudinal high frequency resistance weld.
- D. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
- E. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
- F. A two-piece base cover shall completely seal the entire base plate and be securely fastened.
- G. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the hand-hole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The hand-hole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The hand-hole shall be located 18 inches above the base of the pole.
- H. Finish of pole and accessories shall be electrostatically applied, and thermally cured polyester powder coat. Color shall be selected by Architect.
- I. All structural fasteners shall be galvanized high strength carbon steel.
- J. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
- K. Standards shall be installed plumb and straight on concrete footings. Grout and dry pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 02.
- L. Standards footings shall be provided with a moisture release channel to keep the interior of the standards dry and free from rain, dew or condensation.

- M. Provide in line fuse assembly in hand-hole of each light standard with breakaway receptacle Bussmann HEY series, or OWNER approved equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
- N. Provide all required fixture mounting accessories.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a lighting luminaire for each lighting outlet indicated and label with day of installation.
- B. Luminaire voltage shall be as indicated on Drawings.
- C. Install recessed and surface-mounted luminaires, with plaster frames compatible with ceiling and wall systems employed; secure luminaires mechanically to frames.
- D. Align rows of suspended and surface-mounted luminaires to form straight lines at uniform elevations.
- E. Recessed luminaires shall fit snugly against ceilings to prevent light leakage.
- F. Luminaire installations shall comply with CBC Seismic requirements
- G. Support suspended recessed luminaires in T-bar ceilings as follows: Luminaires shall be attached to ceiling grid to resist a horizontal force equal to weight of luminaires. For heavy-duty grid systems, luminaires weighing less than 56 pounds must also have two 12 gage slack safety wires from diagonal corners to the structure above; luminaires weighing more than 56 pounds shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. For intermediate duty grid systems, luminaires shall be independently supported by not less than four taut 12 gage wires capable of supporting four times the load. Luminaire hanger wire ends shall be twisted three tight turns within a 1 ½ -inch distance. Provide positive point of attachment to T-bar ceiling with four, #8 wafer head tek screws (one at each corner), avoiding conflict with operation of the lens. Luminaire installation shall be coordinated with acoustical ceiling installation.
- H. Emergency light luminaires shall be labeled "Emergency Luminaire" with one-inch high letters produced with a P-touch or similar labeling system.
- I. Continuous suspended luminaires:
 - 1. Luminaire suspension device shall allow vertical adjustment of luminaire without the use of tools. Cable shall be minimum seven strand twisted

stainless steel capable of supporting minimum four times the luminaire weight. For continuous linear suspended luminaires longer than eight feet, provide not less than three suspension points.

2. Top of luminaire shall be suspended as shown on the Drawings, typically 24 inches below the ceiling and a minimum of 18 inches from the ceiling.
 3. Luminaire shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.
 4. White Board Lights shall be suspended 24 inches from the wall unless specifically shown otherwise.
- J. Surface mount luminaires shall be attached to structure. Toggle bolts are NOT permitted. Provide backing where required.
- K. Low level exit signs shall be installed with the bottom of the sign not less than six inches, or more than eight inches above the floor level and shall indicate the path of exit travel. For exit and exit-access doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within four inches of the door frame.

3.02 TESTING

- A. Check and adjust luminaires for required illumination.
- B. Replace defective LED strips and drivers.
- C. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

- A. Furnish ten percent spare LED strips with a minimum of one spare strip of each type.
- B. Furnish ten percent spare motion detectors of each type with a minimum of one spare detector of each type.
- C. Furnish ten percent spare drivers of each type with a minimum one spare driver of each type.

3.04 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by an approved, licensed contractor.
- B. Products with PCBs are not acceptable. Hazardous waste shall be placed in appropriate containers provided by hazardous waste contractor labeled clearly with:

1. Project Name
 2. Quantity of materials
 3. Date materials became waste
- C. Store, remove, transport and dispose of hazardous materials in accordance with state and federal regulations.
- D. Provide Owner with copy of manifest and certificate of destruction.
- 3.05 PROTECTION
- A. Protect the Work of this section until Substantial Completion.
- 3.06 CLEANUP
- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean luminaire surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

ATTACHMENT A

DRIVERS PERFORMANCE CHARACTERISTICS		
No.	Characteristic	Minimum Requirements
1	Input Voltage range	120V, 277V
2	Input Overvoltage	320 VAC for 48 hours, 350 VAC for 2 hours.
3	Frequency	50/60 Hz Nominal
4	Power factor	+0.95 Minimum
5	Inrush Current	Less than 30 amps @ 120V Less than 70A @ 277V
6	Input Current Range	54A @ 120V, 23A @ 277V
7	Output Current	1670 mA Maximum
8	Maximum Power	65 Watts
9	Total Harmonic Distortion	Less than 20%
10	Leakage Current	Less than 500 mA
11	Output Protection	Short and Open Circuit
12	Maximum Case Temperature	90 ⁰ C
13	Minimum Starting	-20 ⁰ C
14	Storage Temperature	No less than 70 ⁰ C
15	Humidity	Rated for dry and damp locations
16	Cooling	Convection
17	Sound Rating	Class A
18	Life Expectancy	>50,000 hours at +50 ⁰ C
19	Dimming, Motion Sensors and Daylight Sensors	0-10V

SECTION 26 5200

EMERGENCY POWER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Emergency system to lighting fixtures, signal systems, and electrical loads.
- B. Related Requirements:
 - 1. Section 26 0513: Basic Electrical Materials and Methods.

1.02 DEFINITIONS

- A. CIS: Central Inverter System.

1.03 DESIGN REQUIREMENTS

- A. Emergency systems shall be supplied from storage batteries with charging unit with a minimum of 90 minutes back-up capacity for lighting systems by the furnishing of an CIS. The system shall be installed in accordance with requirements of all codes and regulations.

1.04 SUBMITTALS

- A. Submit a materials list for this system with catalog cuts, technical data and manufacturer's specifications of all system components including batteries. With submittal, include evidence furnished batteries provide a true 10-year life by furnishing a copy of a test performed by a recognized test laboratory according to Bellcore TR-766.

1.05 QUALITY ASSURANCE

- A. The manufacturer shall have been producing inverter system equipment for at least five consecutive years.
- B. Systems shall undergo full load burn in testing at the factory.
- C. Systems shall be listed by UL, or another Nationally Recognized Testing Laboratory (NRTL).
- D. A manufacturer's technical representative shall be available for system start-up, warranty work, and service calls.

1.06 WARRANTY

- A. Manufacturer shall provide a two year material warranty and a 10 year material warranty for battery cells.

- B. Installer shall provide a two year labor warranty.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. CIS:

1. General: Each system shall be furnished with following features:
 - a. System shall automatically protect itself against damage from overloads and short circuits while powered from either utility AC or during emergency inverter operations. System shall automatically disconnect load when battery voltage drops below approximately 85 percent of nominal battery voltage.
 - b. Batteries of system shall be maintenance-free type with lead calcium grids and shall be provided with a 10-year manufacturer's warranty. Batteries shall have sufficient capacity to power inverter at full rated load for a minimum of 90 minutes for lighting loads and PABX and PA systems, without battery voltage dropping below 85 percent of nominal battery voltage. Battery manufacturer's data sheets shall be provided indicating recommended charge rates, operating conditions and warranty years. Batteries shall be connected and installed in accordance with recommendations of battery manufacturer, and shall be individually labeled with make and model identification. Secure batteries to withstand seismic vibrations. Batteries shall be replaceable in field.
 - c. System shall be enclosed in a heavy gage, commercial grade steel cabinet, including hinged and lockable doors. Locks shall be keyed to Corbin No. 60 keys. Provide input and output manual disconnects for UPS System. Provide complete operating service and parts manuals including, but not limited to, electrical diagrams and factory test data.
2. CIS shall be furnished with following additional features:
 - a. A microprocessor shall oversee inverter, and provide programmable functional self-test according to NFPA 101 to ensure optimal system and sub-system performance. If abnormal conditions or failure occur, warning messages shall be issued and alarms shall be sounded so that timely action maybe taken to alleviate problem or repair system. If inverter becomes inoperable, microprocessor shall be capable of shutting down components to prevent further damage.
 - b. The unit shall include a standard RS232 diagnostic interface module that sends a detailed unit status report when:
 - 1) A self-test is performed.

2) An alarm condition exists.

The status report shall be sent to six user defined locations. These locations can be preprogrammed at factory, programmed on site by customer, or remotely programmed by factory once system is installed.

The standard RS232 self/diagnostic module shall allow for remote monitoring and troubleshooting of any abnormal conditions. The Ethernet connection shall be provided with a dedicated LAN connection to the schools IDF or MDF room..

- c. System shall be self contained, UL924 listed, designed to provide no-break power to operate specified lighting load for 90 minutes upon power loss or brown out of utility voltage.
- d. The system's operation is to be fully automatic. It shall use a linear transformer, with boost tap and surge protection devices. Inverter shall be of Pulse Width Modulated (PWM) design, and shall provide true "no-break" power to load at all times. During normal operation, charger maintains battery bank at full capacity. The three on-board microprocessors continuously monitor charger settings and system's overall readiness. System consists of circuitry including an automatic, multi-rate, software controlled charger; continuous self-diagnostics monitoring 265 various parameters, and programmable system testing capabilities. System shall incorporate 30 individual alarms and nine systems logs. Logs and Alarms are to be automatically recorded and readily displayed through microprocessor controlled User Interface Display (UID). System shall also include a RS232 Serial port for remote communications.

The system's automatic overload and short circuit protection in normal and emergency operations shall consist of 150 percent momentary surge capability, 120 percent overload for five minutes, and 110 percent overload for 10 minutes. System protection shall also include a low battery voltage disconnect, AC input circuit breaker, a DC input fuse and switch, and an AC output fuse. System shall supply a digitally generated sinusoidal output waveform (PWM) with less than 5 percent total harmonic distortion at rated linear load. A boost tap transfer protection circuit shall maintain desired output voltage during low voltage "brownout" situations, without continuously switching to batteries; thereby preserving battery capacity.

- e. Start Up and Maintenance: Microprocessor shall contain commission data including unit size, serial number, order number, and battery configuration. Software shall be furnished to assist in installation of equipment, brownout selection, and functional self-test.

- f. Unit shall be furnished with five normally on output circuit breakers with alarm, and five normally off circuit breakers with alarm. Provide a descriptive circuit designation schedule.
- g. IPS shall be Spectron LSN by Dual-Lite, Illuminator by Myers Power Products, or District approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION, SYSTEM SHIPPING, START-UP AND TESTING

- A. Shipping: System shall be shipped separately from batteries. Batteries shall be shipped to Project site directly from battery supplier and shall remain in their sealed cartons until opened and examined in presence of the Project Inspector. Batteries shall be shipped to Project site not more than 30 days before system start-up.
- B. Start-Up: System start-up shall be performed by a technical representative of manufacturer, in the presence of the Project Inspector, with loads connected, and shall include testing and adjusting to assure proper operation of system functions. System start-up shall include follow-up visits. Following start-up, maintain system on a normally OFF input circuit until Substantial Completion.
- C. Testing: Before Substantial Completion, conduct in the presence of the Project Inspector, a complete performance testing of system. Testing shall include operating system in emergency mode for at least 90 minutes for CIS., with loads connected, while monitoring battery voltage, output voltage and output frequency. Power factor of load shall be measured to ascertain compatibility with system. Furnish and operate necessary test equipment.
- D. Equipment shall be anchored in accordance with CBC seismic requirements.

3.02 BATTERIES

- A. Batteries shall be complete with necessary connectors and accessories, fully charged, and ready for service.
- B. Documentation for 10 year manufacturer's warranty for all batteries shall be delivered to Architect.

3.03 SERVICE MANUALS

- A. Service Manuals: Submit service manuals to OAR including following:
 - 1. A detailed explanation of operation of system.
 - 2. Instructions for routine maintenance.
 - 3. Detailed instructions for repair of major components of system.

4. Pictorial parts list and parts numbers.
5. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, and major components.
6. Programming Instructions.
7. Program listing.
8. Final test report.
9. Installation Instructions: Submit manufacturer's written installation instructions.

3.04 TRAINING

- A. Before Substantial Completion, provide the services of a manufacturer's representative on the Project site to instruct persons designated by the Owner in the operation and maintenance of the system. Instruction time shall not be less than four hours. Provide training video and training materials to designated owner's personnel.

3.05 PROTECTION

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

3.06 CLEANUP

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

END OF SECTION

SECTION 26 5617

PARKING LOT AND SITE LED LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting fixtures, including LED lamps arrangements, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires.
 - 6. Section 26 0533: Raceways, Boxes, Fittings and Supports.
 - 7. Section 26 2416: Panel boards and Signal Terminal Cabinets.
 - 8. Section 26 5000: Lighting.
 - 9. Section 26 5200: Emergency Power Systems.
 - 10. Section 31 2323: Excavating and Fill for Utilities
 - 11. Section 32 1313: Site Concrete Work.

1.02 REFERENCES

- A. Publications are referenced within the text by their basic designation only. The most current version shall apply.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C82.SSL1 – SSL Drivers.
 - 2. ANSI C136.2 - American National Standard for Roadway and Area Lighting Equipment – Luminaire Voltage Classification.

3. ANSI C136.3 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Attachments.
 4. ANSI C136.10 – American National Standard for Roadway Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
 5. ANSI C136.15 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification.
 6. ANSI C136.25 – American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures.
 7. ANSI C136.31 – American National Standard for Roadway Lighting Equipment – Luminaire Vibration.
- C. American Society for Testing and Materials International (ASTM):
1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 2. ASTM A595 - Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 3. ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 4. ASTM G35 – Standard Practice for Determining the Susceptibility of Stainless Steels and Related Nickel-Chromium-Iron Alloys to Stress-Corrosion Cracking in Polythionic Acids.
- D. Federal Trade Commission (FTC):
1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.
- E. Illuminating Engineering Society of North America (IESNA):
1. IESNA DG-13 – Guide for the Selection of Photo controls for Outdoor Lighting Applications.
 2. IESNA LM-64 – Photometric Measurements of Parking Areas.
 3. IESNA LM-79 – IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 4. IESNA LM-80 – IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.

5. IESNA TM-15 – Luminaire Classification System for Outdoor Luminaires
 6. IESNA TM-21 – Projecting Long Term Lumen Maintenance of LED Light Sources.
 7. IESNA RP-13 – Nomenclature and Definitions for Illuminating Engineering.
 8. NEMA/ANSI C78.377 – American National Standard for the Chromaticity of Solid-State Lighting Products.
 9. NEMA WD 7 – NEMA Guide Publication: Occupancy Motion Sensors.
 10. UL – 1449 – Surge Protective Devices.
- F. California Building Code (CBC):
1. California Electrical Code (CEC).
- G. Next Generation Lighting Industry Alliance/Department of Energy:
1. LED Luminaire Lifetime: Recommendations for Testing and Reporting – 1st Edition.
- H. Underwriters Laboratories (UL):

1.03 DEFINITIONS

- A. Lighting terminology used herein as defined in IESNA RP-16. See referenced documents for additional definitions.
- B. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.
- C. Clarification: The term “LED light source(s)” is used herein in accordance with IES LM-80 to broadly cover LED package(s), module(s), and array(s).
- D. Support Assembly: Means a pole or other support structures, brackets, cross-arms, appurtenances, base, anchorage, and foundation.

1.04 SUBMITTALS

- A. List of Materials: Submit a complete list of materials proposed for this section.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of LED boards and drivers, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient

information to assemble and install equipment at the Project site without further instructions.

C. Photometric calculations: Submit calculations with graphic of luminance levels of work and floor planes. Calculations shall comply with IESNA LM-64 recommendations.

D. Performance Reports:

1. Luminaire photometric reports per IESNA LM-79 including laboratory name, report number, date, luminaire catalog number, luminaire and light source specifications. Report shall contain lumen values in Backlight, Uplight, and Glare (BUG) zones per IESNA TM-15 and roadway type classifications luminous intensity, zonal lumen summary, and iso-footcandle diagrams, as well as documentation that specified standards and tests methods were followed.

E. Certifications:

1. LM 79 report at T=0 and T=6000 hours with a summary table showing the percent lumen output change and percent input power change.
2. Provide LM80 test results to demonstrate L70 life expectancy of no less than 50,000 hours after 6000 hours of test.
3. LM-80 test data for the LED(s) at three temperatures per LM-80. Provide 6000 hours test extrapolation data using an exponential decay function to show a documented life of no less than 50,000 hours, at no less than 90% efficacy. Provide the Ts value from the IESNA LM-79 and where the point falls in relation to the IESNA LM-80 extrapolated data. Interpolate between the LM 80 data for the Ts temperature.
4. Provide safety certification and file number as required for the luminaire family that must be listed, labeled or identified per the California Electrical Code (CEC), Applicable testing bodies are determined by the US Occupational Safety Health administration (OSHA), and include ETL, UL, or another Nationally Recognized Testing Laboratory (NRTL).
5. Provide report substantiating compliance with IESNA TM-21.

F. Certified Statements:

1. Submit manufacturer's certified statement indicating that the manufacturer has been in the business of fabricating lighting fixtures for outdoor and general area illumination for a minimum of 10 years.
2. Establish compliance with the California Lighting Efficiency and Toxics Reduction Act requirements for the manufacturer to have in place a collection and recycling system of any end-of life general purpose light fixtures generated in the State of California.

3. Submit manufacturer's certified statement indicating that the manufacturer has local service with offices no more than 50 miles from OWNER's central offices.
4. Certification of product's compliance with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act. The product(s) shall not exceed the following allowed contents in parts per million (ppm):
 - a. Lead content > 0.1% or 1000 ppm.
 - b. Mercury Content > 0.1% or 1000 ppm.
 - c. Cadmium Content > 0.01% or 100 ppm.
 - d. Hexavalent Chromium > 0.1% or 1000 ppm.
 - e. Polybrominated Biphenyls > 0.1% or 1000 ppm.
 - f. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.
- G. Installation Instructions: Submit manufacturer's written installation instructions for fixtures and accessories.

1.05 SUBSTITUTIONS

- A. Luminaires that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating or substituting luminaires, the following information shall be submitted:
 1. Substitution request form with clear indication of reasons and benefits to OWNER.
 2. Provide substantiating evidence of benefits and pros and cons on favor of the proposed material/equipment/components substitution.
 3. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 4. Submit a completed OWNER's LED luminaires evaluation form with supporting documentation for any and all fixtures' performance claims. The form can be found at the following electronic address:
http://www.laschools.org/documents/file?file_id=310976408

1.06 Substitutions: Submittals must comply with contract general provisions, and provide as a minimum necessary installation details, and lighting Foot-Candle level calculations

1.07 QUALITY ASSURANCE

- A. Listing and Labels: Light fixtures shall be Underwriters Laboratory (UL) or Nationally Recognized Testing Laboratory (NRTL) listed, and in compliance with applicable industry standards and codes. NRTL test laboratories shall be qualified by the DOE and listed in the DOE SSL website.
- B. Design of lighting fixtures, accessories, supports, and method of fixture installation shall comply with requirements for earthquake-resistant construction of the State of California.

1.08 COMMISSIONING

- A. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of lighting systems and lighting controls, including submittal review, installation, testing, documentation, and training.
- B. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 9113, General Commissioning Requirements.
- C. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER's CxSP.

1.09 WARRANTY

- A. Five years on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking or fading.
- B. Five years material replacement warranty for defective or non-starting LED source assemblies, drivers, and power supply units (PSU).

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Lighting fixtures in new construction projects:

1. Lithonia – DSX1 LED.
2. Musco

B. Light Standards:

1. Standards shall be as noted in the Fixture Schedule, tapered galvanized steel, unless otherwise indicated on Drawings.
2. Aluminum poles are not acceptable.
3. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one-piece construction with a full length longitudinal high frequency resistance weld.
4. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
5. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. CONTRACTOR to obtain manufacturer required base bolt pattern prior to concrete installation.
6. A two-piece base cover shall completely seal the entire base plate and anchorage and it shall be securely fastened.
7. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the handhole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The handhole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The handhole shall be located 18 inches above the base of the pole.
8. Finish of pole and accessories shall be galvanized. Color shall be selected by Architect.
9. All structural fasteners shall be galvanized high strength carbon steel.
10. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.
11. Standards shall be installed plumb and straight on concrete footings. Grout and dry pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 2.

12. Provide in line fuse assembly in hand hole of each light standard with breakaway receptacle Bussmann HEY series, or equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
13. Provide all required fixture mounting accessories, including round tubular arm brackets supplied with pole.

2.02 EQUIPMENT

- A. Fixtures shall meet the minimum performance requirements of efficiency and quality specified on Article 2.03.
- B. Fixtures of same type shall be of one manufacturer and shall meet the following requirements:
 1. Finish: Baked-on enamel or powder-coated.
 2. Luminaire Attachments in compliance to ANSI C136.3.
 3. Lens: Injection molded UV stabilized high impact acrylic in compliance to ANSI C136.31 requirements for luminaire vibration.
 4. Fixture Optics: Capable of full 90-degree horizontal cutoff on all distributions, and in compliance with the chromaticity of solid-state lighting products per ANSI/NEMA/ANDLG C78.377.
 5. Luminaire housing: Constructed of metal of enough thickness to meet or exceed the rated life of the luminaire LED's. Finish color as indicated in drawings. Powder-coated and rust resistant for the life of the luminaire in compliance with ASTM D1654 requirements.
 6. Driver shall be replaceable and mounted within luminaire housing.
 - a. Screws shall be stainless steel. Captive screws shall be provided for any components that require maintenance after installation.
 - b. Driver surge protection in compliance to UL 1449.
 - c. Approved drivers: Philips, General Electric, Cree, Osram, Nichia, or approved equal.
 7. No parts of the luminaire shall be constructed of polycarbonate, unless it is ultraviolet (UV) stabilized (lens discoloration shall be considered a failure under warranty).
 8. Luminaire shall be "Dark Sky" compliant.

9. Luminaire shall have an option for individual LED's optical shield for house-side light control.
 - a. LEDs shall be Philips, Osram, Nichia, Illumitex, General Electric, Cree, or approved equal.
 10. Luminaire door shall remain securely and safely linked to luminaire body, through a hinge design, when in the door open "down" position during inspection or maintenance.
 11. Luminaire shall be capable of being operated by standard plug-in photoelectric cell, facing north, and shall not draw more than 1 watts of power in the off state. Photoelectric design shall comply with IESNA DG-13.
 - a. Shorting cap shall be provided with luminaire.
 12. Luminaire shall have the option for motion sensor controls and 0-10V step dimming. Motion sensors shall comply with the requirements of NEMA standard WD 7 and photocell controllability per ANSI C136.10.
 13. Luminaire shall include a heat dissipating sink with no fans, pumps, or liquids.
 - a. Luminaire shall be designed so that debris buildup or bird droppings do not degrade heat dissipation performance.
 - b. Luminaire shall meet the requirements of ANSI C136.25 and C136.31 for resistance to dust, solid objects and moisture.
 14. Luminaire shall weigh no more than 40 pounds. 80% of the luminaire material by weight shall be recyclable at the end of life.
 15. Fixtures shall be UL or NRTL listed for wet locations.
 16. Fixtures shall be labeled in accordance with the Federal Trade Commission Green Guides, 16 CFR Part 260, Guide for the Use of Environmental Marketing Claims.
 17. Lighting fixtures shall be classified in accordance with IESNA TM-15.
- C. Luminaire shall have a manufacturer's stencil, or a permanent legible sticker, with the month and year of delivery.

2.03 PERFORMANCE REQUIREMENTS

- A. Luminaire must be subject to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity per ANSI C136.31 without damage to the luminaire.

- B. Wiring cavity shall be field accessible for service or repairs.
- C. Holes required for conduit entrances into speaker poles, floodlight poles or other poles, shall be drilled with the conduit nipple or coupling welded to poles. Welds shall be done using electric arc process and shall be continuous around nipple or coupling.
- D. Coating shall be capable of surviving ASTM B117 salt environment for 500 hours minimum without blistering or peeling.
- E. Gloss retention shall be greater than 90% for the 500 hours exposure QUV test. Results shall conform to ASTM G35, 4 hours UV-B60°/4 hours condensation 50°C.
- F. Provide a minimum 6,000 hours of integral lamp operating data (not just LED data) and documented projection for 50,000 operating hours. Testing procedures and results documentation shall comply with the Department of Energy LED Luminaire Lifetime Recommendations for Testing and Reporting 1st Edition. LED(s) shall comply with the requirements set forth in UL-1449.
- G. Lighting fixtures shall be rated for -20°C to +50°C.
- H. Color Rendering Index shall not be less than 70.
- I. Lighting fixtures shall have a minimum luminaire efficiency rating (LER) equal or greater than 75, and an Initial Lumen Efficacy (ILE) equal or greater than 70. Fixtures with lower LER and ILE shall not be accepted.
- J. The acceptable Correlated Color Temperature (CCT) shall be 4500 degrees K +/- 500 degrees K.
- K. Lumen Maintenance (LM) at 6000 Hrs must be greater or equal to 95%. Provide tests reports and photometric data.
- L. Projected Lumen Maintenance (LM) at 50000 hrs greater or equal to 90%.
- M. The Power Factor (PW) shall not be less than 0.95.
- N. The Total harmonic Distortion (THD) shall be less than 18%
- O. Fixtures shall operate on 120, 208, 240, 277, or 480 Volts in compliance with the requirements set forth in ANSI standard C136.15.
- P. Power supply shall have a Class A sound rating in compliance with the requirements set forth in ANSI standard C136.15.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Drivers and LED boards shall be permanently labeled with the day of installation with one-inch high letters produced with a P-touch or similar permanent labeling system.
- B. Installations shall comply with CBC Seismic requirements, California Electrical code and applicable ordinances and industry standards.
- C. Standards shall be installed plumb and straight on concrete footings. Concrete requirements and procedures are as specified in Section 32 1313.
- D. Emergency light fixtures shall be labeled "Emergency Fixture" with one-inch high letters produced with a P-touch or similar permanent labeling system.

3.02 TESTING

- A. Check and adjust fixtures for required illumination.
- B. Replace defective drivers and LED boards.
- C. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

- A. Furnish ten percent spare drivers with a minimum of one spare LED board of each type.
- B. Furnish five percent spare motion detectors of each type with a minimum of one spare detector of each type.

3.04 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by licensed CONTRACTOR.
- B. Store, remove, transport and dispose of hazardous materials in all accordance with state and federal regulations.
- C. Provide OWNER with copy of manifest and certificate of destruction.

3.05 PROTECTION

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

3.06 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

SECTION 27 0126

TEST AND ACCEPTANCE REQUIREMENTS FOR STRUCTURED CABLING

PART 1 - GENERAL

1.01 SUMMARY

- A. Principal items of work in this section include but are not limited to:
 - 1. Quality assurance, testing and final acceptance requirements for premises cabling and wireless installations, and compliance with industry standards and Project Construction Documents.
- B. Responsibilities for this specification are as follows:
 - 1. Installer: The CONTRACTOR shall follow ANSI/TIA and BICSI installation standards. The CONTRACTOR shall perform horizontal cable installation including Category 5e and Category 6 unshielded twisted pair (UTP) cable runs terminated in the communications cabinet and cable terminations at each work area outlet, vertical cable installation, and fiber optic cable runs and terminations. During installation the CONTRACTOR shall perform tests as required by the Parent Specification and in compliance with testing standards found in Appendixes B, C, and D of this Section. The CONTRACTOR shall notify the Project Inspector 48 hours in advance of any required testing so that the Project Inspector can notify the OWNER's Quality Assurance Team to observe the CONTRACTOR's test procedures. The CONTRACTOR shall forward test documentation to the OAR prior to the OWNER's formal acceptance testing.
 - 2. CONTRACTOR's site responsibilities during formal OWNER's Quality Assurance: During formal OWNER's Quality Assurance, the CONTRACTOR and his/her Subcontractor shall comply with testing standards and requirements detailed in Appendixes A through F. Under the guidance of the Project Inspector and in coordination with the OWNER's Quality Assurance Team, the Installer shall:
 - a. Verify LAN connectivity and WAN extension cabling to MDF.
 - b. Configure the router(s) and switch(es) in compliance with the Contract Documents.
 - c. Aid the OWNER's Quality Assurance Team with network cut over. (For example: existing systems with internet connectivity and administration systems including but not limited to SIS and payroll).
 - d. Provide labor, materials, and testing equipment (For example: Power Meter, OTDR) to correct any deficiencies with labeling, cable charts, terminations, and Installer supplied test results.

- e. Provide keys and access to installed network equipment.
3. OWNER's Quality Assurance Team Responsibilities: Using the procedures specified in the Appendixes of this guideline, the OWNER's Quality Assurance Team shall verify that the infrastructure installed under the Contract complies with the installation standards detailed in the Specifications. Specifically, testing shall be performed by the OWNER on vertical and horizontal cable, (For example: fiber optic, Category 5e UTP and Category 6 UTP) along with component installations performed under the scope of the overall infrastructure effort (For example: Ethernet switches and routers). Generally, testing specifications and procedures cover the following:
- a. Review of equipment rack installation; including placement in the communications cabinets, attachment to the floor, and seismic bracing.
 - b. Review of fiber terminations, patch panel installation, cable labeling, and cable bundling.
 - c. Review of Category 5e and Category 6, T568B terminations, including cable end connections at the patch panel and work area outlets.
 - d. Review of the CONTRACTOR's Redlines for accuracy.
 - e. Review for compliance with industry standard for fiber optic, Category 5e and Category 6 cable performance testing.
 - f. Verify network equipment performance.
 - g. Verify uninterruptible power supply performance.
 - h. Verify communications cabinet layout and facility drop counts.

C. Related Requirements:

- 1. Section 00 7000 – General Conditions
- 2. Division 01 – General Requirements.
- 3. Section 06 1000 – Rough Carpentry.
- 4. Section 26 0500 – Common Work Results for Electrical.
- 5. Section 26 0513 – Basic Electrical Materials and Methods.
- 6. Section 26 0526 – Grounding and Bonding.
- 7. Section 26 0533 – Raceways and Boxes Fittings and Supports.
- 8. Section 26 0923 – Lighting Control Systems.
- 9. Section 26 2416 – Panelboards and Signal Terminal Cabinets.

10. Section 26 5010 – Solid State (LED) Lighting.
11. Section 26 5200 – Emergency Power Systems.
12. Section 27 1014 – Structured Cabling (New Sites).

D. Acronyms:

dB	Decibel
IDF	Intermediate Distribution Frame
ITD	Information Technology Division
LAN	Local Area Network
LDF	Local Distribution Frame
MDF	Main Distribution Frame
MPOE	Minimum Point of Entry
NVP	Nominal Velocity of Propagation
OAR	Owner Authorized Representative
PA	Public Address
PBX	Private Branch Exchange
QA	Quality Assurance
UTP	Unshielded Twisted Pair
VoIP	Voice over Internet Protocol
WLAN	Wireless Local Area Network

1.02 CODES AND STANDARDS

- A. ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises.
- B. ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard, current issue.
- C. ANSI/TIA-568-C.2 Balance Twisted-Pair Telecommunications Cabling and Components Standards.
- D. ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standards.
- E. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted Pair Cabling.
- F. EIA/TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces and all current addenda.
- G. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue
- H. EIA/TIA-606A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- I. ANSI-J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications.

- J. EIA/TIA-OFSTP-14A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
- K. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue in accordance with TIA TR-42.4.
- L. EIA/TIA-OFSTP-7, Optical Power Loss Measurements of Installed Single mode Fiber Cable Plant.
- M. American National Standards Institute (ANSI)/EIA/TIA-455-59, Field Testing.
- N. FCC Part 68.
- O. National Electrical Manufacturer's Association (NEMA).
- P. National Fire Protection Association (NFPA), NFPA-70.
- Q. CCR Part 3 - California Electrical Code (CEC).
- R. CCR Part 2 - Uniform Building Code (UBC).
- S. Building Industry Consulting Services International (BICSI) TDMM, most recent revision.
- T. Institute of Electrical and Electronic Engineers (IEEE).
- U. Other Codes and Standards as defined in the Parent Specification.
- V. Fluke Networks DTX Series Cable Analyzer Technical Reference Handbook 01/11 or newer.

1.03 PUNCH LIST

- A. Per OAR request, The OWNER's Quality Assurance Team shall assist in the Punch List for IT and low voltage systems and provide it to the OAR.

1.04 QUALITY ASSURANCE

- A. OWNER's Quality Assurance Test Schedule:
 - 1. The Project Inspector shall schedule the OWNER's Quality Assurance test after review of the CONTRACTOR's complete Test Results of the school.

PART 2 - MATERIALS - NOT USED

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. The Installer is responsible for basic installation and cross connection of LAN equipment required by the Contract Documents.
- B. The OWNER's Quality Assurance Team shall verify that basic installation is complete and functional.

END OF SECTION

Quality Assurance Guidelines

APPENDIX A - QUALITY ASSURANCE PROCEDURES

A.1 Overview of Quality Testing Procedures

This appendix provides guidelines for visual Quality Assurance reviews of each site. The OWNER's Quality Assurance Team shall examine the Work based upon the guidelines outlined in the following appendixes and their associated forms.

1. Communications Cabinet Review. Verify the design and compliance with contract documents. This may include ANSI/TIA and BICSI cabling practices, standard and specific labeling practices, and safe and logical equipment and wire management placement.
2. Cable Plant Review. Cabling from the Communications cabinet, at various points along the cable path, and in functional work areas for compliance with ANSI/EIA installation specifications including ANSI/TIA-568-C and TIA/EIA-569 and documents referenced therein and professional installation practices.
3. User Work Area Quality Assurance Review. Cabling at the user wall plate location in the functional work areas for compliance with ANSI/EIA installation specifications including ANSI/TIA-568-C and TIA/EIA-569 and documents referenced therein and professional installation practices.
4. Redline As-Built Documentation shall be compared to physical installation. Deviations shall be noted, and the Quality Assurance procedure halted until discrepancies have been rectified.

A.2 General Quality Assurance Guidelines

The OWNER's Quality Assurance Team visually reviews the installation to verify that cabling is supported properly. Cable trays or structural ties shall support cable. No cable shall have been installed in pathways near sharp edges or objects that might cause damage. Cable shall not be supported by, on, or attached to a dry wall ceiling, ceiling tiles, ceiling grid, routed over pipes, conduit, lighting fixtures, or other wiring. The OWNER's Quality Assurance Team should be able to determine the total number of drops dispersed from each communications cabinet, the number of drops for each supported room, and the agreed-upon labeling scheme for the site. The Installer should have met the following general labeling guidelines:

- Clearly labeled each drop number and Communications cabinet on the wall jack faceplate.
- Label each horizontal cable jacket using a permanent label at the workstation end, inside the wall, and the patch panel end no more than two inches from each end.
- At workstation end: communications cabinet, drop, and termination panel.
- At patch panel end: drop and cabinet numbers.

Quality Assurance Guidelines

- Label each patch panel port with drop number and cabinet number.

Because work area room numbers may have been modified since the design, the installer shall provide as built documentation for each communications cabinet; reflecting the room numbers used in the labeling scheme as a reference point. The CONTRACTOR and his/her Subcontractor shall use these working prints to produce post-installation as-built drawings.

A.3 Deficiency Reports

Before beginning any test, the OWNER's Quality Assurance Team shall view any deficiency report(s) (DR) that have been filed with the OAR and Project Inspector. The OWNER's Quality Assurance Team shall review the DR(s) as part of the Quality Assurance review to ensure the required corrective actions have been taken.

A.4 Quality Assurance Test Procedures

The OWNER's Quality Assurance Team shall follow the acceptance test and performance criteria outlined in ANSI/TIA-568-C, OFSTP-14A, OFSTP-7 and shall conduct acceptance and performance testing following each manufacturer's specification on their respective network components to verify compliance with manufacturer's installation instructions.

The OWNER's Quality Assurance Team shall also follow any specific local policy directives or instructions regarding installation practices and acceptance testing identified during the site orientation visit. The details for the design of a particular location shall also comply with any related State, County and Municipal standards.

A.5 Construction Quality Assurance of Work:

During the installation of low voltage systems, upon request by the OAR, the OWNER's Quality Assurance Team shall examine the following:

1. General to Low Voltage Systems:
 - a. Conduit and raceway layout and installation for each low voltage system and verify that they meet project specifications.
 - b. Equipment rack installation, including placement in the communications room, seismic bracing, and attachment to the floor.
 - c. Cable punch-downs, patch panel installation, cable cross-connection, cable labeling, and cable bundling.
 - d. Verify proper equipment installation, cable cross connection, system configuration, and testing.
 - e. Verify system layout and device location(s) match the locations shown on the as-builds.

Quality Assurance Guidelines

- f. Active components, terminal cabinets, cross connects; splices, etc. are located in a secure interior location.
 - g. Verification of Uninterruptible power supply performance.
 - h. Verification of proper air conditioning in MDF and IDFs. Room temperature should maintain between 65 - 72 degrees seven days per week, 24 hours per day.
 - i. Terminations punched down singly and cross-connected on 66 blocks. 66 blocks are primarily used in Public Address systems and Intercom. PBX cable plants are specified to use 110-blocks exclusively, except for one termination block used for the PA interface cabling.
2. LAN, verify the following:
- a. Examine Category 5e and Category 6, T568B terminations, including cable end connections at the patch panel and wall drop receptacles.
 - b. Examine fiber terminations and fiber termination boxes.
 - c. Examine Installer's basic network components installation and operation.
 - d. Review customized configuration and test results.
 - e. Test overall network operation to ensure it meets OWNER's strategic planning and acceptable performance level.

A.6 Start Up

Start-up work is to be completed as a condition for Substantial Completion. Start-Up is to include the testing and commissioning of equipment and systems.

- 1. After start up has been completed but prior to Substantial Completion, the Project Inspector shall schedule the OWNER's Quality Assurance Team site visit.
- 2. The OWNER's Quality Assurance Team shall review documentation and test results for completeness.
- 3. The OWNER's Quality Assurance Team shall visit the site and verify the CONTRACTOR's test results by the Quality Assurance procedures detailed herein.

A.7 Contract Completion and Process Review

The Quality Assurance Team shall review the entire Quality Assurance process and recommend changes to improve it on an as needed basis.

Quality Assurance Guidelines

A.8 Test Procedures

1. Visual Q/A Reviews
 - a. The OWNER's Quality Assurance Team shall conduct a visual review of the installation including the communication cabinet, cable runs, and user work areas. Appendix A documents these Q/A review procedures.
2. Cable Performance Testing
 - a. The OWNER's Quality Assurance Team shall test 100 percent of the fiber optic Backbone cable, a random sample of Category 5e and Category 6 UTP cable and the fiber optic Horizontal cable. Appendix C outlines these specific tests.
 - (1) Test Cable Sampling: The OWNER's Quality Assurance Team shall randomly test 10 percent of installed horizontal cables from each communication cabinet on site. For example, if a communications cabinet has 100 drops, the OWNER's Quality Assurance Team shall test a minimum of 10 drops for each cabinet. Where random testing shows a failure rate of more than 1 percent of the drops (2 in 10 of the random sample), an additional 10 percent of the installed horizontal cabling shall be tested. Appendix B outlines these specific tests.
 - (2) Cable Testing: The OWNER's Quality Assurance Team shall perform the following industry-standard operational and performance cable testing detailed in ANSI/EIA-568-C:
 - (a) Wire map
 - (b) Length verification
 - (c) Insertion loss (attenuation)
 - (d) Near-end crosstalk (NEXT)
 - (e) Power sum near-end crosstalk (PSNEXT)
 - (f) Equal level far-end crosstalk (ELFEXT)
 - (g) Power sum equal level far-end crosstalk (PSELFEXT)
 - (h) Return loss
 - (i) Propagation delay
 - (j) Delay skew

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3. Network Equipment Testing
 - a. The OWNER's Quality Assurance Team shall perform network tests on hardware components for proper installation, per manufacturer's recommendations and configuration. Components shall be tested separately for initial power up and their ability to maintain system configuration. The specific test for network equipment components is described in Appendix D.

A.9 Acceptance Criteria

1. An overall Pass or Fail condition shall be determined by the results of the required individual test. Any Fail and Fail* shall result in an overall Fail. In order to achieve an overall Pass condition, individual results shall be Pass or Pass*. A Pass or Fail result for each parameter is determined by the allowable limits for that parameter. The test result of a parameter is marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer shall provide documentation as an aid to interpret results marked with asterisks.
2. Cable plant acceptance by the OWNER requires 100 percent passing results for cable samples and corrected cabling deficiencies. Acceptance of other components is based upon satisfactory completion of a test configuration scenario, as defined in the appropriate appendix to this plan.

A.10 Corrective Procedures

1. EIA/TIA testing specification details a pass/fail criterion, i.e., if a fiber optic cable is outside of specifications, the test fails, The OWNER's Quality Assurance Team shall identify any deficiencies found during Quality Assurance (e.g., a cable or component failing a test) to site personnel before the OWNER's Quality Assurance Teams departure and shall document these deficiencies in the Quality Assurance Report. If the link attenuation for any fiber optic cable strand is outside acceptable loss as specified in ANSI/EIA-568-C, the Installer shall re-complete the terminations required to reduce the amount of attenuation. If re-termination fails, the Installer shall be required to take steps up to and including the replacement of the cable to eliminate the testing deficiency. After corrective action, the OWNER's Quality Assurance Team shall retest repaired fiber runs and document the results in the Quality Assurance Report.
2. The OWNER's Quality Assurance Team shall identify to the OWNER in writing any deviation from acceptable ANSI/TIA specifications for cabling resulting in a test failure. The OWNER may choose to accept the deficiency via a written waiver. For example, if a fiber optic connection exceeds the allowable termination attenuation by 0.1 decibels (dB), but the total link attenuation is within the length attenuation budget, the OWNER may choose to waive the specification. Other components (e.g., switches or routers) must

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function according to the specified configurations in the final Work Plan for OWNER LAN projects.

A.11 Quality Assurance Reporting

1. Acceptance Recommendation
 - a. At the conclusion of testing, the OWNER's Quality Assurance Team shall provide a recommendation to OWNER to accept or not accept the installation.
2. Quality Assurance Report
 - a. The OWNER's Quality Assurance Team shall deliver a Quality Assurance Report to the project OAR no later than seven (7) working days after completion of testing. This report shall include:
 - (1) A written test report for visual installation tests.
 - (2) Electronic test results of cable testing including verified cable lengths, test personnel, test date, and individual test description.
 - (3) Each detected deficiency with its correction date and retest results, if accomplished.
 - (4) Network operational test results for the switch(s) and router connections.
 - (5) Any condition(s) precluding strict adherence to CEC, ANSI/TIA, and BICSI installations or Quality Assurance standards shall be marked for potential OWNER waiver before system acceptance.
 - (6) A summary confirming the acceptance recommendation given.

A.12 Test Equipment

1. The OWNER's Quality Assurance Team shall use the following test equipment or their equivalent during testing.
 - a. Fluke DTX 1800, or equal, tester with single-mode and multi-mode power meter and light source heads.
 - b. Fluke DTX 1800 OTDR module, Optifiber Optical Time Domain Reflectometer (OTDR), or equal.
 - c. Personal computer with Transmission Control Protocol/Internet Protocol (TCP/IP) protocol stacks.
 - d. Thermometer

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Table 2.6.1 T & A Checklist for OWNER's Quality Assurance Team Projects

Site Location Code / Name _____ OAR _____

Network Engineer _____ Inspector _____

OAR Recommendation _____ Electrical Inspector _____

Review Item	Yes	No	N/A	Pass/Fail
Have deficiencies been cleared by the Project Inspector or OAR?				
Has the vendor provided cable charts in the cabinets?				
Are there any horizontal cables over 90 m?				
Do the cable runs used agree with the cable routing drawings?				
Are the cables routed and terminated per specification?				
Are cable run penetrations terminated to preclude strain on the installed cable?				
Are the copper and fiber optic cables installed per the manufacturer's recommendation?				
Is each cable clearly labeled at the user's location?				
Is each port on the patch panel labeled with the corresponding user outlet location?				
Are cable and patch panel labels securely fastened and easily readable?				
Are the fiber cables in the fiber termination box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?				
Is the cable for each drop identified with the correct labeling scheme at or near the point of termination?				
Does the user outlet plate display the correct labeling scheme and match the distant end label?				
Are connectors free of exposed metal, loose connectors, or other problems?				
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?				
Is the physical plant installed in accordance with specifications of this project?				

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For traditional, hierarchical star cable plants following 27 1013 specification, are there at least 50 percent spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF?				
For new fiber optics cable plant installations following 27 1014 specification, are there at least 15 percent spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF?				
Does this site have an existing Local Area Network?				
Are the T1 lines correctly installed and ready to cut over? Also, has the extension to the MDF been installed?				
Will the site reutilize an existing router? If yes, specify exact model / serial number.				
Is the router configured and ready for cut over?				
Are the required amounts of GB Uplinks provided to accommodate the equipment installed including port expansion?				
Are classroom and administration switches mounted, connected, and operational?				
Has the vendor provided inventory and the drop count been verified or has an Inventory document been completed? If so, please attach.				

A.13 Visual Q/A Review Worksheets

The following pages provide the three visual Quality Assurance worksheets:

1. Communications Cabinet Quality Assurance Review Form
2. Cable Routing Quality Assurance Review Form
3. User Work Area Quality Assurance Review Form

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A.13.1 Communications Enclosure Quality Assurance Review Form

Site _____ Date _____ Quality Assurance Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Is the cabinet ready for a Q/A review? If not, list discrepancies (e.g., debris, punch- list, or un-terminated cable).		
Is the installation performed in the planned communications cabinet?		
Are there clearly identified final or redlined drawings showing the “as-built” installation?		
With devices operating, are ambient cabinet and room temperatures within 50-80° F? The temperature is: _____.		
Are heating, ventilation, and air conditioning (HVAC), lighting, and electrical outlets installed per contract? Are the requirements addressed in the Site Concurrence Memorandum or other documentation?		
Are cabinet rails and wire managers installed so as to preclude any space problems with the UPS?		
Are the cabinets seismically braced to the floor and/or wall?		
Is there adequate space around the racks and fiber termination panel for maintenance?		
Are patch panels, wire management panels, and network equipment properly affixed to the rack?		
Is debris cleaned from inside of cabinets?		
Are cable run penetrations installed so fire barriers are maintained in cabinet locations?		
Are cable run penetrations properly and securely fastened to supporting structures?		
Are cable run penetrations terminated to preclude strain on the installed cable in cabinet locations?		
Are cables routed and punched per specification and industry standards?		
Is each cable clearly labeled with the corresponding user location per specification?		
Is each port on the patch panel labeled with the corresponding user location per specification?		
Are cable and patch panel labels securely fastened and easily readable per specification?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the UTP cable jacket stripped back only as far as required to terminate on		

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connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the fiber optic cable free from excessive strain or stress, sharp bends, or kinks?		
Are service loops in place at each end of the cable?		
Are the fiber cables in the fiber termination unit? Is the box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?		
Is excess fiber optic cable coiled in the termination box so it does not exceed the minimum bend radius per manufacturer's recommendations and specifications?		
Are fiber optic patch cords neatly routed to the network equipment via wire management?		

A.13.2 Cable Routing Q/A Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are cable bundles either secured to the wall or to a non-electromagnetic interference-producing source or hung from the ceiling (e.g., suspended via cable trays, inner duct, J-hooks, D-rings, or ladder rack) per specification or best industry standards?		
Do the cable runs used agree with the redline drawings?		
If not, are accurate redlined drawings available showing the cable routing?		
Is debris from the cable run penetrations adequately cleaned up per specification?		
Is the fiber optic cable runs completely contained within inner duct? Where?		

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Notes:		
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A.13.3 User Work Area Q/A Review Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are wall jack faceplates professionally installed and finished?		
Is cabling precluded from view on the external surface of walls (e.g., ducting used on solid core walls)?		
Does the user outlet plate display the correct labeling scheme?		
Is the cable for each drop identified with the correct labeling scheme and within 2 inches of termination per specification?		
Is the cable installed in a manner that precludes cable strain?		
Are connectors insulated from surrounding cable and objects (e.g., are cable barrel adapters, connectors, devices, and terminators insulated from any earth ground or current-conducting surfaces of the building structure)?		
Are connectors free of exposed metal, loose connectors, or other problems?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the 4 or 6 strand fiber secured properly in the LDFs and LDCs?		
Notes:		

APPENDIX B - CATEGORY 5E AND CATEGORY 6 UTP CABLE PERFORMANCE TESTS

B.1 Overview of Cable Tests

This appendix provides guidelines for electronic testing of Horizontal Category 5e UTP wiring. The OWNER's Quality Assurance Team shall meet the guidelines outlined in the following Q/A review and its associated forms.

- Electronic Testing. This testing verifies that the standard performance parameters for the UTP cable as outlined in ANSI/EIA-568-C are within the specifications as noted below. Refer to Premise Wiring Specification.

B.2 Test and Support Equipment

1. The types of cable to be tested are as follows :
 - a. Category 5E/6 UTP shall be tested based on ANSI/EIA-568-C

B.3 Electronic Tests

The OWNER's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The *permanent* link test configurations described in ANSI/EIA-568-C.2, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 Ohm four-pair Category 5e/6 cabling. 568-C identifies acceptable ranges of test results, test equipment checks, diagnostic information, and specific test procedures.

ANSI/EIA-568-C.2, also specifies laboratory measurement methods, component and field test methods and computation algorithms over the specified frequency range. To ensure verifiable equipment calibration, the OWNER's Quality Assurance Team shall certify test equipment accuracy in compliance with the ANSI/EIA568-C.2 each time a new list of tests is performed.

The OWNER's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet ANSI/EIA-568-C Category 5e/6 specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.4 Data Accuracy

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Tests shall be conducted on the premise that ANSI/EIA-568-C and other applicable specifications were applied to the cable installation. Further, the OWNER's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction.

B.5 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-C), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.6 Communications Wiring Electrical Tests

B.6.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.6.2 Length

The field tester shall be capable of measuring length of pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10 percent to allow for the variation and uncertainty of NVP.

B.6.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term "Attenuation" has been used to designate "Insertion Loss." Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

B.6.4 NEXT Loss

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Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 1

Frequency (MHZ)	Range	Maximum Step Size (MHZ)
1 – 31.25		0.15
31.26 – 100		0.25
100 – 250		0.50

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute

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ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 1, column 2. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

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Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.6.10 Delay Skew

This parameter shows the difference in propagation delay between the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.6.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.12 PSACR

This parameter is not required by ANSI/TIA standards but may be required in order to obtain the premise wiring vendor's warranty. The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

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B.7 Communications Wiring Electrical Test Form

Site _____ Date _____ Q/A Rep(s) _____
Building and Communications Room Numbers _____

MICROTEST SAVE ID	CABLE TESTED ROOM/DROP #	PASS/ FAIL	COMMENTS – IF FAILED (Wire Map, Length, Attenuation, Continuity, or NEXT Tests)

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B.8 Electronic Tests

The OWNER's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The *permanent* link test configurations described in ANSI/EIA-568-C, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 Ohm 4-pair Category 6 cabling. 568-C identifies acceptable ranges of test results, test equipment checks, diagnostic information and specific test procedures as related to Category 6 cabling. ANSI/EIA-568-C also includes laboratory measurement methods, component and field test methods, and computation algorithms over the specified frequency range. The test equipment (tester) shall comply with the accuracy requirements for level III field testers as defined in ANSI/EIA-568-C. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table B.2 of Annex B of the ANSI/EIA-568-C standard. (Tables B.3 in this ANSI/TIA document specifies the accuracy requirements for the Channel configuration.)

The OWNER's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet ANSI/EIA-568-C Category 6 specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.9 Data Accuracy

Tests shall be conducted on the premise that ANSI/EIA-568-C and other applicable specifications were applied to the cable installation. Further, the OWNER's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The CONTRACTOR shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

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B.10 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-C Category 6 related), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.11 Communications Wiring Electrical Tests

The test parameters for Category 5e and Category 6 are defined in ANSI/EIA-568-C standard. The test of each link shall contain the following parameters as detailed below. In order to pass the test, measurements (at each frequency in the range from 1 MHz through 350 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

B.11.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.11.2 Length

The field tester shall be capable of measuring length of pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation. The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10 percent to allow for the variation and uncertainty of NVP.

B.11.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs and the test limit value at this frequency.

B.11.4 NEXT Loss

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Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 2

Frequency (MHZ)	Range	Maximum Step Size (MHz)
1 – 31.25		0.15
31.26 – 100		0.25
100 – 250		0.50
250-350		1.00

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of eight results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance

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on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.9 Propagation Delay

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Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.11.10 Delay Skew

As defined in ANSI/EIA-568-C.2, this parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.11.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.12 PSACR

The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

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B.12 Communications Wiring Electrical Test Form

Site _____ Date _____ Q/A Rep(s) _____

Building and Communications Room Numbers _____

MICROTEST SAVE ID	CABLE TESTED ROOM/DROP #	PASS/ FAIL	COMMENTS – IF FAILED (Wire Map, Length, Attenuation, Continuity, or NEXT Tests)

APPENDIX C - FIBER OPTIC CABLE PERFORMANCE TESTS

C.1 Overview of Cable Tests

ANSI/EIA-568-C states, “The optical fiber cable construction shall consist of 50/125 mm or 62.5/125 mm multimode optical fibers or singlemode optical fibers, or a combination of these media.” Multimode fiber shall have a graded-index optical fiber waveguide with nominal 50/125 μm for installations following specification 27 1014, or 62.5/125 μm core/ cladding diameter for installations following specification 27 1013. Primary and secondary backbone cable testing shall be equivalent to backbone cabling as defined in ANSI/EIA-568-C, such as cabling interconnecting telecommunications closets, equipment cabinets, and entrance facilities. Therefore, the OWNER’s Quality Assurance Team shall perform the following interrelated tests:

1. Verification of multi-mode fiber optic cable installations.
2. Verification of single-mode fiber optic cable installations.
3. Electronic measurement of the distance and equivalent attenuation per kilometer (km) to verify minimum data transmission capacity per specification.
4. Total link attenuation measurements.

C.2 Test Equipment

The following test equipment shall be used:

1. Fluke DSP 1800, tester with copper single mode and multi-mode power meter and light source heads or equal
2. Fluke, DTX 1800, OptiFiber Optical Time Domain Reflectometer (OTDR) Module, or equal.

C.2.1 Cabling Distance

The combined primary (450m) and secondary (10m) backbone multimode fiber strands shall primarily be utilized by the network electronics up to 550 meters and testing shall conform to OFSTP-14A. The Singlemode strands shall be required where cabling the backbone distance exceeds 550 meters and testing shall conform to OFSTP-7.

C.3 Test Procedures

For multi-mode fiber the OWNER’s Quality Assurance Team shall use the Fluke DTX 1800 to test the length and total attenuation at both the 850 nm and 1300 nm wavelengths in each direction (bi-directionally). If the test fails, the OWNER’s Quality Assurance Team may request a repeat test using the OTDR to assess the failure point and address corrective actions. (See Methods A and B attached.)

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For single-mode fiber, the OWNER's Quality Assurance Team shall use a Fluke DTX 1800 with single mode test heads. The specific nanometer wavelength(s) at which the single-mode fiber shall be tested (i.e., 1310 nm and/or 1550 nm) shall be determined based on the length of the fiber cable being tested.

C.3.1 Cable Distance

Using the Fluke DTX 1800,, the OWNER's Quality Assurance Team shall determine the overall fiber optic cable length to ensure the cabling distance is within the maximum allowable length.

C.3.2 Attenuation

ANSI/EIA-568-C, indicates that components compliant with this standard, the single performance parameter necessary for performance testing is link attenuation. The backbone optical fiber cabling link segment should be tested in one direction at both operating wavelengths, to account for attenuation deltas associated with wavelength.

The OWNER's Quality Assurance Team shall use the Fluke 1800 or OTDR to measure the attenuation due to fiber optic cable and connectors. The OWNER's Quality Assurance Team shall test and record attenuation at both 850nm/1300nm for each Multi-mode and 1310nm/1550nm for Single-mode fiber optic strand respectively terminated under this initiative. These tests shall be performed at each communications cabinet and from the MDF cabinet, as required.

C.3.3 Information Transmission Capacity

The fiber optic cable is assumed to be within the allowable attenuation per kilometer as specified in ANSI/EIA-568-C.3. The OWNER's Quality Assurance Team shall presume the transmission capacity of the cable is within specification.

C.4 Data Reporting and Accuracy

The OWNER's Quality Assurance Team shall report loss measurement results, with locations and wavelength identifications, to the OWNER in accordance with EIA/TIA OFSTP-14 and OFSTP-7. The CONTRACTOR shall provide copies of the test results in native format to the OWNER's Quality Assurance team at the conclusion of the structured cabling testing or any time during the testing process.

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C.4.1 Fiber Optic Cable Installation Test Form— Fluke DTX 1800 and OTDR

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Fluke DTX 1800 Serial #: _____ Fluke DTX 1800 Location _____ Distant End Location _____

OTDR Serial #: _____ Near End TFBM Serial #: _____ Distant End TFBM Serial #: _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓
850	1-blue					850	13-blue		
1300						1300			
850	2-orange					850	14-orange		
1300						1300			
850	3-green					850	15-green		
1300						1300			
850	4-brown					850	16-brown		
1300						1300			
850	5-slate					850	17-slate		
1300						1300			
850	6-white					850	18-white		
1300						1300			
850	7-red					850	19-red		
1300						1300			
850	8-black					850	20-black		
1300						1300			
850	9-yellow					850	21-yellow		
1300						1300			
850	10-violet					850	22-violet		

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Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	
1300							1300				
850	11-rose						850	23-rose			
1300							1300				
850	12-aqua						850	24-aqua			
1300							1300				

C.4.2 Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Power Meter Serial #: _____ Power Meter Location _____

Light Source Serial #: _____ Light Source Location _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments
1310	1-blue						1310	13-blue					
1550							1550						
1310	2-orange						1310	14-orange					
1550							1550						
1310	3-green						1310	15-green					
1550							1550						
1310	4-brown						1310	16-brown					
1550							1550						
1310	5-slate						1310	17-slate					

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Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments
1550							1550						
1310	6-white						1310	18-white					
1550							1550						
1310	7-red						1310	19-red					
1550							1550						
1310	8-black						1310	20-black					
1550							1550						
1310	9-yellow						1310	21-yellow					
1550							1550						
1310	10-violet						1310	22-violet					
1550							1550						
1310	11-rose						1310	23-rose					
1550							1550						
1310	12-aqua						1310	24-aqua					
1550							1550						

APPENDIX D - NETWORK EQUIPMENT PERFORMANCE TESTS

D.1 Overview of Equipment Tests

These equipment tests verify the operation of the network components (e.g., switches, and routers) either purchased or provided for use as part of the particular project. This plan addresses industry-standard TCP/IP tests that collectively address Network layer connectivity and IP packet path routing; it does not address network performance (i.e., total throughput capabilities) tests.

The OWNER's Quality Assurance Team shall perform the following interrelated tests:

1. Spanning Tree Root Bridge identification test. Spanning tree protocol is one of the most important layer two protocols at work in switches. Spanning Tree ensures that no loops occur in a network by a designated root bridge. The root bridge is a central point of a spanning-tree configuration and it controls how the protocol operates. It is best practice to configure the core switch to be the root bridge. Run the following command on the core switch to identify it is set as the root bridge: Show spanning-tree summary.
2. Internet Control and Message Protocol (ICMP) Ping Test. This test verifies the Network layer for connectivity by using Ether-type frame pings to reach IP target addresses and obtain or verify four results—the target IP address, the local media access control (MAC), the number of responses, and the response time. The target IP addresses are the upstream and/or downstream gateway IP addresses based on the device's connectivity in the network. The source is the management console on the device. Each test includes two steps, if necessary, as follows:
 - a. Obtain the four results by performing an address resolution protocol (ARP) for the target IP address and verifying the ping.
 - b. If test 1 is unsuccessful, obtain the four results by executing an ARP for the default router, then use the acquired MAC address to determine the IP address, send an ICMP echo request and monitor for the ICMP reply.
3. Trace Route/Path Discover. This test determines the path IP packets follow, and reports each router encountered in the path. Testing elicits an ICMP TIME-EXCEEDED response from each router encountered. Each hop is tested three times to help identify changing routes.
4. Configuration Test. This test verifies that each new network port is operational. Perform an ICMP ping from each port not previously tested, ensuring each port has a link light indicating port operability.

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5. VLAN configuration verification. Inspect VLAN configuration and port assignments to be matching the provided documentation. Inspect VLAN trunking, and verify forwarding state of required VLANs on VLAN trunks.

D.2 Test Equipment

The following test equipment shall be used:

1. Fluke 685 Enterprise LAN Meter or equivalent.
2. Computer with TCP/IP protocol stack, TELNET application and data capture software (optional).

D.3 Test Methodology

The basic test methodology is to verify connectivity from user access ports through and within the installed intra-network to the WAN Router. Overall connectivity is verified by testing to and from points in the network. Site testing reflects the specific switch(s) and router(s) implemented at the site.

D.4 Test Hierarchy for Connectivity (Pings, Trace Routes and Telnets)

Table D.4-1 contains the network equipment performance tests and corresponding descriptions.

Table D.4-1. Network Equipment Performance Tests

TEST	TEST DESCRIPTION
Ping from Wall outlet WAN or Internet location	Connect the computer into the network via the wall plate, obtain DHCP IP address and perform a ping to a known IP address or URL outside the campus network.

D.5 Network Equipment Configuration Verification and Performance Tests

The OWNER's Quality Assurance Team shall follow the test sequence shown. The following sample form lists tests to be performed at this site. For the set of Network Equipment Performance Test forms tailored to the individual communications cabinets, please see enclosed file Network Checklists.doc.

D.5.1 Network Equipment Configuration Verification Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

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Device Name/IP	Type of device	Type of Configuration verified	PASS	FAIL
	Ethernet Switch	VLAN / STP/ port activation/Trunking		
	Ethernet Switch	VLAN / STP/ port activation/Trunking		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		

D.5.2 Network Equipment Performance Test Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

(a packet loss in excess of 1 percent during ping test is not acceptable and is considered a FAIL)

TEST	SOURCE ADDRESS/LOCATION	DESTINATION ADDRESS/LOCATION	PASS	FAIL
Ping from Wall outlet to WAN Router location				
Trace route from Wall outlet to WAN Router location				

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APPENDIX E - PHYSICAL CONFIGURATION AUDIT

E.1 Overview of Physical Connectivity Audit

A Physical Connectivity Audit is completed comparing the vendor supplied Equipment Inventory List (EIL) against the Cabinet Equipment Survey generated by the test team at Quality Assurance. This appendix provides the detailed audit of the physical equipment and materials installed under this expansion effort.

E.2 Physical Connectivity Audit Quality Assurance Review lists

The following sample form shows the general information to be documented for a standard Cabinet Equipment Survey.

Site	Date	Tester(s)
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Building and Communications Cabinet Numbers

Location	Location Annotation	Number of Switches	Number / Type of UPS	Number of Fibers (MM/SM)	Number of Horiz. Copper drops	Number of Horiz. Fibers
MDF						
IDF1						
IDF2						
IDF3						
IDF4						
IDF5						
IDF6						
IDF7						
LDF1						
LDF2						
LDF3						
LDF4						
Notes:						

APPENDIX F - CABLE DOCUMENTATION SPECIFICATION

F.1 Documentation.

- F.1.1** The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- F.1.2** Individual test reports shall be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.
- F.1.3** The test results records saved by the tester in .flw format shall be kept in .flw format for opening at anytime with Fluke Networks LinkWare software, version 6 or newer. It may also be transferred into, an excel spreadsheet, pdf, or zipped in a .RAR file that allows for the maintenance, review and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
- F.1.4** Hardcopy reports may be submitted in labeled three ring binders with an attached affidavit verifying passing execution of tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, and date of test and pass/fail result.
- F.1.5** Electronic reports are to be submitted in CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not needed. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the CONTRACTOR warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
- F.1.6** Test reports shall include the test measurement information specified in Section 5 for each cabling element tested, in addition to:
- F.1.7** Cable manufacturer, cable model number/type and NVP.
- F.1.8** Tester manufacturer, model, serial number, hardware version and software Ver.
- F.1.9** Circuit ID number.
- F.1.10** Auto test specification used.
- F.1.11** Identification of the tester interface.
- F.1.12** Overall pass/fail indication.
- F.1.13** Date and time of test.

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Table F.2 Cable Test Parameter Preferences

When reading the printed test result output, the following parameters must be shown with the associated cable test.

Cable Testing Parameter Preferences								
Cable Test	NV P	Cable	Auto test	Fiber Type	GRI	Referenc e	Test Direction	Pulse Width
Level (IIE) Category 5 E Tester	69 – 72	Cat 5E	Cat 5E Perm link	n/a	n/a	n/a	n/a	n/a
Level (III) Category 6 Tester	69 – 72	Cat 6	Cat 6 Perm link	n/a	n/a	n/a	n/a	n/a
Power Meter Horizontal MM F/O @ 850nm/1300n m	n/a	62.5/12 5 Mnfr	568B Horizontal	Multimo de 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Direction al	n/a
Power Meter Backbone MM F/O @ 850nm/1300n m	n/a	62.5/12 5 Mnfr	568B Backbone	Multimo de 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Direction al	n/a
Power Meter Backbone SM F/O @ 1310nm/1550 nm	n/a	SM Mnfr	1000 Base –LX	Single Mode	1.4640 @1300nm	1 jumper method	Bi- Direction al	n/a
OTDR Horizontal MM F/O @ 850nm/1300n m	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Direction al	<50ns
OTDR Backbone MM F/O @ 850nm/1300n m	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Direction al	<50ns
OTDR Backbone SM F/O @ 1310nm/1550	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Direction al	<50ns

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NOTE: The length of the cable is the variable of which the Power Meter and light source determines the expected dB loss for Backbone cable tests.

Table F.3 Allowable Distance per Fiber Length

Use this table as a guideline to compare references for dB loss in the installed Backbone Fiber. Total loss includes .75 dB loss per mated connector pair.

Fiber Cable Distance	Multimode dB Loss	Singlemode DB Loss		Fiber Cable Distance	Multimode dB Loss	Singlemode DB Loss
100'	1.6	1.53		1200'	2.7	1.86
200'	1.7	1.56		1300'	2.8	1.89
300'	1.8	1.59		1400'	2.9	1.92
400'	1.9	1.62		1500'	3.0	1.95
500'	2.0	1.65		1600'	3.1	1.98
600'	2.1	1.68		1700'	3.2	2.01
700'	2.2	1.71		1800'	3.3	2.04
800'	2.3	1.74		1900'	3.4	2.07
900'	2.4	1.77		2000'	3.5	2.10
1000'	2.5	1.80		2100'	3.6	2.13
1100'	2.6	1.83		2200'	3.7	2.16

END OF APPENDICES

SECTION 27 1013

STRUCTURED CABLING (EXISTING SITES)

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes the equipment provisioning, installation, integration, configuration, testing, and documentation of wiring/cabling and associated pathways for Local Area Networks, Signal Terminal Cabinets, and Telephone systems at the SMC. This specification uses 62.5-micron multi-mode fiber and Category 5E UTP cable and shall be used for additions and modifications at facilities already using the same type of cable plant. Pertinent sections are broken down to reflect the requirements for each system individually.
 - 1. Comply with individual system specifications.
- B. Principal items of Work in this Section shall include labor and materials that consist of provisions, installing, terminating, testing, and documenting a complete and fully functional communications structured cabling system. The work shall include the following:
 - 1. Local Area Network Wiring:
 - a. The installation of either new LAN cabling or additional LAN cabling. Segments, new installations, and/or modifications shall not interfere with or disable any portion of existing, working LANs.
 - b. Provide a plan that includes coordination of required installation efforts with the Telecommunication and CATV Access Providers. This includes installation of new duct banks and vaults for telecommunications cable for Telecommunications and CATV.
 - c. Provide rack space to allow a 50 percent expansion of the number of network data drops provided at the time of initial configuration. This includes space for additional structured cable components as well as active Ethernet equipment. Calculate rack space for one 24 port switch per 20 Category 5E drops in IDFs and LDFs. Allow two rack units (1.75 inches per RU) per switch.
 - d. Conduct underground survey to ensure constructability of outside plant pathway routing.

- e. Provide exterior and interior optical fiber and copper cabling. SMC uses a centralized optical cabling system in accordance with ANSI/TIA 568-C standards. Cabling system colors shall be coordinated using consistent colors for the same type of cabling as indicated elsewhere in this specification.
- f. Install and connect Owner Furnished, rack mounted uninterruptible power supplies and Ethernet switches in equipment cabinets at locations with active equipment.
- g. Furnish and install cabinets/racks, vertical power strips, cable trays and cable management at the MDF.
- h. Furnish and install modular T-568-B patch panels for termination of UTP within the MDF, IDF, and LDF. Use fiber patch cabinets for fiber optic cable terminations located in the MDF, IDF, and LDF where copper drops are provisioned.
- i. Furnish and install connectors and faceplates and terminate cable as specified.
- j. Provide high impact plastic wall and/or faceplate covers and connector housings for communication systems outlet locations.
- k. Provide contiguous (home run cables with service loops) optical fiber and copper backbone, link and distribution cables. No splices are permitted between designated termination points.
- l. Furnish and install floor mounted equipment racks, with required CBC Seismic Design rated seismic bracing and associated accessories in telecommunications spaces where required.
- m. Furnish and install grounding and bonding of communications components per the CEC.
 - 1) Telecommunication Entrance Facilities, Minimum Point of Entry locations, and MDF locations shall be equipped with a telecommunications main grounding busbar or telecommunications grounding busbar as appropriate to the installation environment.
 - 2) Grounding Equalizers or Telecommunications Bonding Backbone Interconnecting Bonding Conductors are not required except in buildings exceeding two occupied stories which use building steel to ground electrical service panels.

- 3) In buildings with two stories or less, where electrical panels are grounded using CEC compliant grounding conductors directly connected to the building ground electrode, IDFs, and LDFs equipment chassis; associated peripherals shall use local panel ground via the equipment branch circuit grounding conductor.
 - n. Furnish and install full labeling of the entire installation prior to testing in accordance with Article 3.04 paragraph C of this specification.
 - o. Premise cable shall be tested in compliance with Specification 27 0126. Testing of each LAN optical fiber element and connector with Power Meters and OTDR. For multi-pair copper communications cable, test pairs within counts and binder groups to ensure that no less than 99 percent of the pairs of a multi-pair cable achieve continuity and operation in voice band tests. For Category 5E copper cable, test and certify 100 percent of drops using test equipment certified for Level IIE test equipment.
2. Telephone Systems Wiring:
- a. Install and connect Owner furnished telecommunications equipment cabinet, attendant consoles, and telephone instruments as indicated on Drawings or in Scope of Work.
 - b. Furnish, install, and connect ground wire and power supplies as specified and/or required. Coordinate provision of dedicated power outlets.
 - c. Furnish and install connecting wiring and modular jacks to each individual phone location as indicated on Drawings. This also includes necessary cross connect blocks and cross connect wiring in cabinets/racks, as necessary to provide for functions and requirements specified. Cables shall be installed in conduits, cable trays, or raceways unless indicated otherwise on Drawings. Cabling system colors shall be coordinated using consistent colors for the same type of cabling as described in Article 2.04 of this specification.
 - d. Provide and install pathway and inside cabling from the MDF to the Minimum Point of Entry (MPOE) and install pathway from MPOE to the property-line Public Switch Telephone Network demarcation.
 - e. Provide infrastructure and facilities for interfacing the site's telecommunications infrastructure with public utilities telephone lines at the MPOE. Provide underground telephone service conduit from public utility serving location to main telephone terminal as indicated on Drawings and in compliance with requirements of access provider.

- f. Coordinate the installation and location of surge-protected outlets in equipment cabinets and enclosures where active equipment is scheduled.
- g. Furnish and install 110 type telephone punch blocks at PBX location using multi-pair cable for interconnection to the MDF and IDFs, as required.
- h. Provide coordination, testing, materials, and components required to provide a complete and operational installation.

C. Related Requirements:

- 1. Section 00 7000: General Conditions.
- 2. Division 01 - General Requirements.
- 3. Section 01 7700: Contract Closeout.
- 4. Section 06 1000: Rough Carpentry.
- 5. Section 26 0500: Common Work Results for Electrical.
- 6. Section 26 0513: Basic Electrical Materials and Methods.
- 7. Section 26 0526: Grounding and Bonding.
- 8. Section 26 0533: Raceways, Boxes, Fittings, and Supports.
- 9. Section 26 2416: Panelboards and Signal Terminal Cabinets.
- 10. Section 26 5000: Lighting.
- 11. Section 26 5200: Emergency Power Systems.
- 12. Section 27 0536: Cable Trays for Communications.
- 13. Section 27 4134: Television Systems – Coaxial Distribution.
- 14. Section 27 4135: Television Systems -Fiber Optic Distribution.
- 15. Section 27 5116: Public Address and Intercommunication Systems.
- 16. Section 27 5127: Public Address Systems (Small Gyms, Multipurpose Rooms) (ES).
- 17. Section 27 5128: Public Address Systems (Auditoriums, Performing Art, M-P Rooms) (MS and HS).
- 18. Section 27 5129: Public Address Systems (Gymnasiums).

19. Section 27 5130: Public Address Systems (Athletic Fields).
 20. Section 28 1600: Intrusion Detection Systems.
 21. Section 28 2313: Video Surveillance Systems (New Facilities).
 22. Section 28 2314: Video Surveillance Systems (Existing Facilities).
 23. Section 31 2323: Excavation and Fill for Utilities.
- D. Acronyms: See Appendix 1.
- E. Definitions: See Appendix 2.

1.02 SYSTEM REQUIREMENTS

A. Local Area Networks:

1. This specification describes the design, installation, testing, and documentation of elements for premise wiring installations and should be read in conjunction with other applicable divisions and sections of the contract documents. Furnish labor, supervision, tooling, miscellaneous mounting hardware, and consumables, including patch cables, for systems installed; in addition, provide construction and integration services to achieve connectivity for classrooms, computer laboratories, libraries, instructional areas, offices, and work areas, as specified by the SMC point of contact. Provide necessary labor and materials for a complete and operable installation.

B. Signal Terminal Cabinets:

1. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets shall measure 12 inches wide by 18 inches high by 5 ³/₄-inches deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
2. Terminal cabinets shall be furnished with 3/4-inch thick plywood backboards within cabinets, fastened in place with machine screws. Backboards shall be largest size that cabinet and conduit terminations will permit.
3. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

4. Terminal Cabinets for exterior Ethernet drop locations shall be NEMA Type 3R continuous hinge cover enclosure with a pad lockable draw pull catch or cylinder lock on the opposite side. The enclosure and cover shall be built of 16 gage galvanized steel and shall carry a NEMA 3R rating. The enclosure shall be large enough to fit a weatherproof single gang deep box and an industrial type Category 5E patch cord 10 feet long as described in paragraph 2.02.N. of this specification. Provide a padlock or cylinder lock keyed to Corbin CAT 80 for each enclosure.

C. Telephone Systems:

1. The scope of this specification covers the conduits and supporting structure for system's cables but not the placement, installation, or termination of cables. These cables connect to the patch panel(s) either by means of Amphenol connectors or punch down connections. Cables shall be designated as follows:

CABLE DESIGNATION	
TYPE	DESCRIPTION
A	Service entrance cables installed by the service provider.
B	Interior grade, multi-pair PVC cables. To be terminated on 110-type blocks.
C	Interior PVC, multi-pair cables, or exterior shielded cables for installation on buried conduit.
D	Category 5E or 6 cables terminated on the patch panel on one end, and on an RJ-45 wall jack insert on the other end.

1.03 SUBMITTALS

- A. Materials list of items proposed to be provided under the specification.
- B. Furnish catalog cuts, technical data, and descriptive literature on components. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data.
- C. Shop Drawings shall indicate equipment locations, wiring and schematics, details, panel configurations, sizes and a point-to-point wiring diagram of circuits. Shop Drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details. Responsibility for each end of interfaces shall be noted on Shop Drawings.

1. For Signal Terminal Cabinets: Shall include a front elevation indicating cabinet dimensions, make, location, and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- D. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The leftmost column shall be the item number; next shall be the description, followed by the applicable specification section number, and followed by the specified item, which is followed by the submitted item. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified.
- E. Each submittal shall contain product data sheets or catalog cut sheets for each item listed in the Index. These shall be arranged in the same order as the index and if more than one item is shown, the submitted items shall be highlighted or marked with an arrow. The product data shall be sufficiently detailed to allow the engineer to evaluate the suitability of the product and to allow other trades to provide necessary coordination.
- F. Provide Shop Drawings, in the same size as the Drawings, prepared and signed by a BICSI Registered Communications Distribution Designer (RCDD). Shop Drawings shall be prepared in latest version of AutoCAD with three CD-ROM electronic copies submitted along with full sized Shop Drawings.
- G. Submit Shop Drawings prepared, signed, and sealed by structural engineer licensed in the State of California. Details shall be provided indicating the proposed means of support and attachment of wall and floor mounted racks. Calculations shall be based on the maximum seismic loads as determined by the CBC based on specifications provided by the cabinet manufacturer. MDF racks or cabinets shall support a minimum of 750 pounds of static weight. IDF racks or cabinets shall support a minimum of 250 pounds of static weight. LDF racks or cabinets shall support a minimum of 125 pounds of static weight.
- H. Provide a Network Protection Plan that defines how an existing school or campus Local Area Network (LAN) will remain in service during the installation of either new LAN cabling or additional LAN cabling segments in a manner that ensures the installation shall not interfere with or disable any portion of existing, working LANs during the project. This plan should be prepared by the Installer and approved by the Architect prior to the start of work.
- I. Samples: Provide samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within ten days from date of request.
- J. Submit one electronic and one paper copy of cable records. Examples of the format for the required cable records are contained in Attachment 3 of this specification.

1.04 CODES AND STANDARDS

A. Complete installation shall meet or exceed the latest edition of following standards:

1. Underwriters Laboratories Inc. (UL): Applicable listings and ratings.
2. UL 50, Cabinets and Boxes.
3. UL 943, GFCI.
4. UL 489, Molded Case Circuit Breakers.
5. California Building Code.
6. California Electrical Code.
7. California Electrical Code, Article 384, 770, 800, latest issue.
8. National, State, and Local Occupational Safety and Health Administration (OSHA) building and fire codes.
9. NEMA PB1.
10. Federal Specifications W-P- 115C and WC-375B.
11. ANSI/TIA/EIA Telecommunications Building Wiring Standards.
12. ANSI/TIA-568-C, Commercial building telecommunications wiring standard and current addenda.
13. ANSI/TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard.
14. ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, current issue.
15. ANSI/TIA/EIA-569-A-1, Commercial Building Standard for Telecommunications Pathways and Spaces Addendum 1 - Surface Raceways (March 2000).
16. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue.
17. ANSI/TIA/EIA-606-A, The Administration Standard for the Telecommunications Infrastructure of Commercial Building, current issue.
18. ANSI/TIA/EIA-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications, current issue.
19. ANSI/TIA/EIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue.

20. Institute of Electrical and Electronic Engineers (IEEE) 802.3 (Ethernet), 802.3Z (Gigabit Ethernet over optical fiber), 802.3ab (Gigabit Ethernet over 4 pair category 5 or higher), 802.11 (Wireless LAN).
21. BICSI Telecommunications Distribution Methods Manual, current issue.
22. FCC Part 68.50.
23. National Electrical Manufacturer's Association (NEMA).
24. National Fire Protection Association (NFPA), NFPA-70.
25. CCR Part 3 - California Electrical Code.
26. CCR Part 2 - Uniform Building Code.

1.05 SYSTEM DESCRIPTION

- A. Local Area Network Cabling Infrastructure: The network-cabling infrastructure at each school will utilize a star topology design consisting of horizontal cabling, backbone cabling, and various telecommunications cabling pathways and spaces. Schools will require design-engineering services to determine the best route and method for cable conveyance throughout the school in accordance with project requirements and applicable installation standards.
 1. Proposed solutions shall be in compliance with TIA/EIA 568-C, centralized optical cabling, with the single exception of allowable cabling distance. TIA/EIA 568-C Annex A allows 300 meters as a maximum multi-mode optical fiber cable distance but District specification allows a maximum total length of 550 meters (450 meter backbone + 90 meter horizontal) using high grade laser optimized 62.5 micrometer multi-mode optical fiber. The installation of the backbone and horizontal cable plant shall include the following:
 - a. 62.5-micron multi-mode solutions which require mode-conditioning patch cords when using VCELS to launch in the 850 nm launch window shall not be accepted.
 - b. The interconnect or splice method as shown in figure 3 of ANSI/TIA 568-C shall be used in all cases. The pull through and splice methods are not acceptable.
 - c. Installation of optical fiber backbones in strand counts adequate to cross-connect active classroom, and instructional support location horizontal fiber to the BBS including a minimum of 10 percent spare strands, in multiples of six strands, in each backbone cable. Fiber termination units (FTU) are required to cross-connect backbone fiber at both the main

equipment (MDF) cross-connect and at secondary (IDF) cross-connect locations throughout the campus.

2. Backbone Cabling - The backbone cabling as a minimum, unless otherwise noted, shall be an indoor-outdoor, Riser rated hybrid multi-mode/single-mode fiber optic cable with a minimum composition of 12 strand multi-mode and six strand single-mode fiber optic cabling for inter-building and intra-building backbone cabling. Backbone cables shall meet or exceed the ICEA-S-104-696 Standard for Indoor-Outdoor Optical Fiber Cable. Connectors, distribution panels, ferrules, enclosures, and consumables shall be included to provide the backbone connectivity between MDFs and IDFs. Designer will show calculations and provide drawings illustrating distance limitations.
3. Horizontal Cabling – Each data outlet unless otherwise noted shall consist of either one Category 5E cable or one Category 5E and four strands of fiber optic cable for classroom locations and six strands for connection to LDFs in locations such as computer labs, libraries and cafeteria.
 - a. Each Category 5E cable shall be terminated on an eight-position, eight-conductor Category 5E jack wired in accordance with T568B. Associated faceplates shall accommodate two jacks at a minimum. Within classrooms and other open spaces, Category 5E cabling shall be routed via EMT conduit or surface mount raceway in walls, and in J-hook in accessible spaces above ceilings, cables shall be routed from the patch panel to a data outlet and placed as close to each workstation as practical. Supply Category 5E rated patch panels and same manufacturer patch cords for telecommunications closets and workstations to maintain an end-to-end Category 5E channel for -horizontal cabling.
 - b. Existing horizontal fiber terminated at a user station may be rerouted to new network cabinets. Remove any obsolete secondary backbone fiber with new cabling where appropriate.
4. Each campus shall receive a minimum of one Main Distribution Frame (MDF). Depending upon the size of the facility, provide one or more Intermediate Distribution Frames (IDFs), and Local Distribution Frames (LDF) are required. Telecommunications spaces will be located in secure areas with proper ventilation, HVAC, power, lighting, and grounding. MDFs and IDFs shall accommodate horizontal and backbone cabling termination equipment including: 19-inch free standing racks, wall-mounted racks, or cabinets, patch panels, vertical and horizontal wire management, patch cables, ladder racking, conduit sleeves, and data electronics. IDFs shall be located within the campus buildings in sufficient quantity to maintain compliance with the 90-meter horizontal cable running distance limitations as specified in ANSI/TIA 568-C.1. LDFs shall be located within every computer lab, student nutritional service area, multi-purpose room, and library to support ESM equipment.

5. If not in the same room, the MDF shall be located as close to the Minimum Point of Entry (MPOE) as practical.
6. WAN Cabling: If the MPOE is in a separate room from the MDF, furnished cabling between the MDF cabinet and the MPOE shall consist of:
 - a. Four separate four-pair 22AWG individually shielded cables with an outer sheath, properly terminated with RJ48C surface mount jacks at each end. Provide service loops of at least ten feet at the MDF and 25 feet at the MPOE cross-connect locations.
 - b. Fiber optic backbone WAN connection - unless otherwise noted, shall be an indoor-outdoor, riser rated multi-mode fiber optic cable with a minimum composition of six strands multi-mode fiber optic cable for inter-building and intra-building backbone cabling. Cables shall meet or exceed the ICEA-S-104-696 Standard for Indoor-Outdoor Optical Fiber Cable. Connectors, distribution panels, ferrules, enclosures, and consumables shall be included to provide connectivity. Refer to Article 2.02 for multi-mode Optical Fiber type and performance requirements.
 - c. WAN cables shall be clearly tagged in accordance with the requirements of this Specification. Provide a dedicated surface raceway and/or EMT conduit for this cable.

B. Signal Terminal Cabinets

1. Signal terminal cabinets shall conform to the Specifications in Section 26 2416, except as modified herein.
2. Terminal cabinets shall be flush or surface type with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be provided in sufficient quantity to allow no more than one signal system per cabinet. Terminal cabinets shall measure a minimum of 12 inches wide by 18 inches high by 5 ³/₄-inches deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
3. Cabinet Boxes shall be fabricated of galvanized steel compliant with NEMA 250; unless otherwise noted. Boxes shall be flush or surface type with removable end-walls and dimensioned as indicated on Drawings. Provide ³/₄-inch thick plywood backboard fastened in place with machine screws and painted matte white with fireproof paint for mounting terminal blocks. Backboards shall be largest size that cabinet and conduit terminations will permit.
4. Cabinet fronts shall be fabricated of steel compliant with NEMA 250, unless otherwise noted. Fronts shall be flush, or surface type as indicated on Drawings, with screw cover front and gray baked enamel finish. Doors shall be cut true

and shall accurately fit opening and finish smoothly across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 90 keys.

5. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
6. Terminal Cabinets shall be located so they are readily accessible and not exposed to physical damage.
7. Cabinet locations shall provide sufficient working space around panels to comply with the California Electrical Code and the BICSI TDMM.
8. Terminal Cabinets shall be securely fastened to the mounting surface by at least four points.
9. Unused openings in cabinets shall be effectively closed.
10. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
11. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
12. Maintain the required bending radius of cable and conductors inside the cabinet.
13. Clean the cabinets of foreign material such as cement, plaster, metal filings, and paint.
14. Remove debris from terminal cabinet interior.

C. Telephone Systems:

1. The telephone wiring system consists of distribution and feeder cables that permit connection of telephone handsets or other interfacing devices, through cross connecting panels, back to connecting blocks associated with an Owner-furnished, Owner installed PBX System. The installation of the PBX system and related powering systems is outside the scope of this specification.
2. The quantity of Telephone System cabling shall be designed based upon the size and scope of the project, or in accordance with drawings furnished by a designer. Telephone cables installed between the Main Distributing Frame (MDF) or PBX system location and respective Intermediate Distribution Frames shall be the sum of current telephone requirements plus a 40 percent growth factor of spare cable pairs.

3. Equipment specifications for the Project site shall be as indicated on Drawings, the scope of work, and as specified herein.
- D. Underground service entrances are required for connections to:
1. Telephone Service Provider.
 2. Community Antenna Television (CATV) Access Provider.

1.06 QUALITY ASSURANCE

- A. In addition to the following requirements, review and comply with Section 27 0126 - Test and Acceptance Requirements for Structured Cabling.
- B. Use adequate numbers of skilled personnel who are manufacturer certified, trained and experienced on the necessary crafts, and familiar with the specified requirements and methods needed for the proper performance of the work.
- C. The work of this section shall conform to California Code of Regulations, Part 3, and other applicable codes and standards.
- D. Permits and Inspections: Obtain and pay for required permits and inspections; deliver certificates of inspection to the Inspector.
- E. Only a qualified Installer holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
1. Contractor shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years.
 2. Include in the Product Data list submission, copies of current manufacturer certificates indicating that the Contractor is an authorized distributor of the manufacturer's products, has been trained in the installation of those products, and has a service organization capable of responding within 24 hours of receipt of written notification and resolution within one day for MDF equipment and five days for equipment located either in the classrooms, IDFs, or LDFs.
- F. Material or work damaged during the planning, installation, testing, and clean-up of this project must be replaced or repaired, at no expense to the Owner, to meet current Owner specifications before final acceptance of work. Examination of, or failure to examine, work by the Owner shall not relieve Contractor from these obligations.
- G. Installation shall be performed in accordance with applicable building codes, industry standards, and best trade practices.
- H. Include in the Material List Submission copies of the manufacturers' certifications that the Contractor is a current authorized distributor of the submitted manufacturers'

products and Contractor's staff has been adequately trained and certified in the installation of those products. This requirement applies to structured cable components and cable described in this specification.

- I. Coordinate cable runs and rack equipment locations with the Owner's Authorized Representative prior to the start of construction. Contractor and Owner's Authorized Representative must agree as to the final location of devices and the cable plant design.

1.07 WARRANTY

- A. Warranty that work executed and materials furnished shall be free from defects in materials, fabrication and execution for a minimum period of three years from date of installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than three years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the District, repair or replace at no expense to the District, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the District shall not relieve Contractor from these obligations.
- B. Provide a performance warranty for the installed data cabling system and components for a minimum of fifteen years after system is turned over to the Owner. Components of the optical data backbone cable system including cables, distribution shelves, LIUs and connectors must carry a fifteen-year single manufacturer's applications warranty at speeds of one Gbit/second.

PART 2 - PRODUCTS

2.01 EQUIPMENT STANDARDS - APPLIES TO ALL SYSTEMS

- A. Where required by Specifications, components installed under this Contract shall be listed by UL or another Nationally Recognized Testing Labs (NRTL).
- B. Equipment Requirements.
 1. Various manufacturers' equipment may meet the standards of quality set by the Owner. Provide equipment specification sheets for items included in the submitted bid.
 2. The Owner's Quality Control representative or designated agent will establish equivalency and compliance of product or components offered for use under this Contract.

2.02 LOCAL AREA NETWORK CABLING

A. Multimode Optical Fiber.

1. The optical fiber shall be multimode, graded-index optical fiber waveguide with nominal 62.5/125-micron core/cladding diameters. The optical fiber shall comply with ANSI/EIA/TIA-492AAAA.
2. The mechanical and environmental specifications for multi-mode fiber distribution cables shall be indoor/outdoor, riser rated, tight-buffered type cables. The cable shall meet the requirements of the California Electrical Code (CEC) section 770 and the requirements of TIA-455-82B water ingress test. Confirm that the cable is listed for the specified application.
3. Cabled optical fiber shall meet the graded-index attenuation performance specifications of ANSI/TIA 568-C including current sub sections and addendum. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-46, -53, or -61. Information transmission capacity shall be measured in accordance with ANSI/EIA/TIA-455-51 or -30. The cable shall be measured at 23 degrees C \pm 5 degrees C.
4. Multi-mode optical fiber shall meet the following minimum performance requirements:
 - a. Attenuation: The maximum attenuation of the multi-mode laser optimized fiber shall be 3.5db/km or less at 850nm and 1.5db/km or less at 1300nm.
 - b. Utilize GbE Gigabit Enhanced 62.5/125 multi-mode fiber to exceed standard bandwidth and distance limitations. Cable manufacturer shall guarantee that the multi-mode optical cable will support Gigabit Ethernet transmission up to 550 meters using SX optics.

B. Single-Mode Optical Fiber.

1. Single-mode optical fibers shall be Class IVa Dispersion-Unshifted Single-mode Optical Fibers and shall comply with ANSI/EIA/TIA-492BAAA. Fiber conductors shall have a nominal core diameter of 8.7 microns. Cable shall have transmission window centered at 1310 and 1550 nanometer wavelengths.
2. The mechanical and environmental specifications for single-mode fiber distribution cables shall be indoor/outdoor, riser rated, tight-buffered type cables. The cable shall meet the requirements of the National Electrical Code (NEC) section 770 and the requirements of TIA-455-82B water ingress test. The Installer shall confirm the cable is listed for the specified application.
3. Cabled optical fiber shall meet the attenuation performance specifications of ANSI/TIA-568-C. Attenuation shall be measured in accordance with

ANSI/EIA/TIA – 455-78ASP-3-3644-RV2 or 61. The cable shall be measured at 23 °C ± 5 °C.

- C. Fiber Optic Connectors. Fiber optic connectors shall be Duplex SC type, MM or SM connector.
- D. Fiber Optic Light Interconnection Units (LIUs). Rack mounted with the capacity to handle a minimum of 18 terminated fibers. Complete kit to include panels' bulkheads and supporting hardware.
 - 1. LIU for Local Distribution Frames and other locations requiring 18 optical fiber strands or less shall not exceed one EIA rack unit in height.
- E. Fiber Optic Distribution Shelves. 72 port rack mountable, with SC-compatible bulkheads and built-in cable management.
- F. Multimedia patch panels for LDC and LDF cross connections: Rack mounted field configurable panels for mixed media installations. The panel shall have a variety of modular inserts which support as a minimum Category 5E and duplex SC connectors.
 - 1. Patch panels for LDF cabinets shall support a minimum of three duplex SC optical fiber connectors and Category 5E connections as required by the number of drops supported at that distribution point.
- G. Fiber Optic Jumper Cables.
 - 1. Multimode or Single-mode duplex cable, OFN rated. Length: three meters, at a minimum, pre-manufactured with SC-SC connectors with same transmission characteristics as the terminated fibers as defined in Article 2.02.
 - 2. Fiber optic patch cables shall be supplied in sufficient quantity to connect each active fiber pair at intermediate cross-connect locations identified in the construction documents. Patch cables are not required for spare fibers. Intermediate cross connect locations include the following:
 - a. MDF – cross connect between the MDF and MPOE and MPOP.
 - b. IDF – cross connect between primary backbone and secondary backbone or horizontal fiber.
 - 3. Fiber optic patch cables shall be OFN type, jacketed with polyvinyl chloride with yellow indicating a single-mode patch cable and orange indicating a 62.5/125 multi-mode patch cable. The cable shall meet requirements of TIA/EIA-568 except for the more stringent requirements on bandwidth and attenuation identified in this Specification.
- H. Fiber Optic Innerduct. Materials: one inch and/or one- and one-half inch, orange corrugated with pull rope, rated as required by code.

- I. Category 5E data Cable. Horizontal enhanced Category 5 cabling shall be 24 AWG, four-pair UTP, UL/NEC rated, with appropriately rated PVC (riser) or FEP (plenum) jacket as appropriate to the installation environment and N.E.C. Individual conductors shall be FEP or polyethylene insulated as appropriate to the installation environment. Cables installed in cable trays or on “J”-hooks shall carry a CMP rating regardless of the installation environment. Cable shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for four-pair Category 5E cabling as detailed in ANSI/TIA-568-C.2. Category 5E data cabling and patch cables shall be blue or green.
- J. Flooded Category 5E cable for underground applications: Enhanced category 5 cabling shall be 24 AWG, four-pair UTP, UL/NEC rated, with appropriately rated polyethylene jacket with water blocking flooded core. Individual conductors shall be polyethylene insulated. Cable shall meet ANSI/TIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for four-pair Category 5E cabling as detailed in ANSI/TIA-568-C.2.
- K. Category 5E Inserts. Category 5E data inserts shall be wired to the T568B wiring pattern. Category 5E data inserts shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Category 5E data inserts shall be blue or green in color as consistent with the cable jackets for this system.
- L. Exterior Category 5E data drops shall be embedded in an environmentally sealed enclosure with an IEC NEMA 6 rating for Protection from live or moving parts, dust, and protection from immersion in water) and with an ADC 110 punch down contacts for field termination of horizontal backbone cable of specified length. The connector shall combine existing RJ-45 connector technology with weatherproof housing assemblies and shall be compatible with standard Category 5E RJ-45 connectors. The exterior Category 5E connector shall interlock with exterior patch cord as described in paragraph 2.02.N of this Specification and provide a seal with a NEMA 6 rating. Category 5E data inserts shall be wired to the T568B wiring pattern. Category 5E data inserts shall meet ANSI/TIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA-568-C.2.
- M. Category 5E Patch Cords. Patch cords shall be Category 5E rated, 24 AWG, four pair assemblies. Patch cords shall be factory assembled by the manufacturer of the cabling system. LAN Patch cords shall be the same color, blue, or green as the cabling system. Provide and install Category 5E patch cords as follows:
 - 1. One two-meter Category 5E patch cord for each work area outlet installed.
 - 2. In the wiring closets, Category 5E patch cords shall be provided in a like manner (one per user port). Patch cords shall be provided in varying lengths to accommodate a patch that can be neatly loomed into the cable management

system. In wiring closets and passive patch locations, patch cords shall be installed and shall cross connect structured cabling to LAN equipment ports.

- a. In LDF locations in cabinets with less than 26 inches of rack space, Patch cables shall be provided in the following distribution of lengths – 30 percent one foot; 40 percent two feet; 30 percent three feet.
 - b. In MDF, IDF, and LDF locations in stand-alone cabinets with between 26 inches and 56 inches of rack space, patch cords shall be provided in the following distribution of lengths – 60 percent one meter; 40 percent two meters.
 - c. In MDF and IDF locations in cabinets with more than 56 inches of rack space, or ganged cabinets, patch cords shall be provided in the following distribution of lengths – 20 percent one meter; 40 percent two meters; 40 percent three meters.
- N. Category 5E patch cords for exterior locations. The patch cord shall combine existing Category 5E RJ-45 plug technology with weatherproof assemblies and shall be compatible with standard Category 5E RJ-45 connectors. One end of the ten-foot patch cord shall be a Category 5E RJ-45 plug embedded in a housing that creates an environmental seal, a strain relief, and a locking mechanism when mated to exterior Category 5E connector, and an ingress protection of NEMA 6. See paragraph 2.02 L of this Specification. The other end of the patch cord shall be a standard Category 5E RJ-45 plug connector.
- O. Category 5E Patch Panels. Patch Panels shall be provided in 24 or 48 port compliments with modular jack ports wired to T568B. Patch panels consisting of 48 ports or less shall not exceed one EIA rack unit in height. Patch panels shall be augmented with cable support bars in rear to properly dress cable. Patch panels shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568 Quantity and size of patch panels must be selected to provide 20 percent expansion capacity. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
- P. Outlet Gang Boxes. As a minimum, the telecommunications outlet box shall be capable of housing four Category 5E terminations or two terminated optical fibers. The outlet box shall have the ability to secure the optical fiber cable and provide for a minimum fiber bend radius of one inch. Typically, the telecommunications outlet/connector box shall consist of a four inch by four-inch electrical box or surface mount box.
- Q. Weatherproof single gang outlet box shall be NEMA 3R rated, either flush mount or surface mount as shown on the Drawings. The weatherproof single gang outlet box shall be used for mounting exterior Ethernet outlets (See paragraph 2.02.L of this Specification). This outlet box shall be mounted inside a terminal cabinet for exterior Ethernet outlet.

- R. Faceplates. Faceplates shall be constructed of ABS molding compound and have the ability to accommodate one insert.
- S. Exterior faceplate shall be a single gang, two ports, and stainless-steel plate. The faceplate shall be pre-punched for mounting use with weatherproof housing assemblies (paragraph 2.02 L.). The faceplate shall be gasketed and have an NEMA 12 rating.
- T. Fiber Faceplates. Fiber faceplates shall be constructed of ABS molding compound and have the ability to accommodate a minimum of two angled duplex multimode or single mode SC connectors.
- U. Horizontal Cable Management panels shall be 19-inch rack mount with a minimum of four-management rings one-rack unit (1.75 inches) in height. Rings shall not exceed more than 1.75 inches in depth unless otherwise noted in the construction documents.
- V. Floor Standing Cabinet. Floor-standing equipment cabinet for MDF or IDF installation use as required. Cabinet shall provide at least 84 inches (48 EIA/TIA rack units) of total mounting space for 19-inch panels and 36 inches of usable interior depth. If two cabinets are required in an MDF, structured cabling components shall terminate within the same rack with the Backbone Switch. Cabinet shall be constructed of steel with 14-gage carbon steel front and rear adjustable mounting rails tapped for #10-32 screws on EIA spacing front and rear. Cabinet shall be tested and certified to the seismic specifications set forth by NEBS Telcordia Technologies GR-63-CORE. Cabinet shall be provided with a thermostatically controlled heat dissipation fan; textured antique finish; matching side panels and louvered top panel; a hinged, key locking, bronze-tinted acrylic window door in front keyed to Corbin Cat 90; and a full length, hinged, key-locking rear door keyed to Corbin Cat 90. Cooling fan thermostat shall be set at 78 degrees Fahrenheit. When installed, both doors shall be able to swing fully open. Cabinets shall be UL listed.
- W. Wall-Mounted Cabinet. Wall-mounted equipment rack for IDF and LDF locations. IDF cabinet shall provide at least 45 inches of mounting space for 19-inch panels (26 EIA/TIA rack units), a 22-inch main body and a minimum of 24 inches of usable interior depth. LDF cabinet shall provide at least 24 inches of mounting space for 19-inch panels (13 EIA/TIA Rack Units), a 22-inch main body and 24 inches of usable interior depth. Cabinet bodies shall be 14 gage or better, welded steel construction with 14-gage carbon steel front and rear adjustable mounting rails, tapped for #10-32 screws on EIA spacing, fully adjustable front-rear. Allowable deflection of an open cabinet when loaded to its maximum weight capacity, shall not exceed .75 inches (3/4 inches) Wall mount IDF and LDF cabinets shall be configured to have a minimum of 18 inches from front to rear rack-mounting rails. Cabinet shall have factory made top or side ventilation capability and a thermostatically controlled heat dissipation fan rated at no more than 32dBA, a front door, and flush mounted locks on both front and rear sections. The front lock shall be keyed to Corbin CAT 90 and the rear lock shall be keyed to Corbin CAT 90. Cooling fan thermostat shall be set at 78 degrees Fahrenheit. Cabinets shall be provided with white powder coat finish. Cabinets shall be UL listed.

2.03 SIGNAL TERMINAL CABINETS

- A. Cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trim shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.
- B. Doors shall be cut true, shall accurately fit opening, and finished smooth across joints. Rabbets shall be inside. Door shall be sized as required to permit removal of devices intact. Gutters shall be provided at sides and top of compartment. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 90 keys.
- C. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three-point latching, vault type door handles with padlocking provisions. Provide stainless steel butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 90 keys. Outdoor terminal cabinets shall be used only if approved by the Owner.

2.04 TELEPHONE SYSTEMS

- A. Wiring
 - 1. Telephone Trunk Cables. Cables shall be rated for inside installation, PVC insulated 22 AWG solid conductor cables unless otherwise specified by access provider. Cables shall be available in standard increments of 25, 50, 100, 200, 600, 800, 1,000 and 1,200 pairs. Any cable that exits the building must be rated for exposed environments and graded as outside plant cable.
 - 2. Installed telephone cable terminations, on 110-type terminating blocks, shall be installed in signal terminal cabinets, on $\frac{3}{4}$ inch plywood backboards, painted using fire-retardant paint. Cables shall be dressed in orderly fashion on entrance to the cabinets, properly secured with cable D-Rings that preclude snagging or inadvertent movement of the cables.
 - 3. Telephone Trunk Cables shall be terminated at the MDF locations using 110 type blocks that meet Category 5E data specifications (i.e., Siemens, or equivalent). Cross connects in the MDF at these blocks will then distribute to interior PVC-jacketed, Riser grade, or outside Plant Grade cables that connect to individual IDF locations, depending on whether IDFs are located in the same building, a different floor, or in a different building.
 - 4. Category 5E Cable, when used to connect voice telephones to the nearest IDF location shall carry the same rating and specifications as listed in the Local Area

Data Networking (Article 2.02). Category 5E telephone wiring systems shall use yellow or red-jacketed cable.

5. Flooded Category 5E cable for underground applications. Category 5E Cable, when used to connect voice telephones to the nearest IDF location shall carry the same rating and specifications as listed in the Local Area Data Networking (Article 2.02).
6. Category 5E Inserts. Category 5E data inserts shall be wired to the T568B wiring pattern. Category 5E data inserts shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Inserts shall be yellow or red in color as consistent with cable color for the system.
7. Category 5E Patch Cords. Patch cords shall be Category 5E rated, 24 AWG, four pair assemblies. Patch cords shall be factory assembled by the manufacturer of the cabling system. Telephone system patch cords shall be the same color (yellow or red) as the telephone cabling system.
8. Category 5E Patch Panels. Patch Panels shall be provided in 12, 24 or 48 port compliments with modular jack ports wired to T568B. Patch panels shall be augmented with cable support bars in rear to properly dress cable. Patch panels shall meet ANSI/TIA/EIA minimum requirements for return loss, propagation delay, delay skew, NEXT loss, PSNEXT loss, FEXT loss, ELFEXT, and PSELFEXT for Category 5E connecting hardware as detailed in ANSI/TIA/EIA-568. Quantity and size of patch panels must be selected to provide 20 percent expansion capacity. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
9. Telephone Modular Jacks. Contractor Furnished, Contractor Installed (CFCI):
 - a. Provide modular jacks, eight-position, TIA-568, Category 5E, using T568B wiring pattern. Jacks shall be UL verified and listed, Category 5E with 110 contacts and blue or red in color – whichever is consistent with the system cable sheath color. Provide duplex faceplate mounting straps, where required. Provide wall and floor outlet plates as indicated in Section 26 0513: Basic Electrical Materials and Methods.

B. Telecommunications Related Equipment:

1. Telephone Type T7. Contractor Furnished, Contractor Installed (CFCI).
2. Type T7 shall be a modular telephone jack - type RJ-11 - on an independent line, separate from the telecommunications system. Provide independent line modular jacks at Administration fax machines to each elevator room, pay

telephones (typically at multipurpose room, gymnasium, and auditorium lobbies), and/or as indicated on Drawings. Each independent line will be terminated at the backboard in the MPOE. Termination of Category 5E cable to an RJ-11 jack shall use the green and green/white conductors for typical tip and ring connections. The green conductor shall be terminated at the jack on the tip side.

PART 3 - EXECUTION

3.01 PREMISE WIRING INSTALLATION

Site Conditions. Examine the areas and conditions under which the work of this Section will be performed. Unsatisfactory conditions shall be reported to Owner before the contractor begins work.

A. Conduit Subsystem:

1. Excavation:

- a. Call the Owner's Authorized Representative at least 48 hours prior to excavation.
- b. Locate and protect existing construction, plant life, and utilities. Before excavation, contact the "Underground Service Alert of Southern California" (USASC) for information on buried utilities and pipelines.

2. Inter-building Conduits:

- a. Provide and install two inner ducts of 1 ½-inch and one inner duct of 1 inch with indexed pull cords.
- b. Duct banks shall have a continuous slope downward toward ground vaults and away from buildings with a pitch of not less than 4 inches in 100 feet.
- c. Inter-building exterior and underground conduit runs shall not exceed 200 feet and shall not contain more than two bends of 90-degrees or less between pull boxes or vaults. Distances of up to 600 feet between underground pull boxes may be allowed if the conduit run between pull boxes has no bends and is indicated on Drawings.
- d. Stagger joints of the conduit by rows and layers so as to provide a duct line having maximum strength.
- e. During and after construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of a duct line is completed from ground vault to ground vault, draw a stiff bristle brush of the proper

diameter through each duct until the conduit is clear of particles of earth, sand, and gravel then immediately re-install conduit plugs.

f. Conduit fill shall not exceed 40 percent.

3. Intra-building Conduits:

a. Interior conduits for multiple cables to communication outlets are to be a minimum of 1 ¼-inch and dedicated conduits shall serve outlet boxes.

b. No more than six feet of flexible conduit shall be used in any conduit run.

1) Flexible conduit shall not be used in concealed or inaccessible areas such as interstitial wall spaces or hard lid ceilings.

2) Where flexible conduit is used, the conduit fill shall be derated by one trade size.

4. Entrance/Access Provider Conduits:

a. Entrance Conduit for Telecommunications:

1) Telecommunications entrance conduits for small and medium size sites less than 100 classrooms shall consist of one, 4-inch trade size) conduit plus one spare of equal size.

2) Telecommunications entrance conduits for large secondary school sites of 100 classrooms or more shall consist of two four-inch trade size conduits plus one spare of equal size.

3) Each installed conduit shall be equipped with a 5/16-inch polypropylene pull rope.

4) The primary entrance conduit shall be provisioned with two 1-1/2 inch and one one-inch inner ducts each installed with indexed pull cords, unless AP representative indicates other requirements.

b. Entrance conduits for CATV Access Provider

1) CATV entrance conduit shall be one three-inch trade size conduit.

2) Each installed conduit shall be equipped with a 5/16-inch polypropylene pull rope.

c. Construction of underground duct banks:

- 1) Construct underground duct banks of individual conduits encased in concrete. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts.
- 2) Separate conduits by a minimum concrete thickness of three inches. Provide plastic duct spacers between ducts, at a maximum five feet on center.
- 3) The top of the concrete envelope shall not be less than 24 inches below grade.
- 4) Duct lines shall have a continuous slope downward toward ground vaults and away from buildings with a pitch of not less than four inches in 100 feet.
- 5) Manufactured bends shall have a minimum radius of 36 inches.
- 6) Stagger joints of the conduit by rows and layers so as to provide a duct line having maximum strength.
- 7) During and after construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of a duct line is completed from ground vault to ground vault or ground vault to building, draw a brush through having the diameter of the duct, and having stiff bristles until the conduit is clear of particles of earth, sand, and gravel then immediately install conduit plugs.
- 8) No underground conduit run, without a pull box, is to be longer than 200 feet and shall contain no more than two bends of 90-degrees or less.
- 9) Pull boxes or ground vaults shall not be used in place of conduit bends.
- 10) Conduit types shall be limited to rigid metal conduit and schedule 40 PVC. Flexible metallic conduit and EMT shall not be used in entrance systems.
- 11) Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.
- 12) Joint trench methods shall not be used in entrance facility duct banks.

d. Ground Vaults and Pull Boxes:

- 1) Ground Vaults and pull boxes shall be installed in paved areas wherever possible. Top of box shall align with finish surface of paving. Wherever possible, install boxes where runoff water will not drain to the box. If vaults or boxes must be installed in an unpaved area subject to runoff, top of box shall be raised to allow no less than one inch of clearance from grade to top of box. In all cases, the top of vault or box shall be at or above the highest point in the runoff area.
 - 2) Provide pulling irons on opposite walls and below horizontal centerlines of ducts and cemented openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - 3) Install a floor drain into sump containing two cubic yards of crushed rock, minimum size 48 inches deep and 36 inches diameter. Provide a 36-inch length of 6-inch diameter perforated tile pipe extending down into sump and fill with gravel. Cover sump with grille.
 - 4) Install ground rod in each concrete pull box. Locate near a wall with six-inch projection above floor for ground clamps. Permanently ground metal equipment cases, cable racks, etc. in pull boxes. Ground conductors shall be #4-0 bare stranded copper.
- e. Above grade exterior and interior conduit systems:
- 1) Conduits placed and mounted to exterior and interior portions of a building to extend conduit pathways from the ground vaults to the site's MPOP shall be Rigid Metallic Conduit (RMC).
 - 2) Conduits shall be bonded and grounded.
 - 3) Securely fasten entrance conduits to the building so they can withstand a typical placing operation performed by the AP.
 - 4) Pull boxes, if needed, must be accessible. Do not place pull boxes above fixed ceilings, HVAC ducts, or piping.
 - 5) No interior conduit is to be longer than 100 feet between pull boxes and shall contain no more than two bends of 90-degrees or less.
 - 6) Pull boxes shall not be used in place of conduit bends unless site conditions do not allow the use of conduits with data sweeps.

- 7) Where not required elsewhere in District Specification or Code, pull boxes shall be sized per the BICSI TDMM current edition.
 - 8) An UL-approved fire stop applicable to the installation must be used when penetrating fire rated walls or floors.
- f. Conduit termination in MPOP:
- 1) For conduits entering telecommunications room from below grade point, conduits shall extend four inches above the finished floor.
 - 2) For conduits entering from ceiling height conduits shall terminate four inches below the finished ceiling.
 - 3) Keep the area around an entrance conduit free of any construction, storage, mechanical apparatus, etc.
 - 4) Seal the inside-the-building end of a conduit to prevent rodents, water, or gases from entering the building. Use rubber conduit plugs, a water plug, or duct sealer, depending upon the conditions.

B. Local Area Network MDFs/IDFs/LDFs:

1. If backboards are necessary for MDFs, IDFs, and LDFs they are to be ¾-inch fire-retarding ACX plywood with the A side out and painted with two coats of flat light-colored fire-retarding paint on all sides. The size of the backboards will be determined by the size of the building and space provided.
2. Provide an MDF, IDFs, and LDFs at each campus. The MDF shall be co-located or located as close to the MPOE as practical. IDFs shall be located within the campus buildings and in sufficient quantity to maintain compliance with the horizontal cable running distance limitations as specified in TIA/EIA 568. IDFs will distribute network connections to the classrooms. LDFs will provide connection for the workstations within offices, student nutritional service areas, multi-purpose rooms, computer labs, and libraries.
3. Provide an LDF in each student nutritional service area, multi-purpose room, computer laboratory, and library. LDFs shall consist of a wall-mounted cabinet containing the data switches, Category 5E patch panels, patch cords, connectors, and wire management required to distribute each Category 5E data drop to the workstations located within the room. However, if the LDF is within compliant distance from an otherwise adjacent MDF or IDF cabinet, the LDF may be physically co-located within that MDF/IDF cabinet.

4. MDF cabinets shall normally be installed in a LAN or Information Services room and may be used for support to some local data drops. Provide receptacles, cabling, and pathways to those local drops.
5. MDF/IDF/LDF Category 5E Termination Installation:
 - a. Category 5E patch panels shall be installed in 24 or 48 port complements. Provide and install necessary patch cords, both copper and fiber optic, for internal cabinet interconnections.
 - b. One EIA rack unit of horizontal wire management shall be provided adjacent to each patch panel both above and below.
 - c. Cables shall be dressed and terminated in accordance with TIA/EIA-568, manufacturer recommendations, and this Specification.
 - d. Pair untwist at the termination shall not exceed one half inch for Category 5E connecting hardware.
 - e. Bend radius of the cable in the termination area shall not be less than four times the outside diameter of the cable.
 - f. Cables shall be neatly bundled, not overly tight, and dressed to their respective panels or blocks. Cable wraps shall not be tight enough to disturb the internal cable pair twists and positioning.
 - g. The cable jacket shall be maintained as close as possible to the termination point.
 - h. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties.
 - i. Patch cords used at the rack or cabinet shall include single-mode and multi-mode duplex fiber, and Category 5E, 24 AWG, four-pair assemblies, as required.
6. MDF/IDF/LDF Fiber Termination Hardware Installation:
 - a. Stripped fiber slack shall be neatly coiled within the fiber termination panel. No stripped slack loops shall be allowed external to the fiber panels. Fiber loops must not be smaller than minimum bend radius of the cable.
 - b. Cables shall be individually attached to the respective termination panels by mechanical means.

- c. Each fiber cable shall be stripped upon entering termination panels and the individual fibers routed neatly into termination panels.
- d. Each cable shall be clearly labeled at the entrance to the termination panel.
- e. Dust caps shall be installed on unused connectors and couplings.

7. Backbone Cabling:

- a. Proper bending radius and pulling strength requirements of cables shall be followed during handling and installation. Cables, splice cases, punch-down frames, LIUs, patch panels, and supporting hardware shall be installed in accordance with manufacturer recommendations.
- b. Outside plant fiber shall be installed in 1 ½-inch or one-inch corrugated inner duct installed within the backbone conduit.
- c. Interior innerduct and cable shall be plenum or riser rated, as required by applicable code regulation or standard. Riser rated innerduct as a minimum shall be installed on floor-to-floor fiber optic cabling.
- d. Interior fiber not installed in cable tray, conduit or raceways shall be installed in innerduct. Innerduct installations shall be properly strapped and supported every four feet in concealed spaces only. Innerduct shall be rated for indoor or outdoor use as applicable by code.
- e. Cables in panels, cabinets, trays, and racks shall be neatly grouped and strapped using hook and loop cable straps. Cables shall be placed in a manner that allows equipment installation without rerouting. Full rack rail travel adjustments shall not be impeded by cable installation. Cables and panels shall be clearly identified at both ends with a unique cable numbering system and in compliance with ANSI/TIA 606. Refer to Section 27 0536 for Cable Tray requirements.
- f. When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - 1) MDF shall be ten feet.
 - 2) IDF and LDF shall be three feet.

Include the slack in length calculations to ensure that the cable does not exceed maximum allowable lengths as defined herein. Do not store slack in bundled loops. Store cable slack in an extended loop or in a figure eight configuration to alleviate stress.

- g. The backbone fiber optic cable shall be installed in configurations based upon the physical topology and logical connections required as follows:
 - 1) If the MDF-to-IDF cabling distance is 450 meters or less:
 - a) The installed cable from MDF-to-IDF shall be a minimum of 12 strands multi-mode and six strands single-mode.
 - b) The multi-mode fiber optic strands shall be installed in multiples of six including a minimum of 10 percent spare multi-mode fiber strands after required fiber optic links are connected.
 - 2) If the MDF-to-IDF cabling distance is greater than 450 meters:
 - a) The installed cable from MDF-to-IDF shall be a minimum of 12 strands multi-mode and 12 strands single-mode.
 - b) The single-mode and multi-mode fiber optic strands shall both be installed in multiples of six with a minimum of 10 percent spare single-mode and multi-mode fiber strands after required fiber optic links are connected.
- h. Fiber optic strands shall be terminated.
- i. Fiber optic cable shall not be spliced.
- j. Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- k. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- l. Cables shall be installed in continuous lengths from origin to destination with no splices.
- m. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- n. Replace any cable damaged or subjected to installation practices outside of those specified within this document.
- 8. Secondary Backbone Cable:
 - a. Fiber distribution cable for data circuits from IDFs to LDFs shall be four or six strands of fiber optic cable, CMP or CMR rated as required. Secondary Backbone cables shall not exceed 90 meters in length.

- 1) If the MDF-to-IDF cabling distance is 450 meters or less, the installed horizontal fiber cable for the computer labs, libraries, classrooms, and other LDF locations shall be a minimum of four strands multi-mode fiber including 10 percent spare capacity rounded up to an even number of strands, terminating on duplex SC network drops. Network drops shall be collocated within the LDF installation - described in this Specification.
- 2) If the MDF-to-IDF cabling distance is greater than 450 meters, the installed horizontal fiber cable for the computer labs, libraries and other LDF locations shall be a minimum of four strands single-mode fiber including 10 percent spare capacity rounded up to an even number of strands, terminating on duplex SC network drops. Network drops shall be collocated within the LDF installation - described in this Specification.
- 3) Fiber cable shall be installed in conduit, cable tray, raceways, or in innerducts when installed in J-hooks. No cable shall be installed laying on ceiling tile. Cable supports shall be installed to independently carry the cable without pinching or crimping the cable in any way. Vary the spacing of supports to prevent frequency dependent aberrations. Fiber hung on J-Hooks shall be installed in innerduct, with proper supports every four feet.
- 4) Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- 5) Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- 6) Cables shall be installed in continuous lengths from origin to destination with no splices.
- 7) When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - a) MDF shall be ten feet.
 - b) IDF and LDF shall be three feet.
 - c) Include the slack in length calculations to ensure that the cable does not exceed maximum allowable lengths as defined herein. Do not store slack in bundled loops. Store cable slack in an extended loop or in a Figure 8 configuration to alleviate stress.

- 8) The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- 9) J-Hook or trapeze system shall be used only if shown on drawings to support cables in dropped ceiling spaces. J-Hooks shall not be used to distribute optical fiber cables within classrooms. Horizontal optical fiber cables distributed using J-hooks shall be placed in innerduct. Horizontal cables shall be supported at a maximum of three-foot intervals and shall be in full compliance with the Codes and Standards as listed in Article 1.04 of this Specification.
 - a) Cable(s) shall not rest on or attach to acoustic ceiling grids or panels.
 - b) Cable shall be installed above fire-sprinkler and other mechanical systems and shall not be attached to the system or any ancillary equipment or hardware.
 - c) Cables shall not be attached to ceiling grid or lighting support wires.
- 10) Replace any cable damaged or subjected to installation practices outside of those specified within this document and the Codes and Standards listed in Article 1.04 of this Specification.

9. Horizontal Cabling:

- a. Optical fiber distribution cable for horizontal data circuits from IDFs to classrooms, libraries, and other instructional areas shall be four strands of multi-mode fiber optic cable, CMP or CMR rated as required. Fiber optic horizontal cables shall not exceed 90 meters in length. Horizontal Fiber terminations will be made as follows:
 - 1) If an LDF is specified – Each four or six strand fiber optic cable shall be terminated on a modular rack mount patch panel which combines connectivity for both the fiber, using duplex SC connectors, and Category 5E, using RJ-45 connectors.
 - 2) When wall jacks are specified - Each four-strand fiber optic cable shall be terminated on a dual SC, duplex outlet with angled connectors at the work area. Associated faceplates shall accommodate both duplex, SC connector outlets.
- b. Copper Horizontal distribution cable shall be TIA/EIA-568, Category 5E, four-pair unshielded twisted pair, and CMP or CMR rated cable, as required. Each Category 5E cable shall be terminated on an eight-

position, eight-conductor Category 5E jack (at the workstation locations) or patch panel (in the MDF/IDF/LDF). Terminations shall be wired in accordance with T568B. Associated faceplates shall accommodate four jacks. Quantities of cables to each outlet shall be in accordance with the location type and project document.

- 1) Cable shall be installed in accordance with manufacturers' recommendations and best industry practices.
- 2) Copper horizontal cable shall not exceed 90 meters in length.
- 3) Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
- 4) Cables shall be installed in continuous lengths from origin to destination (no splices or cross-connects are permitted).
- 5) The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- 6) Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cable outside diameter.
- 7) When cable runs are being installed, provide additional slack at both ends to accommodate future cabling system changes. The minimum amount of allowable slack at the:
 - a) MDF, IDF or LDF will be three feet.
 - b) Work Area Outlets will be 12 inches.
- 8) J-Hook or trapeze system shall be used only if shown on drawings to support cables in dropped ceiling spaces. Horizontal optical fiber cables distributed using J-hooks shall be placed in innerduct. Horizontal cables shall be supported at a maximum of three-foot intervals and shall be in full compliance with the Codes and Standards as listed in Article 1.04 of this Specification.
 - a) Cable installed above fire-sprinkler systems shall not be attached to the system plumbing or any ancillary equipment or hardware.
 - b) Cables shall not be attached to ceiling grid or lighting support wires.
- 9) Pulling tension on four-pair UTP cables shall not exceed 25 pounds for a single cable or cable bundle.

- 10) Replace, before terminations are completed, cables damaged or subjected to installation practices outside of those specified within this document, at Installer's expense.
- c. The following identifies the minimum number of Category 5E and fiber drops to be installed into each area identified. Additional areas and additional drops may be required and will be identified on the project documents. Cable and termination requirements are identified in Article 2.02 of this specification.
- 1) Standard office, workstation, or cubicle will receive three Category 5E drops in a single four-position faceplate. Two Category 5E drops will be marked for Data, the other for Voice. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
 - 2) Administrative office core areas shall receive three Category 5E drops in a single four-position faceplate per user or desk indicated on the drawings. Two Category 5E drops will be marked for Data, the other for Voice. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
 - 3) Conference rooms will receive up to eight Category 5E drops; four each at two separate locations in the room. Each group of four drops will terminate in a single faceplate with two Category 5E indicated for Voice and two for Data. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
 - 4) Classroom:
 - a) A minimum of one four-strand fiber drop to the teacher's drop in the classroom.
 - b) A minimum of five student Category 5E drops, one Category 5E drop for a printer, and one Category 5E drop at the teacher's location. Category 5E drops shall terminate on two-port faceplates. Empty openings on faceplates shall be effectively closed using factory made blank inserts.
 1. For High Schools provide an additional Category 5E student drop.
 - 5) Library: A minimum of one four-strand fiber drop to the LDF in the library and a minimum of 12 Category 5E data drops

distributed from the LDF. Larger libraries shall be provided with up to 20 drops. Category 5E drops must be grouped with two Category 5E jacks (and two blank jacks) per faceplate. Drops must be distributed within the room according to the Project documents. Empty openings on faceplates shall be effectively closed using factory made blank inserts.

- 6) Computer Laboratories: A minimum of one (1), six-strand fiber drop to the LDF in the computer laboratory and 40 Category 5E data drops distributed from the LDF. Category 5E drops shall be grouped with up to six Category 5E jacks per faceplate. Empty openings on faceplates shall be effectively closed using factory made blank inserts. Drops must be distributed within the room according to the Project documents.
- 7) Student Nutritional Support Areas: one, four-strand fiber drop to the LDF and up to 20 Category 5E data drops distributed from the LDF. Category 5E drops must be grouped with two Category 5E jacks and two blank jacks per faceplate. Empty openings on faceplates shall be effectively closed using factory made blank inserts. Drops must be distributed within the room according to the Project documents.
- 8) Student Nutritional Support Areas - Exterior Locations: Each location shall receive two Category 5E drops in an environmentally sealed enclosure as described in paragraph 1.02 B. 4 of this specification.
- 9) Multi-purpose rooms shall contain a total of: one, 4-strand fiber drop and 8 Category 5E data drops distributed from the closest LDF or IDF location. Category 5E drops must be grouped with two Category 5E jacks per faceplate. Empty openings on faceplates shall be effectively closed using factory made blank inserts. Drops must be distributed within the room according to the Project documents and consistent with the descriptions below.
 - a) In the stage area of a multipurpose room, there shall be two Category 5E drops and one, four-strand, multimode fiber optic drop located either at stage apron or the proscenium arch.
 - b) On the other three walls of the multipurpose room, two Category 5E data drops shall be evenly distributed and installed.

- 10) Additional non-instructional and office work area horizontal fiber and Category 5E cabling requirements will be indicated on the Project documents.

10. Labeling and Marking:

- a. Provide complete cable location chart and as-built documentation in an envelope and attach to the inside rear doors of distribution frame cabinets in wiring spaces.
- b. Mark distribution panels, cables, and cover plates with computer-generated labels. Drops shall be labeled with the same identifier on the receptacle faceplate, inside each junction box, on the cable at the jack, on the cable at the patch panel, on the termination side of the patch panel, and on the patch side of the patch panel. Cable markers shall be located within two inches of the end of the cable jacket and shall be directly readable. Panel labels shall be computer-generated and printed using a laser printer. A disk with the label files shall be submitted as part of the project record documents.

C. Racks/Cabinets

1. Racks and cabinets shall be bolted to the floor or wall mounted, as required, and provided with tip bars and additional accessories required for a complete functional system. Racks and cabinets shall be seismically braced and attached to horizontal ladder racking or cable tray with $\frac{3}{4}$ inch threaded rod.
2. MDF/IDF cabinets shall be placed to accommodate 36-inch aisles in the front and rear. When wall mounted, cabinet placement shall allow a minimum of 31 inches clear on each side and 36 inches in front.
3. Provide CAT 90 keys and locks for cabinets and equipment enclosures. The manufacturer and part number shall be Corbin Russwin part number 5865-JVR or ILCO part number S1000V or equal. The locks and keys shall have a 53315 lock/key code.
4. Where backboards are used for mounting IDFs, and LDFs, they are to be $\frac{3}{4}$ inch plywood, ACX grade surface with the "A" side exposed and painted with two coats of flat light, colored fire-retarding paint on all sides. The size of the backboards will be determined by the size of the space provided. Cut edges of plywood shall be sanded smooth.
5. Unused openings in cabinets shall be effectively closed.
6. Cabinet doors shall close without striking installed components.

7. Cabling in cabinets shall be installed and loomed in a manner that allows full travel in rack rail adjustment. Cabling shall not infringe on space used for equipment mounting.
8. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
9. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
10. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
11. Maintain the required bending radius of conductors inside the cabinet.
12. Clean the cabinets of foreign material such as cement plaster and paint.
13. Distribute and arrange conductors neatly in the wiring gutters.

D. Telephone Systems:

1. Terminals, Cabinets, and Racks: Telecommunications system and auxiliary cabinets/racks shall be installed and wall-mounted in accordance with CBC seismic requirements and shall not block any existing removable panels or swing-open doors required for normal system expansion or service.
 - a. Terminal Blocks: See appendix 3 for typical network diagram:
 - 1) Furnish terminal blocks in terminal cabinets/racks, and where indicated on Drawings, as required to provide a termination for conductors in communication cabinets/racks and backboards.
 - 2) Terminal blocks shall be 110 Series, solder-less, push-on type, solid, and 22 - 26 AWG. Terminals for connections to external circuits shall be properly labeled. Terminal blocks shall be installed on mounting legs and installed within cabinets/racks as required. Terminal blocks shall be installed on inside back of cabinets/racks only, not on side. Cross-connect and wire management shall meet or exceed TIA/EIA-568, Category 5E performance standards. Terminal blocks shall be pairs of 25 or 100 with mounting legs.
 - b. Terminal Cabinets/racks:
 - 1) Lines and cables within cabinets/racks and on main terminal backboards shall be secured with cable straps. Cables shall be formed in rectilinear configuration. Insulation between

conductors and ground shall be properly maintained. Cables shall be properly numbered in numerical order and shall maintain the same numbering system throughout the Project site.

- 2) Conductors shall be color-coded per EIA/TIA 568 standards. Individual cables shall be run out and tagged with laser-printed cable markers. Cable index strips shall be typed and installed on terminal cabinet door. Index strips shall be covered with clear plastic adhesive covers. Terminal cabinet cable codes shall be typed on record drawings.
 - 3) Terminations and connections shall be on 110 Series blocks. Cables shall be identified as to buildings and rooms served and terminated in terminal cabinets/racks and backboards.
 - 4) Cables to PA system consoles and amplifier inputs shall terminate on 110 Series blocks where PA system is required.
 - 5) Cables from PA consoles and amplifier outputs shall terminate on 110 Series blocks.
 - 6) Cables to telecommunications switches, trunk inputs, shall terminate on 110 Series blocks.
 - 7) Cables from telecommunications switches (extensions, consoles, night bells, etc.) shall be terminated on 110 Series blocks. Provide blocks and cables for maximum possible system configuration.
 - 8) Cables to satellite terminal locations and classrooms shall be terminated on 110 Series blocks. Provide blocks as needed, plus two vertical rows for future expansion, at main cross-connect locations only.
2. Wiring: Wiring within communication cabinets/racks and backboards shall be installed to conform to ANSI/TIA-568-C, Category 5E performance standards, and shall be terminated on terminal strips for required external connections. Wiring shall be cabled, laced, and securely fastened in place so that weight is not imposed on equipment, controls, switches, or terminals. Input circuits and terminal strips shall be installed to provide separation necessary for proper operation. Wires shall be identified by number and chart, and 120VAC wiring shall be in a required conduit or raceway.
 3. Cables: Discussion of cable terminations and location of blocks are subject to provisions of the Terminal Signal Cabinet section above.

- a. Install conductors and cables to devices indicated on Drawings. Provide conductor terminations to devices for complete telecommunications system to function as specified and as indicated on Drawings.
- b. Cable runs shall be continuous, no splicing shall be allowed. Terminations shall be in communication cabinets/racks or on telephone backboards. Connections from incoming to outgoing shall be provided with cross-connect wires. Cables shall not directly connect to other cables.
- c. Conductors and cables shall be installed within conduits, cable trays, boxes, raceways, and cabinets/racks in a manner, which shall provide an enclosed installation, except where otherwise specified. Furnish and install conductors to connect incoming and outgoing circuits, including spare conductors, to terminal strips in the LAN or telephone equipment room, in accordance with TIA/EIA 569.
- d. Cables and four-pair wires shall be behind 110 Series blocks in space created by stand-offs and shall be neatly laced and securely bundled.

3.02 RELATED SYSTEMS INSTALLATION

A. Telephone Systems:

1. Coordination of Installation of Telecommunication Systems:

- a. Work, including installation or removal, will be coordinated with the OAR. The Contractor shall be responsible for floor plans for cutover, station reviews, and cut sheets. Installer will also provide a complete and detailed scope of work prior to commencement of any implementation.
- b. If the scope of the Work includes the extension and replacement of an existing telephone system, the cutover and station review must be coordinated with the OAR prior to implementation and every effort must be made to minimize interruption of service during the cutover or at any other time.
- c. Examination:
 - 1) The Inspector shall observe installation of main cable runs. Notify the Inspector not less than two days in advance of proposed time of installation.

3.03 CERTIFICATION AND TESTING

- A. Provide the Owner's Authorized Representative (OAR) with copies of factory calibration certificates for each test set used in the testing procedures. Test equipment used shall have been factory calibrated within the previous 12-month period. Operators

of the test equipment shall have factory training in the use of the equipment and its software. Cables and termination hardware shall be 100 percent tested for defects in installation and to verify cable performance under installed conditions. Conductors of each installed cable shall be verified useable prior to system acceptance. Defect in the cabling system installation including, but not limited to, cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100 percent usable conductors in cables installed.

B. Local Area Network:

1. Copper:

- a. Each cable shall be tested for continuity on all pairs and conductors.
- b. Enhanced Category 5E data cable shall be performance verified using an automated test set for Category 5E link configurations.
- c. Test set shall be certified Level IIE. To ensure verifiable equipment calibration, the Owner shall require field calibration each time a new set of tests are performed. Test for the continuity parameters defined above and provide results for the performed tests. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:
 - 1) Attenuation.
 - 2) Wire Map.
 - 3) Attenuation to Crosstalk Ratio ACR.
 - 4) Pair-to-pair NEXT loss.
 - 5) PSNEXT loss.
 - 6) Return Loss.
 - 7) Pair-to-pair ELFEXT.
 - 8) PSELFEXT.
 - 9) Propagation delay.
 - 10) Delay skew.
 - 11) Cable length.
- d. Cable length shall be tested using the cable manufacturer's published Nominal Velocity of Propagation (NVP) parameter. Owner's Quality

Assurance Agent shall verify the NVP setting prior to commencement of the testing process. Generic settings not using the published NVP parameter will not be accepted.

- e. Test results shall be automatically evaluated by equipment, using the most up-to-date criteria from the ANSI/TIA-568-C standard and the results shown as pass/fail.
- f. Test results shall be printed directly from the test unit in native format, and both hard and soft copies in native format shall be provided to the Owner. The printed test results shall include tests performed, the expected test result, and the actual test result.

2. Fiber Optics:

- a. Terminate, test, and document multi-mode and single-mode fiber optic cables with approved connectors at the drop locations and on approved fiber optic patch panels at the MDF, IDFs, and LDFs. No fiber optic cables shall remain un-terminated.
- b. Fiber optic cables shall meet EIA/TIA performance standards and shall be tested in accordance with applicable standards. Light source and power meter tests shall be dual wavelength and shall be tested in both directions at each wavelength on each fiber strand. Optical time domain reflectometer (OTDR) tests shall be performed with an instrument suitable for testing campus cable plants. OTDR tests shall be conducted at both wavelengths from the MDF with sufficient launch cables installed at both ends of the fiber run to clearly identify the mated connectors. OTDR launch and landing cables shall not be less than 100 meters in length. The light pulse duration used shall not be greater than 50 nanoseconds. Sampling resolution shall not be less than five feet per 100 meters.
 - 1) Multi-mode fiber optic cable runs shall be tested in both directions at each frequency with a power meter and light source combination that can verify distance and attenuation. Wavelengths tested shall include 850nm and 1300nm.
 - 2) Single-mode fiber optic cable runs less than or equal to 200m shall be tested in both directions at each frequency with a power meter and light source combination that can verify distance and attenuation. Wavelengths tested shall include 1310nm and 1550nm.
 - 3) Single-mode fiber optic cable runs greater than 200m shall be tested with a power meter and light source combination and with

an OTDR. Wavelengths tested shall include 1310nm and 1550nm.

3. Completion: Work for the installation shall be considered complete after the following have been accomplished:
 - a. System testing has been completed. Certify that system is in working order. Cable Test Forms and equipment-specific test documentation, both electronic files and paper records, have been submitted to the Owner.
 - b. Ceiling panels previously removed have been put back in place.
 - c. System labels have been put in place.
 - d. Construction debris and scrap materials have been removed from project site.
 - e. Marked up, project record documents have been returned to the Owner.
 - f. Unused customer material has been returned to the Owner.
 - g. The Owner has successfully completed acceptance testing of the network wiring installation.
 - h. The Owner's Inspector has inspected and accepted the installation.

C. Signal Terminal Cabinets:

1. Cabinets will be securely bolted to the floor and the wall or ceiling as required by seismic requirements.
2. Cabinet will be serviceable and lockable.

D. Telephone Systems:

1. Provide test and reception gear to test for specified performance.
2. For multi-pair copper communications cable, test pairs within counts and binder groups to ensure that no less than 99 percent of the pairs of a multi-pair cable achieve continuity and operation in voice band tests. For Category 5E copper cable, test and certify 100 percent of drops for using test equipment certified for 10/100 validation and operation.
3. For category 5E cabling, requirements of paragraph 3.03 B above.
4. Before Substantial Completion, submit test results and related documents to the Inspector.

3.04 PROJECT RECORD DOCUMENTS

A. As-Built Documentation

1. Block diagrams indicating items and their point-to-point connections in a manner following floor plan layout.

B. Operating and Servicing Manuals, Record Drawings:

1. Deliver three copies of operating, specification descriptions, and/or service manual. Each complete manual shall be bound in a three-ring binder, and data shall be typewritten or drafted.
 - a. Manuals shall include a page with Project site and Project name, date of Substantial Completion, Contractor name, address, telephone, and fax numbers.
 - b. Manuals shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in Article 1.07 of this specification and shall describe the company's commitment to service the warranty during the terms specified.
 - c. Manuals shall include specifications and instructions necessary for proper operation and servicing of system.
 - d. Manuals shall include installation and coordination drawings specifically related to this section shall be included as follows:
 - 1) Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.
 - 2) Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
2. Deliver two copies of Record drawings on labeled CDs (Compact Disks) representative of the work performed shall be presented at completion of work in the most recent Autodesk's AutoCAD format (.dwg), for Microsoft Windows.
 - a. The submittal shall contain systems wiring installed including telephone, LAN, and any other low voltage system Contractor-installed wiring.
 - b. The submittal shall consist of two electronic copies on CD-ROM and three paper record copies on no less than "E" size drawings, presented prior to the acceptance inspection.
 - c. Owner utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings yet provide control over what is seen on each sheet. Premise wiring shall be

shown on a separate layer, labeled as “Premise Wiring” that uses both building floor plans and conduit supporting structure layers below. The use of any version control blocks, or company logos shall be on a layer separate from the premise wiring as-built drawings.

- d. AutoCAD, electronic files supplied shall be multi-layer drawings with the following layers as a minimum:
 - 1) Layer 1 shall contain title blocks only.
 - 2) Layer 2 shall contain building or site plan backgrounds only.
 - 3) Layer 3 shall contain terminal cabinets, devices, cabling, and other system components.

C. Cable Numbering Records:

- 1. Owner requires both labeling and record documentation at the conclusion of each cable installation project. Labels and cable records allow the Owner to locate, identify, and diagnose cases of trouble more efficiently. They are required for each cable installation project regardless of size and scope.
 - a. Installation, provide a cable management spread sheet that shall include the following:
 - 1) Cable Schedule.
 - 2) Cable Test Forms.
 - 3) Cable Labels.
 - 4) Network planning chart.
 - b. Present the data in an Excel spreadsheet that will operate on Windows XP or Windows 7 platforms. Information shall be presented in paper and electronic forms in a format that will be provided by the Owner.
 - c. A paper copy of the cable schedule in a transparent plastic sleeve shall be affixed to the front door of each Intermediate and Local Distribution Frame (IDF and LDF). In the MDF cabinet, the cable schedule shall be affixed to the rear door of the cabinet.
- 2. The following information is provided to assist architects, engineers, and installation contractors in understanding and complying with the requirements of this specification. Owner’s cable numbering is based on a defined format which readily identifies cable type, and allows maintenance technicians to determine originating and terminating locations by means of cable labels, as required in other sections of the specification.

3. Figure 3-1 below provides a diagram describing functional cabling and network connection elements that have been standardized by the Owner. This cable information is consistent with, but exceeds, the requirements as contained in EIA/TIA Specification 606. Terminating Points In (TPI) and Terminating Points Out (TPO) may be 110-Type blocks, 110-Type blocks, 24 or 48 density RJ-45 Patch Panels, or Fiber Optic Patch Panels. Termination point equipment is not part of cable records.

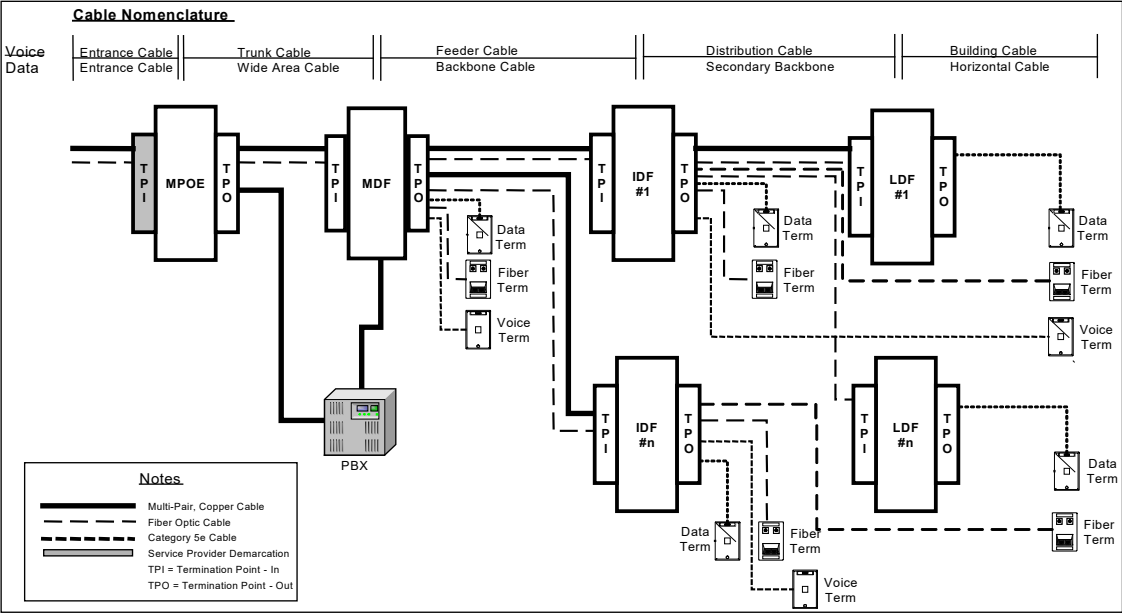


Figure 3-1 - Functional Cabling and Network Connection Elements

4. Each cable sheath shall be identified by laser-generated labels, and on the cabling record document (see attachment 3) by means of a nine-digit alpha/numeric number. In addition to the nine-digit sheath/cable number, provide three-digit, numeric pair/strand-numbering information specific to each cable/sheath number. The pair/strand number will be documented in the cable record document (attachment 3). The following provides the definition and use of each field.

Cable Number								Pair/Strand			
Number											
A	A	N	N	N	N	N	N	-	N	N	N

#1 - Cable Definition	#2 - Cable Type	#3 - Destination No.	#4 - Destination No.	#5 - Destination No.	#6 - Cable Number	#7 - Cable Number	#8 - Cable Number	#9 Reserved	#10 Pair/Strand	#11 Pair/Strand	#12 Pair/Strand
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A=alpha characters only; N=numeric character only

5. The following are the permissible characters that may be entered into each field.

a. Cable Definitions (Field #1):

T Trunk – Voice from MPOE to MDF
W Wide Area – Data from MPOE to MDF
F Feeder – Voice from MDF or PBX to IDF
B Backbone – Data from MDF to IDF
D Distribution – Voice IDF to LDF (see note below)
S Secondary Backbone – Data IDF to LDF
B Building cable drops – Voice IDF to User Jack
H Horizontal – Data IDF, or LDF to User Jack

b. Cable Types (Field #2):

C Multi-pair copper cable
F Multi-pair fiber optic cable

c. Destination Number (Fields #3-4):

Fields 3 -- 5 taken together will be a three-digit sequential number identifying the IDF, or LDF destination. The first digit of this destination number (field #3) will be structured to identify whether the destination is an IDF or LDF using the following convention:

- 1) IDFs are identified in field #3 by the numbers “0” through “1”.
- 2) LDFs are identified in field #3 by the numbers “2” through “3”.
- 3) The numbers “4” through “9” are reserved for future use.
- 4) For each situation, fields #4 and #5 will be a sequential number identifying unique, specific IDF or LDF locations.

By this convention, each IDF or LDF will be represented by a unique three-digit number; IDFs will be numbered in the range 000 – 199 and LDFs will be numbered in the range 200 – 399.

d. Cable Number (Fields #6-8):

This will be a unique and sequential three-digit number assigned to each cable sheath.

- e. Field #9 is reserved and will be represented using a dash “-”.
- f. Pair/Strand Number (Fields #10-12):
This will be a unique and sequential three-digit number for each copper cable pair or fiber strand within a sheath.

Note: Code “D” in the Cable Definition Field is a non-standard cable configuration and normally not used. Owner serves voice jacks directly from IDFs. The Owner must approve, in advance of construction or installation, any installation that brings voice communications through an LDF.

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.

3.07 OWNER ORIENTATION

- A. Completed shop drawings, as specified in Article 3.04 above shall serve as the Owner’s orientation.

END OF SECTION

APPENDIX 1 – ACRONYMS

ANSI	American National Standards Institute
BICSI	Building Industry Consulting Services, International
CESM	Compact Edge Switch-Managed
CLDF	Classroom Local Distribution Frame
EIA	Electronic Industries Alliance
ESM	Edge Switch-Managed
FEP	Fluorinated Ethylene Propylene
HVAC	Heating, Ventilation, and Air Conditioning
IDF	Intermediate Distribution Frame
IEC	International Electrotechnical Commission (IP Code)
IEEE	Institute of Electrical and Electronic Engineers
IP32	Degree of Ingress Protection Provided by Enclosures (IEC)
IP	Internet Protocol
IPX	Inter-network Packet Exchange
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISM	Intermediate Switch-Managed
ISP	Internet Service Provider
ITD	SMC, Information Technology Division
LAN	Local Area Network
LDF	Local Distribution Frame
LIU	Light Interconnection Unit
MDF	Main Distribution Frame
MDF-BBS	Main Distribution Frame Backbone Switch
MPOE	Minimum Point of Entry
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
OAR	Owner Authorized Representative
OFNR	Optical Fiber Non-Conductive Riser
OTDR	Optical Time Domain Reflectometer.
PA	Public Address
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories Inc.
UTP	Unshielded Twisted Pair
WAN	Wide Area Network

END OF APPENDIX 1

APPENDIX 2 – DEFINITIONS

BBS	The Backbone Switch that serves as the central point of network termination, and provides network connectivity to IDFs, computer labs, student nutritional service areas, and libraries.
ISM	The Intermediate Switch–Managed serving as the network termination point for horizontal cabling to classrooms and other areas excluding computer labs and libraries.
ESM	The Edge Switch–Managed serving as the network termination point for horizontal cabling within computer labs, student nutritional service areas, and libraries.
CESM	The Compact Edge Switch-Managed and is a small form factor network access point within the classroom or other designated area for network connections.
MDF	The structure that serves as an entrance facility or main cross-connect, serving the building or campus.
IDF	Located between the MDF and the LDFs and provides a network access point for horizontal fiber cabling.
LDF	A wall-mounted cabinet that serves as the termination point for Category 5E cabling within the room/area in a computer lab, student nutritional service area, or library.

END OF APPENDIX 2

SECTION 27 1017

WIRELESS LOCAL AREA NETWORKS (WLAN)

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes the equipment, installation, integration, configuration, testing, training, documentation, standards, and acceptance criteria, necessary for acquiring and implementing IEEE controller-based 802.11ax Wireless Local Area Network (WLAN) systems at SMC.
- B. The WLAN system and associated components shall consist of IEEE 802.11ax compliance and Wi-Fi Alliance certification wireless Access Points, Bridges, Controllers, and client adapters. The controller and access point combination shall be Wi-Fi Alliance certified under the category of "Enterprise Access Point, Switch/Controller or Router" and possess the associated Interoperability Certificate and Certification ID." The WLAN system shall also include associated radios, antennas, cables, enclosures, administration software, and related materials.

1.02 RELATED SECTIONS

- A. Applicable Division 01 sections
- B. Section 00 7000: General Conditions
- C. Section 01 7700: Contract Closeout
- D. Section 21 2323: Excavating, Backfilling and Compacting for Utilities
- E. Section 26 0500: Common Works Results for Electrical
- F. Section 26 0513: Basic Electrical Materials and Methods.
- G. Section 26 0526: Grounding and Bonding
- H. Section 26 0533: Raceways and Boxes Fittings and Supports.

1.03 REFERENCES

- A. Complete installation shall meet or exceed the latest edition of following standards:
 - 1. EIA/TIA-568C: Commercial building telecommunications wiring standard and all current addenda
 - 2. EIA/TIA-569A: Commercial building standard for telecommunications pathways and spaces
 - 3. EIA/TIA-606A: Administration standard for telecommunications infrastructure of commercial buildings

4. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications
5. California Building Code (CBC)
6. California Electrical Code (CEC)
7. National Fire Protection Association (NFPA), NFPA-70
8. National and State Occupational Safety and Health Administration (OSHA) requirements.
9. Institute of Electrical and Electronic Engineers (IEEE) 802.3 (Ethernet), 802.3u (100Base-TX/FX), 802.3z (Gigabit Ethernet over optical fiber), 802.3ab (Gigabit Ethernet over 4 pair category 5 or higher), 802.3ae (10GbE), 802.3be (40 and 100GbE) 802.3ad Link Aggregation Control Protocol, 802.11 (Wireless LAN) including 802.11n-2009 (part 11 amendment 5), 802.11ac, 802.11ax, 802.11af (PoE), 802.11at (PoE+), 802.1d (spanning tree protocol), 802.1p (QOS), 802.1q (VLAN tagging), 802.1x (Port Based Network Access Control), RFC 2236/5186 (IGMP v2/v3), RFC 3973/4602 (PIM-DM/SM), RFC 2365 (Administratively Scoped IP Multicast)
10. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable
11. ADA – Americans with Disabilities Act
12. BICSI Telecommunications Distribution Methods Manual, current edition
13. BICSI Wireless Design Reference Manual, current edition

1.04 SUBMITTALS

A. following submittals in accordance with Division 01:

1. Materials list: Submit a complete material list for the materials and products of this section.
2. Product Data: Include Product Data sheets and/or catalog cut sheets for all items to be installed. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Items shall be arranged in the same order as the index and if more than one item is indicated, the submitted items shall be highlighted or marked with an arrow. Product Data shall be sufficiently detailed to allow the ARCHITECT to review the product and to allow other trades to provide necessary coordination.
3. CONTRACTOR shall include in the Product Data list submission, copies of manufacturer certificates that the CONTRACTOR is an authorized distributor of the submitted manufacturer's products; and each member of the installation crew has been trained and certified in the installation of those products. CONTRACTOR shall submit proof that his/her company

has a service organization capable of responding within 24 hours of receipt of written notification and resolution within 1 day.

- B. Sample Materials: CONTRACTOR shall provide samples of material and equipment as required by the ARCHITECT. If samples are requested, they shall be submitted within 10 days from the date of request.
- C. Site Survey Report: Prior to the WLAN installation, the CONTRACTOR shall submit a WLAN Site Survey Report to the OWNER ITD PMO for review and acceptance. At a minimum, the report shall include the following information:
 - 1. WLAN system architecture and design
 - 2. RF and interference areas for the WLAN system including signal strengths, antenna types and locations for survey, AP and Bridge model used for survey, types and strength of interference identified.
 - 3. Configuration settings for Access Points and Controllers
 - 4. Name and location of Access Points, Bridges, and Controllers
 - 5. Access Point infrastructure models (i.e., Autonomous AP, Controller-based AP)
 - 6. Antenna types to be used per Access Point
 - 7. Mounting instructions for Access Points, Bridges and antennas
 - 8. Access Point, Bridge, and wireless client channel selections
 - 9. Power provisioning requirements for the Access Points and Bridges
 - 10. Power output settings per Access Point
 - 11. Connectors and cables to be used
 - 12. Digital pictures of locations for all Access Points, Bridges, Controllers and antennas
 - 13. Submit mapping of signal strength levels in all areas of interest on site.
- D. CONTRACTOR shall submit Shop Drawings, providing a complete set of detailed and scaled indication of Access Points, Bridges and antennas with dimensions, WLAN topology maps, location designations, and instrument wiring diagrams. Indicate required interfaces with equipment provided in other sections. At the minimum, Shop Drawings shall include the following engineering documentation:
 - 1. Summary and diagrams of logical and physical wireless design, including:
 - a) A comprehensive description of the logical and physical wireless design and derivation of the design.
 - b) Detailed process used to perform the actual site survey for both indoor and outdoor applications. This process shall include all survey tools, methodologies utilized, and the assumptions made to accommodate the design requirements.

- c) Access Point, Bridge and antenna mounting equipment and diagrams.
- d) Any additional diagrams and information on logical and physical wireless design that the CONTRACTOR feels is necessary to provide a complete solution.
- e) A set of as-built documents showing the completed installation with all of the requirements as detailed in the WLAN site survey.
- f) WLAN Site Survey: when Notice to Proceed has been given, CONTRACTOR shall submit a site survey (SS) plan and subsequent design for the deployment of WLAN technology for each site. Site Survey and design drawings shall, at a minimum, identify and include the following:
 - (1) Cell Planning
 - (2) Cell search threshold
 - (3) Sources of RF interference, if any are present.
- g) All Access Points and Bridges currently in operation, both on-site and other, such as neighboring residences, channel selection and device locations using a strategy to minimize interference with neighboring devices. Locate and identify all WLAN devices currently in operation on the designated site.
 - (1) AP density
 - (2) AP, Bridge, and Controller placement
 - (3) Antenna selection, locations and mounting methodology
 - (4) AP, Bridge, and Controller locations and mounting methodology
- h) Paper copies shall show site building backgrounds, device locations, pathways, wired LAN connection points and WLAN site coverage.
- i) CONTRACTOR shall provide two-dimensional drawings indicating the location of all Access Points, Bridges, and Controllers. Drawings shall be prepared in latest version of AutoCAD or Microsoft Visio with 3 electronic copies submitted along with full sized Drawings.
- j) Riser diagram indicating all connections in a manner following the floor plan layout.
- k) Cabling diagram indicating the CONTRACTOR's designed routing and number of cables in specific raceways or conduits, from the main data sources connecting to other sub-panels, modules, or devices.

- E. Preliminary Plans: Submit documentation including a preliminary installation schedule, architecture and design plan, and call flow patterns to OWNER for review prior to the start of work. Installation Work shall not commence before installation CONTRACTOR receives OWNER approval of design and architecture.
- F. CONTRACTOR shall provide a migration and integration plan that details the CONTRACTOR's implementation strategy to complete the WLAN system. This plan shall be prepared by the CONTRACTOR and approved by the OWNER.
- G. Inventory of installed systems shall be documented in the OWNER provided Asset Management Excel Workbook as required by Contract Documents.
- H. Certified Statements: CONTRACTOR shall provide the following certification statements:
 - 1. CONTRACTOR shall provide shop drawings, in the same size as the Record Drawings. Shop Drawings shall be prepared in latest version of AutoCAD format with 3 electronic copies submitted along with full sized Shop Drawings.
 - 2. CONTRACTOR shall provide a letter from the Manufacturer assuring the availability of spare parts common to proposed system for a period no less than 5 years on all components.
 - 3. Certification of compliance that California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act shall not exceed the following allowed content in parts per million (ppm):
 - a. Lead content > 0.1% or 1000 ppm.
 - b. Mercury Content > 0.1% or 1000 ppm.
 - c. Cadmium Content > 0.01% or 100 ppm.
 - d. Hexavalent Chromium > 0.1% or 1000 ppm.
 - e. Polybrominated Biphenyls > 0.1% or 1000 ppm.
 - f. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.

1.05 SUBSTITUTIONS

- A. Equipment substitutions must be pre-approved by OWNER prior to bid date. CONTRACTOR must demonstrate operation of equipment and compliance with functions and features specified herein. Additionally, CONTRACTOR must demonstrate interoperability of design and systems with existing systems. Equipment substitutions that were not pre-approved prior to bid date shall be rejected.
- B. When deviating or substituting equipment, the following information shall be submitted:
 - 1. Substitution request form substantiating reasons and benefits to OWNER.

2. OWNER'S approval shall be obtained for any equipment or materials substitutions. Proposed substitutions requests shall provide proof of compliance with OWNER'S criteria described in these specifications.
3. Submittals must comply with contract general provisions.

1.05 QUALITY ASSURANCE

- A. Work shall conform to CCR, Title 24 Part 3, Basic Electrical Regulation and National Electrical Code, latest edition.
- B. Only a qualified CONTRACTOR holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
- C. The CONTRACTOR shall use adequate numbers of skilled workers who are manufacturer certified, thoroughly trained and experienced on the necessary crafts, and completely familiar with the specified requirements and methods needed for the proper performance of the work.
- D. Work shall be performed by CONTRACTOR that has completed at least 5 school systems of equal scope to system described herein and shall have been engaged in business of supplying and installing specified type of systems for at least 5 years. CONTRACTOR shall maintain a fully equipped service organization capable of furnishing repair service to equipment.
- E. The CONTRACTOR shall provide technicians and tools required to participate in OWNER's Quality Assurance Testing as detailed in Attachment "A" of this specification.
 1. Items on check list of Attachment "A" shall be examined as a minimum at the Public Address Head End, terminal cabinets, ground vaults and classrooms. Should the examination show deficiencies related to items in the checklist, OWNER's acceptance testing shall be discontinued until corrections have been made. When the CONTRACTOR has completed the corrections, a subsequent Quality Assurance test shall be initiated. This procedure is in addition to the system functionality testing required in section 3.03 below.
- F. Provide equipment mounting structural engineering details in compliance with the California Code of Regulations seismic requirements.

1.06 WARRANTY

- A. CONTRACTOR shall warranty that all work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of five (5) years from date of installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than five (5) years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the OWNER, the CONTRACTOR shall repair or replace at no expense to the

OWNER, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the OWNER shall not relieve CONTRACTOR from these obligations.

- B. All warranty shall provide the OWNER direct access to manufacturer Technical Assistance Center (TAC), software updates, and defect support.
- C. Manufacturer of provided equipment shall guarantee availability of parts common to provided system and/or full replacement units, for a period not less than five (5) years. Parts for the supplied systems shall be available within 30 calendar days during the 5-year period.
- D. CONTRACTOR shall install all equipment in accordance with all manufacturer's specifications and recommendations necessary to ensure continuation of the manufacturer's warranty. If the installation CONTRACTOR cannot install manufacturer's equipment in such a manner, it is the responsibility of the installation CONTRACTOR to provide written, timely notification to the OWNER ITD Project Management Office.
- E. OWNER monitors equipment service records and failure rates. In the event that the OWNER determines that a wireless LAN system, or model part, provided through this specification exceeds acceptable failure rate, or repeated failure rate, the CONTRACTOR shall replace all systems (of the same model) purchased through this procurement with a new model that meets or exceeds the same functional requirements. Units or components exceeding either the acceptable or repeated failure rates shall be known as a "mass failure." The CONTRACTOR shall provide qualified technicians to install the replacement systems and a Project Manager to coordinate replacement schedule with ITD. Replacement of mass failing systems, labor, and project management shall be provided and completed in accordance with this specification and related OWNER installation guidelines at no additional cost to the OWNER.
 - 1. The acceptable failure rate/repeat failure rate for a single system model or individual modular model part, at a single site, or OWNER-wide, shall be less than or equal to 10% in any 12-month period during the original warranty term.
 - 2. If at any time, during the warranty term, the failure rate of the wireless LAN systems or components exceeds 15%, the CONTRACTOR shall replace the failed systems and/or components with new or equivalent models and extend the original warranty term by one year from the installation date of replacement at no additional cost to the OWNER.
 - 3. CONTRACTOR is responsible for replacement of any failed equipment provided by the CONTRACTOR, during the warranty period or the extended warranty period. This includes equipment that falls under the "mass failure" definition.

4. In the event of a “mass failure” the CONTRACTOR shall replace all units and/or components affected within 60 days of written notification from the OWNER.
 5. Upon replacement of each unit or component, the replaced unit warranty shall continue as if the original equipment were still in service.
- F. The warranty shall cover the complete wireless LAN system including all associated components, software, fan assembly, power supplies, and the device itself.
 - G. The warranty shall include coverage 8 hours per day, 5 days per week with next business day parts for all other covered components and chassis.
 - H. The warranty shall include all labor to service and/or replace warranted system(s).
 - I. All equipment shall have the option for OWNER to extend the warranty beyond the initial coverage period.
 - J. In the event any supplier or manufacturer offers additional warranty, at no additional cost, beyond that specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the OWNER without additional cost.
 - K. Equipment manufacturers shall have E-mail trouble reporting and response mechanisms in place and a toll free 24-hour help center to assist with troubleshooting and operation of the equipment at no additional cost to the OWNER, or as part of the warranty.

1.07 SYSTEM REQUIREMENTS

- A. The access points shall support both 2.4 GHz and 5 GHz radios. The 2.4 GHz radio shall be set to support legacy clients
- B. Installation shall include all power cords, cable patches at wireless equipment, as well as cable patches to the OWNER LANs.
- C. CONTRACTOR shall coordinate patch cable runs, equipment locations, and electrical power requirements with the OWNER’s ITD Project Management Office prior to installation. CONTRACTOR and the ITD Project Management Office must agree as to the final location and placement of all devices.

PART 2 - PRODUCTS

2.01 EQUIPMENT STANDARDS

- A. Prior to installation CONTRACTOR shall provide the following:
 1. Max (Wi-Fi) power (in dBm) for each and every WLAN Bridge model, Bridge Antenna model, AP model, and AP antenna model.
 2. Transmit power (in dBm) per port per WLAN Bridge model and AP model.

3. Number of antennas per WLAN Bridge model and AP model.
 4. Antenna gain (in dBi) per Bridge Antenna model and AP model.
- B. Provide Aps mounting details in compliance with manufacturer's specifications.
- C. Provide a padlock to secure each indoor AP to its mounting bracket, using the provided security hasp.
- D. All major WLAN equipment (Access Points, Bridges, Controllers) installed at a standalone or campus site shall be from a single manufacturer except otherwise approved by the OWNER.
- E. Equipment Requirements
1. CONTRACTOR shall provide manufacturer's equipment specification sheets.
 2. Use only OWNER approved products.
 3. Equipment support of Centralized Management:
 - a. The OWNER requires that all networking components deployed on its wide Network shall be capable of supporting local or remote management anywhere within the OWNERs Enterprise network. For the purposes of this document, a network component is defined as any component or device that provides connectivity to the OWNER-wide Network. Examples include: Wireless Access Points, Bridges, Controllers, Connecting switches, routers, gateways, Uninterruptible Power Supplies, etc.
 - b. CONTRACTOR provided devices shall meet the following requirements:
 - (1) Each component shall support remote management in compliance with the Simple Network Management Protocol (SNMP) standards with community string authentication.
 - (2) Device operational status, name, descriptive information, and Operating System (OS) and/or firmware versions (e.g., MIB-II System tree).
 - (3) Interface operational status and traffic/error statistics for all interfaces in use (e.g., MIB-II Interfaces tree).
 - c. The CONTRACTOR shall include and enable for use all manufacturer developed SNMP agents and agent features available for the provided equipment.
 - d. For devices with agents supporting private enterprise MIB extensions (ASN.1 Object Identifier .1.3.6.1.4.x) all extensions

must be included and enabled for use: in addition, the CONTRACTOR shall provide:

- (1) Electronic documentation for all private enterprise MIB extensions supported by the device in Abstract Syntax Notation number One (ASN.1)/Structure of Management Information (SMI) MIB format.
 - (2) Electronic versions of SNMP manageable equipment shall include accessible Internet links (e.g., URL) to all manufacturer developed documentation regarding the features, use, and/or configuration of the device agent(s).
- e. If procedures for remote management, configuration, or software/firmware upgrades of the equipment require the use of proprietary or otherwise manufacturer-specific software, the CONTRACTOR shall include in submittal the specification (i.e. name, version, part number) and price for this software sufficient to perform remote management functions.
- F. Non-Proprietary Implementation: Manufacturers' proprietary protocols or capabilities required to either deliver an operational overall system or preclude future implementations that rely on prevailing industry standards shall not be acceptable.

2.02 WIRELESS LAN EQUIPMENT

All wireless LAN systems and ancillary components shall meet the following requirements:

- A. Wireless LAN System: All Access Points shall have the capability to operate both independently and simultaneously in ax and IEEE 802.11g wireless modes without causing abnormal degradation in client-to-access point performance.
1. WLAN system as a complete operational unit shall be a "Controller-based" system.
 2. The general requirements for 802.11ax Access Points are as follows:
 - a. Adhere to the IEEE 802.11ax
 - (1) At the minimum, the Access Point shall support 4 spatial streams (4SS) dual band 5 GHz and 2.4 GHz.
 - (2) PHY Data rates;
 - (a) 2.5GHz: 550Mbps
 - (b) 5GHz: 2,000Mbps
 - (3) Dynamic Frequency Selection (DFS)
 - (4) Wireless Medium: OFDM/OFMDA, MU-MIMO

- (5) Adjustable Transmit Power for 2.5GHz and 5GHz (indoor and outdoor models)
 - (6) Uplink Interface shall meet the following
 - (a) Comply with IEEE 802.3bz, multi-gigabit
 - (b) Link speed: 100/1000/2500
 - (c) PoE: 802.3af, 802.3at, 802.3bt
 - (7) Enable platform capabilities for IoT applications
- 3. The Controller-based system shall meet the following:
 - a. Compliant with the IEEE 802.11ax standards.
 - b. Certified by Wi-Fi Alliance organization for interoperability.
 - c. For medium and larger installation, a minimum of 10 Gbps fiber-based connection between the controller and the BBS.
 - d. For small installation, a minimum of 2 Gbps connection between the controller and the BBS.
 - e. A minimum of one 10G Ethernet port. Provision the controller's ports to the BBS based upon the anticipated bandwidth requirements.
 - f. Manage concurrent connections from IEEE 802.11ax controller-based Access Points. Controllers shall be sized to support small, medium, and large installations of Access Points in similar groupings to the following:
 - (1) Small: Up to 49 Access Points
 - (2) Medium: 50 to 150 Access Points
 - (3) Large: More than 150 Access Points
 - g. Scalable Controller Based Architecture

Controllers shall be scalable to accommodate the number of managed Access Points, in case of exceeding capacity of a single controller under the same management domain.
 - h. Shall be customizable per Access Point Group;
 - (1) 802.11 data rates and MCS rates
 - (2) 2.4/5 GHz transmit power settings
 - (3) 2.4/5 GHz channelization including channel width
 - (4) Client load balancing settings
 - (5) Assisted roaming parameters
 - i. Operational Modes

- (1) Controllers shall be capable of forwarding wireless traffic between wireless client devices and the wired LAN on behalf of the managed Access Points.
 - (2) Controllers shall be capable of configuring managed Access Points to forward wireless traffic between wireless client devices and the wired LAN.
 - (3) Controllers shall provision managed Access Points to support the Extended Service Set (ESS) operational mode
- j. Management Structure

Controllers shall be capable of supporting a hierarchical management model. At the lowest management tier, controllers manage Access Points. At the highest management tier, a Centralized Controller manages and/or provides backup capability to the Controllers in the lower tier.
- k. IP Address Management
 - (1) IP Management shall be capable of being manually configured with a static IP address.
 - (2) IP Management shall have the ability to retain a previously assigned static IP address for the Controller and managed Access Points after a voluntary or involuntary reset of either device.
 - (3) IP Management shall be capable of being dynamically configured with an IP address using DHCP services.
- l. Support VLAN trunks and tags as defined by IEEE 802.1q. This support should allow the network administrator to differentiate client access and services based on their assigned VLAN.
 - (1) Shall support a minimum of 8 VLANs concurrently.
 - (2) Shall allow the native VLAN to be un-tagged.
- m. Support the IEEE 802.1x port-based authentication standard and the following authentication types:
- n. Security Standards
 - (1) WPA, WPA2 Enterprise, WPA3 Enterprise
 - (2) 802.11i
 - (3) MD5
 - (4) HMAC – Keyed Hashing for Message Authentication
 - (5) TLS v1.2
 - (6) PKI Certificate and CRL Profile

- o. Authentication/Authorization
 - (1) 802.1x
 - (2) EAP-TLS
 - (3) EAP-TTLS
 - (4) EAP-FAST
 - (5) PEAP or EAP-CHAP v2
 - (6) RADIUS Authentication
 - (7) Extensible Authentication Protocol (EAP)
- p. Management
 - (1) SNMP
 - (2) Telnet
 - (3) SNMP MIB, MIB II
 - (4) HTTP
 - (5) Syslog
 - (6) HTTP, HTTPS, SSH, Serial Communication/Console port access
- q. Encryption
 - (1) TKIP-MIC
 - (2) SSL, TLS
 - (3) AES
- r. Support the IEEE 802.11i key distribution and management standard.
- s. Provide support for a minimum of eight (8) SSIDs per Access Point. Each SSID must be able to concurrently support multiple disparate encryption types (for example WPA/WPA2/WPA3 Enterprise).
- t. Configuration Management
 - (1) Shall allow secure access to Controller using TACACS AAA authentication.
 - (2) Shall be capable of establishing access control lists that allow filtering of designated traffic, based on identifiable attributes within an 802.11 frame. At a minimum, the Controller shall provision the Access Point to provide traffic filtering support based upon MAC address and protocol type.
 - (3) Shall provide support for secured local and remote configuration of the Controller:

- (a) TACACS AAA authentication
 - (b) HTTPS and/or SSH
- (4) Shall provide support for secured local and remote firmware upgrades of the Controller and managed Access Points.
- (5) Shall provide support for enabling and disabling SSID broadcasts; power-save mode; system logging; automatic and manual selection of transfer rates; selecting client authentication modes; beacon intervals; DTIM intervals; RTS thresholds; and fragmentation thresholds on managed Access Points.
- u. Status and Monitoring
 - (1) Shall provide diagnostic capabilities for the wireless link's connectivity status and throughput performance on managed Access Points.
 - (2) Shall provision managed Access Points with the capability for radio configuration information including operating channel, transmit power, supported data rates, and regulatory settings can be examined from a remote location (via secure connection). This capability should allow the administrator, from the central management station, to identify clients associated with the access point, run link tests, determine signal strengths and remotely adjust signal and power levels.
 - (3) Shall support the addition of campus, building, and floor plan maps to the controller's database or a management system. The maps shall be capable of providing live view depictions of RF coverage. The controller shall have the capability of having a campus map uploaded and stored on the controller or a management system
- v. WLAN Management
 - (1) Access Points and controllers must have the ability to be securely managed and monitored from a central management system. At a minimum, a WLAN administrator should be able to perform the following activities from the central management and monitoring console:
 - (a) Conduct performance monitoring of the WLAN infrastructure from a central location.
 - (b) Detect (and preferably isolate) non-standard Access Points installed on OWNER network infrastructure.
 - (c) Automatically distribute configuration changes to large groups of Access Points in a single instance.

- (2) Upgrade Access Point and controller firmware and software from a central management system Access Point shall provide support for remote management using the SNMP and MIB I/II standards.
 - (3) Provisioning of the Central Management System and related components are to be specified and furnished per project scope and requirement.
- w. Antenna Configuration and RF Management
 - (1) Shall support MIMO and backward compatibility for 802.11g/n/ac.
 - (2) Shall provision managed Access Points to support manual RF management to assign spectrum channels and client associations based upon configurable parameters.
- x. Power Management
 - (1) Shall provision managed Access Points to allow remote configuration of the radio transmit power to enhance (or constrain) RF coverage areas
 - (2) Shall provision managed Access Points to support the two power management modes as specified by the IEEE 802.11 standard. These modes include continuous aware mode (CAM) and power save polling (PSP) mode.
 - (a) When power management is enabled on a wireless client adapter, the Access Point and client station must support traffic indication maps (TIM) for unicast traffic and delivery traffic indication messages (DTIM) for broadcast and multicast traffic.
 - (3) The Controller shall provision managed Access Points with the capability to receive IEEE 802.3af/at/bt compliant inline power over a Category 5e/6 Ethernet cable infrastructure using the following method:
 - (a) Power is distributed to the Access Point via an 802.3af/at/bt compliant LAN switch.
- y. Bandwidth Management
 - (1) Controller shall provide a bandwidth management functionality (bandwidth allocation per Access Point SSID) to optimize wireless LAN bandwidth for client associations.
 - (2) WLAN System shall be capable of supporting Beamforming.

- (3) WLAN system shall be capable of identifying, isolating, and containing to non-Wi-Fi interfering devices.
- z. QoS over Wireless
 - (1) Controller shall provide support for the IEEE 802.11e (QoS) standard for traffic prioritization services over the wireless link.
 - (2) Controller shall be capable of prioritizing wireless traffic based on the IEEE 802.1p tag in the Ethernet header or the IP type of service/Differentiated Services Code Point (TOS/DSCP) bits in the IP header.
- aa. RF Management Capability
 - (1) Shall support adaptive RF management for managed Access Points to dynamically assign spectrum channels based upon configurable parameters.
 - (2) WLAN System shall be capable of Rogue detection and containment.
 - (3) WLAN shall provide automatic RF interference avoidance by dynamically changing channels to non-effected spectrum.
 - (4) Shall be capable of provisioning managed Access Points to operate in the following mode if required:
 - (a) Repeater Mode – Used to connect wireless clients and/or while providing a wireless uplink connection to a root access point. In this mode the repeater is not connected to a wired Ethernet.
 - (b) Hot Standby Mode – Shall be capable of provisioning managed Access Points to operate as a backup to another Access Point in the event of a failure to one Access Point.
- bb. Roaming Support
 - (1) Inter-Access Point Roaming
 - (a) The controller shall support 802.11r fast Basic Service Set transition between access points.
 - (b) The controller shall support intra-controller roaming.
 - (c) The controller shall support intra-subnet roaming.
- cc. Optional Features
 - (1) The Controller shall be capable of supporting an N+1 fault tolerance model when an additional Controller is added.

B. The Bridge, as provided only on a case-by-case basis, shall support the following. The Bridge is a station in a wireless LAN that connects two or more wired LANs using RF spectrum.

1. The general requirements for 802.11ax Bridge are as follows:

- a. Adhere to the IEEE 802.11ax
 - (1) At the minimum, the Access Point shall support dual band 5 GHz and 2.4 GHz.
 - (2) PHY Data rates;
 - (a) 2.5GHz: 550Mbps
 - (b) 5GHz: 2,000Mbps
 - (3) Dynamic Frequency Selection (DFS)
 - (4) Wireless Medium: OFDM/OFMDA
 - (5) Adjustable Transmit Power for 2.5GHz and 5GHz
 - (6) Uplink Interface shall meet the following
 - (a) Comply with IEEE 802.3bz, multi-gigabit
 - (b) Link speed: 100/1000/2500
 - (c) PoE: 802.3af, 802.3at, 802.3bt

2. The Bridge, as provided, shall support the following with the exception of the identified optional features:

- a. Compliant with the IEEE 802.11ax standard.
- b. Certified by Wi-Fi Alliance organization for interoperability.

3. The Bridge shall be capable of operating in the following bridging mode:

Root Bridge – In this mode, the bridge connects to the wired network and communicates with other bridges. This configuration is used to create wireless point-to-point connections (and optional point-to-multipoint connections) with the intent to extend LAN services.

4. IP Address Management

- a. Shall be capable of being manually configured with a static IP address.
- b. Shall have the ability to retain a previously assigned static IP address after a voluntary or involuntary reset of Bridge.
- c. Shall be capable of being dynamically configured with an IP address using DHCP services.

5. Support VLAN trunks and tags as defined by IEEE 802.1q. This support should allow the network administrator to differentiate client access and services based on their assigned VLAN.
 - a. Shall support a minimum of eight (8) VLANs concurrently.
 - b. Shall allow for the native VLAN to be un-tagged.
6. Support the IEEE 802.1x port-based authentication standard and the following authentication types:
 - a. EAP-MD5
 - b. EAP-TLS
 - c. EAP-TTLS
 - d. PEAP
 - e. EAP-MSCHAP v2
7. Shall support the following encryption types:
 - a. WPA-Personal (TKIP)
 - b. WPA2-Personal (TKIP, AES)
 - c. WPA-Enterprise (TKIP)
 - d. WPA2-Enterprise (TKIP, AES)
8. Support the IEEE 802.11i key distribution and management standard.
9. Configuration Management
 - a. Shall be capable of establishing access control lists that allow filtering of designated traffic, based on identifiable attributes within an 802.11 frame. At the minimum, the Bridge shall be capable of providing traffic filtering support based upon MAC address or protocol type.
 - b. Shall provide support for secured local and remote configuration of Bridge (e.g., authenticated local user console access and remote HTTP/HTTPS and SSH).
 - c. Shall provide support for secured local and remote firmware upgrades.
 - d. Shall provide support for enabling and disabling SSID broadcasts; power-save mode; system logging; automatic and manual selection of transfer rates.
10. Status and Monitoring
 - a. Shall provide diagnostic capabilities for the wireless link's connectivity status and throughput performance.

- b. Shall provide the capability to examine radio configuration information including operating channel, transmit power, supported data rates, and regulatory settings from a remote location (via secure connection). This capability should allow the administrator, from the central management station, run link tests, determine signal strengths and remotely adjust signal and power levels.
- 11. WLAN Management
 - a. Bridges shall have the ability to be securely managed from a central management and monitoring console location via SNMP and HTTP/HTTPS. At the minimum, a WLAN administrator should be able to perform the following activities from the central management and monitoring console:
 - (1) Automatically distribute configuration changes to large groups of Bridges in a single instance.
 - (2) Upgrade Bridge firmware from a central management system.
 - b. Bridge shall provide support for remote management using the SNMP and MIB I/II standards.
- 12. External Antenna
 - a. Dual band 2.4 GHz and 5 GHz antenna should be used whenever applicable.
- 13. Connectors
 - a. Minimum of two 5 GHz RP-TNC or N-type or RP-SMA connectors
 - b. Minimum of two grounding lugs for lightening protection
- 14. Antenna Configuration and RF Management
 - a. Shall support detachable antennas and provide a variety of FCC-compliant, Omni-directional, and directional antennas as required by Contract Documents.
 - b. Shall support antenna diversity and a configurable option for enabling and disabling diversity mode.
 - c. Shall support manual RF management to assign spectrum channels based upon configurable parameters.
 - d. Fixed wireless Bridges shall support a utility to align the antenna or tune the wireless connection by reading or displaying the signal strength.
- 15. Power Management
 - a. Shall provide a capability for locally and remotely configuring the radio transmit power to enhance (or constrain) RF coverage areas.

- b. In addition to supporting local AC power, the Bridge shall be capable of receiving IEEE 802.3af or 802.11at compliant inline power over a Category 5e/6 Ethernet cable infrastructure using the following method:

- (1) Power is distributed to the Bridge via an 802.3af or 802.11at compliant LAN switch.

16. QoS over Wireless

- a. Bridge shall provide support for 802.11e (QoS) standard for traffic prioritization services over the wireless link.
- b. Bridge shall be capable of prioritizing traffic based on the IEEE 802.1p tag in the Ethernet header or the IP type of service/Differentiated Services Code Point (TOS/DSCP) bits in the IP header.

17. Optional Features

- a. Shall support adaptive RF management to dynamically assign spectrum channels based upon configurable parameters
- b. The Bridge shall be capable of operating in the following mode as set by an administrator:
 - (1) Repeater Mode – Used to connect wireless clients, while providing a wireless uplink connection to a root access point. In this mode the repeater is not connected to a wired Ethernet.

B. Wireless LAN Accessories

- 1. RF Amplifier – FCC compliant “fixed-linear” amplifiers shall be used to increase RF strength.
- 2. RF Attenuators –FCC compliant “fixed-loss” attenuators shall be used to reduce RF strength.
- 3. Lightning Arrestors – Shall be installed with all exposed external antenna towers and shall be grounded per California Electrical Code.

B. Wireless LAN Enclosures

- 1. Each access point or bridge shall be mounted and oriented per manufacturer’s recommendations. Access points or bridges are to be mounted to the ceiling, hard lid, or T-bar, installed in an existing or new LDC cabinet with sufficient room, or use an integral AP mounted near the LDC. If this is not possible, use a WDC enclosure, rated as appropriate to the installation environment - unless otherwise noted in the statement of work.
 - a. All enclosures shall be NEMA rated as applicable to the installation environment and designed specifically for WLAN equipment.

- b. Enclosures shall be constructed of RF transparent materials such as fiberglass or fiberglass reinforced polyester to allow mounting without external antenna.
- c. Enclosures shall provide passive ventilation sufficient to maintain manufacturers recommended operating temperature range to protect the access point from overheating.
- d. Enclosures shall contain provisions for mounting the access point and accessories as well as a minimum of two Ethernet ports
- e. Enclosure shall be lockable with integral locking mechanism or exterior hasp and padlock.
- f. Wireless access point shall not be installed in an outdoor enclosure unless otherwise approved by the OWNER.

2.03 GROUNDING

- A. Wiring enclosures, terminal cabinets, outlets, frames of cabinet racks and other enclosures shall be grounded in accordance with requirements of California electrical code and as specified, and as indicated in the ANSI/EIA/TIA applicable standard.

PART 3 - EXECUTION

3.01 EXECUTION AND INSTALLATION OF WLAN EQUIPMENT

- A. All WLAN equipment shall be installed as recommended by the product manufacturer (unless otherwise directed by ITD Project Management Office.
- B. Contract documents shall identify the criteria for the selection and installation of Autonomous Access Points and Controller-based Access Points.
- C. All Access Points, antennas, and related equipment shall be labeled using a naming system approved by the OWNER.
- D. The wireless controller must be located in the MDF cabinet and be linked via Gigabit connection(s) to the Backbone Switch.
- E. Exposed outdoor antenna masts shall be a safe distance from power lines and grounding shall be compliant with the California Electrical Code. Guy wires, gravity mount, and roofing material penetrations are not permitted.
- F. Any requirements to operate outside the IEEE standard (but within the FCC law), must receive written approval from an authorized OWNER ITD representative prior to installation.
- G. All access points are to be installed on opposite corners or sides of the classrooms and a minimum of seven (7) feet away from the user work area. Access points are not to be mounted directly over the instructor's desk.

3.02 CERTIFICATION AND TESTING

- A. Certification: Contractor shall certify that equipment used in the WLAN system is in full compliance with FCC requirements.

B. Testing

Following the installation of the WLAN equipment, the CONTRACTOR shall participate in the initial Quality Assurance process with the OWNERs Network Engineer as described in Specifications 27 0127. The CONTRACTOR shall provide all tools and personnel resources needed to ensure that the WLAN coverage and setup is compliant with the Construction Drawings generated by the CONTRACTOR and that the system operates in a manner compliant with this Specification and related Contract Documents.

All WLAN components shall be tested for proper installation (per OWNER and manufacturer's recommendations for configuration). CONTRACTOR shall develop and execute a written test plan to demonstrate the WLAN's functional compliance with each area of this Specification. The test plan must be accepted in writing from an authorized OWNER representative prior to execution. All final tests shall be conducted during normal school business operation hours with various usage demands generated from each WLAN site individually and collectively.

1. CONTRACTOR shall provide all instruments for testing and demonstrate, in presence of the OWNER, that all circuits and wiring test free of shorts and grounds.
2. Prior to calling for a walk test, the CONTRACTOR shall provide all labor, instruments, appliances, equipment, and materials necessary to demonstrate to the OWNER the installation performs as required and specified.
3. The OWNER reserves the right to perform independent tests of equipment furnished, to determine whether or not equipment complies with requirements specified, and to proceed in accordance with the Contract Documents.
4. Any test failures that result from faulty CONTRACTOR installations, configurations, hardware, or software must be corrected by the CONTRACTOR (without any additional cost to OWNER). If the OWNER deems that the WLAN system, or parts thereof, does not meet specified performance requirements, further tests must be conducted, including complete sweep analysis to locate faulty or defective components. Defective components, parts, and cables must be replaced before conducting further tests.

C. Final Acceptance

The CONTRACTOR shall procure written notification from the ITPMO before work is considered fully accepted. If the OWNER deems that the WLAN system, or parts thereof, do not meet specified performance requirements, further tests must be

conducted, including complete sweep analysis to locate faulty or defective components. Defective components, parts, and cables must be replaced before conducting further tests. The goal is to ensure the specified throughput in an environment occupied by students and staff. Work for the installation of the WLAN system shall be considered complete after the CONTRACTOR accomplishes the following in compliance with Contract Documents:

1. Demonstrates proper functionality of Access Points, Bridges, Controllers, and Client Adapters as specified in “2.02 Wireless LAN Equipment”.
2. Demonstrates proper functionality of administration and configuration features.
3. Demonstrates proper functionality of WLAN management features.
4. Demonstrates proper functionality of link status and monitoring features.
5. Demonstrates proper functionality of Access Point and client adapter interoperability.
6. Demonstrates proper functionality of required security models.
7. Demonstrates proper functionality of client roaming features.
8. Demonstrates proper functionality of bandwidth management features.
9. Demonstrates proper interoperability of Access Point with multiple CONTRACTOR provided client adapter cards.
10. Demonstrates proper functionality of mixed IEEE 802.11n/ac/ax and 802.11g client adapters associated with the same multimode 802.11n/ac/ax Access Point.
11. Demonstrates proper functionality of 5 GHz band radio IEEE 802.11n/ac/ax client adapters associated with the 802.11n/ac/ax Access Point with the 5 GHz radio.
12. Demonstrates proper client performance in various coverage areas.
13. Demonstrates acceptable performance of WLAN services under varying traffic loads and types.
14. Replaces any equipment failing the test plan with properly functioning equipment at no additional cost to OWNER.
15. All WLAN system asset information has been recorded and required labels have been put in place.
16. All system testing has been completed. CONTRACTOR certifies that entire system is in working order and WLAN Test Results have been submitted to OWNER.
17. All construction debris and scrap materials have been removed from project site.

18. All marked up, project record documents have been returned to OWNER.
 19. All unused customer material has been returned to OWNER.
 20. OWNER ITD PROJECT INSPECTOR has inspected and accepted, in writing, the CONTRACTOR's equipment installations and test results.
 21. Documentation, to include as-built, along with required soft copies and completed cable management database has been turned over to OWNER.
- D. If the results of the final Quality Assurance testing indicate that the installation does not comply with the approved Construction Drawings, OWNER Specifications, or Contract Documents, the CONTRACTOR shall, at no cost to the OWNER, make any necessary adjustments to the system components or configurations in order to bring the WLAN installation into compliance.
- E. Testing methodology: Prior to the OWNER's test and acceptance, the CONTRACTOR shall test the IEEE 802.11n/ac/ax 2.4 GHz (802.11n only) and 5 GHz band radios. The CONTRACTOR shall submit the test results in numerical order a wireless download of every installed AP. The OWNER network engineer shall evaluate the wireless performance by examining the results of the CONTRACTOR's wireless captures. The following actions shall take place if the results deem acceptable:
2. While on site and prior to commencing the walk:

The OWNER shall validate the installation of all the APs electronically via a TCP session to confirm that the parameters are correct per the CONTRACTOR's paperwork.
 3. During the wireless system test, the following parameters are checked:
 - a. Channel interference - There shall be an adequate separation between adjacent APs on the same channel.
 - b. Connectivity - Shall connect and receive an IP address to each installed AP.
 - c. Check for throughput on each AP's 802.11n/ac/ax 5 GHz connection - A single user connected to any AP shall provide an average of 100 Megabits per second (100 Mbps throughput). There should be a consistent throughput rate. The throughput rate shall not deviate more than 50% and should not go below a minimum speed of 50 Mbps.
 - d. Check for throughput on each AP's 802.11n/ac/ax 2.4 GHz (802.11n only) connection - A single user connected to any AP shall provide an average of 50 Megabits per second (50 Mbps throughput). There should be a consistent throughput rate. The throughput rate shall not deviate more than 50% and should not go below a minimum speed of 25 Mbps.

- e. Check for retries on each AP - Retries shall be less than 10%
- f. The CONTRACTOR shall provide a computer running as an FTP or Iperf (with Jperf as the graphical user interface) server that shall be hooked up via Ethernet cable to the campus network on the student VLAN.
- g. The CONTRACTOR shall have an ITPMO approved wireless network test tool running on their laptop, the tool shall be capable of monitoring and analyzing the wireless traffic and throughput. The same type of wireless NIC shall be used throughout the project.
- h. At the time of test and acceptance The OWNER Network Engineer shall either:
 - 1. Connect to the FTP server as a wireless client and download a large file to a laptop. This file shall be at least 140 MB in size for 2.4 GHz band radio and at least 1.5 GB in size for 5 GHz band radio. The wireless system shall perform within the parameters listed above for the duration of this download.
 - 2. Connect to the Iperf server via the Iperf (with Jperf as the graphical user interface) client as a wireless client and perform the throughput tests with various parameters. The wireless system shall perform within the parameters listed above for the duration of these tests.
- i. The CONTRACTOR shall have the Wireless analysis application configured to display the following parameters on screen while the OWNER NE downloads the file. The following parameter shall be shown from the aspect of the connecting client and from the AP.
 - (1) S/N Ratio: There shall be no less than 25 db separation between the strongest signal and noise
 - (2) In/Out KB per second: There shall be a consistent throughput rate. There shall not be periods of time when the throughput drops to zero or near zero
 - (3) RX / TX Retry Frame %: Retry rates should be below 30%
 - (4) RX Rate / TX Rate: 60% of frame rates should be 100Mb or higher on 802.1n/ac/ax.
 - (5) Screen shot(s) from the Air Magnet Laptop Analyzer (now called Wi-Fi Analyzer) or ITPMO approved equivalent program demonstrating the performance index/indices associated with the WLAN technologies implemented.

3.03 PROJECT RECORD DOCUMENTS

- A. Prior to the submittal of any final documentation, the CONTRACTOR shall provide to the IT Infrastructure Project Management Office the following for the entire contract:
1. Three (3) electronic (USB flash drive) copies of the hardware manufacturer documentation (PDF format) and software per model number of equipment installed throughout the project.
- B. Prior to the submittal of final documentation for each site, the CONTRACTOR shall provide the following to the IT Infrastructure Project Management Office for review and acceptance:
1. One (1) 24" x 36" hard (paper) copy of the completed full set of As-Built drawings.
 2. One (1) electronic (USB flash drive) copy of the completed full set of As-Built drawings in latest AutoCAD version or Microsoft Visio file format.
 3. Complete set of original red line drawings.
 4. One (1) hard (11" x 17" paper) copy and one electronic copy of the asset/inventory list utilizing the OWNER required Excel format
 5. One (1) hard (11" x 17" paper) copy and one electronic copy of the inventory list of equipment removed from the site utilizing the OWNER required Excel format.
 6. One (1) hard (8 1/2" x 11" paper) copy of the final invoice (bill of materials) for all work, E-rate discounted and/or funded through other sources under the contract.
 7. One (1) hard (8 1/2" x 11" paper) copy of the Visio diagram of the OWNER approved warranty process, the warranty term effective from T&A acceptance, and written narrative that outlines the details the process that includes but is not limited to the following:
 - a. CONTRACTOR's warranty contact information
 - b. CONTRACTOR's process for tracking changes during the warranty period following OWNER requirements outlined in the RFP.
 8. One (1) electronic (USB flash drive) copy of the complete set of final test results in native format and one hard (8 1/2" x 11" paper) copy of the test result summary. Included on the electronic (USB flash drive) copy shall be the associated software to read the test results.
 9. One (1) electronic (USB flash drive) copy of updated cable schedule reflecting actual field conditions. Table shall represent final record set inclusion.
 10. One (1) hard (8 1/2" x 11" paper) copy of the cable management plan (in Excel format).

11. Wireless section to include the following:
 - a. AP summary table.
 - b. Overall site plan signal distribution with AutoCAD or Microsoft Visio overlay. Create one map for “2.4 GHz frequency band” and one map for “5 GHz frequency band.”
 - c. Noise Distribution (electronic copy only).
 - d. Signal Strength versus Signal/Noise Ratio Distribution (electronic copy only).
 - e. Speed/Maximum Measured Data Rate (electronic copy only).
 - f. Retry Rate Distribution (electronic copy only).
 - g. Loss Rate Distribution (electronic copy only).
 12. One (1) hard (8 ½” x 11” paper) copy of all site specific signed RFCs, one (1) hard (8 ½” x 11” paper) copy of the General RFC log, and one (1) electronic (USB flash drive) copy of all RFCs for the site.
- C. Once the above referenced documents have been accepted, the CONTRACTOR shall provide to the IT Infrastructure Project Management Office the following for each site:
1. Three (3) electronic closeout electronic copies, one copy on each USB flash drive. Disk label shall include project name, school name, school location code, contents descriptor, table of contents, revision number and date of disk, and CONTRACTOR information. Each electronic closeout copy shall contain the following:
 - a. Submit media in paper sleeve with see thru window.
 - b. A cover page with school name, location code, address, project name, prepared for, prepared by, revision number, and the final revision date of the bound book.
 - c. A table of contents.
 - d. The asset/inventory list utilizing the OWNER required Excel format
 - e. The final invoice (bill of materials as required for closeout documentation) for all work, E-rate discounted and/or funded through other sources under the contract.
 - f. The complete set of final cable test results in native format and the associated software to read the test results .
 - g. The cable test result summary in PDF format.
 - h. The cable management plan in required format.
 - i. A Visio diagram of the OWNER approved warranty process, the warranty term effective from T&A acceptance, and written narrative

that outlines the details the process that includes but is not limited to the following:

- 1) CONTRACTOR's warranty contact information.
 - 2) CONTRACTOR's process for tracking changes during the warranty period following OWNER requirements.
 - 3) The accepted full set of As-Built drawings with required BICSI RCDD/PE stamps and signatures.
 - 4) All site-specific RFCs and the General RFC log.
 - 5) All General RFCs for the project.
2. One (1) Mylar record set design submittal BICSI/PE stamped and wet signed – ARCH C size.
 3. Three (3) electronic (USB flash drive) copies of the completed full set of As-built drawings in latest AutoCAD version or Microsoft Visio file format (layered with accordance to OWNER specifications).
 4. Two (2) electronic (USB flash drive) copies, identified with "IT Asset Management," which shall consist of the following:
 - a. The asset/inventory list utilizing the OWNER required format.
 - b. The inventory list of equipment removed from the site utilizing the OWNER required format.
 - c. A Visio diagram of the OWNER approved warranty process, the warranty term effective from T&A acceptance, and written narrative that outlines the details the process that includes but is not limited to the following:
 - 1) CONTRACTOR's warranty contact information
 - 2) CONTRACTOR's process for tracking changes during the warranty period following OWNER requirements
 5. All cabinet keys; No keys are to be left with the schools.
 6. Unattached accessories for all electronic equipment at the school site (including serial and other cables, adapters, etc.). The OWNER shall identify the quantities required.
 7. The CONTRACTOR shall provide to the IT Infrastructure Project Management Office and identified as "Facilities Vault" for each site, one (1) electronic (USB flash drive) copy of accepted As-Built drawings in latest AutoCAD or Microsoft Visio file format.

3.04 PROTECTION

- A. Protect the Work of this section until substantial completion.

3.05 OWNER ORIENTATION

- A. WLAN Equipment: A three-day training course shall be provided, no later than 30 calendar days after equipment installation, for two designated persons from the Information Technology Division (ITD) per site in which WLAN infrastructure is installed. The training shall be provided at a facility located in Los Angeles County or at an OWNER location agreed to by the OWNER.
- B. The training shall be designed for OWNER IT service personnel and shall provide comprehensive technical information regarding system maintenance, troubleshooting, configuration and operation of the network infrastructure as built. Training shall include Product Features and Technical Specifications; Design and Implementation; Installation and Configuration, Wireless Security Principles, Maintenance and Operations, and Understanding of As-Built documentation including drawings and all associated project documentation. If applicable, Wired LAN and Wireless LAN training may be combined. Coursework shall consist of lecture and hands-on instruction. Each class size is limited to no more than 15 students.

3.06 CLEANUP

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

END OF SECTION

SECTION 27 1018

LOCAL AREA NETWORK (LAN) SYSTEMS FOR INSTRUCTIONAL LOCATIONS AND SMALL/MEDIUM OFFICE LOCATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: All equipment provision, preparations, installation, hardware and software, integration, configuration, testing, training, documentation, standards, and acceptance criteria for 10 Gigabits per second (Gbps) fiber optic backbone and Power-over-Ethernet 10/100/1000 Base-T switched Ethernet LAN systems.
- B. The system shall consist of local area network and wide area network / Metropolitan Area Network connectivity equipment, Unshielded Twisted Pair and fiber optic switches providing connectivity for local data ports to the fiber backbone. Devices connected to the cabling system, through various network interface cards, shall be Windows, Apple (Mac), and other computers and printers, servers, copiers, etc.

1.02 RELATED SECTIONS

- A. Applicable Division 01 sections
- B. Section 00 7000 – General Conditions
- C. Section 26 0500 – Common Works Results for Electrical
- D. Section 26 0513 – Basic Electrical Materials and Methods.
- E. Section 26 0526 – Grounding and Bonding
- F. Section 26 0533 – Raceways and Boxes Fittings and Supports.
- G. Section 26 2416 – Panelboards and Signal Terminal Cabinets
- H. Section 26 5200 – Emergency Power Systems
- I. Section 27 1014 – Structured Cabling - new construction
- J. Section 27 1017 – Wireless Local Area Networks (WLAN)

1.03 CODES AND STANDARDS

- A. Comply with current versions of the following applicable codes and standards:
 - 1. EIA/TIA-568C: Commercial building telecommunications wiring standard and all current addenda
 - 2. EIA/TIA-569A: Commercial building standard for telecommunications pathways and spaces

3. ANSI/TIA/EIA-606A: Administration standard for telecommunications infrastructure of commercial buildings
4. ANSI-J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications
5. California Building Code (CBC)
6. California Electrical Code (CEC)
7. National and State Occupational Safety and Health Administration (OSHA) requirements.
8. National Fire Protection Association (NFPA), NFPA-70
9. Institute of Electrical and Electronic Engineers (IEEE) 802.3 (Ethernet), 802.3u (100 Base-TX/FX), 802.3z (Gigabit Ethernet over optical fiber), 802.3ab (Gigabit Ethernet over 4 pair category 5 or higher), 802.3ae (10GbE), 802.3be (40 and 100GbE), 802.3ad Link Aggregation Control Protocol, 802.11 (Wireless LAN) including 802.11ac (part 11 amendment 5), 802.11af (PoE), 802.11at (PoE+), 802.1d (spanning tree protocol), 802.1s (Multiple Spanning Tree Protocol), 802.1w (Rapid Spanning Tree Protocol), 802.1p (QoS), 802.1q (VLAN tagging), 802.1x (Port Based Network Access Control), RFC 2236/5186 (IGMP v2/v3), RFC 3973/4602 (PIM-DM/SM), RFC 2365 (Administratively Scoped IP Multicast)
10. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.
11. ADA- Americans with Disabilities Act
12. BICSI Telecommunications Distribution Methods Manual, current edition
13. BICSI Wireless Design Reference Manual, current edition

1.04

SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials and products.
 1. Furnish catalog cuts, technical data, and descriptive literature on components. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. All UPS submittals shall be accompanied by a manufacturers run time matrix indicating capacity as required in this specification.
 2. Shop Drawings shall indicate equipment locations, details, sizes, and a point-to-point interface connection diagram of all systems. Shop Drawings shall indicate interfaces to cabling and equipment and cabling furnished by others, identifying numbers of wires, termination requirements, and other pertinent details.

3. Drawings that are specific to this specification section shall be included in the submittal. "A" size (8.5"x11") and "B" size (11"x17") shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes that are bound into the manual.
4. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The leftmost column shall be the item number; next shall be the description, followed by the applicable specification section number, and followed by the specified item, which is followed by the submitted item. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified. This is visually presented below. Column widths should be adjusted for easy reference and use of space.

Item Number	Description	Applicable Specification Section Number	Specified Item	Submitted Item	Notes :

- B. The product data shall be sufficiently detailed to allow the engineer to evaluate the suitability of the product and to allow other trades to provide necessary coordination.
- C. Provide a Design Review Summary of no more than two (2) pages. Summarize as appropriate, the design principles, equipment sizing, and/or installation practices used to determine the most cost effective method to meet the OWNER's requirements.
- D. Provide a migration plan that details the CONTRACTOR's transition and integration strategy from the existing LAN systems and connectivity to the new LAN systems and connectivity. This plan should be prepared by the CONTRACTOR and approved by the ITD Project Management Office.
 1. The Network Migration Plan shall define how existing LAN systems shall remain in service during the installation and integration of the new LAN/WLAN and converged systems.
- E. Provide a material list of all CONTRACTOR-provided or connected systems specifying quantity, part/specification, and serial numbers on an office, classroom, LDF, IDF, MDF, and IP address and room-by-room basis. Use building insurance numbers followed by the architectural classroom number.
 1. Submit the following documentation:

- a. Drawings of network connectivity, as-built, in one hard copy and one copy provided on USB flash drive in the latest version of AutoCAD or Microsoft Visio format for Microsoft Windows. All information shall be clearly legible on all printed drawings.
- b. OWNER utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings, yet provide control over what is seen on each sheet. LAN Systems shall be shown on a separate layer, labeled as “LAN Systems” that uses building floor plans, conduit supporting structure, and premise wiring layers below as needed. The use of any version control blocks or company logos shall be on a layer separate from the LAN Systems drawings. Diagrams should include, at a minimum:
 - (1) All network connected systems provided by or installed by the CONTRACTOR including device type, model, serial number, OWNER assigned name, date installed, and OWNER provided IP Address. Device symbols should be industry standard symbols or replica of manufacturer’s equipment. Drawings shall be laid-out to clearly show the logical relationship between devices.
 - (2) All SNMP managed devices connected to the network including device type, model, OWNER assigned name, and OWNER provided IP address.
 - (3) Location of equipment. Location is designated by:
 - (a) Building number as indexed on record drawings
 - (b) Room or location number as indexed on record drawings
 - (c) Distribution Frame number as indexed on record drawings
 - (4) Connections between installed systems including type of connection, interface speed, system interface ID, and cable number used.
 - (5) Rack/cabinet elevations indicating equipment locations. Equipment locations and placement within cabinets shall be approved by the ITI Project Management Office prior to equipment installation. CONTRACTOR and ITI Project Management Office shall agree as to the final location of all devices.

- c. Inventory of installed systems shall be documented in the OWNER Asset Management Excel Workbook as required by Contract Documents.

1.05 SUBSTITUTIONS

- A. Equipment and materials that deviate from these requirements shall not be accepted without written approval from OWNER'S Information Technology project manager. When deviating or proposing material substitutions the following information shall be submitted:
 - 1. Substitution request form substantiating reasons and benefits to OWNER, and all necessary documents to validate the claims made in the substitution form.
 - 2. Submittals must comply with contract general provisions.

1.06 QUALITY ASSURANCE

- A. Work shall conform to CCR, Part 3, California Electrical Code.
- B. Only a qualified CONTRACTOR holding licenses required by legally constituted authorities having jurisdiction over the work shall do work.
 - 1. Provide the supervision necessary to install, and configure a complete and operational system.
 - a. Supervisor shall have demonstrated experience in the successful completion of at least three (3) projects of similar size and scope on-time and on-budget.
 - b. Supervisor shall have demonstrated the ability to supervise a telecommunications project of similar size and complexity.
- C. Provide and obtain approval from ITD for the installation plan, Installation shall conform with ITD approved installation practices.
- D. Test installation to validate functionality and interoperability with the OWNER WAN and converged systems.
- E. CONTRACTOR shall be an authorized distributor of the submitted LAN equipment and shall have one or more engineers and/or technicians who have been trained by the manufacturer (or manufacturer authorized organization) and certified in the design, installation, and configuration of the equipment.
- F. Submit a copy of a letter from the manufacturer of submitted equipment certifying that the installer is an authorized distributor and maintenance provider of the submitted manufacturer's equipment.
- G. CONTRACTOR shall include in the Material List Submission a list of five projects of similar scope acceptable to the OWNER and shall have a service organization

capable of responding to warranty service requests within 24 hours of receipt of written notification and resolution within 1 day for MDF equipment and 3 days for equipment located either in the classroom, IDF, or LDF. CONTRACTOR shall include the telephone number of the customer's client contact for each project and a letter signed by a corporate officer, partner, or OWNER of the contracting company describing the service capability of the company and stating the company's commitment to maintain that service capability through the warranty period.

- H. The CONTRACTOR shall use adequate numbers of skilled staff who are manufacturer certified, thoroughly trained and experienced on the necessary technology and systems, and completely familiar with the specified requirements and methods needed for the proper performance of the work.

1.07 WARRANTY

- A. CONTRACTOR shall warranty that all work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of five (5) years from date of installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than five (5) years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the OWNER, the CONTRACTOR shall repair or replace at no expense to the OWNER, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of, or failure to, examine work by the OWNER shall not relieve CONTRACTOR from these obligations.
- B. All warranty shall provide the OWNER direct access to manufacturer Technical Assistance Center (TAC), software updates, and defect support.
- C. Manufacturer of provided equipment shall guarantee availability of parts common to provided system and/or full replacement units, for a period not less than 5 years. Parts for the supplied systems shall be available within 30 calendar days during the 5 year period.
- D. Installation CONTRACTOR shall install all equipment in accordance with manufacturer's specifications and recommendations necessary to ensure continuation of the manufacturer's warranty. If the installation CONTRACTOR cannot install manufacturer's equipment in such a manner, it is the responsibility of the installation CONTRACTOR to provide written, timely notification to OWNER ITD Project Management.
- E. OWNER monitors equipment service records and failure rates. In the event that the OWNER determines that a LAN system component, or model part, provided through this specification exceeds acceptable failure rate, or repeated failure rate,

the CONTRACTOR shall replace all systems of the same model purchased through this procurement with a new model that meets or exceeds the same functional requirements. Units or components exceeding either the acceptable or repeated failure rates shall be known as a “mass failure.” The CONTRACTOR shall provide qualified technicians to install the replacement systems and a project manager to coordinate replacement schedule with ITD. Replacement of mass failing systems, labor, and project management shall be provided and completed in accordance with this specification and related OWNER installation guidelines at no additional cost to the OWNER.

1. The acceptable failure rate/repeat failure rate for a single system model or individual modular model part, at a single site, or OWNER-wide, shall be:
 - a. Equal to or less than 10% in any 12 month period during the original warranty term.
 - b. Equal to or less than 15% cumulative failures during the entire term of the original warranty.
2. If, at any time during of the warranty term, the failure rate of the LAN systems or components exceeds 10%, the CONTRACTOR shall extend the original warranty term by one year, at no additional cost to the OWNER.
3. The CONTRACTOR is responsible for replacement of any failed equipment provided by the CONTRACTOR, during the warranty period or the extended warranty period. This includes equipment that falls under the “mass failure” definition.
4. In the event of a “mass failure” the CONTRACTOR shall replace all units and/or components affected within 60 days or written notification from the OWNER.
5. Upon replacement of each unit or component, the replaced unit warranty shall continue as if the original equipment were still in service.
- F. The warranty shall cover the complete system including fan assembly, power supplies, and the device itself.
- G. The warranty shall include onsite 48-hour advanced part replacement.
- H. The warranty shall include all labor to service and/or replace warranted system(s).
- I. In the event any Supplier or manufacturer offers additional warranty, at no additional cost, beyond that specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the OWNER without additional cost.
- J. Equipment manufacturers shall have E-mail trouble reporting and response mechanisms in place and a toll free 24-hour help center to assist with

troubleshooting and operation of the equipment at no additional cost to the OWNER, or as part of the warranty.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION AND REQUIREMENTS

- A. CONTRACTOR shall Provide all labor, equipment, materials, parts and ancillary components that may be required in addition to the OWNER furnished systems.
1. The BBS is the Backbone Switch and is installed in the MDF and serves as the central point of backbone network termination, and provides network connectivity to IDFs, classrooms, computer labs, libraries, multi-purpose rooms, student nutritional service areas, auditoriums, and offices. The BBS shall provide the primary campus LAN routing/switching functions between user VLANs and the WAN router.
 2. For instructional campus sites greater than 10 classrooms and office locations larger than 100 users, provide the minimum capability of a chassis-based modular switch with modular interface cards in the MDF as a Backbone Switch (BBS).
 3. The ISM is the Intermediate Switch–Managed (Fiber Switch) serving as the network termination point for secondary fiber backbone cabling from an IDF to CESMs located in LDCs. The ISM aggregates CESMs to the BBS.
 4. The ESM is the Edge Switch–Managed serving as the network termination point for copper horizontal cabling from an MDF, IDF or LDF to the work area outlet.
 5. The CESM is the Compact Edge Switch-Managed and is a small form factor network access point serving as the network termination point for copper horizontal cabling from an LDC to the work area outlet.
 6. The Access Router provides all IP protocol gateway services between the OWNER WAN and LANs at the local site. The Access Router shall be installed in the same MDF as the BBS. The Access Router may be used to provide native DHCP and NTP services for all devices at the local site. The typical Access Router shall connect to the OWAN via scalable Metropolitan Area Network or T1 (or multiple T1s). Circuits shall be provisioned by the OWNER and service type shall be identified on the Contract Documents.
 7. An MDF is the structure that serves as the main cross-connect for backbone cabling and connectivity serving all campus LAN systems. The router and BBS shall be installed in the MDF. The MDF may also serve as an IDF for locations within 90 meters (copper cable length). Patch cables shall be

- practical in length such that they may be neatly loomed in the cable management system with minimal excess cable and no cable stress points.
8. The IDF provides the network connection point for secondary fiber backbone and /or horizontal copper cabling. The IDF may also provide cross-connect to backbone cabling where CESM are used. IDFs are located between the MDF, LDFs, and LDCs in classrooms, offices, and other end station locations.
 9. The LDF is similar to an IDF but provides the network access point for a single room or adjacent rooms. An LDF typically uses a cabinet that serves as the termination point for horizontal copper UTP cabling within the same room and installation site of an ESM.
 10. The LDC provides local network access for a single classroom single room. An LDC uses a wall-mounted (recessed or surface mount) cabinet that serves as the termination point for horizontal copper UTP cabling within the same room and installation site of a CESM (as required) within the room/area.
- B. CONTRACTOR shall provide LAN system equipment hardware, firmware, and software necessary in the MDF, IDF, LDF and classroom locations to provide PoE+ full duplex 10/100/1000 Base-T Ethernet ports to connect each workstation, server, router, and other end devices designated on the project document.
 - C. The LAN system design and equipment shall provide, at a minimum, fiber based 10GbE backbone (uplink) connectivity from ISM and ESM equipment in IDFs, LDFs; ISM and CESM 1 Gigabit Ethernet fiber base to the BBS located in the MDF as specified in the project document.
 - D. CONTRACTOR shall install, configure, test, and document the LAN equipment in accordance with Part 3 of this specification to provide a fully functional and complete LAN at each location identified in the Contract Documents. Installation shall include all cable patches at end-devices as well as cable patches in all MDFs, IDFs, LDFs, and classrooms to complete device connectivity to the OWNER WAN.
 - E. CONTRACTOR shall coordinate patch cable runs, rack elevations/equipment locations, electrical power pathways, and available electrical capacity with the ITI Project Management Office prior to installation of the LAN systems. CONTRACTOR and the ITI Project Management Office must agree as to the final location/placement of all devices.
 - F. CONTRACTOR shall coordinate patch cable runs, equipment locations, and electrical power requirements with the ITI Project Management Office prior to installation of the LAN systems. CONTRACTOR and the ITI Project Management Office must agree as to the final location and placement of all devices.

- G. CONTRACTOR shall test and document all installed systems in accordance with requirements and procedures stated in this specification.
- H. Provide an Uninterruptible Power Supply (UPS) system in the MDF. The UPS shall be sized according to section 2.03.G.

2.02 EQUIPMENT STANDARDS

- A. Proposed products must have been commercially available to the general public for a period of at least six (6) months and must be available for purchase at the time of bid submittal. No pioneering, unproven or experimental technologies/products are acceptable.
- B. In order to establish service stability, all proposed switching equipment e.g. BBS, ISM, ESM and CESM and components exclusive of routers and cabling shall be of like products from a single manufacturer for each site except otherwise approved by the OWNER.
 - 1. In order to establish a standard of quality as required by the OWNER, various manufacturers' equipment may meet the requirements in this document. As a reference for comparison of CONTRACTORS, the equipment specification sheets on all items shall be included with the submitted bid and design.
 - 2. The Los Angeles Unified School OWNER's Information Technology Division or designated agent shall establish equivalency and compliance of product or components offered for use on each project.
 - 3. Equipment support of Centralized Management.
 - a. SMC requires that all networking components deployed on its OWNER-wide Network provide standard support for remote management from its central facility. For the purposes of this document, a network component is defined as any component or device that provides connectivity to the OWNER-wide Network. Examples include, but are not limited to, the following: Routers, Switches, Wireless Access Points and Uninterruptible Power Supplies.
 - b. CONTRACTORS proposing equipment for deployment on the OWNER Network shall ensure that each device as provided meets the following requirements:
 - (1) Each component shall support remote management in compliance with the Simple Network Management Protocol standards with community string authentication.

- (2) Device operational status, name, descriptive information, and Operating System (OS) and/or firmware versions (e.g., MIB-II System tree).
 - (3) Interface operational status and traffic/error statistics for all interfaces in use (e.g. MIB-II Interfaces tree).
- c. For the manufacturer equipment, the CONTRACTOR shall also include and enable for use all manufacturer developed SNMP agents and agent features available for the equipment. The only allowable exception to this requirement is that CONTRACTORS may choose not to include additional-cost agent features that pertain solely to device functions for which the device is not provided.
- d. For devices with agents supporting private enterprise MIB extensions (ASN.1 Object Identifier .1.3.6.1.4.x) all extensions must be included and enabled for use. Additionally, when requested, the CONTRACTOR shall provide:
 - (1) Electronic documentation for all private enterprise MIB extensions supported by the device in Abstract Syntax Notation number One (ASN.1)/Structure of Management Information (SMI) MIB format.
 - (2) Electronic versions of SNMP manageable equipment shall include accessible Internet links (e.g., URL) to all manufacturer developed documentation regarding the features, use, and/or configuration of the device agent(s).
- e. If procedures for remote management, configuration, or software/firmware upgrades of the equipment require the use of proprietary or otherwise manufacturer-specific software, the CONTRACTOR shall include in submittal the specification (i.e. name, version, part number) and price for this software sufficient to perform remote management functions.

C. Equipment Substitutions

- 1. Equipment substitutions shall be pre-approved by the OWNER prior to bid date. CONTRACTOR shall demonstrate operation of equipment and compliance with functions and features specified herein. Additionally, CONTRACTOR shall demonstrate interoperability of design and systems with existing systems. Equipment substitutions that were not pre-approved prior to bid date shall be rejected. In the event that no equipment is found to meet all the requirements specified herein, the equipment meeting the most requirements shall be given preferential treatment during the selection process.

D. Non-Proprietary Implementation

1. This design and implementation specification precludes the use of any network equipment CONTRACTOR proprietary protocols or capabilities required to either deliver an operational overall system or preclude future implementations that rely on prevailing industry standards.

2.03 LAN EQUIPMENT

A. Access Router: The Access Router provides the interface between the local network (LAN) and the Wide Area Network (WAN). The router also provides critical IP services such as QoS, DHCP, and NTP. The router is required to provide a variety of interface capability to support individual site requirements. Many of the named interfaces and protocols may not be required during the initial implementation; however, the ability to implement any of the listed capabilities is required.

1. The general router requirements are as follows:
 - a. Modular configuration with slots supporting different interface module types.
 - b. Hot-swappable, load-sharing or redundant power supplies
 - c. Rack-mountable in standard 19-inch rack.
 - d. WAN interface(s) to meet requirements specified in the project record. See following sections for supported interfaces and “as provided” requirement.
 - e. Up to eight T1 synchronous serial ports with built-in DSU/CSU capabilities - to be specified in the Contract Documents.
 - f. Software and firmware to support the OWNER MAN/WAN requirements.
 - g. Maximize use of internal memory to support the next two major operating system upgrades. External compact flash memory shall not be accepted.
2. The router shall be capable of supporting the following:
 - a. Minimum of four Gigabit Ethernet ports
 - b. 1000 Base-SX, LX, and ZX interfaces through SFP GBIC modules.
 - c. Minimum of one T1 Channelized Primary Rate ISDN (PRI).
 - d. Minimum of eight T1 synchronous serial ports supporting data 1.544Mbps with built-in Data Service Unit/Channel Service Unit (DSU/CSU).
 - e. Minimum of two FXO and two FXS interfaces for PSTN connection, telephone set, fax machine, PBX or PA/IC connection;

or have the ability to support Session Initiation Protocol. The router must also be capable of providing Voice over IP PSTN fail-over in the event the WAN IP interface becomes temporarily inoperable.

- f. Industry standard Voice over IP protocols including MGCP, H.323, and SIP.
 - g. SNMP, syslog, traffic analyzer data e.g. sFlow, Netflow, IPFIX
 - h. Hot-swappable, load-sharing or redundant power supplies.
 - i. Dual stack Internet Protocol IPv4 and IPv6
 - j. MPLS
 - k. VRF-Lite
 - l. GRE tunnels
 - m. BFD
 - n. WCCP v2
 - o. PPP Multi-link of serial interfaces
 - p. QoS with the ability to provision 802.1p priority queues and utilize basic dynamic application detection
 - q. The Access Router's performance, at the minimum, shall be no less than 1.5 Gbps throughput with any of NAT, ACL, HQoS, or IPSec features enabled utilizing RFC 2544 standard baseline testing method and IMIX packet sizes
3. The router, as provided, shall support the following:
- a. Minimum of the following ports installed, unless otherwise specified by the OWNER:
 - (1) Three auto-negotiating 10/100/1000 Base-T Ethernet ports
 - b. Minimum of the following IP routing protocols installed:
 - (1) BGP-4 and MP-BGP
 - (2) IGMP v2
 - (3) OSPF v2 and OSPF v3
 - (4) PIM (dense mode and sparse mode)
 - (5) RIP and RIP v2
 - (6) RIPng
 - c. IP Multicast

- d. Network management via industry standard protocols including SNMP, remote configuration, remote notification of errors, events, and alerts.
- e. In-band configuration via command line interface over Telnet, SSH, and SNMP, and out-of-band configuration via direct serial, terminal server, or dial-up (modem) connection.
- f. Centralized user access control and configurable access levels.
- g. Support for access control-based security model. For example, access control lists.
- h. Logging to report user access, configuration changes, system events, traps, and other interface and protocol events, including support for a centralized syslog server.
- i. Internet Protocol IPv4 and IPv6, MPLS.
- j. The router shall provide native DHCP and NTP services for all devices at the local site.
- k. Network Time Protocol (client mode).
- l. IPsec with NAT, PAT, and NAT-PT
- m. The Access Router's performance, at the minimum, shall be no less than 1.5 Gbps throughput with any of NAT, ACL, HQoS, or IPsec features enabled utilizing RFC 2544 standard baseline testing method and IMIX packet sizes

B. Broadband Access Router

The Broadband Access Router provides the interface between the local network (LAN) and the commercial wireless cellular broadband network. The router is required to provide a variety of interface capability to support individual site requirements. Many of the named interfaces and protocols may not be required during the initial implementation; however, the ability to implement any of the listed capabilities is required.

- 1. The general Broadband Access Router requirements for non-WiFi are as follows:
 - a. Support dual SIM for cellular 4G.
 - b. IPsec in compliance with IETF.
 - c. 10/100/1000 Ethernet interface.
- 2. The general The general Broadband Access Router requirements for WiFi are as follows:
 - a. Support dual SIM for cellular 4G.

- b. IPSec in compliance with IETF.
 - c. 10/100/1000 Ethernet interface.
 - d. Wireless LAN access point in compliance with IEEE 802.11 a/b/g/n.
- C. Backbone Switch (BBS): The BBS shall be a modular, rack mountable, chassis based switch with a number of slots as required by the site network configuration. A single BBS shall be used for aggregating LAN system connections (uplinks) and local MDF connectivity for the complete site.
 - 1. The general BBS requirements are as follows:
 - a. Hot swappable, load sharing power supplies (minimum of two installed).
 - b. The BBS shall support in-band configuration via command line interface over Telnet, SSH, or HTTP.
 - c. The BBS shall be of sufficient size to accommodate and of appropriate functional design to support the specified modules regardless of whether all of these modules are required to be furnished at time of installation.
 - d. The optic based Gigabit Ethernet Switch Modules with a minimum of twelve 1000 Base-SX/LX ports per module. The number of such modules configured in the BBS should be sufficient to provide the minimum of one 10 GbE port for each ISM and one 1 GbE port for each CESM uplink connection. SFP GBIC modules are not required for spare ports.
 - e. Fiber optic based 10GbE Switch Modules with a minimum capability of six SFP+ ports per module. The number of such modules configured in the BBS should be sufficient to provide one port for each ESM and one port for each ISM, unless specified otherwise by OWNER staff, configured with a SFP+ 10GbE multi-mode or single mode uplink connection as needed of each type. SFP+ modules are not required for spare ports. Fiber network interface modules shall be designed for multi-mode and/or single-mode fiber as appropriate for the required interface and distance.
 - f. The BBS shall support multiple link aggregation for 10GbE and/or 1GbE uplink connections to support higher bandwidth uplink connections, as required by performance criteria. Aggregated uplink connections shall adhere to the IEEE 802.3ad, Link Aggregation Control Protocol specifications. The BBS shall be capable of supporting a minimum of 4 aggregated ports per uplink.
 - g. The Installing CONTRACTOR shall supply multi-mode and single-

mode duplex fiber patch cables, as appropriate, for every fiber interface provided. Patch cables shall be supplied to provide the required duplex interface to the fiber patch facility. Refer to section 3.01.E for general fiber patch cable requirements. Patch Cables shall be of sufficient length to reach maximum, worst-case length, neatly loomed in the wire management system from the switch to the fiber patch facility. For typical BBS site configurations, the minimum length shall be 1 meter and the maximum length shall be 5 meters.

h. Maximize use of internal memory to support the next two major operating system upgrades. External compact flash memory shall not be accepted.

i. The BBS performance shall provide at a minimum:

(1) For instructional sites with greater than 3,000 users; a minimum of layer 2 switching throughput of no less than 900 Gbps. Layer 3 IPv4 200 Mpps and IPv6 100 Mpps of throughput.

(2) For instructional sites with equal or less than 3,000 users; a minimum of layer 2 switching throughput of no less than 768 Gbps. Layer 3 IPv4 200 Mpps and IPv6 100 Mpps of throughput

(3) For instructional sites with less than 100 users; a minimum of layer 2 switching throughput of no less than 80 Gbps. Layer 3 forwarding rate no less than 60 million packet per second (Mpps)

2. The BBS shall be capable of supporting the following:

a. Sufficient redundancy so that despite the failure of any single replaceable processor, management, or switching fabric component (excluding end-device port modules), the BBS shall maintain its configuration information, the ability to enforce Virtual LANs (VLANs), filtering/forwarding policies, perform routing, and to support network management functions. This redundancy does not apply to end device ports or fiber trunks to ISMs, ESMs, or CESMs unless otherwise specified in the procurement document.

b. Modules which are compatible with specified uplink modules of corresponding data rates and media types for the provided ESM Switches.

c. In order to support future increased efforts to deploy multimedia presentations to the classroom, the Backbone Switch shall be capable of interoperating with other equipment manufacturer routers

- operating in a standards-based IP environment.
 - d. Modules that provide Industry standard 802.3at or PoE+, power over Ethernet, without the requirement for an external power injector.
 - e. All BBS network modules port-to-backplane throughput shall not exceed;
 - (1) 2-to-1 over subscription on 1G line cards.
 - (2) 3-to-1 over subscription on 10G line cards.
 - f. Network Time Protocol (client mode).
 - g. DHCP snooping or protection
 - h. Uni-Directional Link Detection (UDLD)
 - i. 802.1x compliant with support for multiple policies per port.
 - j. Energy conservation features such as the ability to reduce power consumption at times of little activity.
 - k. Support the following routing protocols: OSPFv2, OSPFv3, IGMP V2, PIM, RIP, RIPv2, and RIPng.
 - l. The BBS shall provide QoS services at the local site.
 - m. IEEE 802.1s Multiple Spanning Trees – The BBS shall be capable of supporting multiple, independent Spanning Tree Domains supporting multiple VLANs per domain. Each Spanning Tree Domain must be able to establish its own root bridge and active path.
3. The BBS, as provided, shall support (or provide) the following:
- a. Full compliant with the IEEE 802.3ae, 10GbE; unless otherwise noted by OWNER project requirement.
 - b. Network management via industry standard protocols including SNMP, remote configuration, and remote notification of errors, events, and alerts.
 - c. Static IP address assignment for the network management interface.
 - d. Logging to report user access, configuration changes, system events, traps, and other interface and protocol events.
 - e. Supporting network modules for specified uplink of corresponding data rates and media types for the provided ISM, ESM, and CESM Switches.
 - f. Minimum of one 24-port PoE+ 10/100/1000 Base-T Ethernet module. The total number of PoE+ 10/100/1000 Base-T Ethernet

ports required in the BBS must be determined on a site-by-site basis based on the Contract Documents for each site. All software features, firmware, and protocol support identified for the BBS in this specification.

- g. Minimum of one empty module slot with a blank cover for future expansion.
- h. Interoperate with the same user-created VLANs as on all switches to include the capability for VLANs to span across multiple switches connected to different ports on the BBS. Further, the Backbone Switch shall support a minimum of 1024 VLANs and shall fully support IEEE 802.1q frame tagging functions with native VLAN untagged capability.
- i. Transport and delivery of industry standard IP Multicast. The BBS shall, at a minimum, support IGMP V2 and IGMP snooping.
- j. IEEE 802.1p quality of service functions. QoS support must honor priority set by end devices to support Voice over IP and Video connections as well as support per port priority settings.
- k. User configurable to forwarding and filtering decisions based on protocols and applications to include Transmission Control Protocol (TCP) application ports and/or source/destination IP address filtering. The forwarding and filtering decision abilities shall be capable of enforcing policies on communications between different subnets or VLANs within the campus network as well as on communications through the OWAN connection or the Internet.
- l. IEEE 802.1s Multiple Spanning Trees – The BBS shall be capable of supporting multiple, independent Spanning Tree Domains supporting multiple VLANs per domain. Each Spanning Tree Domain must be able to establish its own root bridge and active path.
- m. Dual power supplies configuration.

D. Intermediate Switch-Managed (ISM):

- 1. The ISM shall be a 19-inch rack mountable gigabit fiber switch,:
 - a. Full compliant with the IEEE 802.3ae, 10GbE for uplink connection unless otherwise noted by OWNER project requirement.
 - b. The ISM Switches shall provide a minimum of twelve fiber-based 1 Gigabit Ethernet ports each and shall provide a modular slot to accommodate a variety of uplink modules. The available Uplink module options shall include, at a minimum:

- (1) 1GbE, or;
 - (2) 10 GbE SFP+
 - c. Fiber interface modules shall be designed for multi-mode and/or single-mode fiber as appropriate for the required interface and distance.
 - d. There are no empty port expansion requirements for an ISM. ISM provision one 10 GbE uplink to the BBS. When applicable, aggregated uplink connections shall adhere to the IEEE 802.3ad Link Aggregation Control Protocol specifications.
 - e. The ISM switches' performance shall provide at a minimum:
 - (1) Provide at a minimum wire-speed, fully non-blocking performance within the switch.
 - (2) Provide a worst-case switch throughput of no less than 3 Gbps.
 - (3) Provide no less than 3 million 64-byte packets per second throughput Layer 2 with any or all features enabled.
 - f. Network Time Protocol (client mode).
- 2. The ISM shall be capable of supporting the following:
 - a. DHCP snooping or protection.
 - b. Uni-Directional Link Detection (UDLD) or equivalent
 - c. 802.1x compliant.
 - d. Energy conservation features such as the ability to reduce power consumption at times of little activity.
- 3. The ISM, when provided as a Small-Site Backbone Switch (small BBS), shall support (or provide) the following:
 - a. Full compliant with the IEEE 802.3ae, 10GbE uplink; unless otherwise noted by OWNER project requirement.
 - b. Network management via industry standard protocols including SNMP, remote configuration, remote notification of errors, events, and alerts.
 - c. Static IP address assignment for network management.
 - d. In-band configuration via command line interface over Telnet, SSH, or HTTP.
 - e. Remote configuration load via TFTP or FTP.

- f. Logging to report user access, configuration changes, system events, traps, and other interface and protocol events.
 - g. 1GbE uplink module as appropriate for distance connection to CESMs.
 - h. The switch shall support a minimum of 255 VLANs and shall fully support IEEE 802.1q frame tagging functions with native VLAN untagged capability.
 - i. At least one fiber optic port for 1000 Base-SX as required for CESM. The use of media conversion external to the switch is not permitted by the OWNER.
 - j. IEEE 802.1p quality of service functions. QoS support must honor priority set by end devices to support Voice over IP and Video connections as well as support per port priority settings.
 - k. Transport and delivery of industry standard IP Multicast.
 - l. DHCP snooping or protection.
 - m. Uni-Directional Link Detection (UDLD) or equivalent
 - n. 802.1x compliant with support for multiple policies per port.
 - o. Energy conservation features such as the ability to reduce power consumption at times of little activity.
4. The ISM with a single power supply acoustic noise level shall not exceed 46 dB.
- E. Edge Switch-Managed (ESM): The ESM shall be a modular or workgroup, 19-inch rack mountable switch, and manageable via a single IP address.
- 1. The general ESM requirements are as follows:
 - a. Full compliant with the IEEE 802.3ae, 10GbE uplink; unless otherwise noted by OWNER project requirement.
 - b. The ESM Switches shall provide a minimum of twenty-four auto-negotiating 10/100/1000 Base-T with atleast one-half of total ports shall be equipped with PoE+. Each and shall provide a modular slot to accommodate a variety of uplink modules. The available uplink module options shall include, at a minimum, 10GbE multimode or single mode SFP+ modules; or 1GbE multimode or single mode uplink module option.
 - c. Fiber interface modules shall be designed for multi-mode and/or single-mode fiber as appropriate for the required interface and distance.

- d. The ESM switches' performance shall provide at a minimum:
 - (1) Provide at a minimum wire-speed, fully non-blocking performance within the switch.
 - (2) Provide a worst-case switch throughput of no less than 80 Gbps.
 - (3) Provide no less than 32 million packets per second throughput Layer 2 with any or all features enabled.
- e. Network Time Protocol (client mode)..
- 2. The ESM shall be capable of supporting the following:
 - a. DHCP snooping or protection
 - b. 802.1x compliant with support for multiple policies per port.
 - c. Energy conservation features such as the ability to reduce power consumption at times of little activity.
- 3. The ESM shall meet the following:
 - a. Full compliant with the IEEE 802.3ae, 10GbE uplink; unless otherwise noted by OWNER project requirement.
 - b. Network management via industry standard protocols including SNMP, remote configuration, remote notification of errors, events, and alerts.
 - c. Static IP address assignment for network management.
 - d. In-band configuration via command line interface over Telnet, SSH, or HTTP/HTTPS.
 - e. Remote configuration load via TFTP or FTP.
 - f. Logging to report user access, configuration changes, system events, traps, and other interface and protocol events.
 - g. 10GbE SFP+ multimode or single mode module as appropriate for distance for each connection to the BBS, unless otherwise noted by the OWNER's project instruction.
 - h. Interface to the BBS Switch and interoperate with the same user-created VLANs as on the ESM Switches to include the capability for VLANs to span across multiple ESMs connected to different ports on the BBS or ISM. The switch shall support a minimum of 255 VLANs and shall fully support IEEE 802.1q frame tagging functions with native VLAN un-tagged capability.

- i. At least one fiber optic port for 10GbE SFP+ multimode or single mode as required, plus PoE+ 10/100/1000 Base-T ports sufficient to accommodate active horizontal UTP connections.
 - j. IEEE 802.1p quality of service functions. QoS support must honor priority set by end devices to support Voice over IP and Video connections as well as support per port priority settings.
 - k. Transport and deliver of industry standard IP Multicast. The ISM and ESM shall, at a minimum, support IGMP V2 and IGMP snooping.
 - 4. The ESM with a single power supply acoustic noise level shall not exceed 46 dB. Project proposal must include manufacturer published product datasheets, which shall include acoustic noise information for technical evaluation purposes.
- F. Compact Edge Switch-Managed (CESM)
- 1. The general CESM requirements are as follows:
 - a. The CESM shall be 19-inch rack mountable and shall not exceed 1 Rack Unit (1.75”) mounting height and shall not exceed 14 inches mounting depth.
 - b. The CESM shall be of a type that operates silently and does not require a fan (internal or external) for cooling.
 - c. The CESM Switch shall provide at a minimum wire-speed, fully non-blocking performance within the switch.
 - d. Capable of supporting SNMP
 - e. DHCP snooping or protection
 - f. 802.1x compliant.
 - g. Energy conservation features such as the ability to reduce power consumption at times of little activity.
 - 2. The CESM shall meet the following:
 - a. Minimum of seven, but not to exceed twelve, auto-negotiating PoE 10/100/1000 Base-T ports.
 - b. Minimum of one user selectable uplink port capable of supporting 1000 Base-SX, or 1000 Base-LX, designed for use with multi-mode or single mode fiber for connectivity to the corresponding interface in the BBS or ISM switch.
 - c. Fiber interface modules shall be designed for multi-mode or single-mode fiber as appropriate for individual required interfaces,

distance, and connectivity to the corresponding modules in the BBS, or ISM Switch.

- d. Interface with the ISM and BBS switches and interoperate with the same user-created VLANs as on the ISM and BBS switches. Further, the CESM shall fully support IEEE 802.1q frame tagging functions with native VLAN un-tagged capability.
- e. IEEE 802.1p quality of service functions. QoS support must honor priority set by end devices to support Voice over IP and Video connections as well as support per port priority settings.
- f. Transport and delivery of industry standard IP Multicast. The CESM shall, at a minimum, support IGMP V2 and IGMP snooping.
- g. Network management via industry standard protocols including SNMP, remote configuration, and remote notification of errors, events, and alerts.
- h. Static IP address assignment for the network management interface.
- i. In-band configuration via command line interface over console Telnet, SSH, or HTTP.
- j. Remote configuration load/upgrade via TFTP or FTP.

G. Uninterruptible Power Supply (UPS): UPS is required for all LAN system equipment in the MDF.

- 1. The general UPS requirements are as follows:
 - a. Each UPS shall provide network grade line conditioning, lightning protection, surge protection, and protection against voltage swell and sag.
 - b. The UPS shall continue to conduct electricity regardless of the battery condition or state.
 - c. The UPS shall receive one auto-negotiate Ethernet Interface supporting SNMP.
 - d. The UPS systems shall support user replaceable, valve regulated lead acid, batteries. The UPS shall support a bypass mode or otherwise support battery service and replacement without interrupting power to the equipment plugged into the UPS.
- 2. The UPS shall meet the following:
 - a. Ethernet Interface supporting SNMP.
 - b. Initiating a safe system shutdown by a server. All necessary hardware and software shall be included.

- c. The UPS shall provide, after a loss of AC power input, the capability to support the continued operation of the connected equipment provided as part of this specification as follows:
 - (1) MDF– 60 minutes run time.
 - (2) IDF/ LDF- UPS not required for non-convergence sites.
- d. On sites where IP convergence technology is being employed, all UPS' shall have 60 minutes run time regardless of the type of frame that it is installed in:
 - (1) MDF – 60 minutes run time
 - (2) IDF/ LDF – 60 minutes run time

PART 3 - EXECUTION

3.01 GENERAL

- A. To ensure that the installation does not diminish the existing capabilities of any school and as precursor to the execution and installation of any LAN equipment, the CONTRACTOR shall review the migration plan for each school with the OWNER's Program Office before a NTP at the school is provided.

3.02 LAN INSTALLATION

- A. CONTRACTORS implementing network components on the OWNER Network are responsible for the initial configuration of the component in compliance with the following OWNER standards:
 - 1. The device shall be physically connected into the OWNER's network using OWNER-approved cabling, cabling specifications, and into the connection point specified by OWNER staff.
 - 2. The device shall be configured in a manner that allows its management functions to be successfully verified by central staff. At a minimum, this includes configuration of the management agent with OWNER-provided values for the following configuration items:
 - a. IP address of all network interfaces
 - b. IP address of the gateway
 - c. VLAN'
 - d. Read-Only SNMP Community String
 - e. Read-Write SNMP Community String
 - f. Centralized authentication/access server.

- g. IP-based SNMP access control
 - h. SNMP trap receiver (destination)
 - 3. All LAN systems shall be installed in accordance with CONTRACTOR installation guidelines and in compliance with the product warranty.
- B. Routers
- 1. The router shall provide the interface to connect the local network to the centralized OWAN Distribution point(s). A minimum of three physical LAN interfaces shall be required. A minimum of one OWAN interface shall be required. Refer to the Contract Documentation for specific site requirements.
 - 2. The router shall provide the single point of OWAN connection from the BBS for the entire LAN. A minimum of one OWAN interface shall be required. Refer to the Contract Documentation for site specific requirements.
 - 3. The router shall be installed in the MDF for the site in the cabinets provided and designated for such.
 - 4. The router shall be installed in accordance with CONTRACTOR installation guidelines and in compliance with the product warranty.
- C. Backbone Switch (BBS)
- 1. Unless otherwise specified in Contract Documentation, there shall be one BBS per location installed in the MDF.
 - 2. The BBS shall be mounted in the designated cabinet, usually the same cabinet or adjacent cabinet to the fiber patch facility and UPS system.
 - 3. The BBS is the central point to which all connections from IDFs and LDFs are terminated. It is also the point at which connection to the OWAN router is made along with connectivity to designated primary campus servers.
 - 4. The Backbone Switch constitutes the intelligent electronics portion of the collapsed backbone ARCHITECTure upon which the system design is based. The BBS shall provide the primary routing functions between user VLANs, between the user VLANs and the Router, and between the user VLANs and the OWAN if an Access router is not to be installed at the site.
 - 5. Installed in accordance with CONTRACTOR installation guidelines and in compliance with the product warranty.
- D. Edge Switch–Managed (ESM)
- 1. ESM Switches (Copper Switches) are used, as required, to provide network connectivity to copper connections that are terminated in IDF and LDF cabinets. The ESM Switches are intended to be located in IDF or LDF

cabinets and connect via fiber optic uplink(s) to the BBS. Where ESM switches are located in LDF cabinets fiber optic patch cables installed between secondary backbone and primary backbone fiber patch panels.

2. Each ESM shall be mounted within an IDF or LDF cabinet.
3. An ESM shall be used, when required, to provide connectivity in the following:
 - a. Library
 - b. Multi-purpose room(s)
 - c. Cafeteria
 - d. Gymnasium(s) and Auditorium as specified on the site plan
 - e. Computer Lab(s) as specified on the site plan
4. Installed in accordance with CONTRACTOR installation guidelines and in compliance with the product warranty.

E. Fiber Patch Cables

1. The CONTRACTOR shall supply multi-mode and single-mode duplex fiber patch cables, as appropriate, for every fiber interface provided. Patch cables shall be supplied to provide a duplex interface to the fiber patch facility.
2. Unless otherwise defined in the Contract Documents, Fiber Patch facilities shall use the following convention:
 - a. Structured cabling fiber patch facility terminations shall be consistent throughout the facility (LC).
 - b. Sites with 50 micron multi-mode fiber shall use LC patch facility terminations (single mode as well as multimode fiber).
3. All patch cables shall be new and shall be certified by the manufacturer for use on the designated equipment interface and the installed fiber cable plant.
4. Fiber patch cable length shall vary depending on location. All patch cables must be of sufficient length to be neatly loomed in the cable management system between the fiber patch facility and the designated equipment interface.
5. 50 micron multi-mode patch cables shall be aqua, and single mode patch cables shall be yellow.

F. Uninterruptible Power Supply (UPS)

1. Each MDF shall be installed with a UPS.
2. The CONTRACTOR shall coordinate the appropriate power connection for

each UPS as specified by the UPS manufacturer's installation requirements and applicable local, state and federal electrical, fire and safety codes.

3. UPS shall be rack mounted at the bottom (or near the bottom) of the cabinet/rack or adjacent rack of the systems for which it shall provide power. If installed in a cabinet in a "raised floor" room, a minimum of 4 inches and maximum of 7 inches of open rack space shall be maintained at the bottom of the rack.
4. Access to the front and back of the UPS shall not be impeded. All service access doors and cages shall be fully accessible.
5. Neither the UPS or associated battery packs shall rest on the bottom of the cabinet, rack or the floor
6. Provision a SNMP interface card for all UPS. Connect and configure the UPS SNMP, Ethernet interface to the network using OWNER provided device name and IP address. Other configuration requirements are contained elsewhere in this specification.
7. Installed in accordance with CONTRACTOR installation guidelines and in compliance with the product warranty.

3.03 RELATED SYSTEMS OR SUB-COMPONENT INSTALLATION

A. Labeling and Marking

1. Provide complete equipment and cable location charts and as-built documentation in an envelope and attach to the inside rear doors of distribution frame cabinets in wiring spaces.
2. Mark all patch cables with computer-generated labels. Patch cables shall be labeled with the same identifier as on the receptacle faceplate, and/or on the patch panel. Cable markers shall be located within 2 inches of each end of the cable jacket and shall be directly readable. The cable marker at both ends of the cable shall be identical and shall identify both the source (device/port) and destination (jack, patch panel, or device/port position identifier). A disk with the label files shall be submitted as part of the project record documents.

3.04 CERTIFICATION AND TESTING

- #### A.
- All hardware components (e.g. switches, routers) shall be tested for proper installation (per manufacturers' recommendations) and configuration. All components shall be tested using standard TCP/IP application utilities that collectively address network layer connectivity, IP packet path routing, and network performance. These tests are to be conducted during normal operation and for each site individually. Test results shall be indexed by site and device tested. Provide one hardcopy (8 ½ x 11 format) and three electronic copies in Microsoft

Excel (newest version for Windows) format. The Excel file shall contain columns for the site name, location, device name, interface, and results for each test.

1. Internet Control and Message Protocol (ICMP) Ping Test: This test verifies the network layer for connectivity by using Ether-type frame pings to reach IP target addresses and obtain or verify four results: 1) the target IP address, 2) the local media access control (MAC), 3) the number of responses, and 4) the response time. Each test shall be conducted from all areas to the router interface and from at least one connection per VLAN to at least one connection on all other VLANs, as required. Each test includes two steps, as necessary:
 - a. Obtain the four results by performing an address resolution protocol (ARP) for the target IP address and by verifying the ping.
 - b. If test 1 is unsuccessful, obtain the four results by executing an ARP for the default router, then use the acquired MAC address to determine the IP address, send an ICMP echo request, and monitor for the ICMP reply.
 - c. ICMP Test results shall identify the target device IP address and Pass/Fail result.
2. Trace Route/Path Discover: This test determines the path IP packets follow and reports each router encountered in the path. Testing elicits an ICMP TIME-EXCEEDED response from each router encountered. Each hop is tested three times to help identify changing routes. The delay between each of the three tests shall not be less than 15 seconds and not more than 1 minute. This test shall be conducted from a workstation on each VLAN with a destination address to be provided by the OWNER.
 - a. Trace Router/Path Discover test results shall be recorded as Pass – same route all three tests; or Fail – different route reported in one of the three tests. In the event of Fail, an explanation of why a different route was reported must be provided.
3. Configuration Test: This test verifies that each new network port is operational. Perform an ICMP ping from each port not previously tested ensuring each port has link light indicating port operability. Any failures in any one port shall constitute the return of the failed equipment for new network equipment from the appropriate CONTRACTOR. Test results should identify the VLAN, IP address obtained or assigned for each port, the target device IP address, and the Ping results (Pass/Fail).
4. Completion: CONTRACTOR's work for each school installation shall be considered complete after the following have been accomplished:
 - a. All system testing has been completed, CONTRACTOR certifies

that entire system is in working order, and Test Forms and Project Record Documents have been submitted and approved by the OWNER.

- b. All ceiling panels previously removed have been put back in place.
- c. All system labels have been put in place.
- d. All construction and installation debris and scrap materials have been removed from project site.
- e. All marked up, project record documents have been returned to the OWNER.
- f. All unused customer material has been returned to the OWNER.
- g. The OWNER has successfully completed acceptance testing of the network installation.
- h. The OWNER's Inspector has inspected and accepted the installation.
- i. Documentation, to include AS-builts, along with required soft copies has been turned over to the OWNER.

3.05 PROJECT RECORD DOCUMENTS

- A. Prior to the submittal of any final documentation, the CONTRACTOR shall provide to the IT Infrastructure Project Management Office the following for the entire contract:
 - 1. Three (3) electronic copies on USB flash drive of the hardware manufacturer documentation (PDF format) and software per model number of equipment installed throughout the project.
- B. Prior to the submittal of final documentation for each site, the CONTRACTOR shall provide the following to the IT Infrastructure Project Management Office for review and acceptance:
 - 1. One (1) 24" x 36" hard (paper) copy of the completed full set of As-Builts.
 - 2. One (1) electronic (USB flash drive) copy of the completed full set of As-Builts in latest AutoCAD or Microsoft Visio file format.
 - 3. Complete set of original red line drawings.
 - 4. One (1) hard (11" x 17" paper) copy and one electronic copy of the asset/inventory list utilizing the OWNER required Excel format
 - 5. One (1) hard (11" x 17" paper) copy and one electronic copy of the inventory list of equipment removed from the site utilizing the OWNER required Excel format.

6. One (1) hard (8 ½" x 11" paper) copy of the final invoice (bill of materials) for all work, E-rate discounted and/or funded through other sources under the contract.
 7. One (1) hard (8 ½" x 11" paper) copy of the Visio diagram of the OWNER approved warranty process, the warranty term effective from T&A acceptance, and written narrative that outlines the details the process that includes but is not limited to the following:
 - a. CONTRACTOR's warranty contact information
 - b. CONTRACTOR's process for tracking changes during the warranty period.
 8. One (1) electronic (USB flash drive) copy of the complete set of final test results in native format and one hard (8 ½" x 11" paper) copy of the test result summary. Included on the electronic USB flash drive copy shall be the associated software to read the test results.
 9. One (1) hard (8 ½" x 11" paper) copy of the cable management plan (in Excel format) as required in Specification 25569.
 10. One (1) hard (8 ½" x 11" paper) copy of all site specific signed RFCs, one (1) hard (8 ½" x 11" paper) copy of the General RFC log, and one (1) electronic USB flash drive copy of all RFCs for the site.
- C. Once the above referenced documents have been accepted, the CONTRACTOR shall provide to the IT Infrastructure Project Management Office the following for each site:
1. Three (3) electronic closeout USB flash drive copies. Disk label shall include project name, school name, school location code, contents descriptor, table of contents, revision number and date of disk, and CONTRACTOR information. Each electronic closeout USB flash drive shall contain the following:
 - a. Submit media in paper sleeve with see thru window.
 - b. A cover page with school name, location code, address, project name, prepared for, prepared by, revision number, and the final revision date of the bound book
 - c. A table of contents
 - d. The asset/inventory list utilizing the OWNER required Excel format
 - e. The final invoice (bill of materials list as required for closeout documentation) for all work, E-rate discounted and/or funded through other sources under the contract

- f. The complete set of final cable test results in native format and the associated software to read the test results
- g. The cable test result summary in PDF format
- h. The cable management plan A Visio diagram of the OWNER approved warranty process, the warranty term effective from T&A acceptance, and written narrative that outlines the details the process that includes but is not limited to the following:
 - i. CONTRACTOR's warranty contact information
 - j. CONTRACTOR's process for tracking changes during the warranty period following OWNER requirements outlined in the RFP.
- k. The accepted full set of As-Builts with required BICSI/PE stamps and signatures
- l. All site specific RFCs and the General RFC log
- m. All General RFCs for the project
- 2. Four (4) electronic USB flash drive copies of the completed full set of As-builts in latest AutoCAD or Microsoft Visio file format.
- 3. Two (2) electronic USB flash drive copies, identified with "IT Asset Management", which shall consist of the following:
 - a. The asset/inventory list utilizing the OWNER required format.
 - b. The inventory list of equipment removed from the site utilizing the OWNER required format.
 - c. A Visio diagram of the OWNER approved warranty process, the warranty term effective from T&A acceptance, and written narrative that outlines the details the process that includes but is not limited to the following:
 - 1) CONTRACTOR's warranty contact information
 - 2) CONTRACTOR's process for tracking changes during the warranty period
- 4. All MDF, IDF, and LDF cabinet keys; No keys are to be left with the schools.
- 5. Unattached accessories for all electronic equipment at the school site (including serial and other cables, adapters, etc.). The OWNER shall identify the quantities required.
- 6. The CONTRACTOR shall provide to the IT Infrastructure Project Management Office and identified as "Facilities Vault" for each site, one

(1) electronic USB flash drive copy of accepted As-Builts in latest AutoCAD or Microsoft Visio file format.

7. One (1) 24" x 36" hard (paper) copy of the completed full set of As-Builts.

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.

3.08 OWNER ORIENTATION (TRAINING)

A. Before contract closeout of installation, provide to designated OWNER personnel:

1. Provide a minimum a one week training course for OWNER designated representatives. The content of the training is advanced instruction on the use, programming, maintenance and troubleshooting of the LAN/WAN devices associated within this specification. Materials shall include training manuals and hands-on lab exercises. The training shall be delivered during the funding year. The training shall be provided at the equipment manufacturer's authorized training facility located in Los Angeles County. Training shall consist of classroom instruction including intensive course work covering the following topics:

- a. Product Features and Technical Specifications
- b. Implementation and Design as-built including installed LAN/WAN ARCHITECTure, familiarization with drawing sets, symbols and notation as well as other record documents.
- c. Complete understanding of the system ARCHITECTure and design of implemented solution.
- d. Complete function and feature analysis on implemented solution including command line interface (CLI) including, but not limited to:
 - (1) CLI Modes and sub-modes
 - (2) CLI Hierarchy
 - (3) CLI Commands
- e. A fault tree analysis to assist the service technician who troubleshoots and fix problems on implemented solution.
- f. Basic elements replacement procedures on implemented solution.

- g. Operating System configuration elements as-built
- h. VoIP and Network requirements and basics elements check list.
- i. maintenance and troubleshooting tools of implemented solution
- j. Support escalation and contact information on implemented solution

END OF SECTION

SECTION 27 5116
PUBLIC ADDRESS AND INTERCOMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Principal items of Work in this Section include but are not limited to:

1. Centralized racks, as indicated on the Drawings, containing a fully operational public address (PA) system, intercommunication system, and UPS. Features required include all-call paging, zone paging, class-tone activation, intercom access to individual speakers, phone to phone communications, radio and CD audio distribution, and classroom phone outside line access to 911. These features are accessible from the PBX, main PA phone, classroom phone or audio microphone. System shall also provide for interfacing with a master clock system for a class change signaling system, and with a Fire Alarm system for override of the tone signaling, PA audio, or both.
2. Conductors, conduits, and terminal strips, including interface cabling to PBX system, autonomous system overrides, Master Clock system and the Fire Alarm system.
3. Provide labor, engineering, design, testing, materials, supervision, tools, mounting hardware, cable management, software and components to provide a complete operable installation. The system shall be installed in compliance with project documents, applicable codes, manufacturer's published recommendations, and industry standards to deliver a system that meets standards of quality and functionality.
4. Provide services on Project site including specified connectivity for administration areas, classrooms, computer and science laboratories, libraries, auditoriums, multipurpose rooms, P.E. areas, quad area, other instructional areas, and work areas as indicated in Project Drawings.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 0500: Common Work Results for Electrical.
3. Section 26 0526: Grounding and Bonding.
4. Section 26 0513: Basic Electrical Materials and Methods.
5. Section 26 0519: Low Voltage Wires (600 Volt AC).

6. Section 26 2416: Panelboards and Signal Terminal Cabinets.
7. Section 26 5200: Emergency Power Systems.
8. Section 28 3100: Fire Detection and Alarm.
9. Section 27 5313: Clock and Program System.
10. Section 27 5127: Public Address Systems (Small Gyms, Multi-purpose Rooms)(ES).
11. Section 27 5128: Public Address Systems (Auditoriums, Performing Art, M-P Rooms)(MS and HS).
12. Section 27 5129: Public Address Systems (Gymnasiums).

C. Acronyms:

DTMF	Dual Tone Multiple Frequency
IC	Intercom
LCD	Liquid Crystal Display
OAR	Owner Authorized Representative
PA	Public Address
PBX	Private Branch Exchange
VFD	Vacuum Fluorescent Display
LED	Light Emitting Diode
SLC	Small Learning Community

1.02 SYSTEM REQUIREMENTS

A. Intercommunication System: System shall be a combined public address and intercommunication system with UPS.

1. Communication hardware shall be furnished with the capacity for internal communication between operator and selected classrooms. Normal and emergency alerts from classroom telephones to the main office shall be annunciated by an alerting tone, appear on a wall-mounted administrative display located where most office staff can view at the same time, and identify the calling room's extension. These alerts shall function as described by the manufacturer. Calls shall be displayed in the order in which they are received and the additional calls stored in memory. The main operator shall be able to answer calls in sequence or out of sequence. Caution office staff during training about using any que-clearing commands without verifying the nature of each call. Dialed calls to classroom phones are initiated by ringing the classroom telephone. These phones shall have their ringer volume control locked in the maximum ring volume position. Dialed intercom calls to the classroom speaker are preannounced by an

alert tone and repetitively beep during the connection. If the classroom handset is lifted from its cradle and the conversation shall automatically transfer from the speaker to the classroom phone. Predetermination as to whether to ring the telephone or to permit talking over the speaker shall be user selectable when dialing. Signal switching for communication operations shall be accomplished by electronic methods.

2. Direct Dial Telephones: A direct-dial telephone system with electronic switching shall be furnished to accomplish the above description. The system control circuit shall be state-of-the-art design with modular plug-in printed circuit construction and advanced type technical mechanism. The central switching exchange shall utilize standard DTMF signaling for conformance with standard telephone practices.
3. Administrative Telephones: Administrative telephone communication system shall provide the following minimum requirements:
 - a. Administrative control center shall be a standard push-button dialing telephone complete with solid state pre-tuned tone oscillators identical to those employed by public telephone companies.
 - b. Central switching exchange shall be of the modular plug-in printed circuit board type, solid state sensing and logic, and shall also provide two-wire balance transmission complete with dial tone, automatic ringing and busy signal facilities.
 - c. Central switching exchange shall be furnished with facilities for a minimum of 8 unrestricted, simultaneous, private telephone conversations between:
 - 1) Administrative and administrative telephones
 - 2) Administrative and staff telephones
 - 3) Staff and staff telephones.
 - d. Capability as provided for direct dialing, private, two-way telephone communication between locations furnished with administrative telephone and staff telephone shall be provided.
 - e. Capability as provided for any administrative telephone to transfer a call from another administrative telephone or any staff (classroom) telephones to any other telephone.
 - f. Capabilities, as provided for the instantaneous distribution of emergency announcements simultaneously to all locations furnished with loudspeakers, by dialing a pre-determined code number.

- g. Provisions for restricting access to the emergency announcements to certain administrative telephone. This shall be accomplished by the use of an authorized administrative telephone.
- h. Capabilities as provided for the origination of both normal and priority emergency calls from any staff station location shall be provided. Priority emergency calls shall take precedence over normal calls.
- i. Facilities as provided for answering calls registered in the readout by pressing a single response button.
- j. Provisions for instantaneous distribution of announcements to prescheduled groups of speakers from any location equipped with an administrative telephone.
- k. Provide an all-cancel function from an administrative telephone to cancel all classroom annunciated calls. Note: During training session, caution users to verify the nature of each call-in before clearing the que.
- l. Local diagnostic functions shall be provided to simplify maintenance.
- m. The system shall incorporate non-volatile memory for programs, which shall not be affected by the loss of line voltage.
- n. Central switch shall be designed to fit in any standard 19 inch rack-mounting. It shall be possible to remove individual circuit boards from the system for inspection and service without disturbing or disconnecting any exchange wiring. Analog PA shall remain operational when circuit boards are removed. Reasonable exceptions are permitted in the design phase (base effort).
DTMF programming: Administrative telephone shall be able to distribute announcements to each individual speaker or (intercom), zone page a group of speakers, or distribute all-call.
- o. Audio level of the telephone intercommunication system shall be attained at sound levels sufficient to override typical ambient school noise levels and to provide for a satisfactory and serviceable system with a minimum of 70 dB isolation between PA and intercommunication signals.
- p. Upon notification from the Contractor, the OAR shall contact the Telecommunications Branch of LAUSD to arrange for ordering of necessary additions to the voice system to coincide with the completion of the installation of the PA or Intercom system. Any work to the PBX system will be provided by the Owner to encompass both

hardware or software additions and any necessary programming, and is outside of the scope of this specification. The Telecommunications Branch will manage connections to the PBX voice system. Any vendor working on the telecommunications system must be pre-approved by the Telecommunications Branch prior to any work commencing.

- B. Public Address: Public address system reproduction shall provide the following minimum requirements:
1. Reproduction of speech shall be clear, high fidelity and with frequencies within range of system faithfully reproduced with no detectable noise, hum or distortion. The signal to noise ratio for the frequency range of 30 Hz to 20 kHz shall be a minimum of 90 dB.
 2. Reproduction shall be attained at sound levels sufficient to override noise levels typical for schools, to provide a thoroughly satisfactory and serviceable system with a minimum of 30 dB signal-to-noise ratio between public address program and background noise level of 65 to 70 dB.

1.03 SUBMITTALS

- A. Provide the following submittals:
1. Material list: Submit a complete material list for the materials and products of this section. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The leftmost column shall be the item number; next shall be the description, followed by the applicable specification section number, followed by the specified item, which is followed by the submitted item. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified.
 2. Product Data: Include Product Data sheets or catalog cut sheets for items listed in index. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Items shall be arranged in the same order as the index and if more than one item is indicated, the submitted items shall be highlighted or marked with an arrow. Product Data shall be sufficiently detailed to allow the Architect to review the product and to allow other trades to provide necessary coordination.
 3. Include in the Product Data list submission, copies of manufacturer certificates that the Contractor is an authorized distributor of the

submitted manufacturer's products; and each member of the installation crew has been trained and certified in the installation of those products. Contractor shall submit proof that his or her company has a service organization capable of responding within 24 hours of receipt of written notification and resolution within one day.

4. Contractor shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years.
5. Provide a letter from the Manufacturer assuring the availability of spare parts common to proposed system for a period no less than five years on components.

B. Shop Drawings: Shop Drawings shall indicate the following :

1. Drawn to scale, details of racks, consoles and cabinets with designations, elevations, dimensions, doors, barriers, mounting details, catalog number of locks, finishes and color. Provide a dimensioned detail of console nameplate including school name, address, and power load. Indicate manufacturer's part numbers for controls, switches, connectors and indicators. Provide a complete set of drawings of wiring diagram for each rack, instrument wiring and schematic diagrams of circuits of equipment.
2. Detailed drawings as to interfaces with equipment furnished by others including number of wires, termination requirements, input or output voltages, input or output signals and other required coordination items, items including point to point connection details for devices and equipment,
3. Provide a terminal block layout for the main public address terminal cabinet indicating the locations of terminal blocks for cables from the field, the public address rack, PBX, and as otherwise required. Indicate the typical lay down for each cable type and the number of blocks and space required. Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included. Indicate terminal cabinet layouts for remote terminal cabinets as required.
4. Power load of public address system and UPS operational time calculations shall be separately calculated and included with Shop

Drawing submittal. Provide cabling and conduit from rack-mounted UPS to one of the MDF cabinets. Notify OAR to contact ITD for SNMP connection from the UPS to the LAUSD network when system is ready.

5. Shop drawings shall indicate equipment locations, wiring and schematics, details, panel configurations, sizes and a point-to-point wiring diagram of circuits. Shop drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, input or output voltages, input or output signals and other pertinent details. Responsibility for each end of interfaces shall be noted on shop drawings.
6. Submit Drawings prepared, signed, and sealed by structural engineer licensed in the State of California. Details shall be provided indicating the proposed means of support and attachment of wall and floor mounted racks. Calculations shall be based on the maximum load rating of the cabinet by the manufacturer per CBC seismic environment requirements, not the weight at time of occupancy.
7. Provide Shop Drawings, in the same size as the Record Drawings. Shop Drawings shall be prepared in the latest version of AutoCad with three – CD-ROM electronic copies submitted along with one set of full sized Shop Drawings.
8. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.

- C. Sample Materials: Provide samples of material and equipment as required by the Architect. If samples are requested, they shall be submitted within ten days from the date of request.

1.04 CODES AND STANDARDS

- A. Complete installation shall meet or exceed the latest edition of following standards.
 1. EIA/TIA-568: Commercial building telecommunications wiring standard.
 2. EIA/TIA-569: Commercial building standard for telecommunications pathways and spaces.
 3. EIA/TIA-606: Administration standard for telecommunications infrastructure of commercial buildings.

4. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications.
5. CCR Part 2 - California Building Code (CBC)
6. CCR Part 3 - California Electrical Code. (CEC)
7. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.
8. BICSI Telecommunications Distribution Methods Manual, current edition.

1.05 SYSTEM DESCRIPTION

- A. The Public Address or Intercommunications system shall be comprised of two separate inter-operating systems which shall provide redundant means of performing an all-call public address function and class tone distribution. Besides all-call and telephone functions, only the software-programmable system provides zone paging, zoned class-change tone distribution, two-way loudspeaker intercommunication, AM/FM radio-CD audio distribution and tone choices. The analog PA system only provides an emergency all-speaker public address from a main office microphone with feedback elimination circuitry, and an all-speaker class tone distribution activated by a service switch. Both public addresses systems shall be furnished with totally separate active electronic components. It shall be possible to remove power from components in one system while retaining the functionality of the other system. Both systems shall share a common, rack-mounted UPS with a SNMP, centrally monitored, network connection. Systems not providing public address and class tone distribution redundancy are not permitted
 1. As a minimum a two hundred and fifty (250) watt public address amplifier shall be provided for the analog PA system. The total wattage load of all the speakers in the system shall be measured to determine if additional two hundred and fifty (250) watts or higher wattage public address amplifiers are needed. The spare wattage capacity for each public address system amplifier shall be a minimum of 33 percent of the total wattage load for each amplifier at the time of occupancy.
 2. Provide antifeedback circuitry or rack mounted feedback eliminator in PA rack. No feedback shall be detected from the fixed volume, always-hot microphone.
 3. Combine networks shall be used to convert stereo auxiliary inputs unless the dual input aux input of a preamp module provides this.
 4. A microphone shall be installed in the main office in a lockable fold-up wall cabinet which also contains an Am/Fm/single CD

player. This microphone shall be “always hot” – activating a microphone switch will connect it directly to the analog public address system, permitting an emergency all-call announcement to be performed. A volume control for this microphone may be provided only if the minimum setting is still audible.

5. A public address administrative telephone shall also be installed in the main the office, in each SLC, and in each Academy on the school site and terminate in the PA rack. Each shall use power originating from the PA UPS so they will be operational during a building power outage. The paging trunk outputs from the PBX shall be connected to unassigned phone ports of the programmable PA system, with PA ports programmed high enough for all-call, and labeled.
6. Program-All distribution through all loudspeakers, outdoor speakers, auditorium system speakers, gymnasium speakers, and multi-purpose room speakers through a relay control. Program-All shall furnish full priority over switching between amplifier and speakers of central control system, except as specified. Program-All shall obtain signal sources as selected.
7. For each autonomous system, a selector switch on the custom control panel shall be provided to automatically override autonomous system speakers.
8. Automatic class change signaling system shall include manual controls to select program and to do all call. A panel mounted in the P.A. rack shall include at a minimum a selector switch to provide selection of three programs and a separate switch to do all call. The number of class change signaling systems shall be determined by the number of small learning communities or other academies at the site. The Public Address and Intercommunication system shall be able to support as many class change signaling needed, by providing a custom panel which can provide additional signal zones and tones. The design shall include the use of additional signal generators in order to provide different tone signals and the selection of three programs and a separate switch to do all call for each of the additional Learning Communities or other academies. The class change signaling selector switches shall be wired to the clock program controller for selection of one of three programs for each independent Learning Community or Academy. The selected program shall be distributed over the microprocessor based loud speaking intercom and P.A. system. At school sites where there are no independent Learning Communities or Academies, and a master clock remote input panel zone selector has been installed, typically

in the main office, the automatic class change signaling system control on the PA rack shall be bypassed.

- a. In Middle and High schools, the class change signaling system shall be programmed to include dressing and cleanup tones for gymnasiums and shop zones.
- B. In Middle and High schools, the master clock will transmit three contact closures from three separate relays per schedule. The other system shall be a microprocessor based, DTMF tone controlled modular loud speaking intercom and public address system. The intercommunication system shall provide communication between classroom telephones, speakers, administrative phones and PABX system and shall operate in conjunction with Public Address equipment. The system shall provide the following features and capabilities:
1. The system shall be available in a rack mounted card cage configuration with a printed circuit backplane or a card shelf with a modular shelf assembly with through plug-in circuit cards. The processor card, speaker control cards, telephone control cards and PBX telephone interface cards shall plug into card connectors on the backplane or into a modular shelf assembly with through plug-in circuit cards.
 2. Speaker cards shall be installed in card cages or card shelves. Each speaker or telephone card can control sixteen or twenty-four speaker circuits depending on the system. Provide speaker and telephone cards for each switch bank as needed.
 3. DTMF tone capable cards shall be installed in any one-card cage or modular shelf. Each card can control sixteen to twenty-four call stations, DTMF telephones or display phones in any combination. Provide one station card for the first switch bank to allow connection of the system control display phone. Provide additional station cards for emergency call buttons or phones.
 4. One relay card or more per switch bank and one or more analog cards are required on switch bank. These relay cards are connected to the printed circuit backplane directly or with ribbon cables. The relays in the relay card allow the system to seize control of speakers and station circuits as required. Control voltage to the relays may be interrupted to drop out system functions and give the intercom or program control panel and associated equipment priority. The relay card is the only item common to both systems. It contains no active circuitry. Each relay card has provisions for attachment of an external power amplifier if required.

5. A power or program panel shall be provided to supply the manufacturer's specified power for the analog speaker cards, telephone cards and for other components in the system. The power supply of the DTMF controlled system shall be independent of the switch bank based Public Address and Intercom System. It shall also be provided with a three channel auxiliary program input chassis into which three modules of various types may be installed. These modules shall include microphone pre-amplifiers; transformer couples line pre-amplifiers, microphone, and telephone paging modules, a multiple tone generator, and a FM tuner module. Three outputs from the auxiliary program input chassis shall be connected to the backplane where their programs may be selected for distribution by the microprocessor-based system.
6. One DTMF based control console administrative telephone with an LCD display shall be installed in the main office in each SLC and in each Academy. It shall be possible to program and control microprocessor-based equipment with this control console, if this feature is provided by the manufacturer. It shall also be possible to make zone pages and all call pages to assign programs to any or all speakers, to assign individual speakers to time and page zones and to make loud speaking intercom calls.
7. An external 250-watt power amplifier shall be provided for the last switch bank, or of the last 2 switch banks if required.
8. Telephones: System shall be ADA compliant and utilize DTMF based, 2554 type wall mounted or 2500 type desk phones. Wall phones shall be fully modular. System shall automatically transfer an intercom call made to a loudspeaker to the associated intercom telephone when the phone is taken off hook.
9. Emergency Calls: System shall possess an emergency call feature, which may be activated by either one of the three following methods: dialing * * and hanging up, by four or more flash-hooks within a two second interval or lift the phone off the hook and wait for a configured length of time (typically 15 or 30 seconds). Emergency calls shall appear at the top of the answer queue and shall ring with a distinctive ring cadence on the designated administrative station or wall display unit.
10. Wall Display Unit: System shall be furnished with only one wall display unit, which displays the time and call-in information. Emergency calls take priority and flash "HELP", "E" or display station number. Information shall be displayed on LED, VFD, or LCD segments and shall be accompanied by distinct tones for emergency, normal, and call waiting originations. Tone level shall

be adjustable. The information from telephones installed in the Public Address system shall be displayed on only one wall display installed at the main office. (In some systems the emergency call will not appear until the display phone line is no longer being used).

11. Privacy Feature: System shall have a privacy feature, which renders impossible unannounced monitoring of intercom conversations from the PA or IC rack, administrative telephones or other intercom station.
12. Channels: A minimum of eight channels of intercommunication shall be provided together with the Public Address System.
13. Loop Start Trunk Ports: System shall provide intercom system dial tone for loop start trunk ports from the PABX via Intercom station ports or telephone adapter modules. PABX based DTMF phones shall hear a beep and then receive PA or IC dial tone. It shall be possible to assign various levels of intercom capability to these ports via intercom system programming. These ports shall allow calls from the PABX to individual intercom stations or to access page functions. The Intercom station ports or telephone adapter modules shall have transformer based isolation circuits to protect both PA or IC and PABX from harmful transient signals that may be present in the lines. Each Intercom station port or telephone adapter module shall use optical isolators to detect the 90 volt ring signal from PABX station ports. In middle schools and high schools, a minimum of four loop start trunk ports from the PABX via intercom station ports or telephone adapter modules, shall be connected. Two such circuits shall be connected for primary centers and elementary schools.
14. Interface Modules: System shall be furnished with a telephone interface module to provide up to eight DTMF based telephone ports, which are compatible with 2500 Series, PABX station ports. System shall be provided to allow up to eight simultaneous calls from the intercom system to PABX connected instruments, or to outside lines. These ports shall allow calls from the intercom system to the PABX and shall appear transparent to the PABX. Each port requires one telephone cable pair. Four such circuits shall be connected to the PABX at time of installation. Circular or linear hunt shall not interfere with PABX to PA or IC interface.
15. Intercoms: System shall provide 2554 or 2500 series telephone in rooms.
16. Provision shall be furnished to connect up to six separate time zone schedule controllers to the microprocessor-controlled system. When

a contact closure is provided by a remote time controller, speakers assigned to the time zone will sound a passing tone of standard tone and duration.

17. The Public Address System shall be configured in such a way as to prevent tones initiated automatically or manually from the Public Address console and manually from any telephone when the Fire Alarm Control Panel is in alarm. See standard detail SD 5.14 for Fire Alarm Control Panel to Public Address System physical interface requirements. An additional separate circuit shall also be required to inhibit loudspeaker audio outputs when another separate relay contact closure occurs from the Fire Alarm system. This second closure shall also require activatingactivation of the muting relay circuits to autonomous PA systems.
18. Central Intercom Switch: Central intercom switch shall fit in standard 19-inch mounting rack. Circuit boards shall be removable from system for inspection and service without disturbing or disconnecting exchange wiring. Units and electronics switches shall be engineered to fit in one 65-inch rack (exchange system and PA system).

1.06 QUALITY ASSURANCE

- A. Work shall conform to CCR, Title 24 Part 3, Basic Electrical Regulation and National Electrical Code, latest edition.
- B. Only a qualified Contractor holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
- C. Persons skilled in trade represented by work, and in accordance with applicable building codes, shall install system in accordance with best trade practice.
- D. Work shall be performed by a Contractor that has completed at least five school systems of equal scope to system described herein and shall have been engaged in business of supplying and installing specified type of systems for at least five years. Contractor shall maintain a fully equipped service organization capable of furnishing repair service to equipment
- E. Use adequate numbers of skilled workmen who are currently manufacturer certified, thoroughly trained and experienced on the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work.
- F. Coordinate cable runs, and rack equipment locations with the Owner's Authorized Representative during the initial design of the cable installation. Contractor and OAR must agree as to the final location of devices and the cable plant design.

- G. Provide technicians and tools required to participate in Owners Quality Assurance Testing as detailed in Attachment “A” of this specification.
 - 1. Items on check list of Attachment “A” will be examined as a minimum at the Public Address Head End, terminal cabinets, ground vaults and classrooms. Should the examination show deficiencies related to items in the checklist, Owners acceptance testing will be discontinued until corrections have been made. When the Contractor has completed the corrections, a subsequent Quality Assurance test shall be initiated. This procedure is in addition to the system functionality testing required in Article 3.03 below.

1.07 WARRANTY

- A. Warranty that work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of three years from date of installation acceptance, date of Contract Completion, excluding specific items of work that require a warranty of a greater period as set forth in this Specification. In the event a manufacturer’s warranty is longer than three years, the manufacturer’s warranty shall be the warranty period. Immediately upon receipt of written notice from the Owner, repair or replace at no expense to the Owner, defective material or work that may be discovered before final acceptance of work or within warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the Owner shall not relieve Contractor from these obligations.
- B. Equipment or materials failure rates of ten percent or more during the warranty period:
 - 1. District shall monitor the performance and reliability of the installed base of Equipment and Materials installed in this Contract. Any deficiencies or malfunctions will be referred to the Contractor for repairs or equipment replacement.
- C. If the District detects a defect within a warranty period as defined here in, it shall notify the Contractor Representative in writing (“Notice of Defect”). Make available and provide the District with the telephone number of a fax machine to receive Notices of Defect. This fax machine shall be available to receive faxes 24 hours per day seven days per week, including weekends and holidays
- D. Upon receipt of written notice from the District of any failure or defect (“Defect”) in any such Equipment or Work, the Contractor shall diligently perform work necessary to determine the cause thereof, and the time necessary to remedy the Defect, and shall propose in writing to the District

how and in what manner it will remedy the Defect. If the District determines that the proposal complies with the terms of the Contract, it shall authorize Contractor to proceed to redesign, repair, or replace the defective or failed Equipment or Work within the agreed time period.

- E. In determining the cause of the Defect, perform such investigations and tests as may be required to determine the cause, and to verify that such redesign, repairs, and replacements comply with the requirements of the Contract Document. Cost associated with such investigation, redesign, repair, replacement, and testing, including, but not limited to, the removal, replacement, and reinstallation of equipment and materials necessary to gain access to defective Equipment, shall be borne by the Contractor. Should the Contractor fail to promptly make the necessary investigations, redesign, repair, replacement, and test, the District may perform or cause to be performed the same at the Contractor's expense.
- F. Contractor will warrant the redesigned, repaired, or replaced Equipment against defective design, materials, and workmanship for the remainder of the warranty period or a period of three years from and after the date of acceptance of the redesigned, repaired or replaced Equipment thereof, whichever occurs later.
- G. Contractor shall be liable for the satisfaction and full performance of the warranties as set forth herein.
- H. Warranties are deemed and acknowledged to explicitly extend to the future performance of the Equipment warranted.
- I. The rights and remedies provided for herein are cumulative, and shall not be exclusive and are in addition to any other rights and remedies provided by law, whether in contract or tort, or under this Contract.
- J. Contractor is deemed and acknowledged to be a merchant with respect to components and replacement parts furnished pursuant hereto, and the District is acknowledged not to be a merchant with respect thereto.
- K. In the event any Supplier or manufacturer offers any extended warranty not specified herein, state the terms of such warranty or warranties in writing and extend the same to the District without additional cost to the District.
- L. Warranties and guarantees of Suppliers of any tier and Manufacturers, whether expressed or implied, are deemed to be made for the benefit of the District regardless of whether stated as such, and Contractor shall enforce such warranties and guarantees for the benefit of the District.

- M. Include a letter signed by a corporate officer, partner, or owner of the contracting company describing their service organization, its capabilities and commitment to servicing the warranty on work executed and materials furnished.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Public Address Intercommunications system shall be Bogen Multicom 2000/MCP-35A (modified), Bogen Quantum Multicom 2000/MCP-3A (modified), Dukane StarCall/(with or without 3200 using alternate audio card), Rauland Telecenter V/MCZ-300 (modified) or Rauland Telecenter VI/MCZ-300 (modified), or equal. In small site projects approved by the ITD PMO office, small paging systems (Bogen PCM2000 or equal) may be integrated with the site PBX.
 - 1. A Public Address and Intercommunication system shall not be expanded past the stations or ports capacity stated in the manufacturer's product specifications.
 - 2. The Bogen Quantum Multicom 2000/MCP-35A is permitted for sites with any number of stations. Interconnecting two card cages, each with a Quantum processor card by use of an Ethernet cable is permissible. Use of SIP1 classroom phones are not permitted.
 - 3. Voice over IP systems or Voice over IP integrated design systems shall not be accepted except in projects approved by the ITD PMO office.. Voice over IP designs to increase the station capacity of any public address intercommunications system shall not be accepted. Manufacturer designed Ethernet interconnections between card cages are permissible if evaluated by ITD.

2.02 SYSTEM EQUIPMENT

- A. System Equipment Rack: The following specifications apply to equipment furnished with the Public Address or Intercommunications System.
 - 1. The equipment rack shall provide a minimum of 77 inches of vertical panel space to accommodate 19-inch panels having 1 ¼-inch by ½ inch mounting spacing. The rack shall be 22 3/8-inch wide by 18 ½-inch deep by 81 3/8-inch high, with louvers and knockout openings on the sides and rear. There shall be a rear door having slip-joint hinges for easy removal without the use of tools. The rack shall be constructed of 16-gage steel. The rack shall be finished in black enamel Cabinet shall be constructed with

mounting rails tapped for No. 10-32 screws on EIA spacing front and rear. Cabinet shall be tested and certified to the seismic specifications set forth by NEBS Telcordia Technologies GR-63-CORE. Calculations for seismic bracing shall be based on the maximum load rating of the cabinet by the manufacturer in a CBC regulated environment, not the weight at time of occupancy. Rack shall be UL listed.

B. Central Card Cage or Shelf Assembly:

1. Central Processor Card

Contains the system software that controls system features, functions, connections, audio, data and configuration for the DTMF controlled part of the Public Address and Intercommunication System.

2. Intercom Telephone Cards or Speaker Cards:

An intercom telephone card or speaker card shall be provided for PA or IC ports for which intercom telephones are provided or for which intercom access is required.

3. Interface PA or IC to PBX

System shall be equipped to provide eight simultaneous calls from the intercom system to a PBX., Direct connection to outside lines in the absence of a PBX, if software restricted to 911 only, may be permitted on a case by case basis with permission from the Telecommunication department.

4. Interface PBX to PA or IC

Provide Intercom station ports or telephone adapter modules to allow four loop start trunks from PBX to obtain access to intercom system dialing capabilities.

C. Administrative Display Telephone:

1. Telephones shall be designed to work with intercom system, shall utilize DTMF dialing and shall be furnished with the following features:

- a. Function keys and display: Telephone shall be furnished with a standard 12-button keypad and LCD display for full alphanumeric menu-driven operation.
- b. Telephone shall display station numbers with priority levels for incoming calls. Unique ring tones and flashing message

or station number on display shall distinguish emergency calls from other calls.

- c. Telephone shall provide two-way, hands-free speaker operation and private handset operation. Handset shall be fully modular with a dynamic receiver and transmitter compatible with adjustable volume handset for the hearing impaired.

D. Intercom Instruments:

1. Wall-mounted: Intercom instrument shall be fully modular Series 2554 telephone instrument with industry standard DTMF keypad and 90 volt, 20 Hz compatible bell ringer. Unit color shall be cocoa brown. Unit shall be mounted with screws through the base; connections shall be provided directly to the network card. The handset cord shall be fully modular.
2. Desk-mounted: Intercom instrument shall be fully modular Series 2500 telephone instrument with industry standard DTMF keypad and 90 volt, 20 Hz bell ringer. Unit color shall be cocoa brown.
3. The bell ringer loudness control for both classroom wall-mounted and classroom desk-mounted sets shall be fixed to the loud position permanently. The loudness control for the ringer shall not be adjustable.

E. Ring Adapter Cards:

1. A ring adapter card shall be provided at PA or IC ports for which intercom telephones are required. This card shall provide standard 90 volt, 20Hz cycle to the telephone instruments to allow industry standard 2500 Series desk and 2554 Series wall telephones to be furnished.

F. Wall Display Unit:

One wall display unit shall be provided and shall display time of day, station number and call priority. Unit shall provide unique ring tones to distinguish emergency calls from non-emergency calls. Emergency calls shall move immediately to the top of the queue and shall be accompanied by flashing "HELP", "E" message or the classroom extension number. Alternative characteristics are permissible if they follow the manufacturer's published description.

G. Intercom or Program Distribution Control Panel:

1. The analog PA system shall be modified versions of the Bogen Model MCP-35A, Rauland MCZ-300 or Dukane 3200 without switchbanks. The intercom function shall be disabled due the

absence of switch banks. Remove or cover intercom operational labeling that has been deactivated.

2. The control panel shall be solid-state and designated for continuous duty service on line voltages of 120 volts, 60 Hz AC.
3. It shall be furnished with two separate amplifiers. The program amplifiers shall provide a minimum of 35 watts RMS at less than one percent distortion at rated power and bandwidth. The frequency response shall be within + one, -3dB from 80 Hz to 15 KHz. The intercom amplifier shall be furnished with an output rating of 15 watts RMS; frequency response shall be shaped for maximum intelligibility. Both amplifiers shall provide balanced 25-volt line output.
4. It shall be furnished with inputs for two Lo-Z balanced microphones, one Hi-Z unbalanced auxiliary input, telephone paging accessories and booster amplifier. Terminals shall be provided to activate the time signal feature and Telco page feature.
5. It shall provide controls necessary for two-way intercom communication with any classrooms, communication with any classroom, distribution of general announcements or program material to classrooms, and transmission of emergency announcement to classrooms. Provisions shall be included to permit emergency paging from a remote telephone, or microphone, which shall capture system priority and override all functions except for the emergency page feature.

H. AM-FM Tuner and CDPlayer.

I. CD Player/Changer

J. Power Amplifier

1. The Power amplifier shall be a solid-state amplifier with transformer isolated output for 25V systems. Direct coupled amplifiers shall not be accepted.
2. The amplifier shall provide an audio output of 250 watts rms continuous or value as determined by design calculation. The rated output shall be obtained with and input that is not greater than 500m V(rms).
3. The amplifier shall provide either balanced or unbalanced constant-voltage outputs of 25 volts and 70 volts, plus four and eight ohm balanced or unbalanced outputs. Output regulation shall be within 2dB from no load to full load.
4. The amplifier shall incorporate electronic shutdown circuitry, which shall activate whenever and overload or short occurs on the

output of the amplifier. A front panel overload shutdown LED shall illuminate to indicate the discontinuance of power output once the cause of the shutdown condition had been removed.

5. The amplifier shall be furnished with thermostatic control to prevent operation at excessive ambient temperatures. The amplifier also shall include electronic overload limiting and short-circuit protection and shall be properly fused and rated for continuous operation.
6. The standard amplifier shall be furnished with an EIA 19-inch front panel suitable for rack mounting.

2.03 ANTENNA AND GROUNDING

A. Antenna and Accessories:

1. FM Antenna: Furnish and install a Blonder Tongue BTY-2-FM, or equal, all-direction FM dipole antenna on roof at indicated location. Lead-in cable shall be 75-ohm weatherproof coaxial type, equipped with necessary weatherproof matching transformer at each end. Cable shall be Belden 8241, or equal. Provide a weatherproof surge protector, with # 6 AWG grounding conductor to a grounding electrode. The grounding conductor shall be bonded to the mast and surge protector
2. AM Antenna: Furnish and install a whip type AM antenna. Antenna shall be insulated from ground. Guy AM antenna whip from mast with an insulated standoff. If signal strength is not adequate from such an antenna, provide and install a 30 foot length of hard drawn #12 copper wire between new roof antenna masts. Lead-in wire shall be 75 ohm coaxial cable, Belden 8241, or equal, furnished with necessary matching transformers at each end. Provide a weatherproof surge protector, or equal with # 6 AWG grounding conductor to a grounding electrode. The grounding conductor shall be bonded to the mast and surge protector.
3. Provide and install an AM/FM antenna coupler in outdoor housing mounted on antenna mast.
4. Provide and install an antenna mast on roof of closest building to the PA rack or as indicated on Drawings. Mast shall be 1-1/4 inch galvanized steel and shall be secured to roof joists with steel straps specifically manufactured for installation.
5. Provide and install 3/4 inch antenna conduit from PA console to antenna. Provide and install a weather head, roof flashing.

B. Grounding:

1. Wiring enclosures, terminal cabinets, outlets, frames of cabinet racks and other enclosures shall be grounded in accordance with requirements of California Electrical Code and as specified.
2. Chassis of amplifiers, power supplies, and other electronic power equipment shall be grounded by bonding to control cabinet.
3. Housing and grips of microphone and conductive housings and other equipment shall be grounded by means of grounding wire or shield in cord or cable furnished for equipment connections.
4. Circuits shall be grounded as recommended by manufacturer of equipment to which they are connected unless otherwise specified.
5. Furnish, install and bond a #6 AWG, green grounding wire from the main public address terminal cabinet to console equipment rack main terminal. Frame of console and circuit wiring requiring grounding shall be grounded to ground system at equipment rack main terminal. Loudspeaker circuits and communication circuits shall operate balanced to ground.

2.04 SPEAKERS AND ACCESSORIES

A. Loudspeakers:

1. Each loudspeaker mechanism shall be mounted in flush back-box or surface baffle as indicated on Drawings and as specified.
2. Frequency response of loudspeakers shall be considered to be frequency response of speaker together with its associated line transformer. Power rating of each speaker shall be its capacity to reproduce, with satisfactory frequency response and performance, at rating level specified. Adjust power delivered to each speaker, as necessary, to insure a satisfactory sound level, with reproduction of good quality, in each of locations where speakers are installed.
3. Speaker mechanism shall be eight inch diameter, cone type radiating element, 9,500 gauss per square inch Alnico 5 magnet, and moving coil type. Cone shall be seamless. Sensitivity shall be a minimum of 94 dB SPL per meter at one watt. Power handling capacity shall be a minimum of 15 watts RMS. Magnet shall have a minimum weight of ten ounces. Nominal frequency response shall be 80 to 8,000 Hz. Speakers shall be Quam 8C10PAOT, or equal, unless otherwise specified.
4. Loudspeaker Volume Controls: Loudspeaker volume controls shall be "L-Pad" attenuators of suitable impedance or autotransformer attenuators with 10 steps (and off). "T-Pad" or potentiometer shall not be accepted as a loudspeaker volume control. Furnish, install and connect volume controls on loudspeakers located in areas other

than classrooms. For wall-mounted baffles, install control within baffle with shaft extending through bottom. For ceiling-mounted speakers, install volume control on wall in a convenient location. Provide shaft with round knob and dial-plate to indicate position of setting. Loudspeaker volume controls shall be installed only where indicated on Drawings.

B. Impedance Matching:

1. Speakers: Each loudspeaker shall be provided with a line transformer having taps as necessary for proper matching and proportioning power to speaker. Frequency response of each transformer shall be within 3dB from 70 to 10,000 Hz. Minimum power handling capacity of each transformer shall be a minimum of 2.5 watts. Transformers shall be Triad S-79Z, or equal.

2. Line:

Each line-matching transformer shall be furnished with similar frequency response as speaker transformer, and be shielded and equal to TC-LS-34.

- a. Speaker line impedances shall be selected as necessary to limit distortion to a minimum. Line loss to any speaker operating at normal input shall not exceed 1 dB. Speaker matching transformer shall be connected to provide a satisfactory division of power among speakers. Sum of power distributed to speakers connected to any one-power amplifier shall not exceed 66 percent of amplifier power output rating specified herein.

- b. Impedance and signal level matching is required.

C. Types of Speakers:

1. Type "A" Flush Mounted Speakers:

- a. Speaker baffle shall be a vandal-proof, round, flush-mount Quam model BR8VP, or equal. It shall be constructed of #14 gage carbon steel with a tensile strength of at least 55,000 psi. Finish shall be white baked powdered epoxy, virtually scratch and mar resistant. Baffle shall incorporate a sub-plate fabricated from heavy-gage steel that shall provide an interlocking lattice grid pattern to protect speaker from tampering and vandalism. Protective sub-plate shall be acoustically transparent. Sub-plate and speaker shall be secured by means of casehardened square-shanked carriage bolts. Baffle shall mount in a Quam ERD-

8NS backbox by means of tamper-proof hardware provided.

- b. Backbox shall be a Quam ERD-8NS, or equal, recessed round enclosure designed to accommodate 8-inch speaker or baffle assemblies. It shall be made of one-piece #22 gage drawn steel with a rust-inhibiting coating, and an interior treated with a fire-retardant resonance damping material. Bottom inside of backbox shall have affixed a 9-inch pad of 3/8 inch thick acoustic foam to provide additional resonance and vibration control. Four combination conduit knockouts 1/2 inch and 3/4 inch shall be deeply scored, but not through, to preserve leak-free integrity of enclosure in air plenum installation. These combination knockouts shall be spaced 90 degrees apart.
- c. Provide spanner type tamperproof screws to secure grille to backbox.

2. Type "B" Surface-Mounted Speakers:

- a. Type "B" surface-mounted speakers shall be a Quam VP2, or equal. Speaker shall be quality 8-inch type, complete with a 25V/70V line matching transformer tapped at 1/2, 1, and 2 watts. Speaker frequency response shall be 50 to 15,000 Hz, with an axial sensitivity of 96dB per meter with one watt input. Power rating shall be 15 watts. The speaker shall incorporate a 10 ounce ceramic magnet; the voice coil shall be 3/4 inch in diameter and shall have an impedance of 8 ohms.
- b. Speaker or transformer assembly shall be mounted in a wall-mount, sloped baffle constructed of special heavy-gage cold-rolled steel which shall be virtually impervious to direct blows: steel back mounting plate shall be pre-punched to fit any standard outlet box and shall be so designed as to make it practically impossible to gain access to speaker. Type 6-32 tamperproof machine screws shall be used to attach baffle to steel mounting plate. Mounting plate shall be installed so that baffle is perfectly level.
- c. Entire assembly shall measure 13 3/4-inch high, 10 7/16-inch wide, 5 3/4-inch maximum depth, and 4 3/8-inch minimum depth. Baffle shall be finished in semi-gloss white epoxy. Complete hardware shall be provided with speaker assembly.

3. Horn Loudspeakers:

- a. Type "C" Horn Loudspeakers: Horn loudspeakers shall be weatherproof vandal-proof type. Speakers shall be Atlas model APF15T with Soundolier VP410S baffle and VPA-APF adaptor, or equal. Furnish and install weatherproof cover plates with plastic bushed holes in plates to admit waterproof cable to speaker in drip loops. Each horn speaker assembly shall be mounted in a vandal-proof steel enclosure. Submit a drawing of assembly to the Architect for review. Type "C" horn loudspeakers shall be furnished for outdoor areas such as lunch shelters, arcades, walkways, etcetera. Note that sound travel distance for this horn is less than the C1 horn due to its higher low frequency cutoff point.
- b. Type "C1" Horn Loudspeakers: Horn Loudspeakers shall be weatherproof and vandal-proof types. Speakers shall be Atlas Model APC-30, or equal. Furnish and install weatherproof cover plates with plastic bushed holes in plates to admit weatherproof cable to speaker in drip loops. Each speaker assembly shall be mounted in a vandal-proof steel enclosure. An optional access door may be provided if secured with fasteners that require a tool to remove, or secured with a Cat-60 padlock. The access door, if provided, shall be large enough to remove the horn driver, change taps, adjust the tilt of the horn, or remove and test the cabling. Submit a drawing of assembly to the Architect for review. Type "C1" horn loudspeakers shall be furnished for large outdoor areas such as playgrounds, physical education fields, athletic fields, etcetera.

2.05 ELECTRONIC RECEPTACLES

- A. Microphone receptacles shall be Cannon XLR or SLR Series, or equal. Receptacles shall be furnished with mounting brackets for floor boxes, Sierra, or equal, .040 inch stainless steel plates, unless noted otherwise on Drawings. Each plate shall be engraved with its receptacle function in 3/16-inch high letters filled with black paint. Receptacles shall conform to following:

<u>Type</u>	<u>Description</u>	<u>Model</u>
"A"	Single male Microphone	LR-3-14, on a one-gang plate receptacle wall mounting
"B"	Single male microphone	LR-3-14N, with a CA015-0094-000, receptacle floor mounting yoke.

2.06 CONDUCTOR OR CABLES

- A. Cable for overriding Autonomous PA system shall be one twisted pair, #18 conductor; West Penn #CL2 293, or equal. For outdoor and underground applications, West Penn Wire Corp. # AQ 293 shall be furnished. This stranded wire shall not terminate on 66 or 110 blocks. Install and use screw terminal strips adjacent to the punch blocks.
- B. Cables for microphone and other input sources and speakers shall comprise one twisted pair of #22 gage solid copper conductors; polyethylene shielded with an aluminum foil-mylar shield, a #22 gage stranded tinned copper drain wire and polyvinyl jacket. Cable shall be West Penn Wire Corp. CL2 290, or equal. For outdoor and underground applications, West Penn Wire Corp. # AQC 291 shall be furnished.
- C. Two-pair #22 gage, fully annealed copper wire. One twisted pair (black and red) conductors shall be shielded and the other twisted pair (green and white) shall be unshielded. Both pairs shall be under one jacket. This cable is to be provided for combination telephone and public address Work. Furnish shielded pair for speaker lines. Mohawk #1772, West Penn CL2 #355, or equal. For outdoor and underground applications, West Penn Wire Corp. # AQC 355 shall be furnished.
- D. Jumper wire or cross connect wire shall consist of solid copper conductors, insulated with polyvinyl chloride and color coded, #22 gage, Brand-Rex, or equal.
- E. Cable for types C and C-1 speakers shall be West Penn CL2, AQ or AQC, as required, 289, 290, 291, 292, 293, 294, 295 or 296. Cable provided shall be selected based on calculation of the cable gage required to produce no more than a 1 dB drop in voltage at the load, given the load at which the speaker is tapped and the distance the cable is run. At the main PA termination field or at any other termination field, do not use the 66 punch blocks for any stranded wire. Install and use screw terminal blocks adjacent to the 66 blocks or remove one of the 66 blocks if adequate room is not otherwise available for these screw terminal blocks.
- F. Interface cable from clock controller to the Public Address rack shall provide a minimum of twelve AWG 20 insulated conductors. Cable shall be West Penn 265, West Penn 283, or equal. For exterior or underground applications, provide West Penn AQ224 two conductor AWG 18 cables, or equal. Termination shall be inside the master clock and inside the PA rack only for a continuous cabling run. Label clock connections where cable terminates inside of rack.
- G. Cables between the P.A. rack and P.A. terminal cabinet for connection of switch bank positions to field circuit shall be Two-pair #22 gage, fully annealed copper wire. One twisted pair (black and red) conductors shall be

shielded and the other twisted pair (green and white) shall be unshielded. Both pairs shall be under one jacket. Mohawk #1772 or West Penn CL2 #355.

2.07 TERMINAL BLOCKS AND CABINETS

- A. Terminal blocks shall be solderless push-on (#20 to 22 gage solid) with integral fanning strip. Solderless push-on type blocks shall be Siemon Company 66-Series. Terminals for connections to external circuits shall be properly labeled. 66B blocks shall be mounted directly to terminal location without use of mounting legs. 66M blocks shall be mounted on 89B mounting spacers. Install the required terminal blocks as necessary within each cabinet.
- B. Terminal blocks shall be installed on back of cabinets only, not on sides. Incoming cables shall be terminated on outside pins of terminal blocks and outgoing cables shall be terminated on second pin from buttside edge. This method shall be provided at satellite terminal locations. At main or cross-connect terminal locations incoming or outgoing cables shall be terminated on outside pins, but with jumper wires terminated on other points. Do not install grouped station cables other than 25, 50, 75 and 100 pairs of telephone cables under terminal blocks.
- C. Auxiliary cabinets shall be securely floor or wall-mounted, in a position that will not block removable panel or swing open doors needed for normal system expansion or service. Doors shall be lockable with a door-mounted lock.

2.08 KEYS AND LOCKS

- A. Provide keys and locks for cabinets and equipment; locks shall be keyed to a Corbin #60 key, for access to operate equipment and Corbin #70 key, for access to service equipment.

2.09 PORTABLE EQUIPMENT

- A. Furnish and deliver to the OAR, one auxiliary console microphone with coiled cord and press-to-talk switch.
- B. Portable equipment shall remain in individual boxes and be delivered to the OAR.

2.010 LOADS ON EQUIPMENT AND COMPONENTES

- A. Equipment and component parts shall carry continuously, without undue heating or change in rated value, loads connected thereto and rated output loads where such are specified. Equipment shall be properly fused. Components and parts shall be designed for continuous operation.

- B. Operating voltages on capacitors shall not exceed 60 percent of their rated working voltages.
- C. Operating wattages to be dissipated by resistors shall not exceed 25 percent of their ratings.

PART 3 - EXECUTION AND INSTALLATION

3.01 INSTALLATION

- A. Install equipment as specified, as indicated on Shop Drawings, and as required. Installation shall be in accordance with manufacturers' instructions and applicable codes. Installation shall be in accordance with manufacturers' instructions and applicable codes.
- B. Systems that are re-designed with the intention to increase station or port capacity of systems shall not be accepted.
- C. Systems not installed as manufacturer instructions shall not be accepted.

3.02 RELATED SYSTEM OR SUB-COMPONENT INSTALLATION

- A. Public Address system installation
 - 1. Rack Equipment Installation: Equipment within each rack shall be logically arranged for accessibility of convenient maintenance. Equipment shall be mounted on shelves or panels and shall be securely attached. Allow 20 percent expansion in the form of empty rack units at time of occupancy. Empty rack unit spaces shall be covered with factory made plates of the same manufacture as the cabinet.
 - 2. Amplifiers, power supplies and other heavy devices shall be mounted on steel shelves made by manufacturer of console and cabinet racks and shall be attached to cabinet by means of rack mount brackets. Heavy devices shall be mounted in the lowest practical space in the rack. Cabinet, console, and panel faces, including drawers shall be the same color. Punch blocks, screw terminals and ancillary equipment shall be installed on metal rack panels mounted on rear rails. Cables to such panels shall be dressed only from the right side of the rack, as viewed from the rear. The cable bundle must be dressed so as to allow the panel to be swung out for service.
 - 3. Wiring within console and cabinets shall be installed to conform to standard engineering practice, and shall be terminated on terminal strips having a terminal for each required external connection.

Wiring shall be cabled, laced and securely fastened in place so that no weight is imposed on any equipment, control switches, or terminals. Wires shall be contiguous between console and cabinets. Splices are permitted only at cross connect points where terminated on punch blocks.

4. Wires carrying audio power shall be shielded. Input and output circuits and terminal strips shall be installed to provide separation necessary for proper operation. Wires shall be identified by number and chart.
5. Cable charts shall be bound to rear cabinet door of PA or IC cabinet, MPATC or backboard, terminal cabinets and service manuals inside transparent plastic envelopes. The information in these charts shall include cable's switch selector position number, designated switch bank, EZ label number from switch bank to main cross connection, EZ label number from main cross connection to end device, speaker wattage, telephone extension number, punch block locations and end device location (classroom number, office, hallway, exterior wall etc).
6. PA or IC cable terminations and connections on 66 Series blocks at terminal cabinets, backboards and MPATC shall be installed from top to bottom in office and classroom logical numerical order and shall maintain the same numbering system throughout the site. It shall follow the orderly sequence used for switchbanks room selector switches.
7. Conductor shields for each system shall be grounded at one location only. Grounding shall be provided within console and cabinet racks. There shall be no metallic connection between systems. Conduits for system and 120 volt AC system shall be bonded together at console and cabinet racks.
8. 120 volt AC supply conductors shall be terminated directly on disconnect switches specified and in a recognized raceway.
9. A minimum of 24 spare stations or ports shall be provided for system expansion capacity, even if this requires installation of a second card cage and ancillary equipment. The required equipment and connectivity shall be provided to allow for this 24 stations spare capacity regardless of the stations provided at the time of occupancy. The 24 spare stations shall be readily available for connectivity to classrooms, offices or specified location. The 24

station shall be clearly labeled and terminated on a punch block in the main public address terminal cabinet

10. A minimum of 25 spare communication cables shall be provided between the P.A. rack and the main PA terminal cabinet. 25 communications cables shall be connected to the respective telephone card, speaker card, relay module, ring module and switch bank. The 25 spare ports shall be active and ready for connectivity now or for future expansion. These 25 spare communication cables are for connection of switch bank positions to field circuits and are in addition to override, remote input, and other miscellaneous cables required for the P. A. rack.
11. At the main PA cabinet these cables, along with the other miscellaneous cables shall be neatly dressed and secured to the backboard. At the backboard they shall be routed around the exterior of the backboard so as to assure the availability of at least six feet of spare cable, terminated, bundled, secured and routed by the most direct path.
12. At the PA rack the cable bundle shall be neatly dressed and secured to the back mounting rails of the PA rack. If the conduits enter from the top of the rack, route the bundle down the left side of the rack as viewed from the rear, across the bottom of the rack and up the right side. Cables shall be broken out from the right hand side, dressed, secured, and routed to their termination point. If cables enter from the bottom, route them up the left side, over at the top and down the right side for breakout, dress and termination.

B. Telephone interface system installation

1. Install, program and connect 4 circuits to the PABX system. Upon notification from the Contractor, the OAR shall contact the Telecommunications Branch to arrange for ordering of necessary additions to the voice system to coincide with the completion of the installation of the PA or Intercom system. Label circuits with tag at the punch block, and inside the PA rack.
2. The work provided by the Owner will encompass both hardware or software additions and any necessary programming.
3. The Telecommunications Branch will manage connections to the PBX voice system from the 66 block located under the PBX to the 110 block also located under the PBX. The contractor is responsible for the cabling, conduit, and connections from this 66 block (ports on block typically labeled by the Telecom Branch) to the main PA termination field 66 blocks.

4. Contractors working on the telecommunications system must be pre-approved by the Telecommunications Branch prior to start of construction.
- C. Telephone access installation for incoming call:
1. Provide, install and connect 4 ports for High and Middle schools and 2 access ports for Elementary schools and primary Centers to allow loop start trunks from the PABX to obtain access to intercom system dialing and function capabilities. These circuits shall be used only to interface PABX to PA or IC.
 2. Clearly label cabling for PBX connected telephone ports with a tag inside rack and on the punch blocks.
- D. Administrative display telephones
1. Provide, program, install and connect a minimum of one administrative telephone in the Main Office, in each SLC and in each Academy.
 2. Connect the administrative telephones in sequential order starting on the first circuit of the first switch bank relay card.
 3. Wall Display Unit: Install unit in the main office unless indicated otherwise on Contract Drawings, in accordance with manufacturers instructions. For Bogen PA systems, verify and change if necessary, the ring voltage for the display tip and ring pair by moving the voltage selection shorting plug to 12v on the ringer card inside the PA rack. This associated ringer card station port is typically port number one, and shared with the main display phone (they ring together, both were designed to operate off of a 12v ring signal and act erratic if provided a 90v ring signal. (To be precise, the Bogen Multicom 2000 delivers a 60v ring signal from the ringer card, or a 12v square wave ring if the card is bypassed).
- E. Intercom instruments
1. Wall-mounted: Install where indicated modular wall plate.
 2. Desk mounted: Install and connect where indicated and specified.
- F. Special programming requirement
1. Privacy
 - a. The system shall be configured to prohibit the initiation of a two way conversation from any telephone or speaker to any speaker connected to the system without the presence of a supervisory, or privacy tone. This requirement extends

to calls from the office to any classroom, from a classroom to any other classroom and from any classroom to any office. The tone shall annunciate at the initiation of the call and a minimum of every 15 seconds thereafter. The tone shall have sufficient volume to alert the occupant of a classroom with typical ambient sound that a two-way communications path has been initiated.

G. Terminal cabinet installation

1. Lines and cables within cabinets and on main terminal backboards shall be carefully dressed with cable ties. Cables shall be formed into bundles from their emergence from conduits and shall make a 360-degree wrap around the inside of the cabinet or the exterior edge of the backboard. Cables shall be formed into a rectangular configuration and secured to the backboard. Each cable shall be properly enumerated in numerical order with commercial wire markers and shall maintain the same number throughout the site. Wire markers shall be uniformly located within one inch of the end of the cable jacket and the numbers shall be immediately visible.
2. Conductors shall be color-coded and individual cables shall be rung out, and tagged with code markers such as W.H. Brady Co. or E-Z Code wire markers. Each cable index strip shall be typed and installed on terminal cabinet door. Each index strip shall be covered with Zellerbach # R125, or equal, typed on "as-built" drawings.
3. Terminations and connections throughout system shall be on Siemon # 66 series blocks, except at equipment that requires removal for servicing and for terminating stranded type cable. Connections to such equipment and cables shall be screw-terminal type or plug-in type. Wires connected to screw-terminal blocks shall use spade lug type terminal connectors for attachment. 110 terminating blocks shall not be accepted as a replacement for 66 series terminating blocks. Cables shall be identified as to buildings and rooms served, and terminated in terminal cabinets and backboards.
4. Cables from Telco interface blocks shall terminate on left side of 66 M1-50 blocks, with jumpers leaving from right side-bridge with Siemon Co. sneak current protector units.
5. Cables to public address system console or amplifier inputs shall terminate on 66 M1-50 blocks.

6. Cables from public address console or amplifier outputs shall terminate on 66M1-50 blocks; provide blocks for required number of switches.
7. Cables to PABX switch (trunk inputs) shall terminate on 66 M1-50 blocks, if only PABX system is included in this Contract.
8. Cables to PABX switch (extension, console, night bells, etc.) shall be terminated on 66 M1-50 blocks. Provide blocks and cables for maximum possible system configuration, if only PABX system is included in this Contract.
9. Cables to satellite terminal locations and or classrooms shall be terminated on 66 M1-50 blocks. Provide blocks as required, plus 2 vertical rows of 89B spacers for future expansion, at main cross-connect locations only.
10. Cables from auxiliary equipment shall be terminated on 66 M1-50 blocks. Provide blocks as required, plus space for a future block.
11. Feeding cables at remote cross-connect locations shall be terminated on 66 M1-50 blocks for jumpering.
12. Blocks shall be mounted in vertical rows only. Cable with lowest number shall be terminated on upper left side, with next cable in numerical order just below first cable and so on. When left side of first row of blocks is full, next cable in numerical order shall be terminated on the upper right side of first row of blocks, and so on.
13. Do not pass grouped cables in area that is to be used for jumpering. Cables shall enter blocks from top or bottom only, and shall not be in same area as jumper wires.
14. Cable distribution rings for jumper wires shall be Dracon Industries #10910-00, or equal.
15. Cable distribution rings for inside wiring cable and distribution cable shall be Dracon Industries #10941-000, 10942-000 or 1094-000, size as required.

H. Conduit

1. No more than 6 feet of flexible conduit shall be used in any conduit run.

- a. Flexible conduit shall not be used in concealed or inaccessible areas such as interstitial wall spaces or hard lid ceilings.
 - b. Where flexible conduit is used, the conduit fill shall be derated by one trade size.
 - c. Flex shall not be used from MPATC or backboard to the PA or IC rack.
2. Pull boxes shall not be used in place of conduit bends unless site conditions do not allow the use of conduits with data sweeps. If pull boxes are proposed, it must be approved by the Owner.
 3. Where not required elsewhere in District Specification or Code, pull boxes shall be sized per the BICSI TDMM current Edition, Chapter 5, Table 5.13.

3.03 OWNERS QUALITY ASSURANCE CERTIFICATIONS AND TESTING

- A. Provide instruments for testing and demonstrate, in presence of the Owner, that circuits and wiring test free of shorts and grounds.
- B. Provide test and reception gear to test for specified performance of active equipment.
- C. Furnish labor, instruments, appliances, equipment, and materials necessary to demonstrate to the Owner the installation performs as required and specified.
- D. Before Substantial Completion, submit test results and related documents to the Project Inspector.
- E. The Owner reserves the right to perform independent tests of equipment furnished, to determine whether or not equipment complies with requirements specified, and to proceed in accordance with the Contract Documents.

3.04 PROJECT RECORD DOCUMENTS

- A. As-Built Documentation
 1. Provide three copies size E (30 by 42-inch) of Project site and building plans, indicating location of equipment, conduit, cable routing, ground vaults terminal cabinets, pull boxes and other installation information.
 2. Provide three CDs of the system CPU programming and configuration.

3. Provide two copies of the record Drawings in DWG format prepared using the most recent version of AutoCAD on a labeled CD-ROM for use on a Windows platform.
 - a. LAUSD utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings, yet provide control over what is seen on each sheet. Public Address wiring shall be shown on a separate layer, labeled as "Public Address" that uses both building floor plans and conduit supporting structure layers below. The use of any version control blocks or company logos shall be on a layer separate from the premise wiring as-built drawings.
 - b. AutoCAD files (software copies) supplied shall be multi-layer drawings with the following layers as a minimum:
 - 1) Layer one shall contain title blocks only.
 - 2) Layer two shall contain building or site plan backgrounds only.
 - 3) Layer three shall contain devices, cabling and other system components.
 4. Floor plans indicating devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable.
 - a. Drawings shall include block diagrams indicating items and their point-to-point connections in a manner following floor and site plan layout. Drawings shall also include as-built single line diagram, cable site plot plan and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on each cable.
 - b. Floor plans shall indicate devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable
- B. Operating and Servicing Manuals, Record Drawings:
1. Deliver three copies of operating and servicing manual. Each complete manual shall be bound in three ring binders and data shall be typewritten or drafted.

- a. Each manual shall include a page with Project site and Project name, date of Substantial Completion, Contractor name, address, telephone, and fax numbers.
- b. Each manual shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in Article 1.07 of this section and shall describe the companies' commitment to service the warranty during the terms specified.
- c. Each manual shall include instructions necessary for proper operation and servicing of system and shall include:
 - 1) A single line diagram of the system indicating items and their point-to-point connections in a manner following floor and site plan layout.
 - 2) A complete two wire diagram of connections made between components inside the system console.
 - 3) A wiring destination schedule for each circuit leaving console and each rack.
 - 4) Custom fabricated circuits, components and connections not detailed in the manufacturer's manuals shall have wiring diagrams detailing to component level, the manner in which the circuits are connected. Provide details of input or output voltages and input or output signal levels.
 - 5) A schematic diagram of each amplifier and other components, transistor complements and replacement part numbers.
- d. Each manual shall also include as-built single line diagram, cable site plot plan and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on each cable. Drawings Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes bound into the manual. Programming forms of each system shall be submitted with complete information.

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.

3.07 OWNER ORIENTATION

- A. Before Substantial Completion, provide an eight hour Owner instruction period to designated Owner personnel. Contact OAR first, if assistance is needed in scheduling an appropriate time, location, or list of attendees for this training.
- B. Instruction shall be based on manufacturers written operating instructions covering those features of interest to the Owner and applicable to the Work. Instruction shall include the following:
 - 1. Making normal calls from intercom telephone to other intercom telephones or to the intercom administrative station. Revisit office staff preferred method for clarity and understanding of function and methodology.
 - 2. Answering normal calls from intercom telephones.
 - 3. Transferring loudspeaker intercom calls from the speaker to the intercom phone.
 - 4. Answering normal or emergency calls from the intercom administrative station.
 - 5. Returning calls shown in the administrative station display queue.
 - 6. Answering calls shown on the wall display from PABX phones (remote answer feature).
 - 7. Answering calls ringing at a secondary station from admin phone or assigned intercom phone.
 - 8. Placing calls from PABX phones to intercom station.
 - 9. Placing calls from intercom stations to PABX phones.
 - 10. Placing calls from intercom telephone to the public switched telephone network (PSTN).
 - 11. Making intercom calls from PA or IC rack to classrooms.
 - 12. Show how to set the passing bell schedules if selector switch is located on PA rack but might have been replaced by a remote selector in the main office.

13. Making an emergency all call from the rack, program all call, zone all call and individual announcement from the admin telephone and PABX telephone, and all-call from the hand held microphone located in the main office. Explain that emergency all-call from rack activates the hearing assistance system. Also explain where these hear assistance systems and the autonomous systems are located.
 14. Show distribution of radio or cassette player and CD player programs. and from which web sites the instructions can be downloaded.
 15. Provide copies of manufacturer user's manual to training staff and explain users' manual functions described. Provide 3 quick user's functions reference guides in a plastic laminated form. The training shall include hands on equipment.
- C. After Substantial Completion, and before contract completion, provide two additional one hour "refresher" instruction sessions at times agreed upon by the Owner.

SECTION 28 1600

INTRUSION DETECTION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes fully functional, state-of-the-art, digital Intrusion Detection System (IDS) including control panels, sub-panels, wiring, keypads, system control devices, and an appropriate array of zones and sensors that provide effective security coverage.
- B. Principal items of Work in this Section include but are not limited to:
 - 1. Infrared motion detectors and associated power supplies, batteries, and cables.
 - 2. Door switches and cables.
 - 3. Controller, annunciator, expansion modules, power modules, TCP/IP network modules and batteries.
 - 4. Connect Intrusion Detection System equipment to adequate electrical grounding in accordance with manufacturer's specifications.
 - 5. Installation of power and signal circuits for all equipment, including associated raceway, wiring and terminal cabinets as required for a complete and operable system.
- C. Related Requirements:
 - 1. Division 01- General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires (600 Volt AC).
 - 6. Section 26 0533: Raceways and Boxes Fitting and Supports.
 - 7. Section 26 2416: Panelboards and Signal Terminal Cabinets.
 - 8. Section 27 1513: Structured Cabling (Existing Sites).

9. Section 27 1514: Structured Cabling (New Sites).
10. Section 28 05 00: Integrated Security Management and Monitoring System (ISMS).
11. Section 28 4100: Integrated Security Management and Monitoring

1.02 REFERENCES

- A. Electronics Industries Alliance (EIA):
 1. EIA/TIA-568: Commercial building telecommunications wiring standard.
 2. EIA/TIA-569: Commercial building standard for telecommunications pathways and spaces.
 3. EIA/TIA-606: Administration standard for telecommunications infrastructure of commercial buildings.
 4. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications.
- B. California Electrical and Fire Codes.
- C. Building Industry Consultant Service International (BICSI):
 1. Telecommunications Distribution Methods Manual
- D. Federal Trade Commission (FTC):
 1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.
- E. Underwriters Laboratory listings and other labels
- F. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.

1.03 SUBMITTALS

- A. Materials list: Submit a complete material list for the materials and products of this section. Each submittal shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns. The first assembly shall be the major head end equipment. The leftmost column shall be the item number; next shall be the description, followed by the applicable Specification section number, followed by the specified item, which is followed by the submitted item. The rightmost

column shall be for notes, which shall be used to reference the reason for submitting items, other than as specified.

- B. Product Data: Include Product Data sheets and catalog cut sheets for items listed in index. Items shall be arranged in the same order as the index and if more than one item is indicated, the submitted items shall be highlighted or marked appropriately. Product Data shall be sufficiently detailed to allow the Architect to review the product and to allow other trades to provide necessary coordination.
- C. Shop Drawings:
 - 1. Provide Shop Drawings, in the same size as the Drawings. Shop Drawings shall be prepared in latest version of AutoCAD with three electronic copies submitted along with full sized Shop Drawings.
 - 2. Shop Drawings shall indicate typical wire connections and cable types for detectors and detector wiring, single gang deep box location for security key switch and keypad locations for all main and remote security panels. Provide wiring schematics including point-to point, terminal blocks, connections to batteries, and power supplies, including the estimated anticipated wiring lengths required for all connection points (i.e., zone and system communications bus runs) within the system. Indicate interfaces to equipment furnished by others.
 - 3. Submit dimensioned Shop Drawings indicating mechanical layout of all intrusion detection equipment, including cabinets and interconnecting conduit for the main security panel, typical remote security panel and single gang deep box for security key switch, keypad and indicator locations, identifying all parts by manufacturer and part number. Indicate mounting details for the motion detectors appropriate to each ceiling type.
 - 4. Shop Drawings shall be accompanied by engineering documentation including:
 - a. Floor Plans indicating components, raceways, and terminal boxes and cabling.
 - b. Riser diagram indicating connections in a manner following the floor plan layout.
 - c. Cabling diagram indicating the CONTRACTOR's designed routing and number of cables in specific raceways or conduits, from the main alarm panel connecting to other sub-panels, modules or devices. Diagram shall include length, in wire feet, and capacitance calculation charts for all Bus cables.
 - d. Zone schedule indicating code numbers and its protected areas.

- e. Infrared motion detector mounting and all other necessary details.
- 5. Submit preliminary design calculations and system architecture plan For OWNER's review prior to the start of work. Installation shall not commence prior to CONTRACTOR receiving OWNER's acceptance of design and architecture.
- 6. Installation and coordination drawings for items in other sections shall be included with Shop Drawings submittals.
- D. Permits and Inspections: CONTRACTOR shall obtain and pay for required permits and inspections; deliver certificates of inspection to the PROJECT INSPECTOR.
- E. Burglar Alarm Licensing: Provide evidence that the CONTRACTOR is properly licensed by the Bureau of Security and Investigative Services of the State of California Department of Consumer Affairs, including, but not limited to the following licenses: Alarm Company Operator, Qualified Manager, and/or Alarm Agent.
- F. CONTRACTOR shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years.
- G. Include in the Material List Submission copies of the manufacturers' certifications that the CONTRACTOR is an authorized distributor and service provider of the submitted manufacturers' products and CONTRACTOR's staff has been adequately trained and certified in the installation of those products.
- H. Provide a letter from the Manufacturer guaranteeing the availability of spare parts common to proposed system for a period no less than five years on all components.
- I. Provide Samples of material and equipment as required by the ARCHITECT. If Samples are requested, they shall be submitted within 10 days from date of request.

1.04 SUBSTITUTIONS

- A. Equipment and materials that deviate from these requirements shall not be accepted without written approval from OWNER'S ITD project manager. When deviating or substituting equipment, the following information shall be submitted:
 - 1. Substitution request form substantiating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions. Proposed substitutions requests shall provide proof of compliance with OWNER'S criteria described in this specification.
 - 3. Submittals must comply with contract general provisions.

QUALITY ASSURANCE

- A. Use adequate numbers of skilled personnel who are manufacturer certified, trained and experienced on the necessary crafts and familiar with the specified requirements and methods needed for the proper performance of the work.
- B. Only a qualified CONTRACTOR holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
- C. Only persons skilled in trade represented by work, and in accordance with all applicable building codes, shall install system in accordance with best trade practice.
- D. Burglar Alarm Licensing: Provide evidence that the CONTRACTOR is properly licensed by the Bureau of Security and Investigative Services of the State of California Department of Consumer Affairs, including, but not limited to the following licenses: Alarm Company Operator, Qualified Manager, and/or Alarm Agent.
- E. CONTRACTOR shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years.
- F. Include in the Material List Submission copies of the manufacturers' certifications that the CONTRACTOR is an authorized distributor and service provider of the submitted manufacturers' products and CONTRACTOR's staff has been adequately trained and certified in the installation of those products.
- G. Provide a letter from the Manufacturer guaranteeing the availability of spare parts common to proposed system for a period no less than five years on all components.
- H. Provide Samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within 10 days from date of request.
- I. Coordinate cable runs, and equipment locations with OWNER's Authorized Representative prior to the start of installation. CONTRACTOR and OWNER representative must agree as to the final location of all devices and the cable plant design.
- J. Provide sufficient personnel and tools required to participate in OWNERs Quality Assurance testing as detailed in Attachment A of this specification.
 - 1. Items on check list of Attachment "A" will be examined as a minimum at the Alarm Head End and one remote security panel. Should the examination show deficiencies related to items in the checklist, OWNERs acceptance testing will be discontinued until corrections have been made. When the CONTRACTOR has completed the corrections, a subsequent Quality Assurance test shall be

initiated. This procedure is in addition to the system functionality testing required below.

1.06 PROJECT RECORD DOCUMENTS

- A. Operation and Maintenance Manual: Supply, as a condition of final payment and acceptance, three complete bound sets containing the following documentation:
1. Each manual shall include a page with Project site and Project name, date of Substantial Completion, CONTRACTOR name, address, telephone, and fax numbers.
 2. Each manual shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in Article 1.07 of this section and shall describe the companies' commitment to service the warranty during the terms specified.
 3. One page shall contain a list describing all furnished materials by Manufacturer and model number.
 4. Site and building zone maps and zone codes indicating areas served, materials, brochures, wiring and connection diagrams of equipment, plot plan of Project site indicating conduit and cable runs and cable counts between termination points, and cable identification. A sample of a typical site plan zone map is included in this specification as an example of the required finished product.
 - a. The project site plan zone map shall be supplied in a single drawing on two USB drives that include all project drawings in AutoCAD format as well as three paper copies, and shall contain the following information:
 - 1) Site layout of buildings indicating the physical locations of all buildings on the campus. The drawing shall coincide with the architectural as built of the project as constructed.
 - 2) Each building shall be labeled with hardware zones of coverage as built. (An example of typical labels is: Administration Building – Z1-8).
 - 3) Site Zone maps shall show School Location Code, School Name and School Address on the upper right side of Drawing. Refer to Attachment C for sample.
 - b. Floor Plans on separate drawings shall show each building, all equipment placement locations with: areas of coverage, room numbers or other designators if numbers are not available, and the individual hardware

zones for each room or covered area. Each device and its location, including but not limited to PIR's, all modules, point to point cabling and all panels, shall be clearly shown.

- c. AutoCAD files (software copies) supplied shall be multi-layer drawings with the following layers as a minimum:
 - 1) Layer 1 shall contain title blocks only.
 - 2) Layer 2 shall contain building or site plan backgrounds only.
 - 3) Layer 3 shall contain hardware zone identifiers only.
 - 4) Layer 4 shall contain all devices and cabling only.
- 5. One complete riser, site and building drawing set. Size A (8-1/2 inch by 11 inch) and size B (11 inch by 17 inch) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
- 6. A block diagram showing how the LX/Keypad-Bus (es) feeds from the main panel controller to re-power modules, with modules numbered in enrollment sequence, and labeled as to physical location. Diagram should also include how the re-power module(s) feed(s) LX-Keypad-Bus (es) to keypad, Expansion modules and any other modules.
- 7. Index of material in bound set including page numbers.
- 8. Manufacturer maintenance brochures.
- B. Record Drawings: Prior to start of system Testing, submit three paper record copies on "E" size, and two copies of drawing representations on a labeled USB drive (DWG drawing format prepared with current Microsoft Windows version of AutoCAD). Layer information shall be organized as required in section 3.04 of this specification.

1.07 WARRANTY

- A. Warranty that materials and workmanship provided are free from defects of material for a period of three years excluding specific items of work that require a warranty of a greater period.
- B. Immediately upon receipt of written notice from the OWNER, repair or replace at no expense to the OWNER, defective material or work discovered before final acceptance of work or within the warranty period; material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or

failure to examine work by the OWNER shall not relieve CONTRACTOR from these obligations.

- C. Equipment or materials failure rates of 10% or more during the warranty period:
 - 1. The OWNER will monitor the performance and reliability of the installed base of Equipment and Materials installed in this Contract. Any deficiencies or malfunctions will be referred to the CONTRACTOR for repairs or equipment replacement.
- D. If the OWNER detects a defect within a warranty period as defined here in, it shall notify the CONTRACTOR Representative in writing ("Notice of Defect"). The CONTRACTOR shall make available and provide the OWNER with the telephone number of a fax machine and email address to receive Notices of Defect. This fax machine and email address shall be available to receive faxes and emails 24 hours per day 7 days per week, including all weekends and holidays.
- E. Upon receipt of written notice from the OWNER of any failure or defect ("Defect") in any such Equipment or Work, the CONTRACTOR shall diligently perform all work necessary to determine the cause thereof, and the time necessary to remedy the Defect, and shall propose in writing to the OWNER how and in what manner it will remedy the Defect. If the OWNER determines that the proposal complies with the terms of the Contract, it shall authorize CONTRACTOR to proceed to redesign, repair, or replace the defective or failed Equipment or Work within the agreed time period.
- F. In determining the cause of the Defect, the CONTRACTOR shall perform such investigations and tests as may be required to determine the cause, and to verify that such redesign, repairs, and replacements comply with the requirements of the Contract Document. All cost associated with such investigation, redesign, repair, replacement, and testing, including, but not limited to, the removal, replacement, and reinstallation of equipment and materials necessary to gain access to defective Equipment, shall be borne by the CONTRACTOR. Should the CONTRACTOR fail to promptly make the necessary investigations, redesign, repair, replacement, and test, the OWNER may perform or cause to be performed the same at the CONTRACTOR's expense.
- G. The CONTRACTOR will warrant the redesigned, repaired, or replaced Equipment against defective design, materials, and workmanship for the remainder of the warranty period or a period of to five (5) years from and after the date of acceptance of the redesigned, repaired or replaced Equipment thereof, whichever occurs later.
- H. The CONTRACTOR shall be liable for the satisfaction and full performance of the warranties as set forth herein.
- I. All warranties hereunder are deemed and acknowledged to explicitly extend to the future performance of the Equipment warranted.

- J. The rights and remedies provided for herein are cumulative, and shall not be exclusive and are in addition to any other rights and remedies provided by law, whether in contract or tort, or under this Contract.
- K. CONTRACTOR is deemed and acknowledged to be a merchant with respect to all components and replacement parts furnished pursuant hereto, and the OWNER is acknowledged not to be a merchant with respect thereto.
- L. In the event any Supplier or manufacturer offers any extended warranty not specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the OWNER without additional cost to the OWNER.
- M. All warranties and guarantees of Suppliers of any tier and Manufacturers, whether expressed or implied, are deemed to be made for the benefit of the OWNER regardless of whether stated as such, and CONTRACTOR shall enforce such warranties and guarantees for the benefit of the OWNER.
- N. CONTRACTOR shall include a letter signed by a corporate officer, partner, or OWNER of the contracting company describing their service organization, its capabilities and commitment to servicing the warranty on all work executed and materials furnished.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Detectors/ Sensors:
 - 1. Shall support passive infrared and microwave motion detection.
 - 2. Shall be tightly integrated with OWNER's Integrated Security Management System (ISMS) platform. Refer to Specification Division 28 0500 Integrated Security Management System for compliance.
 - 3. UL listed.
 - 4. All motion detectors shall be field adjusted for sensitivity and correct aim per manufacturer's specification.
 - 5. Wall mounted detectors shall be used only if shown on Drawings or as directed by OWNER Authorized Representative (OAR).
- B. Glass Break Detectors:
 - a. Shall detect shattering of framed glass by direct impact.
 - b. Contractor shall test the installed detectors for true range with an FG-701 glass break simulator/tester.
 - c. Glass break detectors shall be ceiling mounted adjacent to windows and store fronts that are accessible from the exterior.

C. Contacts:

- a. Operational up to 5 years using a single user replaceable AAA lithium battery.
- b. Provide contacts at Café refrigerator doors and Café freezer doors.
- c. The door switches shall be concealed recessed units mounted at the top of each leaf, opposite the hinge side, 12 inches from outer edge of door.

D. Cables: Zone cables shall be, as follows:

1. Shall be in conformance with equipment manufacturer products specifications.
2. Four-conductor, #22 West Penn 240 or equal, for power and detector contact for indoor applications.
3. Four-conductor, #22 West Penn AQC240 or equal for detector contact and power for outdoor and underground applications.
4. Two conductor door switch cables, #22 West Penn 221, or equal. Larger size conductor shall be furnished when higher mechanical strength is required.
5. Four conductor bus cables, #22 West Penn 240, or equal, for indoor applications and West Penn AQC 240 or equal for outdoor applications, in accordance with Intrusion System Manufacturer's specifications and installation practices, unless otherwise noted herein.
6. Power cable shall be 2 #12 for 120 VAC and 2 #18 for 16 VAC.
7. Wire and cables shall meet FR-1 Flame Test and shall be UL listed.
8. Wire and cables shall be indexed with a code marker and identified on a sheet, one copy of which shall be left in each equipment cabinet and one copy placed in as-built data.
9. Wire and cables shall be installed in raceway, partitioned cable tray or conduit.
10. Cable not directly connected to circuit board or terminal equipment shall be terminated on 66M blocks mounted on 89B mounting spacers.
11. Cabling Topology: Loop or Hierarchical Star as indicated on drawings.

E. Locks/Keys:

1. Each panel door shall be furnished with a flush type lock, Corbin or equivalent, keyed for CCL Cat. 102 key.

2. Provide raceway, deep box, and cable for OWNER-furnished, OWNER-installed bypass key switch as required on Drawings.
- F. Component Enclosure: Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or alternatively with two locks, one located near each end.
- G. Electronic Components
1. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
 2. The panel shall have an over current notification LED that lights when devices connected to the Keypad Bus and Loop Expansion LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the Loop Expansion LX-Bus (es) and Keypad bus are shut down.
- H. Main Security Panel (MSP):
1. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.
 2. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.
 3. Control unit must be "Flash ROM" updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
 4. Control unit shall be capable of operating using an optional built in Encrypted Alarm Router application that is certified by NIST (National Institute of Standards and Technology) for 128-bit or 256-bit AES (Advanced Encryption Standard) Encryption communications.
 5. The optional built-in Encrypted Alarm Router shall be capable of compliance with and UL 2050 standards.

I. Remote Security Panels:

1. The system shall support a maximum of sixteen (16) supervised remote annunciators with the identical capabilities, functions and display layout. Operation of the remote annunciators shall be limited to authorized users by the use of a code or key.
2. The remote annunciators shall be capable of operating at a maximum wiring distance of 15,000 feet from the control unit on unshielded, non-twisted cable.

J. Control Designations: Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function; controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.

K. Test Function:

1. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the central station.
2. The system shall include a provision for an automatic, hourly, daily, weekly, thirty (30) day, or up to sixty (60) day communication link test from the control panel installation site to the central station.
3. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power, battery voltage level, charging voltage, panel box tamper, phone trouble line 1 and trouble line 2, transmit trouble, and network trouble.

L. Power Supplies:

1. Power supplies for the control unit shall operate from 120V AC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.
2. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.

M. Software:

1. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:
 - a. Direct cable connection interface card.
 - b. Receiver phone line connection.
 - c. Standard phone line connection.
 - d. Ethernet network connection.
 - e. Network connection across the Internet.
 - f. Cellular network connection using the 263C or 263H Cellular Communicators.
2. The system shall interface with computer software capable of locking down all controlled doors.
3. The system shall interface with computer software capable of monitoring and logging all events.
4. The system shall interface with computer software capable of exporting reports in the following file formats:

Excel spreadsheet (*.xlsx)	Text (*.txt)
Rich Text (*.rtf)	Comma-separated (*.csv)
Windows Metafile (*.wmf)	HTML document (*.htm)
QuickReport (*.qrp)	

5. The system shall interface with computer software capable of printing custom, filtered reports including:

All Events	Door Access Granted
Zone Action	Door Access Denied
Arming/Disarming	Opening/Closing Schedule Changes
Area Late to Close	System Monitors
User Code Changes	System Events

N. Control Panel Capability

1. The minimum requirements for the control panel are as follows:

- a. Zone Requirement:
 - (1) Programmable zones: 500
 - (2) Control panels zones: 8
 - (3) Control panel fire zones: 2
 - (4) Hardwired expansion zones: 500
 - (5) Wireless expansion zones: 500
 - (6) Powered smoke zones up to: 200
 - (7) Shall be capable of zone expansion buses
 - (8) Shall be capable of zone expander modules
- b. Keypad Requirement:
 - (1) Minimum supervised keypad: 16
 - (2) Minimum access doors: 8
 - (3) Shall be full keypad programmable
- c. User Information Requirement:
 - (1) User codes/access cards: 100
 - (2) Event memory: 1,000
 - (3) Zone monitor.
- d. System Information Requirement:
 - (1) Shall support Contact ID (CID) format
 - (2) Reporting paths: 4
 - (3) Shall be Remote Access Compatible.
- e. Communication Requirement:
 - (1) LAN/WAN/IP Network Communication

- (2) Cellular Communications
- f. False Alarm Reduction Requirement:
 - (1) Cross zoning
 - (2) Abort reporting
 - (3) Programmable Entry/Exit delay
 - (4) Transmit delay
 - (5) Swinger zone bypassing
 - (6) Report bypass to central station
 - (7) Unique duress code
 - (8) Support applications for IOS and Android mobile devices
- g. Security Features Requirement:
 - (1) Encryption: AES 128 or 256 bit
 - (2) Two-Man rule
 - (3) Card plus pin by areas
 - (4) Early morning ambush
- h. Compliance Requirement:
 - (1) ANSI/UL 365 Police Connected Burglar
 - (2) ANSI/UL 609 Local Burglar
 - (3) ANSI/UL 1610 Central Station Burg
 - (4) SIA-CP-01-2010 False Alarm Reduction
 - (5) ULC-S304 Standard for Central and Monitoring Station Burglar Alarm Units

2.02 FUNCTIONAL DESCRIPTIONS

A. System Description

1. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
2. To ensure continued, one-call support, the system shall be constructed of sensing components provided directly by the system manufacturer or manufacturer's authorized VARs, such as power supplies, motion detectors, door and window position switches, glass break detectors, or other sensing devices that the manufacturer offers.
3. The system controller, user interfaces, zone input devices, relay output devices, and the system signal receiving equipment shall be engineered, manufactured, assembled, and must be distributed from a location within the United States of America.
4. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, text messaging, or smart phone application using integrated or auxiliary devices provided by the system manufacturer.
5. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products.
6. The system shall provide capability for addressable modules.
7. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
8. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
9. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the Internet, cellular communications paths.
10. The control unit shall be completely programmable using remote annunciators, and/or using upload/download software that communicates using SDLC or IP addressed data network.
11. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

B. Zone Configuration

1. Each zone shall function in any of the following configurations: Night, Day, Exit, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.

2. The digital SLCs and the annunciator/keypad bus shall be able to operate from the control panel. All related cabling shall be in conformance with manufacturer equipment specifications.
3. Each zone shall function in any of the following configurations:

Night	Supervisory	Auxiliary 1	Cross-Zone
Day	Emergency	Auxiliary 2	Priority
Exit	Panic		Arming

C. Communication

1. The system shall be capable of signaling to 4 remote monitoring station receivers. Paths shall be capable of being assigned as either a “primary” or “backup” path. In such a manner the system shall have multiple primary paths to multiple remote monitoring stations as well as multiple backup paths to multiple monitoring stations.
2. The system shall allow a backup communication path programmed for Network or Cellular to switch to the backup path should the Primary path become unavailable and automatically reverse back to the Primary path upon restoration of service.
3. The system shall leverage the enterprise IP infrastructure which may include, but not limited to, PSTN, existing data networks, satellite communication, fiber optic networks, LAN, Wireless LAN, WAN, cellular communication, and retail data networks.

D. Network Communication

1. The control panel shall be capable of asynchronous network communication with a retry time between 2 and 240 minutes and a fail time of 2 and 240 minutes. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to the same receiver or a backup receiver.
2. Network communication between the control panel and the receiver shall be in a proprietary communication format.
3. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
4. Underwriters Laboratories (UL) shall list network communication by the control panel for Standard or Encrypted Line Security.
5. The control panel shall be capable of two-way network communication using standard Ethernet 10/100 BaseT in a LAN, WAN, or Internet configuration.
6. The control panel shall be capable of communication by means of a 128-bit or 256-bit AES (Advanced Encryption Standard) Encryption.

7. The control panel shall be UL listed.

2.03 INTEGRATED INTRUSION ALARM AND ACCESS CONTROL OPERATION

- A. Access Authority Levels: The system shall be capable of programming access credentials authority levels to check whether the user has access to a specific area and also has the authority to disarm or arm the area. If the user access credential has access and disarm/arm authority the system shall provide the user the option to disarm the area simultaneously upon opening the door, or to open the door and begin an entry delay timer. With the timer option the user then disarms the area using an intrusion control keypad inside the area. If the user only has access authority to the area and the area is in an armed condition, the user is denied access to the area.
- B. Common Area: The system shall be capable of programming a common area to be armed when the last area in the system is armed and disarmed when the first area in the system is disarmed. To ensure the common area works properly it shall not have any user codes assigned to the common area. The system shall also be capable of programming multiple common areas.
- C. Area Access Control
 - 1. The system shall be capable of integrating area access control capability where specified into the same control panel with the ability to have up to 10,000 user credentials. User access is limited to custom profiles and/or schedules. Anti-passback shall be available. The networked version shall support a Two-Man Rule feature. The system shall support up to sixteen (16) access doors, connected to the system using a manufacturer-approved interface module.
 - 2. The System shall support a minimum of eight (8) access doors connected to the system using a manufacturer-approved interface module.
- D. Access Control Equipment: Access Control equipment shall communicate to the system by way of the control panel keypad bus.
- E. Use designated special code to test the system. The One-Man Walk Test feature allows a single technician to check the panel response to burglary, fire, panic, and supervisory zones.
- F. Multi-lingual Display Option: The system shall be programmed to display the User Menu and Status Display text in multiple languages.
- G. User Inactivity Audit: System shall allow user code inactivity to notify the central station after a programmable period of days of no activity. The system shall be programmable from 0-365 days.

- H. Communication Function Diagnostics: The system shall have enhanced diagnostic menu that enables technicians to check network and cellular communication status and cell signal strength from the keypad.
- I. GUEST Operation: The system shall be capable of in the Home/Sleep/Away with Guest House operation, create up to three separate systems (main and two guests).
- J. Keypads in each system can selectively arm the perimeter, interior, or bedrooms for only their protected areas. Main system users can add authorized users to all protected areas, but guests can add users only for their protected system.

2.04 CERTIFICATION AND TESTING

- A. Overview: Intrusion detection system shall detect entry through a door-switched door or motion of a body taking no more than two steps in an area secured with motion detection equipment.
- B. Prior to calling for a walk test, the following shall be completed:
 - 1. Submit to the ARCHITECT the Project Site Map and Installation Worksheets described below.
- C. Alarm System Initialization:
 - 1. Upon notification from the CONTRACTOR, the PROJECT INSPECTOR will contact the OWNER and request a pre-walk test meeting and a two-day system test buffer report.
 - 2. System shall be complete and properly operating. In addition to other completion criteria, the event buffer shall be free of unexplainable false alarm reports and system errors.
- D. Walk Test:
 - 1. Prior to start of system Testing, complete and submit to the PROJECT INSPECTOR the six program sheets referred to as Attachment B.
 - 2. Walk the system with the PROJECT INSPECTOR before or after normal building hours, holidays or Saturdays at OWNER's option. Coordinate time of test with the PROJECT INSPECTOR. A "Walk Test" shall be performed with the PROJECT INSPECTOR present to verify correct programming and functionality of each zone. Any improperly placed or malfunctioning equipment shall be noted. Upon repair of discrepancies, system shall be walk-tested again, until no further problems exist. The PROJECT INSPECTOR will keep a record of problems noted, and the date they were repaired. A copy of this log shall be

supplied to OWNER and ITD Project Manager upon successful resolution of discrepancies.

3. Provide minor necessary adjustments to system in presence of the PROJECT INSPECTOR.
4. Upon completion of a successful walk test and prior to time testing, provide the programming sheets included within this specification and AutoCAD files, showing all areas of coverage and the corresponding hardware zones as delineated in section 3.04 of this specification. Time testing will not begin until these files have been delivered to the OWNER and the accuracy of the files has been ascertained.
5. Upon completion of the walk test and delivery of zone maps, a time test shall be performed by connection to the alarm test bed of the OWNER. During the test, the OWNER shall remotely monitor the system for a period of not less than one week. At the conclusion of the test, correct unexplained errors or false notifications. Upon completion of the test and any required adjustments, OWNER shall provide a statement of acceptance based on Substantial Completion.

2.05 BURGLARY CONTROL

- A. Burglary Standards: The Burglary system shall be listed as a Power Limited Device and be listed under the standards below. Each system shall be supplied with complete details on all installation criteria necessary to meet the following listings:
 1. ANSI/UL 1076; ANSI/UL 1610
 2. SIA CP-01-2010 False Alarm Reduction
 3. UCL-S304 Standard for Central and Monitoring Station Burglar Alarm Units
- B. Area System Mode
 1. The system user shall be capable of selectively arming and disarming any one or more of 32 areas within the intrusion detection system based on the user PIN code and/or keypad used.
 2. The system user shall be capable of assigning an opening and closing schedule to all areas or to each area separately. Each area shall be able to arm or disarm automatically by a schedule. The system shall have the capacity for common areas that automatically disarm when any other area disarms and that automatically arm when all others areas arm.

- C. All/Perimeter Mode: The system shall be capable of being configured into the All/Perimeter configuration to enable the selective arming of both the interior and perimeter when armed "All" or arming just the perimeter devices if arming "Perimeter".

PART 3 - EXECUTION

3.01 INSTALLATION

- A. System Component Installation: Materials shall be installed in strict compliance with all local, state, county, province, district, federal and other applicable building, safety, and fire standards, laws, codes, regulations, and guidelines including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ). Installation shall be in accordance with manufacturers' instructions and best practices.

1. Motion Detectors:

- a. End of Line resistors shall be installed on the motion detectors.
- b. Motion Detectors shall be "ON" at all times, unless noted otherwise. Main security keypad turns zone alarms Partitions on and off and reports to OWNER School Police. Alarms are annunciated at all times in the Project site annunciator when the system is either in the "Armed" or "Disarmed" condition, but will not report to the OWNER School Police when the system is in the "Disarmed" condition.
- c. A 90-degree motion detector shall be installed in the corner of a room, facing away from sunlight, heating elements, HVAC outlets and any turbulent air movements. All 360-degree motion detectors shall be installed in the center of the room. The PROJECT INSPECTOR shall confirm these locations on site. All motion detectors shall be field adjusted for sensitivity and correct aim per manufacturer's specifications.

2. Glass Break Detectors:

- a. End of Line resistors shall be installed on the glass break detectors.
- b. Glass Break Detectors shall be "ON" at all times, unless noted otherwise. Main security keypad shall turn zone alarms partitions on and off and report to OWNER School Police. Alarms shall be annunciated at all times in the Project site annunciator when the system is either in the "Armed" or "Disarmed" condition, but will not report to the OWNER School Police when the system is in the "Disarmed" condition.

- c. Install glass break detectors in ceilings at a distance of fifteen (15) feet away from windows or glass store fronts.
- 3. Door Switches:
 - a. End of Line resistors shall be installed on the door switch.
 - b. Perimeter Doors: Install J-Box (es) six inches above door switch facing inside of a room. Door switches shall be installed at top of door, opposite the hinge side, 12 inches from outer edge of door.
 - c. Café refrigerators and Freezers: A J-box shall be installed six inches above each door switch facing inside of a room. Door switches to be installed at top of door, opposite the hinge side, 12 inches from outer edge of door. Special surface-mounted, watertight aluminum boxes shall be provided to accommodate surface mounted magnetic door switch on outside of walk-in freezer and refrigerator.
- 4. Main Security Controller:
 - a. Controller shall be powered by a dedicated, unswitched 120 VAC power source. The circuit number shall be clearly identified and noted on both Electrical panel directory, record drawings, and on alarm panel.
- 5. LCD Keypad:
 - a. The Main display keypad for each controller shall be installed in the Main Office as shown on drawings. An additional service keypad shall be installed immediately adjacent to each Controller if the controller is not located in the Main Office.
 - b. The location and distance from the main system panel along with the total quantity of keypads must be considered in the wiring capacitance calculations. LCD display keypad locations may be placed in some or all of the following locations, as specified in the project design drawings.
 - c. In Elementary Schools:
 - 1) Main Building in main office.
 - 2) Multi-purpose building.
 - 3) Kitchen.
 - 4) Cafeteria.

- 5) Computer Classrooms.
- d. In Secondary Schools:
 - 1) Main Building in Main Office.
 - 2) Auditorium/Multi-purpose Building.
 - 3) Kitchen.
 - 4) Cafeteria.
 - 5) Laboratories (Computer, Science, Multi-Media).
 - 6) Gymnasiums.
 - 7) Adult School Administrative Areas.
 - 8) Student Store.
 - 9) Music or Band Room.
6. Provide lock-on device on all circuit breakers serving security equipment. Switch panel locations shall be as indicated on Drawings.
7. Main and remote security panels shall be placed only in telecommunications equipment rooms unless otherwise indicated on Drawings.
8. Graphic Annunciator:
 - a. The system should support a Graphic Annunciator panel, using a computer generated map overlay shall display an outline of coverage areas, with a single LED indicating each zone. Map overlay shall be produced using a method that will not fade or wash out, on a media that will not yellow or degrade from natural light exposure. Laser printing, Silkscreen, or Archival Ink, on UV stabile Vellum or other translucent material shall be used to create the map overlay. Where there are large quantities of zones on a single map, it is permissible to combine two or more zones onto a single indicator, provided these zones cover the same localized area of the map. As an example, two separate zones that provide adjacent coverage to the same entrance area of a building, or cover areas of large room, may display status on a single LED of the annunciator to represent the general area of coverage.
 - b. On small zone systems (12 or fewer zones), provide a durable, written zone description mounted on the face of the GA in lieu of a map overlay.

9. Batteries:

- a. Calculations shall be made and submitted to guarantee that the batteries in each panel location are sized for a minimum of eight (8) hours back-up protection for all modules powered at that location.
- b. Battery installation date shall be clearly marked on each battery in a location easily read upon opening cabinet.
- c. Battery shall be located in the same cabinet housing the control module or in a NEMA box adjacent to the control module cabinet.

3.02 RELATED SYSTEMS INSTALLATION

- A. Wiring Installation: Provide 120V wiring in conduit, as required, for all equipment. 120V outlets shall be located in a separate NEMA enclosure adjacent to required device cabinets. This NEMA enclosure shall be sized to allow any required power adapters. Low voltage wiring from power adapter to controller shall be in raceway or conduit. Wiring from sensor to controller or terminal cabinet shall be in raceway, cable tray or conduit. Wiring shall conform to the California Electrical Code.
- B. Labeling and Marking:
 1. Mark all panels, devices and cables with laser printer generated labels.
 2. Each system panel shall have a comprehensive index placed in a plastic envelope secured to the inside of the panel door. Final system test and acceptance shall not commence until all completed index cards are installed.
 3. At the Main Security Panel, the index shall indicate zones that are covered by the MSP, cross-referenced to cable labels, Remote Security Panels connected, and LX/Keypad cable identifiers for cables entering and leaving the cabinet. This identification shall include all cable references including those to telecommunication or networking connections.
 4. At Remote Security Panels, the index shall indicate zones that are covered by the respective RSP, cross-referenced to cable level, the cable connecting to MSP, and the LX/Keypadcable identifiers for cables entering and leaving the cabinet. This identification shall include all cable references including the telecommunication or networking connection.
 5. Each cable shall be labeled with the same identifier on the cable at the terminal device, on the cable at the alarm panel, and at all other cable and device termination points. Cable markers shall be located within two inches of the end of the cable jacket and shall be directly readable. All labels shall be printed by a laser printer.

6. Each device shall be labeled to indicate the associated zone. Labels shall be TBD

C. Wire Terminating:

1. Conductors shall be terminated on Terminal blocks that shall be solderless push-on (#20 to 22 gage solid) with integral fanning strip. Solderless push-on type blocks shall be Siemon Company 66-Series or equivalent. Terminals for connections to external circuits shall be properly labeled. 66B blocks shall be mounted directly to terminal location without use of mounting legs. 66M blocks shall be mounted on 89B mounting spacers. Install the required terminal blocks as necessary within a NEMA 3R with hinged cover, wooden backboard, and flush type lock, Corbin or equivalent, keyed for CCL Cat. 60 key.
2. Terminal blocks shall be installed on back of cabinets only, not on sides. Incoming cables shall be terminated on outside pins of terminal blocks and outgoing cables shall be terminated on second pin from buttside edge. This method shall be provided at satellite terminal locations.
3. Wires shall be consistently color-coded. Wire nuts, shall not be installed.
 - a. Wires shall be provided with code marker tags and be indexed to equipment and noted on as-built Drawings, and on index sheet or cards placed in all equipment cabinets and in as-built data folder.
 - b. Provide wire termination index sheets or cards in all terminals and equipment cabinets and include a Project site zone plot plan in relay cabinets.
4. Provide all terminal boxes with screw type terminals allowing sufficient terminals for all conductor termination.

3.03 PROTECTION

Protect the Work of this section until Substantial Completion. Material or work damaged during the planning, installation, testing, and clean-up of this project must be replaced or repaired, at no expense to the OWNER, to meet Project specifications before final acceptance of work.

3.04 CLEANUP

CONTRACTORs work for each school installation shall be considered complete when all of the aforementioned requirements specified in this document have been met. This includes (but is not limited to) the following:

1. Ceiling panels previously removed have been put back in place.

2. System labels have been put in place.
3. Construction and installation debris and scrap materials have been removed and legally disposed of from project site.
4. System testing has been completed, CONTRACTOR certifies that entire system is in working order, and Test Forms and Project Record Documents have been submitted and approved by the OWNER.
5. Marked up, project record documents have been returned to the OWNER.
6. Unused customer material has been returned to the OWNER.
7. The OWNER has successfully completed acceptance testing of the network installation.
8. The PROJECT INSPECTOR has inspected and accepted the installation.
9. Documentation, to include as-builts, Zone Maps and Programming sheets along with required soft copies has been turned over to the OWNER.

END OF SECTION

SECTION 282300

VIDEO SURVEILLANCE SYSTEM AND AUDIO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

- A. The Video Surveillance system shall be a TCP/IP based High Definition CCTV Digital Video System.
- B. The Audio Surveillance System shall be an analog audio monitoring and notification system.
- C. The Video surveillance system shall be integrated with SMC's Integrated Security Management and Monitoring System (ISMS).
- D. The Audio Surveillance Systems(ASS) shall be deployed only in underground and/or enclosed parking structures. No other area of the site may have audio surveillance systems installed. If the CCTV VSS camera system submitted includes microphones or other audio capabilities, those features shall be permanently disabled.
- E. The Video Surveillance System(VSS) Cameras located in enclosed parking structures shall have view synchronization with the Audio Surveillance System wherein a close proximity PTZ camera will pan to audible sound alerts and/or manual call station alerts.

1.02 RELATED SECTIONS

- A. Applicable Division 1 sections
- B. Section 00 7000: General Conditions
- C. Section 01 7700: Contract Closeout
- D. Section 21 2323: Excavating, Backfilling and Compacting for Utilities
- E. Section 26 0500: Common Works Results for Electrical
- F. Section 26 0513: Basic Electrical Materials and Methods.
- G. Section 26 0526: Grounding and Bonding
- H. Section 26 0533: Raceways and Boxes Fittings and Supports.
- I. Section 26 2416: Panelboards and Signal Terminal Cabinets
- J. Section 265200: Emergency Power Systems.

1.03 REFERENCES

- A. IEC/EN/UL 60950-1: – Information Technology Equipment - Safety - Part 1: General Requirements
- B. IEC/EN/UL 60950-22: Technology Equipment Safety – Part 22: Equipment to be Installed Outdoors
- C. SMPTE 296M (HDTV 720p) - 1280 x 720 Progressive Image Sample Structure – Analogue and Digital Representation and Analogue Interface.
- D. SMPTE 274M (HDTV 1080p) - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates.
- E. SMPTE ST 2036-1 (UHDTV): Ultra High Definition Television (UHDTV)
- F. ISO/IEC 14496-10 Advanced Video Coding (H.264) – Advanced Video Coding (H.264)
- G. IEEE 802.3at (Power over Ethernet Plus) – Power over Ethernet Plus
- H. IEEE 802.1X (Authentication) – Standard for Local and metropolitan area networks-Port-Based Network Access Control (Authentication)
- I. IPv4 (RFC 791) – Internet Protocol Version 4
- J. IPv6 (RFC 2460) – Internet Protocol Version 6
- K. QoS – DiffServ (RFC 2475) – Scalable End-to-End Quality of Service Model
- L. Relevant ONVIF “S”profile as defined by the ONVIF Organization.
- M. IEC/EN 60529 IP66 (Ingress protection) – Degrees of Protection Provided by Enclosures (IP Code)
- N. NEMA 250 Type 4X – Enclosures for Electrical Equipment
- O. IEC/EN 62262 IK10 – Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

1.04 SUBMITTALS

- A. List of Materials: Submit a complete list of proposed materials.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of parts or modules, sizes, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring and cabling diagrams. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.05 SUBSTITUTIONS

- A. Equipment and materials that deviate from these requirements shall not be accepted without written approval from OWNER'S Information Technology project manager. When deviating or proposing material substitutions the following information shall be submitted:
 - 1. Substitution request form substantiating reasons and benefits to OWNER, and all necessary documents to validate the claims made in the substitution form.
 - 2. Submittals must comply with contract general provisions.
- B. The CONTRACTOR assumes all responsibility for additional costs, directly or indirectly, associated with proposing and installing an approved substitution products. All substituted products must meet the intent of form and function identified in the specification.

1.06 QUALITY ASSURANCE

- A. The CONTRACTOR or security sub-CONTRACTOR shall be a licensed security CONTRACTOR with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity, and evidence that CONTRACTOR has completed at least three (3) projects of similar scope, and is currently engaged in the installation and maintenance of systems herein described.
- B. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- C. The CONTRACTOR or designated sub-CONTRACTOR shall submit installer's third party verified credentials of completion of manufacturer certification. The CONTRACTOR system programmer shall have attended manufacturer training and obtained the highest level certifications for the ISMS, ACS and VMS.
- D. The CONTRACTOR shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system.
- E. The video surveillance system shall be in compliance with applicable industry standards listed under article 1.03-References.

1.07 WARRANTY

- A. CONTRACTOR shall warranty that all work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of five (5) years from date of installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than five (5) years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the OWNER, the CONTRACTOR shall repair or replace at no expense to the

OWNER, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of, or failure to, examine work by the OWNER shall not relieve CONTRACTOR from these obligations.

- B. Warranty shall provide the OWNER direct access to manufacturer Technical Assistance Center (TAC), software updates, and defect support.
- C. Manufacturer of provided equipment shall guarantee availability of parts common to provided system and/or full replacement units, for a period not less than 5 years. Parts for the supplied systems shall be available within 30 calendar days during the 5 year period.
- D. Installation CONTRACTOR shall install all equipment in accordance with manufacturer's specifications and recommendations necessary to ensure continuation of the manufacturer's warranty. If the installation CONTRACTOR cannot install manufacturer's equipment in such a manner, it is the responsibility of the installation CONTRACTOR to provide written, timely notification to OWNER ITD Project Management.
- E. OWNER monitors equipment service records and failure rates. In the event that the OWNER determines that a LAN system component, or model part, provided through this specification exceeds acceptable failure rate, or repeated failure rate, the CONTRACTOR shall replace all systems of the same model purchased through this procurement with a new model that meets or exceeds the same functional requirements. Units or components exceeding either the acceptable or repeated failure rates shall be known as a "mass failure." The CONTRACTOR shall provide qualified technicians to install the replacement systems and a project manager to coordinate replacement schedule with ITD. Replacement of mass failing systems, labor, and project management shall be provided and completed in accordance with this specification and related OWNER installation guidelines at no additional cost to the OWNER.
- F. The acceptable failure rate/repeat failure rate for a single system model or individual modular model part, at a single site, or OWNER-wide, shall be:
- G. Equal to or less than 10% in any 12 month period during the original warranty term.
- H. Equal to or less than 15% cumulative failures during the entire term of the original warranty.
- I. If, at any time during the warranty term, the failure rate of the LAN systems or components exceeds 10%, the CONTRACTOR shall extend the original warranty term by one year, at no additional cost to the OWNER.
- J. The CONTRACTOR is responsible for replacement of any failed equipment provided by the CONTRACTOR, during the warranty period or the extended warranty period. This includes equipment that falls under the "mass failure" definition.

- K. In the event of a “mass failure” the CONTRACTOR shall replace all units and/or components affected within 60 days or written notification from the OWNER.
- L. Upon replacement of each unit or component, the replaced unit warranty shall continue as if the original equipment were still in service.
- M. The warranty shall cover the complete system including fan assembly, power supplies, and the device itself.
- N. The warranty shall include onsite 48-hour advanced part replacement.
- O. The warranty shall include all labor to service and/or replace warranted system(s).
- P. In the event any Supplier or manufacturer offers additional warranty, at no additional cost, beyond that specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the OWNER without additional cost.
- Q. Equipment manufacturers shall have E-mail trouble reporting and response mechanisms in place and a toll free 24-hour help center to assist with troubleshooting and operation of the equipment at no additional cost to the OWNER, or as part of the warranty.

PART 2 – PRODUCTS

2.01 CAMERAS AND CAPABILITIES

- A. General Requirements:
 - 1. System overall shall be capable of intelligent video analytic and triggers actions based on programming requirements.
 - 2. Cameras shall be IP-based and comply with established network and video standards.
 - 3. Cameras shall support true day/night vision modes using IR cut filters.
 - 4. Camera enclosure shall be rated as follow;
 - a. Vandal resistance – IK10
 - b. Ingress protection – IP67, NEMA 4X, or higher
 - 5. The primary power source of cameras shall be powered by data network switches equipped with PoE/PoE+/UPoE capabilities as specified by Section 27 1018 10G Local Area Network (LAN) Systems. The secondary power sources (e.g. injectors, midspans, local power) shall be reviewed and approved by OWNER on a case by case basis.
 - 6. Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

Manufacturers SDK (software development kit) must be available to the general public.

7. Cameras shall be in conformance with profile S as currently defined by the ONVIF Organization (www.onvif.org/conformant-products) including firmware upgrade to meet future revisions.
8. Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single manufacturer per site, and meet or exceed the following requirements:
 - a. The camera shall be equipped with IR progressive scan sensor.
 - b. The camera shall provide true day/night functionality.
 - c. The camera shall be equipped with shall provide local video storage (e.g. a microSD/microSDHC/microSDXC memory card expansion).
9. The camera shall allow for video to be transported over:
 - a. HTTP (Unicast)
 - b. HTTPS (Unicast)
 - c. SRTP (Unicast & Multicast)
 - d. RTP over RTSP (Unicast)
 - e. RTP over RTSP over HTTP (Unicast)
10. The camera shall support Quality of Service (QoS) for traffic prioritization.
11. User Interface shall comply with the following:
 - a. The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software or specialty plugins
 - b. The camera shall be accessible via camera IP address directly using client software supported by the equipment manufacturer
12. Protocol Requirements:
 - a. At the minimum, camera shall incorporate support for IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS, TCP, ICMP, SNMPv1/v2c/v3 (MIB-II), RTSP, RTP, SRTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, ARP, DNS, DynDNS, SOCKS, SSH, NTP, CIFS/SMB.
13. Text overlay requirement:
 - a. Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, minimum of 45 ASCII characters.

- b. Provide the ability to apply privacy masks to the image.
 - c. Allow for the overlay of a graphical image, such as a logotype, into the image.
- 14. Security
 - a. The camera shall support the use minimum of 128 bit encryption for secured authentication and communication of both administration data and video streams.
 - b. The camera shall support IEEE 802.1X authentication.
 - c. The camera shall provide support for restricting access to pre-defined IP addresses only.
 - d. The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.
 - e. The camera shall not allow third party firmware to be loaded onto the camera.
- 15. The camera shall be equipped with basic intelligent video analytic functionality that can be triggered by:
 - a. Intelligent Video Detection
 - b. Audio Detection (optional)
 - c. Live Stream Accessed
 - d. Camera tampering
 - e. Auto tracking
 - f. Scene alteration detection (e.g. removed object detection)
- 16. Response to triggers shall include capability of:
 - a. Send SNMP trap or email notification
 - b. Send images, using FTP, HTTP, HTTPS, network share or email
 - c. Send video clip, using FTP, HTTP, HTTPS, network share or email
- 17. The camera shall incorporate a function for image stabilization
- 18. The camera shall provide remote focus, remote zoom, and alignment
- 19. Hardware interface requirements
 - a. Network interface
 - (1) The camera shall be equipped with one (1) auto-negotiating 10/100 Base-T Ethernet port.
- 20. Environmental operational requirements

- a. Operate in a temperature range of -40 °C to +60 °C (-40 °F to 140 °F).
 - b. Operate in a humidity range of 10–100% RH (condensing).
21. Installation and maintenance:
- a. The camera shall be supplied with management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
 - b. The camera shall allow updates of the software (firmware) remotely over the IP network infrastructure.
 - c. The camera shall provide Autorotation functionality.

B. Type 1 Camera Requirements

- 1. Illumination: The camera shall meet or exceed the following illumination specifications:
 - a. Color: 0.3 with WDR image processing capability;
 - b. B/W: 0.02 lux with WDR image processing capability
- 2. Target Resolution:
 - a. Ability to distinguish an object from background within 125 feet (*)
 - b. Provide 20 pixels per linear foot. Contractor shall provide a pixel count per linear foot.
- 3. Encoding - The camera shall support the following video encoding algorithms:
 - a. Compression Format:
 - (1) Motion JPEG
 - (2) H.264 (Baseline/Main/High Profiles)
 - (3) The camera shall provide configurable compression levels.
 - b. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

Type 2 Camera Requirements

- 4. Illumination: The camera shall meet or exceed the following illumination specifications:
 - a. Color: 0.1 lux with WDR image processing capability. Minimum WDR of 120 db.
- 5. Target Resolution:
 - a. Ability to classify an object class within 95 feet.

- b. Provide 40 pixels per linear foot.
- 6. Encoding - The camera shall support the following video encoding algorithms and format:
 - a. Motion JPEG
 - b. H.264 (Baseline/Main/High Profiles)
 - c. The camera shall provide configurable compression levels.
 - d. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

Type 3 Camera Requirements:

- 7. Illumination: The camera shall meet or exceed the following illumination specifications:
 - a. Color: 0.2 with WDR image processing capability and minimum WDR of 120 db.
 - b. B/W: 0.008 lux with WDR image processing capability and minimum DWR of 120 db.
- 8. Target Resolution:
 - a. Ability to describe the object in details within 45 feet.
 - b. Provide 80 pixels per linear foot.
 - c. The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).
- 9. Encoding:
 - a. The camera shall support the following video encoding algorithms and format:
 - (1) Motion JPEG
 - (2) H.264 (Baseline/Main/High Profiles)
 - (3) The camera shall provide configurable compression levels.
 - b. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

Onboard Camera Minimum Requirements:

- 10. Electronic day/night
- 11. Meet EN 50115 (vibration and shock) and ISO 16750-3

12. Maximum power consumption: 4 watts
13. Illumination: The camera shall meet or exceed the following illumination specifications:
 - a. Minimum sensitivity of 1.0 lux with WDR image processing capability; (with minimum WDR of 70db)
14. Target Resolution:
 - a. Ability to describe an object in details within 45 feet.
 - b. Provide 80 pixels per linear foot.
15. Encoding - The camera shall support the following video encoding algorithms:
 - a. Compression Format:
 - (1) Motion JPEG
 - (2) H.264 (Baseline/Main/High Profiles)
 - (3) The camera shall provide configurable compression levels.
 - b. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

2.02 NVR AND RELATED COMPONENTS

A. NVR general requirements:

1. The NVR shall be based on a true open architecture that shall allow the use of non-proprietary workstation and server hardware, non-proprietary network infrastructure and non-proprietary storage.
2. The NVR shall be a pre-assembled appliance solution, or software based supporting VM (e.g. VMWare, Microsoft hypervisor). Other solution platforms be reviewed and approved by the OWNER on the case by case basis.
3. The NVR shall be an IP enabled solution. All communication with the VSS system shall be based on standard TCP/IP protocol and have the capability to use network security.
4. The NVR shall provide minimum of two (2) 1Gbps Ethernet network ports
5. The NVR shall support user authentication with claims-based authentication using external providers.
6. The NVR shall offer a complete and scalable video surveillance solution that shall allow cameras to be added on a unit-by-unit basis.
7. The NVR shall interface with analog-to-digital video encoders and IP cameras.

8. All video streams supplied from analog cameras or IP cameras shall be digitally encoded in MPEG-4, MPEG-2, MJPEG, H.264, H265, Wavelet, or JPEG2000 compression formats and recorded simultaneously in real time.
9. All audio streams supplied from IP video servers shall be digitally encoded in G.711 (u-law), G.721, G.723, or AAC compression formats and recorded simultaneously in real time.
10. Each camera's bit rate, frame rate, and resolution shall be set independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
11. The NVR shall support only secured media stream requests, unless explicitly configured otherwise. Or have the capability to leverage network security controls. Secured media stream requests shall be secured with strong certificate based authentication leveraging RTSPS (aka RTSP over TLS). Client authentication for media stream requests is claims-based and may use a limited lifetime security token.
12. The NVR shall have the capability to encrypt the media stream, including video, audio, and metadata with authenticated encryption for transmission. Media stream encryption shall be done at rest and in transit and be a certificate based AES 128b bits encryption. The VMS shall:
 - a. Allow encryption to be set on a per camera basis for all or some of the cameras.
 - b. Allow encrypted streams to be exported.
13. The NVR shall support end to end encrypted streams with cameras supporting Secure RTP (SRTP) both in unicast and multicast from the camera.
14. The NVR shall be able to use multiple VSS keyboards to operate the entire set of cameras throughout the system, including brands of cameras from various manufacturers and including their PTZ functionalities.
15. The NVR shall be able to retrieve and set the current position of PTZ cameras using XYZ coordinates.
16. The NVR shall support PTZ camera protocols from multiple manufacturers, including analog and IP protocols.
17. The NVR shall arbitrate the user conflict on PTZ usage based on user levels per camera.
18. The NVR shall support Audio and Video storage configuration for the NVR shall support:
 - a. Internal or external computer data storage in RAID 0, 1, 5, 6, or 10 configuration.
 - b. Within the overall storage system, the Audio and Video shall have the capability to include disks located on:

- (1) Local.
- (2) Network Attached Servers (NAS).
- (3) Storage Area Networks (SAN).

B. NVR RECORDING FUNCTION

1. The Recorder shall use an event and timestamp database for the advanced search of audio/video archives. This database shall use a SQL database.
2. The Recorder shall protect archived audio/video files and the system database against network access and non-administrative user access.
3. The Recorder shall digitally sign recorded video using 248-bit RSA public/private key cryptography.
4. The Recorder shall have the capacity to configure the key frame interval (I-frame) in seconds or number of frames.
5. The Recorder shall provide a pre-alarm and post-alarm recording option that can be set between one second and 5 minutes on a per camera basis.
6. The Recorder shall provide the functionality of storing of video and audio streams based on triggering events, such as:
 - a. Digital motion detection.
 - b. Digital input activation.
 - c. Macros.
 - d. Through SDK application recording.
7. The Recorder shall be capable of intelligent video analytic detection on each individual camera leveraging management template or leverage external server video analytics. Detection can be set into four different modes:
 - a. Full Screen: All 1320 blocks on screen are activated and a general threshold for the overall detection in the entire image can be set, and when it is reached, it can trigger recording and a motion event or a custom event.
 - b. Full Screen Unit: This is the same as the Full Screen but the motion detection takes place in the DVS.
 - c. Detection Zone: Six overlapping zones can be defined in the 1320 blocks on screen with each of these zones having its own threshold, and, when that threshold is reached, each one of them can trigger recording and a motion event or a custom event. Each zone triggering its own event allows for the configuration of directional motion detection events and other complex motion detection logic.
 - d. Detection Zone Unit: This is the same as the Detection Zone, but the motion detection takes place in the DVS and only one zone is supported.
 - e. Disabled: No motion detection is performed on this camera.

8. The Recorder shall allow for multiple recording schedules to be assigned to a single camera. Each schedule shall be created with the following parameters:
 - a. Recording mode:
 - (1) Continuous.
 - (2) On Motion/Manual.
 - (3) Manual.
 - (4) Disabled.
 - b. Recurrence pattern:
 - (1) Once on specific days.
 - (2) Specific days on a yearly basis.
 - (3) Specific days on a monthly basis.
 - (4) Specific days on a weekly basis.
 - (5) Daily.
 - c. Time coverage:
 - (1) All day.
 - (2) Specific time range(s).
 - (3) Daytime or night time based on the times of sunrise and sunset that are automatically calculated from the time of year and a geographical location. Provision shall be given to offset the calculated sunrise or sunset time by plus or minus 3 hours.
9. The Recorder shall allow each camera (video source) to be encoded multiple times for each camera stream in the same or different video formats (MPEG-4, MPEG-2, MJPEG, H.264, H.265, Wavelet or JPEG2000), limited only by the capabilities of each DVS.
10. The Recorder shall have the capacity to manage up to 10,000 video endpoints from one operation manager.
11. The Recorder shall allow users to view up to 5 million camera feeds across a federation model.
12. The Recorder shall have open APIs allowing integration into 3rd party applications, internally development applications and/or data connectivity for deeper analytics.
13. Whenever multiple video streams are available from the same camera, users shall be free to use any one of them based on their assigned usage. The standard video stream usages are:
 - a. Live.
 - b. Recording.

- c. Remote.
 - d. Low resolution.
 - e. High resolution.
14. The Recorder shall allow the video quality to vary according to predefined schedules. Such schedules shall have the same configuration flexibility as the recording schedules mentioned earlier. The video quality shall be based on, but not limited to, the following parameters:
- a. Maximum bit rate.
 - b. Maximum frame rate.
 - c. Image quality.
 - d. Key frame interval.
15. The Recorder shall have the ability to dynamically boost the quality of the "recording stream" (see previous bullet) based on specific events:
- a. When recording is started manually by a user.
 - b. When recording is triggered by a macro, an alarm or detected motion.
16. The Recorder shall have the capacity to communicate using 128 bits SSL encryption and HTTPS secure protocol.
17. The Recorder shall have the capacity to redirect audio/video streams to active viewing clients on the network using unicast UDP or TCP.
18. The Recorder shall empower the administrator with a full range of disk management options:
- a. The Recorder shall allow the administrator to choose which disks to use for RECORDING and to set a maximum quota for each.
 - b. The Recorder shall allow the administrator to spread the RECORDING of different cameras on different disk groups (groups of disks controlled by the same controller) so that RECORDING could be carried out in parallel on multiple disks.
19. The Recorder shall offer the following options to clean up old archives, on a camera by camera basis:
- a. After a preset number of days.
 - b. Write over the oldest archives first when disks are full (FIFO – First In First Out).
 - c. Stop RECORDING when disks are full.
20. The Recorder shall allow important video sequences to be protected against normal disk cleanup routines.
21. Users shall have the following options when protecting a video sequence:

- a. Until a specified date.
 - b. For a specified number of days.
 - c. Indefinitely (until the protection is explicitly removed).
22. The Recorder shall allow the administrator to put a cap on the percentage of storage space occupied by protected video.
23. The Recorder shall have the capacity to down-sample video streams for storage saving purposes. The down-sampling options available are the following:
- a. For H.264, MPEG-4, and H.265, streams the down-sampling options are: all key frames, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.
 - b. For MJPEG streams the down-sampling options are: 15 fps, 10 fps, 5 fps, 2 fps, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.

C. VMS CLIENT USER INTERFACE (UI)

- 1. The Client Application shall provide the user interface for VSS configuration and monitoring over any network and be accessible locally or from a remote connection.
- 2. The Client Application shall provide an easy-to-use graphical user interface (UI).
- 3. The Client Application shall allow users to access up to 10,000 video end points.
- 4. The Client Application shall allow users the capability to access up to 5 million video end points when in federator type of architecture.
- 5. The client application for monitoring shall support running in 64-bit mode.
- 6. Logging on to a Client Application shall be done either through locally stored user accounts and passwords the operator's credentials when Active Directory integration is enabled.
- 7. When integrated with Microsoft's Active Directory, the Client Application shall authenticate users using their Active Directory credentials.
- 8. The Client Application shall fulfill the role of a Unified Security Interface that is able to monitor intrusion detection and access control events and alarms, as well as view live and recorded video.
- 9. The Client Application shall provide a graphical user interface to control and monitor VSS. It shall allow administrators and operators with appropriate privileges to monitor their unified security platform, run reports, and manage alarms.
- 10. The Client Application shall include advanced video capabilities, including:

- a. Advanced live video viewing functionality.
 - b. Advanced archive playing and video playback functionality.
 - c. Monitoring and management of video system events and alarms.
 - d. Intercom or duplex audio or SIP based application.
 - e. Generation of video reports.
 - f. Control of PTZ cameras.
 - g. Creating and monitoring archive transfer requests.
 - h. Display metadata overlaid on live or playback video.
11. The live video viewing capabilities of the Client Application shall include:
- a. The ability to display all cameras attached to the NVR's.
 - b. Support for live video monitoring on each and every display tile within a task in the user's workspace.
 - c. The ability to drag and drop a camera into a display tile for live viewing.
 - d. The ability to drag and drop a camera from a map into a display tile for live viewing.
 - e. Support for digital zoom on live camera video streams.
 - f. The ability for audio communication with video units with audio input and output.
 - g. The ability to control pan-tilt-zoom, iris, focus, and presets.
 - h. The ability to bookmark important events for later retrieval on any RECORDING camera and to uniquely name each bookmark in order to facilitate future searches.
 - i. The ability to start/stop recording on any camera in the system that is configured to allow manual recording by clicking on a single button.
 - j. The ability to activate or de-activate viewing of all system events as they occur.
 - k. The ability to switch to instant replay of the video for any RECORDING camera with the simple click of button.
 - l. The ability to take snapshots of live video and be able to save or print the snapshots.
 - m. The ability to view the same camera multiple times in different tiles.
12. The video playback (archive playing) capabilities of the Client Application shall include:
- a. Support for audio and video playback for any time span.
 - b. Support for video playback on each and every display tile.

- c. The ability to instantly replay the video for any RECORDING camera with the simple click of a button.
- d. The ability to select between instant synch of all video streams in playback mode, allowing operators to view events from multiple angles or across several camera fields, or non-synchronous playback.
- e. The ability to simultaneously view the same camera in multiple tiles at different time intervals.
- f. The ability to control playback with:
 - (1) Pause.
 - (2) Lock Speed.
 - (3) Forward and Reverse Playback at: 1x, 2x, 4x, 6x, 8x, 10x, 20x, 40x, 100x.
 - (4) Forward and Reverse Playback frame by frame.
 - (5) Slow Forward and Reverse Playback at: 1/8x, 1/4x, 1/3x, 1/2x.
 - (6) Loop playback between two time markers.
- 13. The ability to display a single timeline or one timeline for each selected video stream, which would allow the operator to navigate through the video sequence by simply clicking on any point in the timeline.
- 14. The ability to display the level of motion at any point on a timeline.
- 15. The ability to clearly display bookmarked events on the timeline(s).
- 16. The ability to query archived video using various search criteria, including, but not limited to, time, date, camera, and area.
- 17. The tool necessary for searching video and associated audio based on user-defined events or motion parameters.
- 18. The ability to define an area of the video field in which to search for motion as well as define the amount of motion that will trigger search results with the client or with intelligent video analytics. The Client Application shall then retrieve all archived video streams that contain motion that meets the search parameters. There shall be a graphical timeline on which the time of each search hit shall be indicated.
- 19. The ability to browse through a list of all bookmarks created on the system and select any bookmarked event for viewing.
- 20. The ability to add bookmarks to previously archived video for easier searching and retrieval.
- 21. Support for digital zoom on playback video streams.
- 22. Still image export to PNG, JPEG, GIF, and BMP format with Date and Time stamp, and Camera Name on the image (snapshot).

23. Tools for exporting video sequences in standard video formats, such as ASF.
24. The ability to encrypt exported video files.
25. The ability for an operator to load previously exported video files from their computer or network.
26. The ability for queries to be saved upon closing the Client Application and reappear when the application is reopened.
27. The ability to dynamically block, on demand, video stream dynamically to lower level users to prevent access, for a specific time, to live and recorded video.
28. A tool building and exporting a set of videos into a single container. This tool shall allow the operator to build sequences of video to create a storyboard and allow the export of synchronous cameras.
29. The ability to store the video export and still image export at a pre-defined storage location.
30. An interface with the ability to list, search, and manipulate previously generated video exports.
31. The ability to export sequences of video in open standards including ASF and MP4
32. Visual Tracking
 - a. The Client Application shall support the ability to manually track a moving target with the single click of a button.
 - b. The ability to switch from one camera view to an adjacent camera shall be done within a single display tile.
 - c. Switching between camera streams shall be accomplished by simply clicking on a semi-transparent shape or overlay.
 - d. Visual tracking shall be available with both live and recorded video.

D. WEB CLIENT

1. The VSS shall provide a desktop application and a web client interface for configuration, management, and/or viewing.
2. The web client shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.
3. The web client shall be platform independent and run within Microsoft Internet Explorer, Firefox, Safari, and Google Chrome.
4. Video Stream shall be redirected to the Web Client with no stream transformation or re-encoding for all streams in H264, H265, and Mpeg4 ISO.
5. The CONTRACTOR shall provide up to 10 number of simultaneous Web Clients.

6. Functionalities:
 - a. Login using name and password or Active Directory support shall be available.
 - b. Encrypted communications for all transactions.
 - c. Print reports and export to CSV file.
 - d. Video
 - (1) Live and playback video at 320 x 240, 640 x 480 or 1280 x 1024 @ 15 fps.
 - (2) Video export.
 - (3) 1, 4, 6 or 9 tiles.
 - (4) Basic PTZ Controls (Pan/Tilt, Zoom, go to presets, start pattern).
 - (5) Start / Stop recording.
 - (6) Alarm report.

E. MOBILE APPLICATION GENERAL REQUIREMENTS

1. The VSS shall support mobile apps for various off-the-shelf smartphones and tablets. The mobile apps shall communicate with the Mobile Server of the VSS over any WiFi or mobile network connection.
2. Mobile apps shall communicate with the VSS via a Mobile Server. Communication between the mobile device and the Mobile Server shall support optional encryption.
3. Supported manufacturers shall include:
 - a. Apple IOS devices.
 - b. Android based tablets and Smartphones.
 - c. Microsoft Windows based devices.
4. It shall be possible to download the mobile apps from the Central application store (Apple iTunes App Store, Google Play, Windows Store).
5. Functionalities:
 - a. Live monitoring and command and control of the VSS.
 - b. Receive alarm push notifications from the Apple Push Notification Server or from the Google Android push server.
 - c. Alarm management (view and acknowledge alarms, video tied to alarms).
 - d. View VSS hierarchy and search for entities.
 - e. Stream video from the mobile device using the built-in camera.

- f. Video streams from mobile devices shall be available in the VSS to be viewed in live and recorded on the Archiver.
- g. Video system shall provide the following:
 - (1) View live and playback video at 320 x 240, 640 x 480 or 1280 x 1024 @ 15 fps.
 - (2) Monitor camera status.
 - (3) View up to 6 video feeds.
 - (4) Control PTZ functionality of a camera, including access to PTZ presets.
 - (5) Save snapshots locally on the device.
 - (6) View video tied to access control events, and alarms.

F. AUDIO SURVEILLANCE SYSTEM REQUIREMENTS

1. The Audio Surveillance System shall include the following:

- a. Audio surveillance equipment shall consist of microphones, speaker/microphones, combiners, and call stations with alarming base station. An alarm will be announced during a cry for help, distress call, breaking glass, or sounds of vandalism.
- b. System shall be able to listen-in to zone that is in alarm, talkback, and interrogate situation with 2-way communication.
- c. System components shall be as follows:
- d. Audio surveillance controller shall consist of a microprocessor-based monitor contained within a 19-inch standard rack panel 5-1/4 inches high. It will process input from microphones of condenser electret quality, phantom-powered with frequency characteristics of 20HZ through 15 KHz + 4, -5 db. Microphone zones will be listening constantly, and up to six microphones may be combined in one zone. In addition, standard cone speakers or re-entrant projector horns may be combined with the system to allow audio interrogation, as required, to zones for 2-way communication.
- e. Provide zone cards with the following features and functions:
- f. N/O or N/C dry contact outputs for activation of CCTV system, remote alarm device, or annunciator panel
- g. LED zone alarm identification
- h. Two-second audio alert tone to sound when a zone goes into alarm state.

- i. Two continuously variable alarm threshold levels for amplitude of sound
- j. Two user-selectable, frequency-sensitive filters to match user-frequency demand
- k. Three-position selector switch for monitor/off/talk/back with spring return to off position
- l. Frequency and amplitude sensitivity adjustments shall be secured from unauthorized tampering by a panel door integral with unit, but accessible to operator from front panel.
- m. Provide 19-inch rack panels with the following:
- n. Front panel-mounted "ALLZONE RESET" button
- o. Day/night threshold sensitivity switch with user-programmable 24-hour clock
- p. Controller shall be sound activated monitor base station Louroe Electronics No. DG-25 III and listen/talkback amplifier companion, or equal.
- q. Microphones:
- r. Microphones shall be omni-directional on stainless steel cover for mounting to single-gang box.
- s. Frequency response shall be 40 Hz to 15 KHz and supply voltage shall be 12 volt DC supplied from controller.
- t. Microphone shall be Louroe Electronics Verifact D, or equal.
- u. Microphone Mixer/Combiner:
- v. Mixer/combiner shall add up to 6 microphones per zone with sensitivity controls for zone balance for microphones. Unit shall be Louroe Electronics No. MLA-6, or equal.
- w. Frequency response: 100 Hz to 10 KHz
- x. Input level: 3dB
- y. Output level: 13 dB
- z. Supply voltage: 12 volt DC

- aa. Call station shall consist of stainless steel cover-plate with red "CALL FOR HELP" panic button, containing 3 KHz oscillator to trigger controller zone sensor. Unit shall be Louroe Electronics No. DCS, or equal, and flush-mounted to single-gang box. Output shall be 1.5 volts RMS into 10K ohm load at 3 KHz.
- bb. Talk/listen 2-way security station shall consist of stainless steel cover-plate and red "CALL FOR HELP" button. Unit shall be Louroe Electronics No. TLMC, or equal, and flush-mounted to 8 inch x 6 inch x 4 inch backbox.
- cc. Microphone frequency response: 40 Hz to 15 KHz
- dd. Microphone supply voltage: 12V DC
- ee. Microphone current drain: 3 MA
- ff. Speaker frequency response: 150 Hz to 12KHz
- gg. Speaker power handling: 2 watts
- hh. Speaker voice coil impedance: 8 ohms
- ii. Speaker input voltage: 70.7V
- jj. Microphones and Call Stations Cable:
 - 1. Cable Type B for, 2-conductor, 22 AWG (7" x 30") with 24 AWG (7" x 32") drain. West Penn No. 452, or equal.
- kk. Mixer/combiners, 2-Way Call Stations and Speakers/Microphones cable:
 - 1. Cable Type C, 4-conductor, 2 shielded 20 AWG (7" x 28"), 2 unshielded 18 AWG (7" x 26") with No. 22 AWG (7" x 30") drain wire. West Penn No. 356, or equal.

PART 3 - EXECUTION

3.01 DEPLOYMENT

- A. Deployment Management Service
 - 1. The Deployment Management service from the vendor shall include a Project Manager acting as the single point of contact for all communications between the CONTRACTOR and the vendor organization and who will be responsible for:

- a. Conducting a Risk Assessment of the impact of potential risk factors on the operation of the vendor's ISMS.
 - b. Providing a project plan for the deployment of the vendor's ISMS.
 - c. Managing the development and deployment of the custom solution components that will be integrated into the vendor's ISMS (if applicable).
 - d. Providing a scope of work detailing the services to be provided by the vendor to assist in the deployment of the vendor's ISMS.
 - e. Coordinating and scheduling the vendor field services with the CONTRACTOR to assist with the deployment of the vendor's ISMS.
 - f. Providing regular project status updates to the CONTRACTOR regarding the development of custom solutions (if applicable) and the deployment of the vendor's ISMS.
2. System Configuration and Commissioning Service. The System Configuration and Commissioning service from the vendor shall include a Field Engineer who will be responsible for:
- a. Assisting the CONTRACTOR's or subcontractor's onsite/remote technicians with the configuration and commissioning of the vendor's ISMS at the client site.
 - b. Conducting a test of the ISMS following the deployment of the system using real-world operator scenarios to ensure optimal system performance.
 - c. Providing the CONTRACTOR with a Service Report detailing the tasks completed during the deployment of the ISMS at the client site, as well as any recommendations for improving the performance of the ISMS that must be implemented by the CONTRACTOR.
 - d. Providing a knowledge transfer of the vendor's ISMS to the CONTRACTOR following the deployment of the ISMS at the client site.

3.02 INSTALLATION

- A. The CONTRACTOR or subcontractors main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third party organization to confirm sufficient product and technology knowledge.
- B. The CONTRACTOR shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.

- C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- D. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the integrator of the VSS system.
- E. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- F. A proper installation shall meet NEC (National Electrical Code) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

3.03 AUDIO SURVEILLANCE SYSTEMS INSTALLATION

- A. Cable runs shall be continuous between devices. Connectors, fittings, terminations, splices, and passive devices shall not be installed in inaccessible locations. Provide connections only at outlets, junction boxes, and terminal cabinets and as indicated on Drawings.
- B. Exterior junction boxes for conduit and cable runs shall be 6 inch x 6 inch x 4 inch weatherproof enclosures, Federal No. A6R44, or equal. Conduit entries to junction boxes shall be furnished with compression waterproof connectors.
- C. Coaxial cable connectors shall be solderless type with nominal impedance of 75 ohms.
- D. Cables entering and exiting terminal cabinets and junction boxes shall be tagged with plastic-coated cable markers wrapped around cable.
- E. Cable connectors shall be installed with factory-recommended tools designed for connectors being installed.
- F. Provided cables provided shall be new and of recent manufacture. Cables with abrasions, kinks, or other damage shall not be installed.
- G. Wiring enclosures, terminal cabinets, outlets, control boxes, frames of cabinet racks and other enclosures shall be grounded.
- H. Work shall conform to California Electrical Code regulations and applicable local ordinances.

3.04 NAMING CONVENTIONS

- A. Cameras - All cameras shall be named in the NVR configurations using the following labeling scheme:

LOCATION CODE				CAMERA NUMBER				CHANNEL		
8	4	3	6	-	0	0	1	-	0	1

Example 1 → 8436-001-01 Camera No. 1 Channel 1

8	4	3	6	-	0	0	1	-	0	1
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Example 2 → 8436-102-04 Camera No. 2 Channel 4

- B. Weather proof labels showing the corresponding camera number shall be applied to each camera's housing.

3.05 TESTING

- A. The VSS system shall be tested in accordance with the following:
1. Conduct a complete inspection and test of all installed access control and security monitoring equipment. This includes testing and verifying connection to equipment of other divisions such as intrusion detection and access control systems.
 2. Provide staff to test all devices and all operational features of the Security Management System for witness by the Owner's representative and authorities having jurisdiction as applicable.
 3. Correct deficiencies until satisfactory results are obtained.
- B. Submit written copies of test results.
Complete Checklist for Security VSS provided in Appendix A.

3.06 PROTECTION

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

3.07 OWNER ORIENTATION (TRAINING)

- A. Before contract closeout provide the following training and orientation:
1. Provide a minimum 48 hours training for SMC designated representatives. The content of the training is advanced instruction on the use, programming, maintenance and troubleshooting of the video surveillance system, devices and components.
 - a. Materials shall include training manuals and hands-on lab exercises.
 - b. The training shall be provided at the equipment manufacturer's authorized training facility located in Los Angeles County.

- c. Training shall consist of classroom instruction including intensive course work covering the following topics:
 - (1) Product Features and Technical Specifications
 - (2) Implementation and Design as-built documentation, including familiarization with drawing sets, symbols and notation as well as other record documents.
 - (3) Complete understanding of the system architecture and design of implemented solution.
 - (4) Complete function and feature analysis on implemented solution including programming, operation, trouble shooting, error messages, etc.

3.08 CLEANUP

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

END OF SECTION

SECTION 28 3100
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire alarm system shall consist of fire alarm control panel or networked nodes of the same make and be CSFM (California State Fire Marshall) listed for the application.
2. Labor, equipment, materials, connections, testing, and performance of operations in the installation of fire alarm system.

B. Related Requirements:

1. Division 01 General Requirements.
2. Section 26 0500: Common Work Results for Electrical.
3. Section 26 0513: Basic Electrical Materials and Methods.
4. Section 26 0519: Low-Voltage Wire (600 Volt AC).
5. Section 26 0526: Grounding and Bonding.
6. Section 26 0533: Raceways, Boxes, Fittings, and Supports.

1.02 SYSTEM REQUIREMENTS

A. Fire detection system shall continually supervise and monitor the following initiating, signaling, and monitoring circuits:

1. Manual fire-pull stations.
2. Smoke and heat detectors, duct detectors, multicriteria detectors, combination smoke/heat/CO Detectors, including detectors installed under other sections.
3. Fire sprinkler flow and tamper switches. In existing installations also include PIV tamper switches.
4. Alarm signaling circuits including alarm bells, horns and visual alarm units.
5. Annunciators.
6. Power supplies and batteries.
7. Interconnection with Central and Autonomous Public Address systems, telephone network system, Clock System-Classroom or Program schedule change, HVAC system where applicable, kitchen fire suppression system, Theatrical and House Lighting, elevator equipment for control of recall function and elevator circuit breaker shunt trip, and other systems required by code.

- B. System controls shall be UL listed for power limited applications in accordance with California Electrical Code.
- C. System shall be listed for Internet of Things (IoT) security in compliance with UL 2900.
- D. The fire alarm devices and equipment shall be listed for installation for the fire alarm control panel to which they are being connected.
- E. Complete installation shall conform to the version of NFPA 72, California Fire Code, California Building Code (CBC), and California Electrical Code (CEC) as approved by DSA on stamped drawings.
- F. System labels and devices programming addresses shall be based on final signage and building labeling submittals. For existing facilities contractor shall obtain from Owner Authorized Representative a copy of the current site layout and building labeling designations.

1.03 CERTIFICATION

- A. Certification: Installation of fire alarm system shall not begin until Shop Drawings, including State Fire Marshal listing numbers of fire alarm components, are submitted and reviewed by the Architect. Written certification by fire alarm equipment distributor or manufacturer shall be submitted to the Architect stating that system and its component parts are as approved and listed by the State Fire Marshal, and that the design conforms to requirements set forth in CBC.

1.04 PERFORMANCE

- A. System shall be fully programmable, configurable, and expandable in the field without special tools or PROM programmers and shall not require replacement of memory ICs. Installer shall provide a CD of system installed software, site specific system programming and information and tools required to re-program or modify the system.

1.05 SYSTEM FUNCTIONAL OPERATION

- A. When a fire alarm condition is detected by one of the system initiating devices, the following functions shall occur:
 1. System alarm LED shall flash.
 2. Local sounding device in panel shall be activated.
 3. The LCD display shall indicate type of device, custom label location label and point status alarm condition.
 4. Appropriate change of status message shall be transmitted to remote annunciator(s).
 5. Automatic programs assigned to alarm point shall be executed and associated indicating devices and relays activated.

6. In the event of a fire alarm control panel activation, manual and automatic electronic tone or electromechanical bell class passing signals shall be disabled.
 7. In the event of a fire alarm condition the Central and Autonomous Public Address System shall be overridden.
 8. UDACT (Universal Digital Alarm Communicator Transmitter) shall activate.
 9. Provide necessary hardware and labor for a complete and tested interfacing of the fire alarm system with the lighting controls systems in Auditoriums, Multi-Purpose rooms, and Gymnasiums; lighting in these areas shall be brought to full brightness in the event of a fire alarm.
- B. Trouble and Supervisory Conditions.
1. When any trouble condition is detected the following functions shall occur:
 - a. System trouble LED shall flash.
 - b. Local sounding device in panel shall be activated.
 - c. The LCD display shall indicate the type of trouble and custom label location associated with the trouble condition and its location. Unacknowledged alarm messages shall have priority over trouble messages. If such an alarm is displayed, then trouble messages shall not be displayed.
 - d. Appropriate message shall be transmitted to remote annunciators.
 - e. UDACT shall activate.
- C. When any supervisory condition occurs such as a sprinkler valve tamper, the following function shall occur:
1. System supervisory LED shall flash.
 2. Local sounding device in panel shall be activated.
 3. Appropriate message shall be transmitted to remote annunciators.
 4. UDACT shall activate.
- D. Activation of control panel ACKNOWLEDGE switch in response to a single new alarm, trouble or supervisory condition shall silence panel sounding device and change system alarm, trouble, or supervisory LED from flashing to steady-ON. If additional new alarm, trouble, or supervisory conditions exist in the system; activation of this switch shall advance display to next alarm, trouble, or supervisory condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm, trouble, or supervisory condition shall cause panel to resound, and sequences as described above, shall repeat.

- E. Activation of the signal silence switch shall cause appropriate notification (indicating) appliances and relays to return to normal condition. Selection of notification appliance circuits and relays silenced by this switch shall be fully programmable.
- F. Activation of system reset switch shall cause electronically latched initiating devices or zones, as well as associated output devices and circuits, to return to normal condition after sixty seconds of alarm. If alarm conditions exist in system after system reset switch activation, system shall then re-sound alarm conditions as indicated hereafter.
- G. Activation of lamp test switch shall turn on LED indicators, LCD display, and local sounding device in panel, and then return to previous condition.
- H. Fire alarm indicating appliances may be silenced or extinguished, after one minute, by operating signal silence switch at the FACP or by use of key supervised alarm silence switch at remote annunciators. A subsequent zone alarm shall reactivate signals. Audible indicating appliances shall be automatically silenced after no less than five nor more than ten minutes of operation. Visual indicating appliances shall be extinguished at system reset, or automatically after no less than five nor more than ten minutes of operation. Fire sprinkler flow alarm bells shall not silence until the contacts in the fire sprinkler flow switch return to the normal non-alarm state. Appropriate signage must be installed on or next to the sprinkler alarm bell.
- I. Elevator lobby, machine room and hoistway smoke detectors shall, in addition to operations listed above, cause elevator cars to be recalled as follows:
 - 1. Elevator cars shall be recalled to main level of egress through the use of a primary recall interface relay.
 - 2. Elevator cars shall be recalled to predetermined alternate level if main lobby smoke detector is activated.
 - 3. Fire Fighter's hat light indicator in elevators shall provide visual warning when elevator lobby, machine room, and hoistway smoke detectors are activated.
- J. System's circuits including but not limited to initiation, indicating, and equipment interfacing shall be monitored for open or short circuit and ground fault conditions, these conditions shall be indicated on the Fire Alarm Control Panel and Annunciator displays while remaining circuits continue to operate normally.
- K. Notification appliance circuits shall be silenceable for testing purposes by authorized persons. Protected passcodes, keys, or another secure method that does not require entering into the system programming shall be used.

1.06 POWER REQUIREMENTS

- A. The fire alarm control panel and remote power supply shall receive 120 VAC power, 60 Hz, through a dedicated 20 amps circuit. Circuit breaker protection for the dedicated fire alarm power circuits shall be equipped with a handle lock-on device; the breaker handle shall be colored red and labeled "FIRE ALARM". Clearly label the Electrical panel name, location and circuit number on the inside

of the fire alarm control panel and remote power supplies using a p-touch style labeling system. Transient voltage surge suppression shall be provided at the 120VAC input terminal.

- B. System shall be provided with sufficient battery capacity to operate entire system upon loss of normal 120 VAC power, in a normal quiescent mode, for a period of 24 hours with five minutes of alarm indication at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70 percent capacity in 12 hours.
- C. Circuits requiring system operating power shall be 24 VDC and shall be individually protected at control panel.

1.07 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Component Plan Submittal: Availability and listing for its application shall be verified for system components before presentation of the submittal. Include the following information and details as applicable:
 - 1. Installer name, address, telephone number.
 - 2. List of system components, equipment and devices, including manufacturer model numbers, quantity and California State Fire Marshal listing numbers, mounting heights, and symbols per the symbol list.
 - 3. Copies of manufacturer specification sheets for equipment and devices indicated. Highlight or identify the specific components on Catalog cut sheets.
 - 4. Voltage Drop Calculations: Include the following information for the worst case:
 - a. Point-to-point or Ohms law calculations.
 - b. Zone used in calculations.
 - c. Voltage drop percent. Voltage drop shall not exceed manufacturer's requirements. If voltage drop exceeds ten percent, indicate manufacturer listed operating voltage ranges for equipment and devices.
 - 5. Battery types, amp hours, and load calculations including the following:
 - a. Normal operation: 100 percent of applicable devices for 24 hours to equal control panel amps plus list of amps per device that draw power from the panel during standby power condition including, but not limited to, zone modules, detectors and devices as identified.
 - b. Alarm condition: 100 percent of applicable devices for five minutes to equal control panel amps plus list of amps per device that draw power from panel during alarm condition including, but not limited to, the following:

- 1) Zone modules.
 - 2) Signal modules.
 - 3) Detectors.
 - 4) Signal devices.
 - 5) Annunciator.
 - 6) Other devices as identified.
 - c. Normal operation plus alarm operation load calculation shall include total amp hours required and total amp hours provided.
6. Provide one copy of testing procedures.
- C. Shop Drawings: Provide Shop Drawings, in the same size as the design Drawings, include the following:
1. Provide drawing scale, elevations of system enclosures, and actual layout of the Fire Alarm Control Panel, power supply, annunciator, and main system components.
 2. Site Plan indicating PIV and related fire sprinkler system devices and equipment to be monitored or supervised; such as water flow valves, and main equipment such as control panels, power supplies, annunciators, and components such as outdoor wall-mounted horns, sprinkler bells, pull boxes, underground pull boxes, wiring routes on buildings exteriors and underground locations. In each conduit or raceway run indicate conduit sizes, and quantities and type of wires.
 - a. In existing facilities make a distinction between existing and new installation.
 3. Complete battery calculations, and voltage drop calculation shall be included; these calculations shall be based on the devices maximum UL current rating.
 4. One line drawing for the entire system network indicating system components and wiring. The one line diagram shall show but not be limited to panel to panel interconnections, conductors gage and quantity, conduit size and type (designation) and specific function.
 5. System panel one-line drawings indicating the quantity and type (designation) of conductors entering and exiting the fire alarm terminal cabinet in each building (enclosure) for initiating, notification, or other command control functions required for complete system operation:
 - a. Individual floor or building plan view drawings indicating device locations including end of line resistors "EOLR" in accordance with the legend provided.
 - b. Individual point addresses for initiation and notification devices.

- c. Device “typical” wiring diagrams. These drawings shall indicate specific termination details for peripheral equipment and interface devices.
- 6. Provide interfacing with equipment furnished by others including voltages, and other required coordination items. Refer to 3.01-B.
- 7. Each of the pictorial diagrams included shall appear identical to the products they are intended to depict, in order to speed installation of the system, and to enhance the accuracy of the installation Work. Typical wiring diagrams or catalog sheets are not permitted.
- 8. Background Drawings with device locations of DSA approved drawings are available in electronic format and may be obtained from the Owner Authorized Representative (OAR). Contractor is solely responsible for the accuracy and completeness of shop drawings. Buildings that are not part of the contract shall be clearly identified “NOT IN CONTRACT”. Shop Drawings shall be prepared in the latest version of AutoCAD with three – CD ROM electronic copies submitted along with full sized Shop Drawings.
- 9. Other installation and coordination drawings specifically related to this section shall be included as follows:
 - a. Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.
 - b. Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
- 10. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.
- 11. Samples: Provide Samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within ten days from date of request.
- D. In addition to the above requirements, provide submittals to meet any additional requirements of DSA.
- E. Submittal of Equivalent Systems:
 - 1. In addition to the submittal requirements of this section, if an equivalent system listed in Section 2.01A is submitted in lieu of the designed system shown on DSA approved drawings, the Contractor shall also submit a letter stating that the system is equivalent, and that device locations and quantities of devices are unchanged. Attached to this letter shall be a copy of the revised equipment schedule with corresponding CSFM numbers and a cut sheet for each item.
- F. Modifications or additions to existing fire alarm systems shall be compatible and of the same manufacturer as the existing system. Contractor shall be solely

responsible for engineering, plan check and any fees resulting from an installation that deviates from this requirement.

- G. Prior to Substantial Completion submit to the Architect or Engineer of Record and to Owner Authorized Representative a complete updated set of the Shop Drawings showing changes made to the Fire Alarm System during construction. These drawings will become the System As-Built Drawing set for the Fire Alarm System Owner's Manual.

1.08 QUALITY ASSURANCE

- A. Installer shall have successfully completed at least five projects of equal scope in the past five years, and have been in business of furnishing and installing fire alarm systems of this type for at least five years.
- B. Installer shall be a factory authorized distributor and service provider for the brand of equipment offered and shall provide documentation to the Architect upon request.
- C. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
- D. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
- E. Certifications: Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
- F. Materials and equipment installed shall be new.
- G. Equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment. Furnish a letter from the manufacturer of major equipment, which certifies that the installer is an authorized distributor and that the equipment has been installed according to factory intended practices. Furnish a written guarantee from the manufacturer that they will have a service representative assigned to this area for the life of the equipment.
- H. Installer shall be Underwriters Laboratory (UL) listed company under the UUJS classification, and shall certify that the installation has been made in accordance with UL requirements.
- I. The fire alarm contractor shall have a NICET II Certified Technician on staff in their facility directly involved with this project to ensure technical expertise to this project and adherence with these specifications.
- J. Contractor or Installer's Electricians and fire and life safety technicians shall be certified in accordance with Labor Code sections 3099, and 3099.2, and section 209.0 of the California Code of Regulations.
- K. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR. Provide a legible half size reproduction of the original

completed fire alarm red-line drawings (this copy will be retained by the Owner), an accurate copy of the fire alarm system points list, and a copy of the construction drawings on CD in AutoCAD format.

- L. At the time of installation the most current software package available shall be provided.
- M. Provide at the time of Owner Acceptance of the installation, equipment, and updated software which is to include the appropriate operating system, pass-codes, electronic keys and program disks, manuals and cables employed in the installation of the system. These components shall be delivered to the OAR.
- N. Provide a backup copy of the most current software revision, in disk format. This copy shall be delivered to the OAR
- O. A software license agreement shall be made available for the responsible Owner representative to sign at the time of training.

1.09 WARRANTY

- A. The Fire Alarm Equipment Manufacturer shall provide a three year material warranty. Installer shall provide a three year labor warranty.
- B. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer for a period of five years after expiration of the warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fire alarm equipment shall be standard products of the Notifier Co., Edwards Systems Technology, Siemens Building Technologies, Inc. Johnson Controls and Gamewell-FCI, or equal.
- B. Catalog and model numbers listed are intended to establish type and quality of equipment and system design as well as operating features required. Deviations from intended functions of specified system are not permitted. Equipment shall not be ordered or installed until such equipment has been reviewed and approved by the Architect.
- C. Products requirements indicated in articles 2.02 through 2.05 are based on Notifier system components. Refer to Attachment A – Fire Alarm Approved System Components for a complete list of approved products.

2.02 FIRE ALARM CONTROL PANEL (FACP) OR NETWORK NODES

- A. Furnish Fire Alarm Control Panels as indicated on drawings.
- B. Operator Control:
 - 1. Acknowledge Switch: Activation of control panel acknowledge switch in response to a single new trouble or alarm condition shall silence panel

sounding device and change system alarm or trouble LED from flashing to steady-ON. If additional new alarm or trouble conditions exist in system, activation of this switch shall advance display to next alarm or trouble condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm or trouble condition shall cause panel to resound, and sequences as described above, shall repeat.

2. Signal (Alarm) Silence Switch: Activation of the signal silence switch shall cause programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully fielded programmable within the confines of applicable standards at the job site. The FACP software shall include silence inhibit and auto-silence timers.
3. Alarm Activate (Drill) Switch: Alarm activate switch shall activate notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
4. System Reset Switch: Activation of the System Reset switch shall cause electronically-latched initiating devices, appliances or software zone, as well as associated output devices and circuits, to return to their normal condition.
5. Lamp Test Switch: Switch shall activate local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personnel.
6. Hot Button Switch: Hot Button Key switch shall be provided in FACP to disable all output devices for testing or repair of system. Key switch shall silence all horn and strobes, disable PA cutouts, HVAC shutdowns, door closures, and Autonomous PA systems. Key switch shall be password protected to enable function. LED indicator shall illuminate a trouble condition while Hot Button Switch is activated and shall turn off when system is re-enabled.

C. System Capacity and General Operation

1. The control panel or each network node shall provide or be capable of expansion to 636 minimum intelligent addressable devices in smaller systems, and 3180 intelligent addressable devices for larger systems.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of two amps at 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notifications Appliance Circuits.
3. The control panel or each network node shall support up to eight output modules (signal or relay), each with eight circuits for a total of 64 circuits for the smaller capacity panels, and 12 output modules for a total of 96

circuits for the larger capacity panels. Programmable notification appliance circuits shall be class B.

4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. The FACP shall support up to 20 logic equations, including “and” “or” and “not”, or timed delay equations to be used for advanced programming. Logic equations shall require the use of a PC with software utility designed for programming.
7. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift Compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector Sensitivity tests, meeting requirements of NFPA 72 Chapter seven.
 - c. Maintenance alert, with two levels (maintenance alert or maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 0.5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advance detection laser detectors with an alarm level range of 0.03 percent per foot to one percent per foot. The system shall also include up to nine levels of Pre- alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. Circuit boards, programming, and interconnecting cables to enable the system to display or print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS pre-signal testing in accordance with California Fire Code (CFC) and NFPA 72 requirements.
 - h. Rapid manual station reporting (less than three seconds) shall meet CFC and NFPA 72 requirements for activation of notification circuits within ten Seconds of initiating device activation.

- i. Periodic detector test, conducted automatically by the software.
 - j. Self-optimizing pre-alarm for advance fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
 - k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - l. Walk test, with a check for two detectors set to same address.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day or night automatic adjustment of detector sensitivity.
 - o. RS 232 serial port to support a District supplied printer to be used for silent testing and certification of the system.
8. The FACP shall be capable of coding main panel(s) node notification circuits in temporal code (NFPA 72 A-2-2.2.2). The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific “sync pulse”.
9. Network Communication:
- a. The network architecture shall be based on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent non-proprietary protocol.
 - b. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations. A node may be an intelligent Fire Alarm Control Panel (FACP), Network Control Station PC (NCS) or Network Control Annunciator (NCA).
 - c. Each network node address shall be capable of storing Event Equations which shall be used to activate outputs on one network node from inputs on other network nodes.

D. System Display:

- 1. Utilize the 640-character display option. The design of the CPU shall provide for a configuration with the 640-character display mounted on the front of the unit in place of the standard 80-character display.
- 2. The 640-character display shall provide the controls and indicators used by the system operator: The 640 character display shall include the following operator control switches; Acknowledge, Alarm, Silence, Alarm Activate (drill), System Reset and Lamp Test.

3. The display shall annunciate status information and custom alphanumeric labels for intelligent detector, addressable modules, internal panel circuits, and software zones.
 4. The 640-character display shall provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC Power and Network Communication, Fire Alarm, Pre alarm Warning, Security Alarm, Supervisory Event, System Trouble, Alarm Silence, Disabled Points, CPU failure.
 5. The 640-character display shall use ten “soft” keys for screen navigation or to accomplish dedicated programming functions. Full programming access shall require use of a laptop and the proper programming utility. The programming utility shall be provided to the OAR who will forward it to the local maintenance area representative.
 6. The system shall support the display of battery charging current and voltage on the LCD display.
- E. Network Control Annunciator:
1. When a networked system is installed a network controlled annunciator (NCA) shall be provided to display system intelligent points. The NCA shall be capable of displaying information for all possible points on the network.
 2. The NCA shall include a minimum of 640 characters, backlit by a long life, solid-state LCD display. Additionally, the network display shall include ten soft keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.
 3. The NCA shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of event by type.
 4. The NCA shall mount in a Notifier ABS-2DB or equal keyed box; provide a key enable or disable switch for the network node fire alarm control panels. The network display may mount in a backbox designed for this use. The network shall support the NCAs.
 5. The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in nonvolatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in nonvolatile memory.
 6. The NCA shall include two EIA-232 ports for UL864 listed printers and CRT's.
 7. The NCA shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A mechanical means, by which the controls switches are locked out, such as a key, shall be provided.

8. The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals, Silenced, Disabled Prints, other (non-fire) Events, and CPU Failure.
9. The NCA shall include a Master Password and up to nine user Passwords. The Master password shall be required to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password. Passwords installed into the NCA shall be made available to the OAR who will forward them to the local maintenance area representative.
10. The NCA shall allow editing of label for points within the network, control on or off of outputs, enable or disable of network points, alter detector sensitivity, clear detector verification counters for any analog addressable detector within the network, clear any history log within the network, change the Time or Date settings, initiate a Walk Test.
11. The NCA shall include a time of day clock.
12. Each NCA shall support 80-character remote display annunciators for displaying network activity. These "Terminal Mode" displays will mimic the activity appearing on the corresponding NCA. There shall be only one annunciator or control system consisting of components manufactured by one manufacturer for the fire alarm system.

F. Signaling Line Circuits (SLC):

1. Each FACP or FACP network node shall support a minimum of one SLC for the smaller panels and ten SLC's for the larger panels. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices.
2. CPU shall receive analog information from intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors including the accumulation of dust in each detector. The analog information shall also be used for automatic detectors testing and for the automatic determination of detector maintenance requirements.

G. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.030 steel with provisions for electrical conduit connections into the sides and top.

3. The supplied door shall include a key lock and shall include glass or other transparent opening for viewing of indicators. For convenience, the door may be site configured for either right or left hand hinging.

H. Power Supply:

1. An off-line switching power supply shall be available for the fire alarm control panel or network nodes.
2. Provisions shall be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Over-current protection shall be provided on power outputs. The power supply shall provide an integral battery charger. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor field wires for earth ground conditions, and shall have the following LED indicators:
 - a. Ground Fault LED.
 - b. AC Power Fail LED.
 - c. NCA-2 on LED (4).
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide power for the FACP or network node(s).
6. The main power supply shall provide a battery charger using dual rate charging technology for fast battery recharge and be capable of charging batteries up to 60 AH for the smaller panels and 200 AH for larger panels.

2.03 REMOTE ANNUNCIATORS

- A. A non-networked fire alarm system annunciator is required when there is only one FACP in the system. Provide alphanumeric display remote annunciator(s) per plans. A Network annunciator is required for any system that contains more than one fire alarm control panel (FACP) or network node. Display shall be back lit and be furnished with a maximum of 20 characters of 4 lines for the smaller panels, and 40 characters on 16 lines for the larger panels. Annunciators shall provide the following functions:
 1. Control switches for system acknowledge, signal silence and system reset via a touchpad.
 2. Time and date display field.
 3. Local piezo sounder with alarm or trouble resound.
 4. On-line green LED (flashing).
 5. Evacuation and drill switches, via a touchpad.
 6. Pre-signal hold via a touchpad.
 7. System test at control panel and CTR.
- B. Following additional features shall be furnished:

1. Device Fire Annunciation.
 2. Device Trouble Annunciation.
 3. System Operation Annunciation.
 4. "Power On" LED.
- C. Typewritten operating instructions and a site map shall be posted adjacent to remote annunciator(s). The site map shall be sized and include designations and devices as described in paragraph 3.02 N. of this specification. Project site map shall depict fire alarm devices in the building(s) in which they are installed. The instruction and site map shall be mounted in suitable document frames and attached to the wall with a minimum of two screws each. Contractor's name and telephone number shall not be placed on either the instruction or the site map.

2.04 POWER SUPPLIES

- A. Remote Notification Appliance Circuit (NAC) extender power supplies shall be furnished with main printed circuit board, transformers, lockable cabinet, and batteries. Unit shall be configured to drive 4 notification appliance circuits. The remote power supplies shall be configured with a monitor module to report trouble conditions to the controlling FACP via an SLC. Triggering of NAC inputs shall be directly controlled from the FACP without the use of addressable control or relay modules.

2.05 PERIPHERAL DEVICES AND EQUIPMENT

- A. Manual Stations (interior): Manual pull stations shall be addressable semi-flush, non-breakable glass type for building interiors. Station housing shall be fabricated of die-cast aluminum with reset lock and key. Provide an addressable monitor module for each manual station.
- B. Manual Stations (exterior): Manual stations shall be addressable semi-flush, non-breakable glass type for building exteriors. Station housing shall be fabricated of die-cast aluminum with reset lock and key. Provide an addressable monitor module for each manual station.
- C. Smoke Detectors: Smoke Detectors shall be addressable. Detector shall be microprocessor based, using a combination of photoelectric, and thermal sensing technologies. The smoke detector shall have its loop number and electronic address permanently and clearly labeled onto the device base using a p-touch type labeling system. The label shall be visible without re moving the detector head.
- D. Non-Explosion Proof Automatic Addressable Heat Detectors shall be combination rate-of-rise and fixed-temperature type. When fixed-temperature portion is activated, units shall provide visual evidence of such operation (LED). The location of the heat detector must be clearly marked below the ceiling and the detector must be readily accessible. The heat detector shall have its electronic address permanently and clearly labeled onto the device and be readily accessible. For spaces such as attics, where the ambient temperature can reach around 150° degrees Fahrenheit in hot days, use detectors rated for the application. The heat detector

shall have its loop number and electronic address permanently and clearly labeled onto the device using a p-touch labeling system. The label shall be visible without removing the detector head.

- E. Explosion Proof Automatic Heat Detectors shall be rated for 135° degree Fahrenheit alarm temperature. Mount the detector on a JL threaded hub cover manufactured by Killark Electric, or equivalent from other owner approved manufacturers. Seals, conduit type, and fittings shall be suitable for the hazardous zone and location where the device will be installed. Provide an appropriate wire protective cover over box and detector. Addressable module(s) associated with this type of devices shall be installed outside of the hazardous area.
- F. Weatherproof Automatic heat Detectors: Detectors shall be rated for 135° degree Fahrenheit alarm temperature. Detector shall be mounted horizontally in a two gang weatherproof box with cover manufactured by Hubbell/Bell or equivalent from other owner approved manufactures. Install an appropriate wire protective cover over box and detector. Conduit type and fittings shall be suitable for the environment where the device will be installed.
- G. Duct Smoke Detectors: Duct smoke detectors shall be of solid-state photoelectric type and shall operate on light-scattering photodiode principle. The location of the duct detector must be clearly marked below the ceiling and the detector must be readily accessible. The duct smoke detector shall have its electronic address permanently and clearly labeled onto the device. The label shall be visible without removing the detector head. Duct smoke detectors that are already installed as part of packaged ventilation equipment that are not the detector specified above shall be connected to the fire alarm system via a monitor module. The existing power source shall be disconnected and resettable power from the FACP or Remote Power Supply shall be connected in place of the existing power source for fire alarm system resettable power and alarm initiation.
- H. Projected Beam Infrared Type Smoke Detectors shall consist of a transmitter/receiver unit and reflector to be used in accordance with manufacturer's recommendations. Each detector shall include six user-selectable sensitivity levels. Alignment shall be achieved with a signal strength meter incorporated into the beam detector. The detector shall feature automatic detection and adjustment to the optimum level for the specific environment. Provide remote Notifier Model RTS-451KEY test stations with key lock for detectors or equal, locate test stations below ceiling.
- I. Linear Heat Detectors: Linear detectors shall be Protectowire or equal. linear detectors shall be rated for 150-degree Fahrenheit installed ambient temperature and 190-degree Fahrenheit alarm temperature. Damaged detector due to excessive bending or kinking during installation shall not be accepted. Interface the Protectowire detector with the FACP system via addressable monitor module(s) located on one extreme of the detector and an end of line resistor at the other extreme. End of line resistor shall be readily accessible for testing. Provide appropriate signs indicating the existence of linear heat detectors at the entrances of areas protected with this type of fire detection. Installation shall be done in

accordance with applicable codes and standards, and manufacturer's published installation recommendations.

1. Provide a system that utilizes linear heat detectors in concealed or controlled access areas. The detection wire shall be installed within 20 inches of the underside of the building roof or the above floor as recommended by the manufacturer. In shallow areas install the detection wire within the upper part of the space to be protected.
 - a. One circuit of linear heat detection shall be utilized for areas not exceeding 4,000 square feet above multiple rooms.
 - b. Areas above Gymnasiums and Auditoriums exceeding 4,000 square feet shall be considered one zone.
 - c. Areas divided by a fire rated wall shall be protected separately and considered an independent zone.
- J. Multi-Criteria Fire Detectors (MS and HS Only): These Detectors shall be used on performing stages and surrounding areas of the performing stage and other locations where the use of special effect smoke systems may be used.
 1. Multi-Criteria Fire Detector shall combine four separate sensing elements into one unit:
 - a. Photoelectric chamber shall sense airborne particulate for smoke detection.
 - b. Electrochemical cell technology shall monitor carbon monoxide.
 - c. Infrared sensing shall measure ambient light levels and flame signatures.
 - d. Thermal detection shall monitor temperature.
 2. Multi-Criteria Detector shall be capable of generating only one alarm signal from at least two sensors of the four when positively confirming a fire. The sensor output shall be mathematically evaluated to determine when a signal is warranted.
 3. Twin LED indicators shall provide 360 degree visibility.
- K. Monitor Modules:
 1. Monitor modules shall connect a supervised zone of conventional initiating devices, N.O. dry contact devices, including four-wire smoke detectors, to one of SLC loops. Monitor module shall install in a four-inch square by 2 1/8-inch deep electrical box. The module shall have its loop number, electronic address, and function label on the front cover using a P-Touch type or equal labeling system.
 2. Monitor module shall provide address-setting means using rotary decimal switches and shall store an internal type of device. An LED shall be provided which shall flash under normal conditions indicating that monitor module is operational and in regular communication with control panel.

L. Control Modules:

1. Control modules shall be used to connect conventional indicating appliances or MR type isolation relays to one of the SLC loops. Control modules shall be installed in a standard four-inch square by 2 1/8-inch deep electrical box. Audio or visual or relay power shall be provided by a separate loop from main control panel or from supervised remote power supplies. Each module shall have its loop number, electronic address, and function label on the front cover using a p-Touch type or equal labeling system. Provide Air Products PAM-3 Relay Model or equal power supervision relay to monitor 24-volt DC power.
2. Control module shall provide address-setting means using rotary decimal switches and shall store an internal identifying code which control panel shall use to identify type of device. An LED shall be provided which shall flash under normal conditions, indicating that control module is operational and in regular communication with control panel.

M. Relay Modules:

1. Relay Module shall be Notifier FRM-1 or FMM-101 depending on requirements. Modules shall provide as a minimum one set of form "C" dry contacts and have its loop number, electronic address, and function labeled on the front cover using a P-Touch type labeling system.
2. Provide a buffer relay that is part of the control system if controlled circuit(s) exceeds the voltage or current rating of the relay module.
3. Relays used to interface control of other systems shall be electrically supervised and shall only be wired in a fail-safe mode of function during a power failure.
4. Relay modules for HVAC units on roof shall be located in a NEMA 3R box next to unit being controlled. Provide approved weather listed vibration connection conduit and fittings to interface fire alarm system module with HVAC controls compartment. Do not penetrate the HVAC unit from the bottom. Bottom penetrations shall not be accepted.

N. Isolator Modules:

1. Isolator module shall isolate wire-to-wire circuits on an SLC loop in order to limit number of other modules or detectors that are incapacitated by short circuit fault. If a wire-to-wire short occurs, isolator shall automatically open-circuit SLC loop. When short is corrected, isolators shall automatically reconnect isolated section of SLC loop.
2. Isolator module shall not require address setting, although isolators will electrically reduce capacity of loop by two detectors or module addresses. Isolator module will install in a standard 4-inch deep electrical box. It shall include a single LED that shall flash to indicate that isolator is operational

and shall illuminate steadily to indicate that a short has been detected and isolated.

- O. Horns and Strobes: Horns and strobes shall be products of the same manufacturer. In order to establish a standard of quality, items are specified from the products manufactured by System Sensor, acceptable manufacturers are Honeywell, Wheelock Inc., Gentex or District approved equal. Addressable or multifunction two wire indicating (Audible or Visual) appliances shall not be acceptable.
1. Alarm horns shall be polarized and operated by 24 VDC. Entire unit shall be red finish. Horn assemblies shall be furnished with separate wire leads for in or out wiring for legs of associated signal circuits. Tapping of signal device conductors to signal circuit conductors is not permitted. Suitable gaskets shall be provided for weatherproof installation. Horns shall provide a minimum sound pressure level of 100 dB at 10 feet. Horns shall be mounted on manufacturer's recommended outlet boxes. Provide horns with a back box skirt on indoor surface mount outlet boxes.
 2. Horn/strobe shall be wall mounted or ceiling mounted System Sensor or equal. Horn/strobe shall operate on two separate two wire 24 VDC polarized circuits and shall be provided with a semi-flush mounting plate. Entire unit shall be red finish. Strobe light shall have a clear Lexan lens. The word "FIRE" shall be printed on the two sides of the strobe body. Horn shall provide a minimum sound output of 100 dB at 10 feet. The strobe shall provide a selectable minimum light intensity of 15, 30, 60, 75, 90, 110, 135, 150, or 185 Candela as indicated on Drawings to meet or exceed requirements of CBC, CHAPTER 11B AND ADAAG and UL 1971. Horn/Strobes shall be mounted on manufacturer recommended outlet boxes. Weather proof horn or strobe shall be model No. P4RK or Model No. P4RHK. Provide a model No. BBS-2 back box skirt on indoor surface mounted outlet boxes.
 3. Strobe indicating appliances shall be System Sensor or equal. Devices shall be UL listed and shall be wall-mounted. Entire unit shall be red finish. Strobe light shall have a clear Lexan lens. The word "FIRE" shall be printed on two sides of the strobe body. Strobes shall meet CBC, CHAPTER 11B AND ADAAG and UL 1971 requirements. The strobe shall provide a selectable minimum light intensity of 15, 30, 60, 75, 90, 110, 135, 150, or 185 Candela as indicated on the Drawings to meet or exceed requirements of CBC, CHAPTER 11B AND ADAAG and UL 1971. Strobes shall be mounted on manufacturer recommended outlet boxes. Weather proof strobe shall be model No. SRK or Model No. SRHK. Provide a model No. BBS-2 back box skirt on indoor outlet boxes.
 4. Strobe synchronization modules if required shall be System Sensor or equal, to be installed in conjunction with two or more strobes located in same room or corridor or as indicated on Drawings. (Strobe synchronization modules must be compatible with installed strobes).

- P. Electromagnetic Door Holder: Electromagnetic door holders shall be installed on doors as indicated on Drawings or as required. Electromagnetic Doors shall consist of a wall-mounted electromagnet and a door-mounted armature with an adjustable contact plate. Electromagnets shall provide a force of attraction of 35 pounds when energized and less than three pounds residual with power disconnected. Armature contact plates shall provide a horizontal adjustment of 25 degrees. The holding force of Electromagnetic Doors shall be totally electromagnetic and without the use of mechanical linkage or other moving parts. Electromagnetic Door Holders shall normally be energized, and a release shall be accomplished by interrupting the circuit. Door holders shall be Reliable Security Group DH Serie or Altronix. The power supply shall be equipped with a failsafe input trigger circuit and five individually protected outputs. (Electromagnetic Door holders shall not be powered by an FACP or remote NAC power supplies).
- Q. Bells shall be System Sensor polarized type and operated by 24 VDC. Bell shall be powered from FACP or Remote NAC power supply. When used as a notification appliance to indicate fire sprinkler water flow the bell shall be directly controlled by contacts in the associated flow switch. Addressable relays or control modules shall not be used to supervise sprinkler bells. Bell assemblies shall provide separate wire leads for in or out wiring for legs of associated signal circuits. Bells shall be vibrating type providing a minimum sound pressure level output of 84 - 87 dB at ten feet. Bells shall be ten inches in diameter, finished with baked-on red enamel paint, UL listed for fire alarm installation, and suitable for surface or semi-flush mounting. Provide a sign adjacent to the water flow bell with one inch tall and 3/8 inch stroke white lettering on a bright red background. The sign shall read: "NOTIFY FIRE DEPARTMENT WHEN ALARM SOUNDS".
- R. Water-flow Switches:
1. Water-flow switches shall be Potter Electric or equal. Vane-type water-flow switches shall be installed on system piping as designated on Drawings or as required. Detectors shall install on clear pipe spans of appropriate nominal size, either a vertical or horizontal run, at least six inches from fittings or valves which may change water direction, flow rate or pipe diameter, and not closer than 24 inches to valves or drains. Detector shall respond to water-flow in specified direction after a preset time delay that is field adjustable. Actuation mechanism shall include a polyethylene vane inserted through a hole in the pipe and connected by a mechanical linkage to delay mechanism. Output shall consist of ten amps (dual SPDT switches form-C contacts). A conduit entrance for standard electrical conduit fittings shall be provided on detectors. Detectors shall be listed by UL for indoor or outdoor installation. No more than 18 inches of seal-tight flex may be used to connect the water flow or tamper switch to the site conduit system at any one location.
 2. Sprinkler valve tamper switches shall be System Sensor for use with outside screw-and-yoke valves or for use with post indicating valves or equal, as indicated. Supervisory switch shall be installed on valves as designated on Drawings or as required. Switches shall be installed to not interfere with

normal valve operation and shall be adjusted to operate within two revolutions of valve control or when stem has moved no more than 1/5 of distance from its normal position. Mechanism shall be housed in a weatherproof die cast metal enclosure, also providing a 3/4 inch tapped conduit entrance to incorporate necessary facilities for attachment to valve. Switch mechanism shall be furnished with a minimum rated capacity of ten amps at 125 VAC and 2.5 amps at 24 VAC. Entire installed assembly shall be tamper-resistant. Tamper switches shall be UL listed. No more than 18 inches of seal-tight flex may be used to connect the water flow or tamper switch to the site conduit system at any one location.

- S. Universal Digital Alarm Communicator Transmitter shall be Notifier Model No. UDAC-2 (CSFM 7165-0028:0243/7165-0028:0224). The UDACT is an interface for communication of digital information between a fire alarm control panel and a UL-Listed central station.
1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status.
 2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL or NFPA or FCC requirements. It shall include the ability for split reporting of panel events between up to three different telephone numbers.
 3. It shall be completely field programmable from a built in keypad or laptop computer, and shall be capable of transmitting events in multiple formats.
 4. Communication shall include vital system status such as:
 - a. Independent Zone (Alarm, trouble, non-alarm, supervisory).
 - b. Independent Addressable Device Status.
 - c. AC (Mains) and Earth Fault.
 - d. System Off Normal.
 - e. 12 and 24 Hour Test Signal.
 - f. Abnormal Test Signal (per UL requirements).
 - g. EIA-485 Communications Failure.
 - h. Phone Line Failure.
 5. The UDACT shall support independent zone or point reporting when used in the Contact ID format. This enables the central station to have exact details concerning the origin of the fire or response emergency.
 6. The UDACT shall be supplied with two eight conductor, two to six foot long line cords. One end of the cords shall plug into the jacks on the

UDACT. The other end of the cords shall plug into industry standard RJ-31X surface mounted telephone jacks. Install jacks in a screw cover box adjacent to the FACP if sufficient space is not available within the FACP, or adjacent fire alarm terminal cabinet. The line cords shall be installed in conduit when it is necessary to locate the jacks remotely from the FACP enclosure. The jacks shall be mounted to the rear of the box. The telephone number for each line shall be labeled on its respective jack.

T. Voice Evacuation System:

1. The Voice Evacuation Control (EVAC) Panel. The self-contained control panel shall be equipped with dual 25-watt audio amplifiers each with a single style Y (Class B) supervised 25 Vrms output circuit. The EVAC panel shall have the ability to record a minimum of two field-programmable messages of up to 60 seconds total duration with an integral microphone or an external source via an audio input jack. The messages shall be stored digitally onto a non-volatile EEPROM. The message(s) shall be individually field programmable for three, four, six, eight, or indefinite repeat while triggered by the host FACP. Any message being delivered at the time of the trigger circuit(s) reset shall not stop in mid-sentence but shall be completed to the end of the message. A tone generator shall be provided capable of emulating a field programmable lead-in or trailing alert tone or an Audible Emergency Evacuation Signal (Temporal Pattern). The EVAC panel shall be capable of electrically supervising in both active and standby conditions, the amplifier outputs, field wiring, message generator, tone generator, microphone and primary or secondary power supplies to an internal trouble relay(s). The trouble relay(s) contacts shall be accessible via a terminal strip and be configured and connected to report internal or external trouble conditions to the host FACP via the trigger circuit or a separate monitor module. The minimum of two trigger circuits shall be individually field-configurable for triggering with a NAC circuit or a supervised dry contact. The control panel shall be equipped with LED indicator lights for Power On, System Trouble, Message Generator Trouble, Tone Generator Trouble, Microphone Trouble, Battery Trouble, Charger Trouble, Ground Fault, Output Circuit Trouble and Amplifier Supervisory. The panel shall be equipped with an internal monitor speaker for reviewing the field recorded messages. The primary power supply shall operate at 120 VAC through a dedicated 20 amp. circuit and shall be capable of charging 18 AH lead acid batteries. Provide two 12 volt batteries that will provide a secondary power source for the same or longer duration than is required by the host FACP. An auxiliary 24 volt DC power output shall be provided for use by an associated addressable control module. The EVAC control panel shall be triggered either directly by the associated FACP with a NAC circuit or by an addressable control module. Provide 3/8 inch minimum P Touch labeling on the window in front of the built in microphone indicating that "THE INTERNAL MICROPHONE IS TO BE USED FOR THE RECORDING OF ANNOUNCEMENTS ONLY. NOT FOR USE BY STAFF OR FIRE DEPARTMENT PERSONNEL."

2. Ceiling Mounted eight-inch EVAC Speakers shall be mounted in a Notifier Model CBB-8 back box or equal. The speaker assembly shall be supplied with a white 12 inch round metal grill. The 8 inch speaker shall have an impedance of 8 ohms, minimum 9.5 ounce magnet and an attached 25 volt audio line matching transformer with 1/8, 1/4, 1/2, 1, 2, 4 and 8 watt tap settings and DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 75, 78, 81 87, 90 or 93 dba at ten feet. Input or output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other. Multiple speakers in areas such as Auditoriums or Gymnasiums shall be divided into two circuits in a checker board pattern and connected separately to the two audio output circuits.
 3. Wall Mount four-inch EVAC Speakers shall be mounted on a manufacture recommended outlet box. When mounted on a surface mount outlet box, Provide a Model No. BBS-SP201R surface mount backbox skirt. The speaker assembly shall be supplied with a square high impact red grill. The four inch speaker shall have an attached 25 volt audio line matching transformer with 1/4, 1/2, 1 and 2 watt tap settings and a DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 80, 84, 86 or 89 dba at ten feet. Input or Output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other; but when installed facing opposite directions they shall be connected out of phase.
- U. Network Cables or SLC or Annunciator Data or Audio Output Cables: The construction and physical characteristics such as aqua-seal water block, wire gage, insulation and jacket types, etc. shall not be altered. Equivalent cables must be specifically approved and recommended by the manufacturer of the fire alarm system equipment. Substitutions will require review from the Architect or Engineer of Record.
- V. The cable types listed below are based and specified on the recommendations of Notifier Fire Alarm Systems. If the submitted fire alarm system requires a different cable configuration with additional conductors, multi-conductor versus twisted pairs, etcetera, other than as is specified above, then request a substitution to supply and install the configuration of cables by the make and model of the fire alarm system that is to be installed.
1. Indoor Network and EVAC System Audio Output Circuit(s) applications shall be in conduit or in surface mounted raceway as indicated on drawings: West Penn No. D980, one pair 18 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.
 2. Indoor SLC applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D990, one pair 16 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.

3. Indoor Annunciator applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D975, one pair 18 gage solid copper, shielded, Copolene II insulated and PVC jacketed, or equal.
4. Outdoor or Underground Network Applications: West Penn AQ224, two-conductor 18 gage stranded copper, unshielded, water-blocked construction and PVC insulated, or equal.
5. Outdoor or Underground SLC applications: West Penn AQ225, 2-conductor 16 gage, AQ226, 2 conductor 14 gage, or AQ227, 2 conductor 12 gage stranded copper, unshielded water-blocked construction and PVC insulated, or equal.
6. Outdoor or Underground Annunciator applications: West Penn AQ293, 2 conductors, 18 gage stranded copper, shielded water-blocked construction and PVC insulated, or equal.

W. Protective Covers

1. Provide protective covers for pull stations, smoke and heat detectors, and audible and visual devices located in areas occupied by students that can be subjected to vandalism such as gyms, restrooms, locker and shower rooms, and all hallways and corridors associated with these spaces. Installation of cover must not protrude over current ADA limitations.

PART 3 - EXECUTION

3.01 GENERAL

- A. Fire alarm system shall not be used for any purpose other than fire alarm functions.
- B. Fire alarm shall be interconnected but not limited to the following systems:
 1. Systems required by code to be connected to the fire alarm systems shall be connected.
 2. Public address system for disabling the manual and automatic bell or tone class passing signals. Manual and automatic class passing signals shall not be operable during alarm conditions.
 3. Ventilation systems where required for the purpose of fan shutdown
 4. Damper control or smoke management systems.
 5. Water based fire sprinkler systems.
 6. Chemical fire extinguisher systems.
 7. Central and Autonomous PA system(s).
 8. Theatrical lighting control system.
 9. Elevator controls for the purpose of elevator cab Phase 1 recall and shunt trip control, circuit supervision and shunt trip power supervision.
 10. Fire pump controller for required signaling and trouble supervision.

- C. Fire alarm system shall not be interconnected to any of the following:
 - 1. Sump warning systems,
 - 2. Carbon monoxide detection systems.
 - 3. Methane gas detection systems.
 - 4. Elevator car alarm bell circuit.
 - 5. Other unrelated system.

3.02 SYSTEM INSTALLATION

- A. Install required conductors to devices indicated on Drawings. Provide required conductor terminations to devices for a complete system to function as specified and indicated on Drawings. Refer to Section 26 0519: Low-Voltage Wire (600 Volt AC), for installation and color coding requirements.
- B. Splices are not allowed in junction boxes. Terminations shall be in terminal cabinets or on equipment terminals.
- C. Conductors shall be installed within conduits, boxes, and terminal cabinets in a totally enclosed installation. Furnish and install conductors required to connect incoming and outgoing circuits, including spare conductors, to terminal strips within terminal cabinets.
- D. Wiring within equipment and terminal cabinets shall be installed to conform to contract documentation and NFPA 72 standards, and shall be terminated on terminal blocks having terminals for required connections. Wiring shall be cabled, laced, and securely fastened in place so that no weight is imposed on equipment or terminals.
- E. Install required terminal blocks within terminal cabinets. Terminal blocks shall be installed on inside back of cabinets only, not on side. Incoming wiring shall be terminated on the left side of terminal blocks; outgoing wiring shall be terminated on the right side of the terminal blocks.
- F. Conductors shall be color-coded per specification section 26 0519 Low Voltage wires and tagged with code markers at terminal cabinets, and equipment. A wire index shall be typed and installed on terminal cabinet doors. Index shall be covered with clear plastic adhesive covers. Wiring shall be identified as to building and location of devices in the index.
- G. Wiring within equipment and terminal cabinets shall be carefully strapped, and shall be formed in rectangular configuration. Wires shall be properly numbered in numerical order and shall maintain same number throughout the Project site.
- H. Complete installation shall comply with local building codes and applicable provisions of the California Electrical Code, California Fire Code and the NFPA 72 National Fire Alarm Code.
- I. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Do not scale Drawings to determine locations and routing of conduits and outlet boxes. Location of outlet boxes and equipment shall conform

to architectural features of the building and other Work already in place, and must be ascertained in the field before the start of Work.

- J. Drawings generally indicate Work to be provided, but do not indicate all bends, transitions or special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits are to be installed, and furnish and install required fittings.
- K. Provide P-touch label of approximately one inch wide with red lettering for each initiating device that is hidden from view. Tags shall indicate the name and type of device: Heat Detector, or Duct Smoke Detector. Tags shall be permanently attached on access panel or t-bar grid which is used to access a hidden device.
- L. Provide smoke and heat detectors in elevator hoist-ways if a fire sprinkler head is located at the top of the elevator hoist-way. Provisions shall be made for access to the detector without entering the elevator hoist-way. Access shall be provided through an approved enclosure with self-locking fire rated door. The detectors shall be so placed as to allow service to them without the service personnel having to reach into the hoist-way in the way of travel of the elevator car. Access to elevator hoist-ways and machine rooms (including escalators) must be supervised by the Owner's licensed elevator or escalator maintenance contractor. OAR is responsible for coordinating access in accordance with Contractor's schedule. Contractor shall provide a minimum of 48 hours' notice.
- M. Provide adjacent to each annunciator a neatly typewritten copy of the Fire Alarm Operating Instructions. The instructions shall reflect the installed and programmed features of the system. Instructions that include information on non-installed or programmed features will not be acceptable. The instructions shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with appropriate anchors.
- N. Provide adjacent to each annunciator a neatly drawn site map showing rooms with designations and buildings with names as programmed into the system. This map shall be sized to allow (normal vision) reading of the designations, names etc. A map so reduced in size to the point of not being readable will not be acceptable. This map shall include symbols indicating the locations of installed fire sprinkler flow switches, riser shut off valves, post indicating valves and manual pull stations. Provide a symbol list on the map for the symbols used. The site map shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with the appropriate anchors.

3.03 SYSTEM PROGRAMMING

- A. Programming shall be performed in accordance with District requirements set forth in this section – the local authority having jurisdiction and applicable codes. If a conflict arises or a clarification is required, the contractor through the project's OAR shall contact the Districts Fire Life Systems Testing Group (FLSTG) for clarification

- B. As part of the 50 percent construction completion label devices and locations in the manner indicated in the attached guidelines on a separate copy of the shop drawings. Request a meeting with OAR, Project Inspector, and representative of FLSTG to review, finalize and obtain approval of the proposed device, equipment and location descriptors that will be programmed into the system. The District may at time of substantial completion request minor changes to program descriptors if needed to conform to site conditions.
- C. The following functions and features as required by the site or system configuration and installed peripheral equipment and systems shall be programmed into the fire alarm systems. The definition of programming shall include but not be limited to the use of a built in keyboard, the use of a connected PC with the appropriate software, dip or rotary switches, wiring or installable or removable jumpers as required or provided in the fire alarm equipment.
1. Signal Silence Switch Inhibit: The audible signal silence switch located on the remote fire alarm annunciator(s) or any fire alarm control panel(s) shall be programmed to not silence the audible or extinguish the visual alarm circuits during the first minute (60 seconds) of alarm activation. Activation of this switch shall silence only the audible signals. Enabling or disabling this feature shall be allowed only if approved by the local Fire Marshal and District's Supervising Electrical Engineer, and authorized District maintenance personnel. The activation feature shall be protected by a maintenance level password.
 2. Fire Sprinkler Water Flow Audible Appliance: The fire sprinkler water flow appliance (bell) shall not require any programming but shall be directly controlled by a set of dry contacts within the associated sprinkler water flow switch(s). The 24 volt DC auxiliary power for the sprinkler water flow audible appliances shall be supplied by an FACP or a remote power supply. This audible appliance shall operate continuously during the detection of fire sprinkler water flow and shall not be coded in any manner nor silenced automatically by any FACP or manually by any user controls at any FACP or remote annunciator.
 3. Fire Sprinkler Water Flow Switch: Fire sprinkler water flow switches shall be programmed in a manner that shall prevent the above Signal Silence Switch from silencing the audible coded signals or visual signals after the initiation of an alarm by a fire sprinkler flow switch.
 4. Audible Notification Appliance Circuits: Audible notification appliance circuits shall be programmed to emulate the temporal code (ANSI S 3.41) from fire alarm audible appliances (horns). This coding shall originate and be controlled by a single coder residing within the FACP(s). The use of coders within remote power supplies either mounted adjacent to an FACP or at a remote location or directly by an audible notification appliance will not be permitted. Programmable audible notification appliances shall be configured to emulate a steady tone at approximately 1000 Hz. Audible notification appliance circuits shall be programmed to be silenced as described above. Notification appliance circuits throughout the site shall

be activated by any alarm initiating device. Coded audible signals shall be controlled by a single synchronized FACP.

5. Visual Notification Appliance Circuits: Visual notification appliance circuits shall be programmed to provide steady non-coded power to the visual appliances (strobes). As required by code and the system configuration, a synchronization signal shall be superimposed onto the NAC by the FACP, a remote power supply or an add-on synchronization module. Visual notification appliance circuits shall be programmed to be extinguished as described above. Visual notification appliance circuits throughout the site shall be activated by any alarm initiating device.
6. System Reset Button: The system reset button located on FACP's and remote annunciators in addition to resetting the fire alarm system and silencing or extinguishing notification appliances except for the sprinkler water flow appliances shall be programmed to reset analog and addressable smoke detectors, duct detectors, beam detectors and relays, addressable control modules and addressable relay modules used to interface to other systems and equipment. Each installed system reset button shall be programmed to operate as a "single point of reset" for the complete system.
7. HVAC Shutdown: Relays and addressable relay modules used to interface to HVAC equipment dampers, and supply and exhaust fan motors shall be programmed to shut down this equipment only within the same building where the detection of smoke, heat, carbon monoxide or fire sprinkler water flow has taken place. Manual pull stations within any building shall not affect the operation of the HVAC equipment. These relays shall return to normal only after the system is reset.
8. Elevator Recall: The addressable relay modules for the primary and alternate elevator recall function shall be programmed to activate only with the detection of smoke by a detector located in the elevator machine room, elevator hoistway or the main floor or alternate floor landing(s) smoke detector associated with that elevator or bank of elevators. Recall of an elevator shall be on a per-elevator or on a per-bank of elevators basis. Activation of other initiating devices shall not cause the recall of an elevator.
9. Fire Fighter Warning: In conjunction with the above elevator recall function, an additional addressable relay module shall be programmed to operate only with the detection of smoke by a detector located in an elevator machine room or elevator hoistway to provide a warning signal to fire fighters attempting to use the phase II elevator function.
10. Elevator Shunt Trip: The addressable control module or MR control relay for the elevator shunt trip shall only be activated by the heat detector located within the elevator machine room or elevator hoistway for each elevator or bank of elevators. Circuit integrity, and AC and DC power to

the MR control relay shall be electrically supervised. Activation of other initiating devices shall not operate the shunt trip.

11. Smoke Detector Maintenance Alert: Addressable smoke detectors shall be programmed with the capability of initiating a maintenance alert when any one detector becomes obscured by dust or any other contaminates at approximately 10 percent below the level of obstruction that would initiate an alarm.
12. Disabling Class Passing Signals: The relay or addressable relay module shall be programmed to disable the class passing signals during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.
13. Disabling Audio of a Public Address System: The relay or addressable relay module shall be programmed to mute the audio output of the associated public address system during any activation of an audible notification appliance circuit or a voice evacuation announcement. This or these relays shall automatically restore to normal upon the silencing of the audible NACs and the voice evacuation announcement.
14. Release of Electro-Magnetically Held Doors: The relay or addressable relay module shall be programmed to open or close the control circuit as needed of the 24 volt DC door holder power supply. This relay(s) shall operate during any alarm condition within the same building as the door holders. The contacts shall return to normal only after system reset.
15. Illumination of House Lighting: The relay or addressable relay module shall be programmed to turn on to full brilliance the house lighting of an Auditorium, MP Room, etc. during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.
16. UDACT: The FACP and the associated Universal Digital Alarm Communication Transmitter shall be programmed to transmit to the central monitoring station separate indications for General Alarm, Fire Sprinkler Water Flow Alarm, System Trouble and Supervisory Conditions. These indications shall be in addition to any indications initiated by the UDACT itself.
17. Voice Evacuation Panel: The NAC originating at, or the addressable control module controlled by the associated FACP that is controlling the EVAC panel shall be programmed to emulate the above paragraph "E" Audible Notification Appliance Circuits except that it shall be non-coded. Trouble conditions at the EVAC panel shall report back to the associated FACP via the controlling NAC or addressable control module or a separate addressable monitor module. Transformer taps at the EVAC speakers shall be selected to provide the proper balance of audio volume in larger and smaller areas. The message shall be programmed in a female voice in the English language as follows: A minimum of two but no more than three cycle sounding of an approximate 1000 Hz tone in the pattern

of the NFPA required temporal code followed by: “May I have your attention please. May I have your attention please”. The fire alarm has been activated in the building. The fire alarm has been activated in the building. Please proceed to the nearest exit and leave the building.” The sounding of the temporal patterned signal followed by the indicated message shall repeat indefinitely until the controlling NAC is reset.

18. Power Failure Reporting Time Delay: Main and remote NAC power supplies shall be programmed to delay the reporting of a site AC power failure for a minimum of 6 hours.

D. Device Descriptors:

1. Descriptors shall enable responding personnel to identify the location of a fire quickly and accurately, and shall indicate the status of emergency equipment or fire safety functions that might affect the safety of occupants. The minimum required information for devices intended to report smoke, fire, or fire sprinklers water flow include, but may not be limited to: Building, floor (if multiple floors exist in the building), room or space description, and device type and digital address (Smoke detector, Heat detector, Fire sprinkler water flow switch, etc.)
 - a. Building: The building must always be included in the descriptor, even if there is only one building on the site. Additional building(s) may be added at a later date creating the possibility of confusion by similar designated spaces, such as “Work room” or “Staff restroom” if more than one building has these similar designated spaces. The building designation in the descriptor must be what the site-based personnel call the building. The building should be provided with signage to aid fire department personnel in the identification of the building.
 - b. Floor: In multi-floor buildings the floor designation (1st, 2nd, etc.) must be included in the descriptor.
 - c. Room Description: The room or space description must be unique. Using the same designation for multiple spaces, such as “Workroom”, “Counselor’s Office”, or “Men’s restroom”, etc. is not acceptable. If, during a project, the room numbers or the use of the room changes then the room or space descriptor must be changed to agree with the change. Proper signage should be provided for each space to aid fire department personnel in the identification of the room or space.
 - d. Device Type, Address and Compass Designations: The device type and digital address must be included with the descriptor, such as smoke detector or heat detector, etc. Some systems provide this information automatically in the descriptor. Compass designations, (N, S, E, and W) are required in spaces such as corridors where there are multiple detectors and this information would be helpful to responding fire department personnel in locating the device

reporting alarm. It is not necessary to include compass designations in smaller spaces where there are multiple detectors located in close proximity to each other.

E. ACCEPTABLE ABBREVIATIONS

Rm.- Room	Bldg.- Building	Smk. - Smoke
Corr.- Corridor	Lby- Lobby	Asst. - Assistant
Eng.- English	N – North	Nrs. - Nurse
Flr.- Floor	S – South	Cnclr - Counselor
Ht.- Heat	E – East	Off. - Office
Lib.- Library	W – West	PE – Physical Education
Lkr. – Locker	Kit- Kitchen	RR- Rest Room
Stu Str – Student Store	Sci - Science	By = near
Stor Rm – Store Room	Café - Cafeteria	PM – Plant Manager
1 st - First	2 nd - Second	3 rd - Third
Hopr Rm – Hopper Room	Det - Detector	Elev - Elevator
Prin – Principal	Blr Rm – Boiler Room	Conf – Conference
Park – Parking	Bsmt –Basement	MPR.- Multi-Purpose room

3.04 SYSTEM OPERATION

- A. Unless otherwise specified, but not limited to actuation of manual stations, smoke detectors, heat detectors, linear heat or smoke detectors, or water-flow switches shall cause the following operations to occur, refer to Attachment B:
1. Activate audible circuits.
 2. Actuate strobe units until the panel is reset or strobe circuit time-out.
 3. Release magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated.
 4. Where required, return elevators to the primary or alternate floor of egress.
 5. Smoke detectors in elevator lobbies shall, in addition to the above functions, return elevators to the primary or alternate floor of egress.

6. Smoke detectors in elevator machine rooms or tops of hoist-ways shall return elevators to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall perform this function in accordance with ANSI A 17.1 requirements and shall be coordinated.
7. Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as required.
8. Activation of fire sprinkler system low-pressure switches, post indicator valve or tamper switches shall initiate a system supervisory alarm indication.
9. UL listed central station shall be notified via – Universal Digital Alarm Communicator Transmitter (UDACT).

3.05 TESTING

- A. A 48 hour notice shall be provided to the Project Inspector before final testing.
- B. Testing of fire detection system shall be as required by the State Fire Marshal and local authorities having jurisdiction. Installer is responsible for identifying required testing, coordinating, scheduling, and conducting tests before Substantial Completion. Tests shall include the following:
 1. Operation of signal-initiating devices (smoke detectors, heat detectors, pull stations etc.).
 2. Operation of indicating devices (alarm horns, alarm bells and alarm strobes).
 3. Operation of system features under normal operation.
 4. Operation of system supervisory features.
 5. Operation of system features on standby power, with primary power turned off.
 6. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 7. Close sprinkler system flow valves and verify proper supervisory alarm at the FACP.
 8. Verify activation of flow switches.
 9. Open initiating device circuits and verify that trouble signal actuates.
 10. Open signaling line circuits and verify that trouble signal actuates.
 11. Open and short notification appliance circuits and verify that trouble signal actuates.
 12. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
 13. Ground initiating device circuits and verify response of trouble signals.

14. Ground signaling line circuit and verify response of trouble signals.
 15. Ground notification appliance circuit and verify response of trouble signals.
 16. Check alert tone to alarm notification devices.
 17. Check installation, supervision, and operation of intelligent smoke detectors.
 18. Alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
 19. When the system is equipped with optional features, consult the manufacturer manual to determine proper testing procedures.
 20. Theatrical lighting house light control override.
 21. Central and Autonomous PA systems for muting during the sounding of the audible notification appliances and voice evacuation announcements.
 22. Disabling electronic tone or electromechanical bell class passing signals until system reset.
- C. Upon completion of installation of fire alarm equipment, provide to the OAR a signed, written statement confirming that fire alarm equipment was installed in accordance with the Specifications, Shop Drawings, instructions and directions provided by the manufacturer.
- D. Demonstrate in presence of the Project Inspector that circuit and wiring tests are free of shorts and grounds and that installation performs as specified herein and within manufacturer's guidelines.
- E. Software Modifications:
1. Provide the services of a factory trained and authorized technician to perform system software modification, upgrades or changes. Response time of the technician to the Project site shall not exceed 24 hours.
 2. Provide hardware, software, programming tools, and documentation necessary to modify the fire alarm network on the Project site. Modification includes: addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modification on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being provided.
- F. Complete the inspection and testing form as required by NFPA 72, and submit one copy of the completed form to the Architect and Project Inspector.

3.06 SERVICE MANUALS

- A. Deliver to OAR, three copies of the service manuals. Each manual shall include the following:

1. Installation manuals, programming manuals and user manual if applicable for every control panel, control panel power supply, FACP input or output or relay or control module, auxiliary power supply, UDACT, remote NAC extender power supply, door holder power supplies, installed annunciators, initiating and indicating devices and addressable monitor, relay and control modules. Catalog cut sheets are not acceptable.
2. A printed copy of the system configuration as programmed, including system labeling codes, and passwords.
3. An electronic copy on compact disk of the system configuration program
4. Final test report.
5. Detailed explanation of the operation of the system.
6. Instructions for routine maintenance.
7. Detailed wiring diagram for the connection of relays, addressable monitor, and control or relay modules as applied in the interfacing of peripheral systems or equipment to the fire alarm system. Updated shop drawings shall include revisions made in the field via plan changes, RFIs, Field Change Directives, and any other construction change documents including interface details with ancillary systems.
8. An electronic copy (CD) of the posted site or fire alarm map in Auto-Cad and pdf formats.
9. Provide a CD ROM electronic copy of the updated system As-Built Drawings to the OAR, prepare this copy in the latest version of AutoCAD; along with the electronic copy provide a full size bond copy. Include one CD-ROM of the up-dated As-Built Drawings into each of the Service Manuals. CD and folded drawings shall be secured and inserted into the Service Manuals via a three-hole punched protective CD case and protective envelopes for the drawings.
10. Provide codes and passwords for fire alarm system at testing.

3.07

SPARE PARTS

The following new spare parts shall be furnished in unopened boxes:

1. Five percent spare pull stations including the associated monitor module (minimum one spare pull station per type).
2. Five percent spare smoke and heat detectors (minimum one spare smoke and heat detector per type).
3. Five percent spare audible devices (minimum one spare audible device per type).
4. Five percent spare strobe devices (minimum one spare strobe device per type).

SYSTEM USER AND MAINTENANCE PERSONNEL TRAINING

- A. Before Substantial Completion, provide one instruction period for the Project site based Owner operators and system users. The instruction period shall be scheduled and coordinated by the OAR.
- B. Training materials and required deliverables shall be submitted to the OAR.
 - 1. Prior to beginning the operational demonstration, notify Central monitoring Station that an instructional activity is beginning; inform them that it includes setting and resetting the system in test mode. After the demonstration is completed and the system restored, notify the Central Monitoring Station that the system has been restored and it is back on line for continuous monitoring.
- C. User Instruction and Training
 - 1. Before substantial completion and with a fully functional fire alarm system installed at the site, the contractor shall provide a minimum of four hours of user training for site based staff. The date and time for this training shall be coordinated by the project OAR.
- D. Instruction period training for site based staff shall consist of the following:
 - 1. Overview:
 - a. Explain the fire system is “addressable” which means every device-smoke detector, heat detector, sprinkler water flow switch, manual pull station, etc. has a unique address or identity. This makes it possible to positively identify the exact device causing an alarm, trouble or supervisory condition.
 - b. Explain the fire alarm control panel also controls the horns and strobes throughout the campus or building.
 - c. Explain that the fire alarm system is interconnected to various other systems and equipment throughout the site such as:
 - 1) Elevators to recall them to the main floor or to an alternate floor and as an option dependent circumstances turn off the power to the elevators.
 - 2) Heating and air conditioning equipment to turn off fans and close dampers to stop the spread of smoke throughout a building.
 - 3) The class passing signaling system to disable the bells or tones to not accidentally signal students and staff to return to the buildings.
 - 4) Magnetically held doors to close them to stop the spread of smoke.
 - 5) To turn up house lighting in an occupied Auditorium or Multi-Purpose room to provide adequate egress lighting.

- 6) The Central and Autonomous PA systems to mute them during the sounding of the alarm signal.
 - d. Explain the fire system has a battery backup in case of power failure and that it will continue to function for a minimum of 24 hours after a total power failure.
 - e. Explain that the fire alarm system components and wiring are monitored to report a malfunction, damage or vandalism. When this occurs, a trouble indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.
 - f. Explain that other equipment and systems are monitored for abnormal conditions such as the fire sprinkler water being turned off. When this occurs, a supervisory condition is created. A supervisory indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.
 - g. Explain that the fire system in addition to notifying the occupants of a possible fire condition also transmits an alarm indication to the central monitoring station that will in turn notify and dispatch the local fire department to your site.
2. Basic:
- a. Hand out the SYSTEM OPERATION instructions to attendees.
 - b. Point out the Fire Alarm Control Panel and have them observe the normal LED status (one green LED only should be on):
 - 1) GREEN = Normal.
 - 2) YELLOW = Trouble.
 - 3) RED = ALARM.
 - c. Have the attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.
 - d. Point out the Fire Alarm System Annunciator and have attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.
3. Operation and Demonstration:
- a. After putting the system or having someone put the system central station monitoring into the test mode demonstrate the following:
 - b. Activate a Manual Pull Station to demonstrate ALARM.
 - 1) Demonstrate audible and visual notification appliances and if installed the voice evacuation signal announcement.

- 2) Demonstrate panel or annunciator sounder tone for ALARM.
 - 3) Have staff SILENCE system.
 - 4) Show LCD display and LED of alarm.
 - 5) Demonstrate and have staff reset the manual pull station.
 - 6) Have staff RESET fire system.
- c. Activate Smoke Detector with canned smoke to demonstrate address identification:
- 1) Have staff SILENCE system.
 - 2) Show LCD and display LED of ALARM.
 - 3) Have staff RESET fire system.
- d. Remove Smoke Detector to demonstrate SYSTEM TROUBLE.
- 1) Demonstrate panel or annunciator sounder tone for TROUBLE.
 - 2) Have staff SILENCE system.
 - 3) Show LCD display and LED of TROUBLE.
 - 4) Replace the smoke detector.
 - 5) Have staff RESET fire system.
- e. Remove power to demonstrate function during power failure.
- 1) Have staff SILENCE system.
 - 2) Show LCD display and LED of TROUBLE.
 - 3) Activate Manual Pull station to demonstrate audible or visual functions in power failure mode.
 - 4) Reset manual pull station.
 - 5) Reset fire system.
 - 6) If applicable, point out sprinkler riser and shut off valves.
 - 7) Show location of a water flow switch.
 - 8) Show location of a valve tamper switch.
 - 9) Point out valves must always be OPEN or fully counter clock wise.
 - 10) Point out PIV (Post Indicator Valves) if applicable.
 - 11) Have water flow through the inspectors test valve and point out the ringing water flow bell.

- 12) After the horns are silenced by an assistant, show that the water flow bell is ringing continuously indicating water flow.
- 13) Have the assistant turn off the inspectors test valve to show that water flow alarm bell turns off.
- 14) Reset system.
- 15) Unlock and turn off a PIV or riser valve to show a supervisory condition.
- 16) Turn valve back on, lock the valve open and demonstrate the end of the indication of a supervisory condition.

4. Training documentation.

- a. Insure fire panel is reset and indicates normal and central station monitoring is taken off of the test mode.
- b. Have staff attendees sign off training sheet and provide a copy to the PROJECT INSPECTOR.

3.09 PROTECTION

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

3.10 CLEANUP

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

END OF SECTION

SECTION 31 1000

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Removal of vegetation, grass, grass roots, shrubs, tree stumps, trees, upturned stumps, weed growth, tree roots, brush, masonry, concrete, rubbish, debris and other materials.
2. Removal of concrete and bituminous surfaces.
3. Removal of existing fences and gates.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2200 - Grading.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2316 - Excavation and Fill for Pavement.
5. Section 31 2319 - Excavation and Fill for Structures.
6. Section 31 2323 - Excavation and Fill for Utilities.
7. Section 31 2326 - Base Course.
8. Section 32 3113 - Chain Link Fences and Gates.
9. Section 32 9000 - Planting.

1.02 SUBMITTALS

- ###### A. Shop Drawings: Submit site plan indicating extent of site clearing.

1.03 QUALITY ASSURANCE

- ###### A. Comply with Standard Specifications for Public Works Construction, current edition, as a minimum requirement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 TREE AND STUMP REMOVAL

- A. Remove trees and stumps indicated or required to be removed. Remove trees, together with bulk of roots, to a minimum depth of 4 feet below required grade, and within a radius of approximately 7 feet beyond perimeter of trunk at grade.
- B. Fill and compact excavation from tree and stump removal. Fill in 6 inch layers, each compacted to 90 percent of maximum density in accordance with ASTM D1557.
 - 1. Back filling shall not commence until the excavation is inspected and tested.

3.02 CONCRETE AND BITUMINOUS SURFACING REMOVAL

- A. Break up and completely remove existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to indicated limits. Cutting shall be performed to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1 1/2-inch, unless otherwise indicated. Remove concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match existing.

3.03 FENCING

- A. Existing fences scheduled to remain may be removed to facilitate the Work, provided they are installed to their original condition in accordance with requirements of Section 32 3113 - Chain Link Fences and Gates.
- B. Fencing indicated to be removed and not reinstalled shall be completely removed, including footings. Fill and compact excavations.
- C. Install chain link fencing indicated to be relocated or reset in accordance with applicable requirements specified under Section 32 3113 - Chain Link Fences and Gates.

3.04 CLEANUP

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

END OF SECTION

SECTION 31 2200

GRADING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and hillsides.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 1000 - Site Clearing.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2316 - Excavation and Fill for Pavement.
5. Section 31 2319 - Excavation and Fill for Structures.
6. Section 31 2323 - Excavation and Fill for Utilities.
7. Section 31 2326 - Base Course.
8. Section 32 9000 - Planting.

1.02 PROJECT REQUIREMENTS

A. General:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.
4. Before grading, contact Underground Service Alert of Southern California (USASC) for information on public buried utilities and pipelines. Retain the services of an underground utility locator for on-site utilities.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall conform to requirements specified in this and related sections.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain installed stakes until their removal is required for the Work. Provide replacement grade or location stakes lost or disturbed.
- B. Install grade stakes and compare to indicated grades. If discrepancies are found between existing grades and grades indicated on Drawings, do not proceed until discrepancies are resolved.

3.02 ROUGH AND FINE GRADING

- A. Rough grade area sufficiently high to require cutting by fine grading:
 - 1. Grade area for bituminous surfacing and other paving to the indicated grades, equal to the section of the indicated base and pavement.
 - 2. Slope banks to required finish grades as cut progresses or leave cuts full and finish grade by mechanical equipment to provide grades and soil densities indicated on the Drawings.
 - 3. Rough grade, fill and compact banks beyond indicated finish grades. Finish grade banks and slopes to indicated grades and specified soil densities.
 - 4. Grade Only Areas: In areas not indicated to receive pavement, rough grade to approximate finish grades and then scarify, moisten and roll to obtain required density and indicated finish grades.
 - 5. Tolerances: Finish grades shall be within a tolerance of 0.05 inch per foot above or below grades indicated. Provide an average grade as indicated.
- B. Base or Subgrade:
 - 1. After subgrade has been constructed to approximate required grades, scarify to a depth of at least 6 inches:
 - a. After scarifying, process loosened material to a finely divided condition and adjust moisture content to optimum condition by addition of water, addition and blending of dry suitable material, or by drying of existing material.
 - b. Subgrade material shall be compacted by tamping, sheepfoot rollers or pneumatic tire rollers. Required relative compaction shall be 90 percent minimum for the top 6 inches below subgrade.

c. Install base course in accordance with Section 31 2326 - Base Course.

2. Tolerance of completed grades of base or subgrade shall not vary more than 0.03 inch per foot from grades indicated. Provide an average grade as indicated.

3.03 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of CalOHSA.
- C. Remove shoring upon completion of the Work of this section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.04 EXCESS MATERIAL DISPOSAL

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

3.05 PROTECTION

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

END OF SECTION

SECTION 31 2313

EXCAVATION AND FILL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, filling, backfilling, and compacting for Project site pavement, planting areas, and other structures.
2. Trenches for utility lines such as water, gas, storm drain and sewer lines, concrete-encased conduits, manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes, and other utility appurtenances.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2326 - Base Course.
6. Section 32 0117 - Pavement Repair.
7. Section 32 1313 - Site Concrete Work.
8. Section 32 3113 - Chain Link Fences and Gates.
9. Section 32 9000 - Planting.
10. Section 33 1100 - Site Water Distribution Utilities.
11. Section 33 3000 - Site Sanitary Sewer Utilities.
12. Division 22 - Plumbing.
13. Division 26 - Electrical.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 SUBMITTALS

- A. Shoring calculations as required in Article 3.03 of this Section.

1.04 QUALITY ASSURANCE

- A. Comply with the Standard Specifications for Public Works Construction, current edition, except as modified herein.
- B. Sampling, testing, and certification of imported and exported soils shall be performed in accordance with Section 01 4524, Environmental Import/Export Materials Testing.

1.05 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.06 PROJECT CONDITIONS

- A. Information on Drawings or in soil investigation report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.01 FILL AND BACKFILL MATERIALS

- A. Fill and backfill material shall be a granular material previously removed from excavation or imported fill material, free of clods and stones larger than 3 inches, (2½ inches for utility trenches) foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended and aerated to stabilize and upgrade the material.
- C. Bedding material from trench bottom to one foot above the pipe:
 - 1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.
 - 2. Sand complying with the Specifications for cement concrete aggregates.
- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site No such material shall be imported from outside the Project site.

E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

<u>Sieve Size:</u>	<u>Percentage Passing:</u>
3/4 inch (19mm)	100
3/8 inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
3. Provided backing for weep-holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system Miradrain by Mirafi, Inc., American Wick Drain, JDR Enterprises, or equal, may be provided if reviewed and approved by the ARCHITECT.

- F. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.

2.02 BASE MATERIALS

- A. Concrete Slabs on Grade: Provide "Crushed Aggregate Base" as specified in Standard Specifications for Public Works Construction, Section 200 - Rock Materials, with 3/4 inch maximum size aggregates. Provide 3 inch thick base, unless noted otherwise.
- B. Bituminous Surfacing: Provide as indicated on Drawings and specified in Section 31 2326 Base Course.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Where the Work includes a building extension or addition on an occupied Project site, perform Work in such a manner, and at such times, as not to disrupt performance of

existing utility services to existing Project site facilities. Where an interruption is necessary, obtain review from the OAR before proceeding.

- C. Remove concrete or bituminous pavement to straight lines by saw cutting.

3.02 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, OSHA regulations.
- B. Protect existing improvements including landscaping against damage. Repair or replace damaged items.
- C. Protect existing utility services and distribution systems from damage or displacement.
- D. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of two feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.
- E. Shore, crib, or lag excavations and earthen banks as necessary to prevent cave in, erosion or gullying of sides.
- F. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed earth and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

3.03 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of governing Cal-OSHA requirements.
- C. Remove shoring upon completion of the Work of this Section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.04 EXCAVATION

- A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork", except as modified herein.
- B. Form sides of footings, pads, grade beams, and slab foundations, unless otherwise indicated. Provide excavations of sufficient size to permit installation and removal of forms and other required Work.
- C. Machine-drill excavation for round footings to size and depth indicated. Provide a collar or casing, or other adequate protection, to exclude dirt and debris. Protect excavations with plank covers until concrete is placed.
- D. Provide excavation bottoms level and free from loose material. Excavate to indicated or required elevations of undisturbed earth.

- E. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 5000 - Construction Facilities and Temporary Controls, and in accord with Cal-OSHA standards and requirements.
- F. Trenches over five feet in depth shall comply with the Construction Safety Orders of the California Division of Industrial Safety.
- G. Where indicated or required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- H. For Structures:
 - 1. Calculate excavation quantities based on elevations or depths indicated on Drawings.
 - 2. Provide 2,000 psi concrete for backfill of over-excavated areas to indicated or required elevations.
 - 3. Special preparation of bottom of excavated planes areas: Excavate areas shown on Drawings as bottom of excavated planes (B.E.P.), by excavating and filling to indicated grades and elevations.
- I. For Utilities:
 - 1. Excavate trenches to required depth for utility lines, such as pipes, conduits, and tanks, with minimum allowance of 6 inches at the bottom and 6 inches at the sides for bedding or concrete encasement as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before placing sand bedding or concrete encasement.
 - 2. Do not install piping lengthwise under concrete walks without review by the ARCHITECT.
 - 3. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.
 - a. Unless otherwise indicated on Drawings, depth of excavations outside buildings shall provide for a minimum coverage above top of piping, tank or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finish grade
Copper Water Tube	18 inches below finish grade
Cast-Iron, Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structure	36 inches below finished grade
Soil, sewer and storm drain	minimum 18 inches below finished grade, and as required for proper pitch

and traffic load. Install polypropylene sewer pipe with at least 24 inches of coverage.

Irrigation Pipe:

Non-pressure pipe - 12 inches,
pressure pipe - 24 inches.

- b. Trench width shall provide space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.
- 4. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117 - Pavement Repair.
- 5. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits placed in the same trench or outside surfaces of containers and tanks.

3.05 IMPORT/EXPORT OF MATERIALS

- A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300 - Earthwork, except as modified herein. Install and compact fill in layers not to exceed 6 inches in thickness.
- B. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- C. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524, Environmental Import/Export Materials Testing.
- D. Imported fill materials shall be sampled by the Geotechnical Engineer, for compliance with the requirements of Part 2 of this Section.
- E. The Geotechnical Engineer, will submit the samples to an independent DSA approved testing laboratory for testing.
- F. Initial sampling and testing shall be performed before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and entity responsible for the source site. The Geotechnical Engineer, will obtain both the initial and additional samples from the identified site and submit samples for required testing.
- G. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- H. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish

copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, California Building Code, and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by the CBC.

- I. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- J. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.06 INSTALLATION OF MATERIALS

- A. Pavement: Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the Geotechnical Engineer, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but not more than 1 in 20. Provide adequate drainage at all times during installation of the Work of this Section.
- B. Structures:
 - 1. After concrete has been placed, forms removed, and concrete Work inspected, backfill excavations with earth to indicated or required grades. Backfill simultaneously on each side of walls or grade beams. Remove rubbish, debris and other waste materials from excavations before placing backfill.
 - 2. Before placing backfill, adequately cure concrete and provide bracing, if required to stabilize structure. Protect waterproofing or damp-proofing against damage during backfilling operations, with required protection board. Remove bracing as backfill operation progresses.
 - 3. Do not furnish or install expansive soils for retaining wall backfill.
 - 4. Rigidly control the amount of water to be installed to provide optimum moisture content for type of fill material furnished. Do not over-saturate or compact by flooding or jetting.
 - 5. Install wall backfill before installing railings and fences on walls.
 - 6. Install weep hole drainage at the backside of walls so the backing completely covers the weep holes, is horizontally centered and extends at least 12 inches above the bottom of the weep opening. Provide an 8-inch square section of 1/4 inch galvanized or aluminum screen, with a minimum wire diameter of 0.03 inch, and install at the backside of each weep hole before installing the backfill material.

7. Where a reviewed drainage matting system is provided instead of permeable backfill for retaining structures, install in accordance with the manufacturer recommendations.

C. Utilities:

1. Do not install backfill until the Work of this Section has been inspected and tested. Do not furnish or install materials excavated from the Project site containing materials not permitted for backfill.
2. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the IOR.
3. Install backfill in layers not exceeding 4 inches in thickness, except cement-sand slurry.
4. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grades plus one inch.

3.07 COMPACTING

- A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.
- B. Install and compact sand bedding to provide a uniform bearing under the full length of piping and conduits.
- C. Unless otherwise indicated, compact each layer of fill material to a relative compaction of at least ninety percent.
- D. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each layer of compacted fill before installing the next succeeding layer.

3.08 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality for testing as set required in Part 2 and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source and submit samples to the independent approved testing laboratory before delivery to the Project site.
- C. Installation of backfill shall be observed by the Geotechnical Engineer.

- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.
- F. The Project Inspector will inspect foundation excavations when completed and ready for forms, after forms are in place, and before first placement of concrete.

3.09 PROTECTION

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

3.10 CLEANING

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

END OF SECTION

SECTION 31 2316
EXCAVATION AND FILL FOR PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfill, and compacting for paved areas.
2. Installation of fill materials.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2323 - Excavation and Fill for Utilities.
6. Section 32 2326 - Base Course.
7. Section 32 0117 - Pavement Repair.
8. Section 32 1216 - Asphalt Paving.
9. Section 32 1313 - Site Concrete Work.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition, except as modified herein.

- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.04 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.05 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.

PART 2 - PRODUCTS

2.01 BASE MATERIALS

- A. Concrete Slabs On Grade: Provide "Crushed Aggregate Base "as specified in the Standard Specifications for Public Works Construction, Section 200: "Rock Materials," with ¾ inch maximum size aggregates. Provide 3-inch thick base, unless noted otherwise.
- B. Bituminous Surfacing: As indicated on Drawings and specified in Section 31 2326 - Base Course.

2.02 FILL AND BACKFILL MATERIALS

- A. Fill and backfill materials shall be previously excavated materials or imported fill material, free of clods and stones larger than 3-inch, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended or aerated to stabilize and upgrade the material.
- C. Imported Fill Material:
 - 1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.
 - 2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not

more than 6 percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site. No such materials shall be imported from outside the Project site.
- E. Permeable Backfill:
 - 1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

Sieve Size:	Percentage Passing:
3/4 inch (19mm)	100
3/8 inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3
 - 2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
 - 3. Provided backing for weep holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
 - 4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system, Miradrain by Mirafi, Inc., or equal, may be provided if reviewed and approved by the ARCHITECT.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Clear the Project site as indicated in Section 31 1000 - Site Clearing.

3.02 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.
- B. Protect adjacent existing improvements including landscaping against damage.

3.03 EXISTING UTILITY LINES

- A. Protect existing utility lines from damage or displacement.
- B. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of 2 feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.

3.04 EXCAVATION

- A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

3.05 FILL

- A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.
- B. Provide fill materials as specified in Part 2 - Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- C. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524 - Environmental Import/Export Materials Testing.
- D. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- E. The Geotechnical Engineer will submit samples to a DSA approved independent approved testing laboratory for testing.
- F. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial and additional samples from the identified site and will submit samples to the approved independent testing laboratory for testing.
- G. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- H. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in

accordance with applicable provisions of the Contract Documents, CBC, and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer shall submit a verified report to the DSA as required by CBC.

- I. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- J. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.06 INSTALLATION OF MATERIALS

- A. Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the Geotechnical Engineer, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but no more than 1 in 20. Provide adequate drainage at all times during construction of the Work of this Section.

3.07 COMPACTING

- A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.
- B. Unless otherwise indicated, compact each layer of earth fill to a relative compaction of at least 90 percent.
- C. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each compacted layer before installing the next succeeding layer.

3.08 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source before delivery to the Project site.
- C. Installation of backfill will be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and/or other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.

3.09 PROTECTION

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

3.10 CLEANING

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

END OF SECTION

SECTION 31 2319
EXCAVATION AND FILL FOR STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting for buildings and structures.
2. Fill materials.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2616 - Excavation and Fill for Paving.
6. Section 31 2323 - Excavation and Fill for Utilities.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 SUBMITTALS

- A. Imported Soils: A Geotechnical Engineer, retained by the Owner as an Owner Consultant, will obtain initial product Sample for testing in accordance with the terms of Article 3.05 of this Section.
- B. Shoring calculations as required in Article 3.03 of this Section.

1.04 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition, except as modified herein.
- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.05 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.06 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.

PART 2 - PRODUCTS

2.01 FILL AND BACKFILL MATERIALS

- A. Fill and backfill materials shall be a granular material previously removed from excavation, or imported fill material, free of large clods and stones larger than 3 inches, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.
- B. Fill material exhibiting a wide variation in consistency and or moisture content shall be blended and/or aerated to stabilize and upgrade the material.
- C. Imported Fill Material:
 - 1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.
 - 2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site. No such materials shall be imported from outside the Project site.

E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

<u>Sieve Size</u>	<u>Percentage Passing</u>
3/4 inch	100
3/8 inch	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
3. Provided backing for weep-holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system, Miradrain by Mirafi, Inc., or equal, may be provided if reviewed and approved by the ARCHITECT.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Clear the Project site as indicated in Section 31 1000 - Site Clearing.

3.02 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.
- B. Protect adjacent existing improvements including landscaping against damage.
- C. Shore, crib, or lag excavations and earthen banks as necessary to prevent caving-in, erosion or gullyng of sides.

- D. Divert or de-water excavations until concrete is placed, forms are removed, and backfilling is complete.

3.03 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of Cal-OHSA. Remove shoring upon completion of Work, or when no longer needed.

3.04 EXCAVATION

- A. Form sides of footings, pads, grade beams, and slab foundations, unless otherwise indicated. Provide excavations of sufficient size to permit installation and removal of forms and other Work as required.
- B. Machine-drill excavation for round footings to size and depth indicated. Provide a collar or casing, or other adequate protection, to exclude dirt and debris. Protect excavations with plank covers until concrete is placed.
- C. Provide excavation bottoms level and free from loose material. Excavate to indicated or required elevations of undisturbed earth.
- D. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.
- E. Calculate excavation quantities based on elevations or depths indicated on Drawings.
- F. Provide 2,000 psi concrete for backfill of over-excavated areas to indicated or required elevations.
- G. Special preparation of bottom of excavated planes areas: Excavate areas designated on Drawings as bottom of excavated planes (B.E.P.), by excavating and filling to indicated grades and elevations.

3.05 IMPORT/EXPORT OF MATERIALS

- A. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- B. In addition to the requirements of this Section, import and/or exported materials shall comply with the requirements of Section 01 4524 - Environmental Import/Export Materials Testing.
- C. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.

- D. The geotechnical engineer will submit all samples to a DSA approved independent testing laboratory for testing.
- E. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial sample and additional samples from the identified site and will submit samples to the approved independent testing laboratory for testing.
- F. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- G. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by CBC.
- H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- I. Upon completion of import operations, provide the OAR a certification statement attesting that all imported material has been obtained from the identified source site.

3.06 BACKFILLING

- A. After concrete has been placed, forms removed and concrete Work inspected, backfill excavations to indicated or required grades. Backfill simultaneously on each side of walls or grade beams. Remove rubbish, debris, and other waste materials from excavations before placing backfill.
- B. Before installing backfill, adequately cure concrete and provide bracing to stabilize structures. Protect waterproofing or dampproofing against damage during backfilling operations with required protection board. Remove bracing as backfill operation progresses.
- C. Do not furnish or install expansive soils for below grade building walls.
- D. Install each layer of material in a not to exceed thickness of 6 inches, unless otherwise required.

- E. Rigidly control the amount of water to be installed to provide optimum moisture content for type of fill material furnished. Do not over-saturate or compact by flooding or jetting.
- F. Install wall backfill before installing railings and fences on walls.
- G. Impervious backfill materials shall be installed in layers along with and by the same methods specified for structure backfill. Impervious backfill materials shall be at the approximate grade and elevation and where exposed to erosion, shall be covered with at least a 12-inch layer of fill material as reviewed by the Geotechnical Engineer.
- H. Install weep hole drainage at the backside of walls so the backing completely covers the weep holes, is horizontally centered and extends at least 12 inches above the bottom of the weep opening. Provide an 8-inch square section of 1/4 inch galvanized or aluminum screen, with a minimum wire diameter of 0.03 inch, and install at the backside of each weep hole before installing the backfill material.
- I. Where a reviewed drainage matting system is provided instead of permeable backfill for retaining structures, install in accordance with the manufacturer recommendations.

3.07 COMPACTING

- A. Compact each layer of fill material by tamping, sheepsfoot rollers or pneumatic-tired rollers, to such extent as to provide specified relative compaction. At inaccessible locations, compact to specified requirements with hand-held, operated and directed compaction equipment.
- B. Unless otherwise indicated, compact each layer of fill material to a relative compaction of at least 90 percent.
- C. Do not compact by flooding or jetting.
- D. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each layer of compacted fill before installing the next succeeding layer.

3.08 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source before delivery to the Project site.
- C. Installation of backfill shall be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and/or other materials.

- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.
- F. The Project Inspector will inspect foundation excavations when completed and ready for forms, after forms are in place and before first placement of concrete.

3.09 PROTECTION

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

3.10 CLEANUP

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

END OF SECTION

SECTION 31 2323
EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 4524 - Environmental Import/Export Materials Testing.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2316 - Excavation and Fill for Paving.
6. Section 31 2319 - Excavation and Fill for Structures.
7. Section 32 0117 - Pavement Repair.
8. Section 32 1313 - Site Concrete Work.
9. Section 32 8413 - Potable Water Irrigation.
10. Section 33 1100 - Site Water Distribution Utilities.
11. Section 33 3000 - Site Sanitary Sewer Utilities.
12. Division 22 - Plumbing.
13. Division 26 - Electrical.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.
- B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Section 01 4524 - Environmental Import/Export Materials Testing.

1.04 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.02 of this Section.

1.05 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.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding material from trench bottom to one foot above the pipe:

1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.
2. Sand complying with the Specifications for cement concrete aggregates.

B. Backfill Materials:

1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2 ½-inch in any dimension.

2. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.
3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing a 200 mesh sieve. Material shall provide a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 5000, Construction Facilities and Temporary Controls, and in accordance with Cal-OSHA standards and requirements.
- C. Saw-cut concrete or bituminous paving for trench installation.
- D. Trenches over 5 feet in depth shall conform to the Cal-OSHA.
- E. Where indicated and required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.
- G. Do not install piping lengthwise under concrete walks without review by the ARCHITECT.
- H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.

1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finished grade
Copper Water Tube	18 inches below finished grade
Cast-Iron Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structures	36 inches below finished grade
Soil, Sewer & Storm Drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene sewer pipe with at least 24 inches coverage)
Irrigation Pipe:	nonpressure pipe 12 inches, pressure pipe 24 inches

2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.
 - I. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.
 - J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.
 - K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and tanks.
 - L. Do not install backfill until required inspections and testing is completed.
 - M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the Project Inspector.
 - N. Install backfill materials in layers not exceeding 4 inches in thickness and compact to 90 percent of the maximum density.
 - O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.
 - P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.

- Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117, Pavement Repair.

3.02 IMPORT/EXPORT OF MATERIALS

- A. Provide fill materials as specified in Part 2, Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- B. In addition to the requirements of this Section, import and exported materials shall comply with the requirements of Section 01 4524, Environmental Import/Export Material Testing.
- C. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- D. The Geotechnical Engineer will perform the tests by utilizing an independent approved testing laboratory.
- E. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial sample and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory.
- F. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- G. The independent approved testing laboratory will perform the required tests and report results of all tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by CBC.
- H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- I. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.03 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.
- B. Compaction test shall be performed in accordance with ASTM D1557, method "C."

3.04 PROTECTION

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

3.05 CLEANUP

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

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 01 4524 – Environmental Import / Export Material Testing.
2. Section 31 1000 - Site Clearing.
3. Section 31 2200 - Grading.
4. Section 31 2313 - Excavation and Fill.
5. Section 31 2316 - Excavation and Fill for Paving.
6. Section 32 0117 - Pavement Repair.
7. Section 32 1216 - Asphalt Paving.
8. 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. The CONTRACTOR shall submit written documentation, which identifies the source, volume, and proposed transport date of the material for review and approval by OWNER'S Office of Environmental Health and Safety (OEHS) prior to importing the material. A statement on company letterhead from the CAB source, stamped by either a California Professional Geologist or Engineer, which states that the subject materials are native rock, do not contain any recycled materials and that the source quarry does not mine ultramafic materials, a source of natural occurring asbestos shall be included in the submittal to OEHS. The CONTRACTOR may request variance from analytical testing required by Section 01 4524 for CAB. To be considered for a variance, the CONTRACTOR shall submit a documentation package for OEHS approval, which includes all of the aforementioned information at least 48 hours in advance of planned import.

1. Frequently used suppliers for projects include:

- a. Hansen Aggregates.
- b. Vulcan Materials, Reliance Company.
- c. Vulcan Materials Durbin.

B. 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.

C. 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.
- B. Grade base course to elevations indicated on Drawings, ready to receive surfacing, in accordance with Section 31 2200 - Grading.

3.02 PROTECTION

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

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3.03 CLEANUP

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

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Paving for playground, parking areas, areas between buildings surfacing adjacent to planting and turf areas as indicated.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2200 - Grading.
3. Section 32 0117 - Pavement Repair.
4. Section 31 2326 - Base Course.
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.
- B. ADA related slopes shall be measured with a twenty-four-inch digital level.

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.
- B. Asphalt Concrete Mix:
 - 1. Paved slopes: Type III, D, PG-64-10.
 - 2. Between buildings, playgrounds, parking and fire lanes: Type III, C3, PG-64-10.
 - 3. Driveways for trash and delivery trucks: Type III, C3, PG-64-10 and Type III, B3, PG-64-10

2.02 HEADERS

- A. Concrete: Per specification Section 32 1313 - Site Concrete Work.

PART 3 - EXECUTION

3.01 HEADERS

- A. Concrete Headers:
 - 1. Install headers along edge of bituminous surfacing as indicated on the Drawings.
 - 2. Verify that gradients and elevations of base are correct. Maintain subgrade clean and in a smooth, compacted condition until the concrete is placed.
 - 3. Construct forms, install steel reinforcement and place concrete as indicated on Section 32 1313 Site Concrete.

3.02 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

- A. Pavement Thickness: Unless otherwise indicated on Drawings or specified, install bituminous surfacing to a compacted thickness of 2 inches.
- B. Base course shall be 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 at 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, hand roller or asphalt plate compactor.

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.

L. Allow bituminous surfacing a thirty day curing time before applying surface seal.

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. Asphalt Pavement to Receive Solar Reflective Coating:
 1. After asphalt paving has been installed and after a 24 hour period, flood test entire area in presence of the Project Inspector. Inspect area after waiting one hour. Entire area tested shall be free of standing water or puddles in excess of 0.01 foot. Practical field measurement 0.01 foot = two quarters stacked. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.
 2. No seals are to be applied to areas of asphalt paving that are to receive solar reflective coatings.
- B. Asphalt Pavement to Receive Bituminous Seal: refer to Section 32 1236 Seal for Bituminous Surfacing.

3.05 SURFACE SEALING

- A. Refer to 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.
2. Section 32 0117 - Pavement Repair.
3. Section 32 1216 - Asphalt Paving.
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:

Product NameManufacturer

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.
- B. After first coat of surface seal has been installed and after a 24-hour period, flood test entire area in presence of the Project Inspector. Inspect area after waiting one hour. Entire area tested shall be free of standing water or puddles in excess of 0.01 foot.

Practical field measurement: 0.01 foot = two quarters stacked. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.

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. Pipe encasements, thrust blocks, and equipment pads.
5. Retaining walls, planter walls and concrete benches.
6. Skateboard deterrents.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 - Electrical.
3. Section 31 2200 – Grading.
4. Section 31 2316 - Excavation and Fill for Pavement.
5. Section 31 2319 – Excavation and Fill for Structures.
6. Section 31 2326 - Base Course.
7. Section 32 1216 - Asphalt Paving.
8. Section 33 1100 - Site Water Distribution Utilities.
9. Section 33 3000 - Site Sanitary Sewer Utilities.
10. Section 33 4000 - Storm Drainage Utilities.

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).
 - E. ADA related slopes shall be measured with a twenty-four-inch digital level.

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.

2.02 SKATEBOARD DETERRENTS

A. Manufacturer: Barrett Robinson Inc. or equal.

B. Fabricated from 6061-T6 aluminum, clear anodized.

1. Fixed Angle Series:

- a. FR0.12: For walls with 1/8" radius edge. Dimensions: 4.875" top x 1.0" face x 2.0" wide.
- b. FA90A: For walls with 1/8" radius edge. Dimensions: 4.0" top x 2.375" face x 2.0" wide.
- c. FA135: For chamfered edges, where the chamfer is 3/4" or more. Dimensions: 2" wide X 3-1/2" long X 1-1/8" tall.
- d. FA902.5: For 90 degree walls with 1/2" radius edge. Dimensions: 3.75" top x 2.375" face x 2.0" wide.

2. Fixed Radius:

- a. FR.12: For 1/8" radiused edges. Dimensions: 4.875" top x 1.0" face x 2.0" wide.
- b. FR.05: For 1/2" radiused edges. Dimensions: 3.75" top x 1.0" face x 2.0" wide.
- c. FR1.0: For 1" radiused edges. Dimensions: 4.375" top x 1.625" face x 2.0" wide.

3. Gorilla Series:

- a. Gorilla 012: Rounded edge. For square corners from 0" - 3/8" radius. Size: 1-1/8" wide x 8" deep x 1-1/8".
- b. Gorilla 0135: Chamfered edge. For square corners from 0" - 3/8" radius. Size: 1-1/8" wide x 8" deep x 1-1/8".

4. Two-part epoxy adhesive shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).
5. Fastening pins as recommended by skateboard deterrent manufacturer.

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.
- B. Wall Formwork: Forms shall be constructed to conform to final concrete shape, lines and dimensions of members required by Drawings and Specifications. Forms shall be sufficiently tight to prevent leakage of concrete and properly braced or tied together to maintain position and shape.

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.
- D. Clean reinforcement of loose rust and mill scale, earth, or bond-reducing materials.

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 STAIRS AND RAMPS

- A. Install support post sleeves into the perimeter concrete curbing during the installation process of the curbing. Sleeves shall be three-inch diameter, schedule 40 PVC with a cap solvent welded to the bottom of the sleeve. Drill a half-inch weep hole on the bottom of the cap. Sleeve and cap shall be Nibco products or approved equal. Sleeves shall be embedded into concrete a minimum of nine inches and spaced at a maximum of four feet, or as indicated on the Drawings. Fill sleeve with non-shrink grout Quickcrete #1585-01 when setting posts. Provide control joints into the concrete on both sides for each post.
- B. Finish step nosings with a safety step edger/groover with a 1/2 inch radius and four grooves spaced equally 3/4 inch on center and a bit depth between 1/4 to 3/8 inch. Paint with contrasting color.

3.08 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

- A. Formed Curb and Gutter: Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Finish curve shaped gutters with a standard curb mule or concrete slipformed curb paving equipment.
- B. Concrete Finishing: Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter to grade with a wood float.
- C. Surface and Thickness Tolerances: Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.9 TRACK AND FIELD CONCRETE WORK

- A. Provide a Conformance Survey for concrete curbs, bands, drains, edge of paving dimensions and elevations in accordance with Section 32 1219 Asphalt Paving for Synthetic Running Track Surfacing.
- B. Corrective Measures: Determine If the planarity, cross slopes, elevations or general specifications have not been met submit corrective measures for the ARCHITECT's and OWNER's review and approval. Once the corrective measures have been

completed the track surfacing contractor shall submit a notification accepting the concrete work.

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 32 15 40 STABILIZED

AGGREGATE PATHWAY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section Includes: All services, materials, labor, transportation, tools and equipment necessary to perform work indicated on Drawing including the installation of base material and header edging for construction with Decomposed granite or crusher fines 3/8" minus or 1/4" minus aggregate paving with soil binding agent additive for the following items:

1. Stabilized aggregate pathway and patios

- B. Related Documents: The Conditions of the Contract and Division 1 are part of this Section as fully as if repeated herein.

- C. Related Sections:

1. 02 00 00 Site Preparation
2. 31 00 00 Earthwork
3. 022 30 Granular Materials
4. 33 00 00 Drainage and Containment
5. 31 10 00 Bases, Ballasts, Pavements and Appurtenances
6. 32 90 00 Landscaping

PERFORMANCE REQUIREMENTS

- A. Perform gradation of decomposed granite material or 3/8" minus or 1/4" minus crusher fines aggregate in accordance with ASTM C 136 – Method for Sieve Analysis for Fine and Course.
- B. The edition of the specifications and standards referenced herein, published by the following organization, apply to the granular paving work only to the extent specified

by the reference. Refer to Section 01 42 00 for information concerning availability and use of references.

- C. Standard Specifications for Public Works Construction, 2000 Edition including Regional Supplements Amendments. Add Special Requirements by City or County.

1.2 SUBMITTALS

- A. Products and Data:
 - 1. Conform to procedures and quantities as specified under Section 01 33 00.
 - 2. For base course, if required, submit material Certification and Analysis Report.
 - 3. Decomposed Granite: Provide packaged sample equal to one half (1/2) pound of decomposed granite or crushed 3/8" minus or 1/4" minus for strength and color, include source of material with telephone number and address.
 - 4. Aggregate Binder: Provide packaged samples equal to one half (1/2) pound, include source of material with telephone number and address as well as manufacture's instructions for mixing and application.

1.3 PROJECT/SITE CONDITIONS

- A. Field Measurements: Each bidder is required to visit the site of the Work to verify the existing conditions. No adjustments will be made to the Contract Sum for variations in the existing conditions.
 - 1. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.
- B. Environmental Limitations: Do not install decomposed granite or crushed 3/8" or 1/4" minus aggregate paving during rainy conditions or below 40 degrees Fahrenheit and falling.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer to provide evidence to indicate successful experience in providing stabilized decomposed granite or crusher fines 3/8" minus or 1/4" minus aggregate paving.

1.5 FIELD MOCK-UP

- A. Construct at earliest possible time and at approved location before proceeding with the work.

1. Prepare one (1) 10 feet by width of path, paving mock-up, complete with base coarse-if required, edging, and compacted as specified. Include adjustments, approved by the Owner's Representative from reviews of the mock-up process. Coordinate work with conditions and material placement of other work and adjacent conditions.
2. The Mock-up shall be reviewed and approved by the Owner's Representative prior to proceeding with the work. When necessary, remove and reconstruct the field sample until approved. Approved mock-up shall serve as the standard of acceptance for the paving work.
3. The approved mock-up may be incorporated into the final work. Demolish and remove non-approved mock-ups.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Bulk Material: Comply with Section 01600 for delivery and storage requirements.
- B. Do not expose materials to excessive moisture or other conditions that would adversely affect their serviceability.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the installer agreeing to repair or replace components of stabilized surfacing that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 1. Premature wear and tear provided the material is maintained in accordance with manufacturer's written maintenance instructions.
 2. Failure of system to meet performance requirements.
- C. Warranty Period: Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.
- D. Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pre blended decomposed granite and binder for crushed stone surfaces provided by the following Supplier:
- Decorative Stone Solutions, Inc.
197 Woodland Pkwy, STE 104 #813, San Marcos, CA 92069
Phone: 1(800) 699-1878
www.decorativestonesolutions.com
email: info@decorativestonesolutions.com

2.2 MATERIALS

- A. Binder: Organic, non-toxic, non-staining, odorless, environmentally safe powder which binds decomposed granite, crusher fines 3/8" minus or 1/4" minus aggregate.
- B. Decomposed Granite: Crushed aggregate fines color shall be California Gold and Baja Cresta Gray as supplied by Decorative Stone Solutions, Inc. Material shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation recommendations shall be as follows unless otherwise specified.

U.S. Sieve No.	Percent Passing by Weight
# 1/2"	95 – 100
# 3/8"	90 – 100
# 4	65 – 80
# 8	48 – 63
# 16	40 – 49
# 30	30 – 40
# 50	20 – 27
# 100	10 – 18
# 200	10 – 12

- C. Sand: Equivalent shall be in the range of 35-55. The R-value shall be a minimum of 71. ASTM testing shall be used for the sand equivalent and R-value determination.
- D. Decomposed Granite and Binder Compound: Decomposed Granite or 3/8" minus or 1/4" minus crushed aggregate screenings will be supplied to Contractor from a single source in a preblended ratio of 12 lbs of soil binding agent per 1-ton of Decomposed Granite.
- E. Water, clean potable.

- F. Imported Base Material if required: Class 2 base Crushed aggregate base consisting entirely of crushed rock and rock dust, uniformly graded and conforming to the requirements of Standard Specifications Section 200-2.2.
- G. Other Materials: Specify

2.3 EXCESS MATERIALS

- A. Provide owner's authorized rep. With the following excess materials for use in future decomposed granite or 3/8" minus or 1/4" minus crushed aggregate paving repair: 40 to 50 lb. bags of the aggregate paving blended with proper amount of binder.

2.2 HEADER AND EDGING MATERIALS

- A. Specify *[Suitable materials include: Pressure treated lumber, secured masonry/stone units "block, brick, ledgerstones, and cobbles", as well as various landscape edgings capable of withstanding lateral forces of compaction]*

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Areas receiving paving materials shall be examined for correct and complete base preparation, compaction, grade, pitch, and drainage installation. To prevent path erosion in slope condition, path shall have drainage channel on upside of slope, so that runoff shall not cross path, to allow sufficient drainage runoff.
- B. Prepared subgrade shall be proof rolled to check for unstable conditions and areas requiring additional compaction. The subgrade shall be compacted to a minimum 95% dry density. A compaction test shall be taken at questionable areas identified by the Owner's Representative. ***If native soil will not sufficiently compact, import Class 2 aggregate base to be wet.***
- C. Report unsatisfactory conditions to the Owner's Representative. Do not begin paving work until unsatisfactory conditions have been corrected and is ready to receive paving. Proceeding with the installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.
- D. Herbicide Treatment: Pre-emergence herbicide shall be recommended and applied by a licensed pest control service. Apply herbicide in strict compliance with manufacturer's recommended instructions, and local and state regulations. Apply to compacted, dry, subgrade prior to application of aggregate base course. Do not use weed control chemicals that may stain decomposed granite or surrounding surfaces.

3.2 PREPARATION

- A. Pre-soak base material with water prior to installing stabilized Aggregate Paving material.

- B. Install the specified header or edging material on peripheral edges of area to be paved not already adjacent to a solid surface.

3.3 PLACEMENT

- A. Place the stabilized D.G. on the prepared sub grade, and rake smooth to desired grade and cross section. Place material to sufficient depth to allow approximately ¼” of compaction for every 2” of loose D.G.
- B. Depth of pathways – 3” for heavy foot traffic and light vehicles.

3.4 WATERING

- A. Areas shall be thoroughly watered as to achieve moisture penetration to the full depth of the paving material. Water is the activation mechanism for binding agent. During water application test water penetration depths with a probing device. Take care to not underwater, it is not possible to over-water this product, it will however extend the set up time before compaction can take place.

3.5 COMPACTION

- A. Upon thorough moisture penetrations do not begin compaction for at least 6 hours and up to 48 hours after placement or until such time that the paving material is able to accept 85% relative compaction from a 1 to 5 ton roller/compactor without separation, plowing or any other physical compromise of the paving material. Compact the material with compactor as specified above making 3 to 4 passes. Avoid a vibratory plate compactor when possible, however tight spaces may mandate the use of a small handheld unit.
- B. Take care in compacting decomposed granite or crushed 3/8” or ¼” minus aggregate screenings when adjacent to planting and irrigation systems. Hand tamping with 8” or 10” hand tamp recommended.
- C. Header and Edging Tolerances to Path:
 - 1. Elevation: 1/4 inch.
 - 2. Surface Gap: Minus 1/4 inch.

3.6 INSPECTION

- A. Finished surface of entire pathway shall be smooth, uniform and solid, free of ruts, dips and roller marks with surface of path crowned to allow sufficient water run-off due to irrigation, weather or undue water application. There shall be no evidence of chipping or cracking. Cured and compacted pathway shall be firm throughout profile with no

spongy areas. Loose material shall not be present on the surface. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.

- B. At the end of the day, the installation shall terminate at a paving edge or other transition. No material shall be deposited on paving which has hardened sufficiently to cause the formation of seams, planes, weakness within the section, or visible lines in the finished surface.
- C. Protect the entire area from foot or vehicular traffic until fully dried. Protect the area from contamination or damage by other work in progress.

3.7 MAINTENANCE

- A. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed.
- B. During the first year, a minor amount of loose aggregate will appear on the paving surface. If this material exceeds a 1/4", redistribute the material over the entire surface. Water thoroughly to the depth of 1". Compact with power roller of no less than 1000 lbs. Repeat process as needed.
- C. If cracking occurs, simply sweep fines into the cracks, water thoroughly and hand tamp with an 8" – 10" hand tamp plate.

3.8 REPAIRS

- A. Excavate damaged area to the depth of the stabilized aggregate and square off sidewalls.
- B. If area is dry, moisten damaged portion lightly.
- C. Pre-bend the dry required amount of soil binding agent with the proper amount of aggregate in a concrete mixer.
- D. Add water to the blended mix. Thoroughly moisten mix with 25 to 45 gallons per 1-ton of pre-blended material or to approximately 10% moisture content.
- E. Apply moistened pre-blended aggregate to excavated area to finish grade.
- F. Compact with an 8" to 10" hand tamp or 250 to 300 pound roller. Keep traffic off areas for 12 to 48 hours after repair has been completed.

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. Exterior athletic court markings.
3. Playground markings.
4. Fire lane "No Parking."
5. 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
Athletic Court Lines:	2 inches	*White
Letters and numbers:		As indicated

*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.

END OF SECTION

SECTION 32 1726

DETECTABLE WARNING SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Precast concrete detectable warning tile pavers installed on mortar bed over concrete slab.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2200 – Grading.
3. Section 31 2316 - Excavation and Fill for Pavement.
4. Section 31 2326 - Base Course.
5. Section 32 1216 - Asphalt Paving.
6. Section 32 1313 – Site Concrete.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A1046- Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C67 – Standard Methods of Sampling and Testing Brick and Structural Clay Tile.
4. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C920 – Standard Specifications for Elastomeric Joint Sealants.
8. ASTM C936 - Standard Specification for Solid Concrete Interlocking Paving Units.

- B. The Masonry Society (TMS); American Concrete Institute (ACI), and American Society of Civil Engineers (ASCE):
 - 1. TMS 602 / ACI 530.1 / ASCE 6 - Specifications for Masonry Structures.
- C. Tile Council of North America (TCNA):
 - 1. TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.
 - a. TCNA F101 - Mortar Installation.
 - b. TCNA EJ171 - Movement Joints.
- D. American National Institute Standards (ANSI):
 - 1. ANSI A118.4 - Specifications for Modified Dry-Set Cement Mortar.
 - 2. ANSI A118.7 – Specifications for High Performance Cement Grouts for Tile Installation.

1.03 REGULATORY REQUIREMENTS

- A. Detectable warning surfacing shall conform to:
 - 1. Title 28 Code of Federal Regulations, Part 36, Subpart D: 2010 ADA Standards for Accessible Design, 2010 Standards for Public Accommodations and Commercial Facilities: Title III.
 - 2. CBC Section 11B-705, Detectable Warnings and Detectable Directional Texture.
- B. Installed detectable warning pavers shall provide consistent side to side and end to end spacing that complies with the regulatory requirements.

1.04 PROJECT CONDITIONS

- A. Weather Limitations for Mortar and Grout:
 - 1. Cold Weather Requirements: The cold weather construction provisions of TMS 602 / ACI 530.1 / ASCE 6 shall be implemented when the ambient temperature falls below 40F°.
 - 2. Hot Weather Requirements: The hot weather construction provisions of TMS 602 / ACI 530.1 / ASCE 6 shall be implemented when the ambient temperature exceeds 100° F or 90° F with a wind velocity greater than 8 mph.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Products covered under this Section shall be produced by a single manufacturer, unless otherwise specified, with a minimum of five years proven production experience.

- B. Installer Qualifications: Installer shall have a minimum of three years proven construction experience with the work specified in this Section.
- C. Pre-Installation Conference: CONTRACTOR shall coordinate and conduct pre-installation conference in conformance to Section 01 31 19 Project Meetings.
- D. Field applied primers, paintings, sealers, adhesives and cleaners shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).

1.06 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including installation instructions maintenance recommendations.
- B. Shop Drawings: Submit layout drawings showing pattern of detectable warning pavers and provide details at curbs and adjacent construction. Indicate pavers requiring cutting.
- C. Material Test Reports: Submit current test reports from an independent testing laboratory indicating that materials used comply with the specification requirements and the proposed products meet the properties specified.
- D. Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns. Color will be selected by ARCHITECT.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Protect detectable warning pavers during shipment, storage and construction against damage. Store a minimum of 4 inches off the ground on pallets in a dry location and cover with polyethylene to protect from contact with materials which would cause staining or discoloration.

1.08 WARRANTY

- A. Detectable Warning Pavers shall remain free from defects for a period of five years.
- B. CONTRACTOR shall warrant that his work will remain free from defects of labor and materials used in conjunction with his work for three years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Hanover Architectural Products.
- B. StepStone, Inc.
- C. Tile Tech Pavers Inc.

D. Wausau Tile Co.

E. Equal.

2.02 MATERIALS

A. Detectable Warning Paver Materials:

1. Portland Cement: In conformance with ASTM C150.
2. Aggregates: In conformance with ASTM C33, cleaned and properly graded to size. Aggregates shall be a blend from 200 mesh to 5/8 inch.
3. Coloring: Pigments used shall be inorganic, resistant to alkalinity and used per manufacturer's recommendations.
4. Color Blending: Factory-blend pre-cast paver that has a natural color range so products taken from one batch will have the same range as products from a separate batch.
5. Cleaner: Liquid neutral chemical cleaner with pH factor between 7 and 8, of formulation recommended by sealer manufacturer and approved by OWNER's OEHS.
6. Sealer: Colorless, slip and stain resistant penetrating or acrylic sealer with pH factor between 7 and 10 that does not affect color or physical properties of precast paver surface. Sealer shall be approved by OWNER's OEHS.

B. Setting Bed, Mortar and Miscellaneous Materials:

1. Setting Bed:
 - a. Portland Cement: In conformance to ASTM C150.
 - b. Aggregate: Sand in conformance to ASTM C144. Sand shall be clean, graded and pass a 16 mesh screen.
 - c. Reinforcing Mesh: In conformance to ASTM A1046. 2 inches X 2 inches 16/16.
2. Mortar: In conformance to ANSI A118.4.
3. Grout: In conformance to ANSI 118.7. Grout colors: selected by the ARCHITECT from the manufacturer's complete color range.
4. Water: Potable and free from deleterious substances.
5. Mortar and Grout Mixes: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their

initial set before being used.

6. Primer: As recommended by the mortar material manufacturer and approved by OWNERS's OEHS.
7. Sealant and backing materials: In conformance to ASTM C920, Type T, joints subject to pedestrian and vehicular traffic and approved by OWNERS's OEHS.

2.03 DETECTABLE WARNING PAVER FABRICATION

- A. Detectable Warning Pavers: Factory precast concrete pavers with raised truncated domes conforming to CBC Section 11B-705.
 1. Dome Size: Base diameter of 0.90 inch minimum and 0.92 inch maximum, a top diameter of 0.45 inch minimum and 0.47 inch maximum and a height of 0.20 inch.
 2. Dome Spacing: Truncated domes in a detectable warning surface shall have a center-to-center spacing of 2.3 inches minimum and 2.4 inches maximum, and a base-to-base spacing of 0.65 inch minimum, measured between the most adjacent domes on a square rigid.
 3. Color: In conformance to CBC section 11B-705.1.1.3.
 4. Contrast: Detectable warning materials shall provide a 70 percent minimum visual contrast with adjacent walking surfaces.
 5. Resiliency: Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact.
- B. Physical Properties:
 1. Size: Nominal 12 inches x12 inches.
 2. Thickness: Nominal 2 inches.
 3. Sizing Dimensions: Shall not differ by more than 1/16 inch from width, height, length or thickness. Unit shall conform to a true plane and not differ by more than 1/16 inch in either concave and/or convex warpage.
 4. Compressive Strength: Shall not be less than 8,000 psi per ASTM C140.
 5. Water Absorption: Shall not be greater than 6% per ASTM C936 or ASTM C140.
 6. Freeze/Thaw: Durability of the paver shall meet the freeze/thaw tests per Section 8 of ASTM C67 and shall have no breakage and not greater than 1 % loss in dry weight of any individual unit when subject to 50 cycles of freeze/thaw.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine concrete base and verify no sealers, curing compounds or other coatings have been applied. If present remove in accordance to paver manufacturer.
- B. Concrete base shall have a fine broom finish or wood float finish. If not provided scarify mechanically as recommended by paver manufacturer.
- C. Remove debris and loose particles and sweep concrete surfaces.

1.02 SETTING BED

- A. Installation of mortar bed shall conform to TCA F101.
- B. Install red wood float strips so that a straight edge can reach the maximum edges of the intended mortar bed. Verify top of float strips are at the correct elevation to allow a flush installation of the detectable warning pavers with the adjacent surfaces.
- C. Moisten concrete base and float strips.
- D. Apply a thin, continuous coat of pure Portland cement slurry on the concrete surface or dust a thin layer of dry Portland cement on the concrete and wet it. Broom to completely coat the concrete surface with a thin and uniform coating.
- E. Place welded wire fabric on chairs or spacers or small mounds of mortar to hold the reinforcement at the center of the setting bed. Welded wire fabric shall overlap a minimum of one mesh.
- F. Mix and apply mortar setting bed material in accordance with the manufacturer's instructions to a thickness of 1-1/4 inches. Trowel mortar between the float strips compacting the mortar as much as possible.
- G. Using the float strips as the guide cut off the excess mortar placing the excess further down the area to be floated.
- H. While the mortar bed is still plastic or has not cured remove the float strips and fill the grooves with fresh mortar.

1.03 PAVER INSTALLATION

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- C. Lay pavers in pattern on mortar bed as indicated on the Drawings.

- D. Apply mortar using the flat side of the trowel first. Move notched side of trowel in a parallel pattern allowing for air to escape. Apply bond coat over the entire setting surface including grout joints. "Back-butter" pavers with 1/8 inch thick mortar for full mortar to mortar contact.
- E. Position paver on mortar bond coat using a slight back and forth motion. "Squeeze up" mortar minimum 1/8 inch in grout joints along tile edges and corners eliminating air voids.
- F. Level pavers using a straight edge or taught string.
- G. Placement Tolerances:
 - 1. Maximum of 1/16 inch height variation between adjacent pavers.
 - 2. Individual pavers shall not vary more than 1/16 inch from level across width of the paver.
 - 3. Paved areas shall not vary more than 1/4 inch from level in a distance of ten feet measured at any location and in any direction.
 - 4. The surface elevation of pavers shall be 1/8 inch to 1/4 inch above adjacent drainage inlets.

3.04 EXPANSION AND CONTROL JOINTS

- A. Locate expansion and control joints as indicated on the Drawings and where pavers are in contact with dissimilar materials such as curbs, concrete pavement and walls.
- B. Joints shall be uniform, straight of **[3/16 inch] [1/8 inch]** wide.
- C. Install in accordance with TCA Detail EJ171,
- D. Carry joint completely through the assembly to surface.
- E. Keep joints clear of mortar setting materials and grout.
- F. Apply backer materials and sealant in joints following manufacturer's instructions.

3.05 GROUTING

- A. Follow grout manufacturer's instructions.
- B. Dampen grout joints prior to grout insertion.
- C. Install grout using a grout bag or a tuck pointer. Tool the joint with a round tool ("spoon") or brick jointer.
- D. Allow excess grout to set up briefly until it can be swept off using a stiff brush or broom.

- E. For final cleaning use cheesecloth, clean damp sponge or when necessary, steel wool. Do not use any acidic cleaners to remove excess grout or grout haze.
- F. Remove, scrub and wash clean mortar stains and all other types of soiling from exposed paver surfaces.
- G. Apply sealer in accordance with manufacturer's directions.

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 32 18 16

PLAYGROUND GRASS RESILIENT SURFACING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of this contract, including general and supplementary conditions and other division 1 specification sections apply to this section.

1.2 DESCRIPTION OF WORK

- A. Playground Grass resilient surface systems for surfaces under and around playground equipment including but not limited to the furnishing and installing of an artificial grass safety surface over a compacted base. Finished products shall be seamed to provide a resilient, continuous surface over the entirety of the project surface. Work includes all labor, materials, tools, equipment, and applicable taxes to perform all work and services for the installation of the surface.

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials and methods of construction shall comply with the latest provisions of the following standards:
 - I. ASTM F 1292-04: “Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment”.
 - II. ASTM D2859: “Flammability Standard”.
 - III. ASTM F1951-99: “Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.”
 - IV. ANSI/ESD STM97.2-2016: “Standard for the Protection of Electrostatic Discharge Susceptible Items: Footwear/Flooring System-Voltage Measurement in Combination with a Person”

1.4 SUBMITTALS

No alternate product must be submitted without prior approval packages a minimum of ten (10) days prior to bid date. Submittal packages shall include but not be limited to:

- A. Laboratory Test Reports: Materials certificates certifying each material item complies with, or exceeds, specified requirements. Certificates of compliance must be signed by materials producer and contractor.
- B. Product Verification: Delivery slip for each material shipment, including turf and infill material.
- C. Warranties: Product and maintenance warranties must be provided to owner prior to installation.
- D. Field test inspection reports and samples for material including Impact Attenuation, Permeability, Flammability, and Electrostatic Discharge.
- E. Playground Grass Surface Installer Qualifications: A list of ten (10) playground surfacing projects completed with a similar product within the last five (5) years. List shall include names of project representatives and respective telephone numbers. This list shall also contain projects which require the same level of difficulty, e.g., number of poles and cutouts, transitions, and other special requirements. These ten (10) projects shall have been contracted and installed by the company bidding the job.

F. Product Substitution Submittals: Contractor shall provide the following material for playground grass material substitution.

- I. At least one project in excess of 5,000 square feet and completed in the two (2) years.
- II. Two 1'x1' product samples.
- III. Product warranty and guarantee from manufacturer warranting against all defects for a fifteen (15) year period.
- IV. A written guarantee from manufacturer for workmanship.
- V. Impact attenuation (per fall height requirements), permeability, and flammability test results from independent approved and certified testing laboratories.
- VI. The artificial grass installer/contractor will provide a maintenance procedure for the installed surface.
- VII. Electrostatic testing by a third party consultant or laboratory.

1.5 TESTING OF MATERIALS

A. The following are test results from an independent testing laboratory which must also be submitted:

- I. Impact Attenuation: ASTM 1292-04: Impact attenuation test results will be provided. These test results shall be certified and submitted on the letterhead of an independent testing lab. Impact attenuation test results shall meet or exceed Consumer Product Safety Commission

Guidelines for impact attenuation (G-max and Head Injury Criterion "H.I.C."). Test results must be administered and evaluated under the same test and these results must be shown for three drops at each required temperature: 32°, 72°, 120°; yield less than 200 G's and less than 1,000 H.I.C. Only test results from ASTM testing approved laboratories, F8 committee will be acceptable. Approved testing laboratories are TSI and Detroit Testing.

- II. Permeability: Product shall meet or exceed a coefficient of permeability of 30" per hour.

NOTE: From a geotechnical standpoint, the permeability of a material is a measure of the velocity at which water will flow through the void spaces or pores under a given hydraulic gradient. The product shall handle a minimum of 20" of rainfall per hour.

- III. Flammability (PILL test)

NOTE: To assure compliance with a, b, and c installation shall be provided by an approved installer, who has at least five successful installs.

- IV. Electrostatic Discharge: Product must have ANSI/ESD STM97.2 Electrostatic testing indicating that it is 1,000 volts below the 2,000-volt limit for commercial applications with a wide variety of footwear.

1.6 WORKMANSHIP AND QUALITY ASSURANCE

A. The artificial grass is to be installed per manufacturer's specifications.

B. All artificial grass and components shall be provided by a single source.

1.7 DELIVERY AND STORAGE OF MATERIALS

A. Artificial grass will be delivered in rolls 15' wide, wrapped in plastic. SafetyFoam Pro™ will be delivered on pallets in a separate shipment.

B. Products will be stored out of sight (as much as possible) and secured to prevent tampering.

1.8 GUARANTEE/WARRANTY OF THE MATERIAL AND WORKMANSHIP

- A. The artificial grass installed under this contract will be warranted for a period of fifteen (15) years for materials and workmanship and covers the surface for wear through, deterioration and excessive fading/ UV degradation. Vandalism and force majeure will not be covered. Written warranty must be submitted by the installer.
- B. When defective material or workmanship is discovered which will require repair or replacement, all such repair work or replacement work shall be done by the contractor at its own expense after written notification is given of such required repairs. However, if the contractor fails to comply with the requirements of the above guarantee within reasonable time after notification is given, the repairs will be made by others at the contractor's expense.
 - I. Any unsafe conditions that arise shall be secured and maintained by the installer until all required repairs or replacements have been completed.
 - II. All resurfacing will conform in kind and quality to the specifications set forth in the plans and specifications and will be free of defects in workmanship and material.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF SYSTEM

Resilient safety surface shall be Playground Grass Ultra as manufactured by ForeverLawn Inc. Resilient safety surface shall meet all of the following requirements independently and collectively:

- A. Blades: Primary blades are a slit film polyethylene with anti-microbial agent AlphaSan® integrated into the primary yarn. A patented anti-static technology must also be integrated into the construction so as to not allow static charge build-up. Secondary blade is a heat textured nylon monofilament. Tufting construction requires dual primaries in the same row.
- B. Weight: The product face weight will be 48 ounces. With backing, the total weight of the product will be 98 ounces.
- C. Tufting: The tufting gauge will be 3/8", pile height 1 5/8". Tufting configuration – dual yarn same row set up.
- D. Backing: The backing shall be a multi-layered, three parts.
 - I. First single layer (stabilized primary consisting of polyester, fiberglass, and polyurethane. It is 18 pic construction and 6 ounces.
 - II. Second layer is a minimum 40 ounce urethane layer.
 - III. Third layer is nonwoven, recycled, geotextile fleece.
- E. Seams: Primary seaming system shall be a micromechanical seam, utilizing hook and loop technology.
- F. Resilient subsurface padding: SafetyFoam Pad which is a closed cell expanded polypropylene panel.
- G. Infill: Rubber options include 0.75-1 lbs. of 10/20 or 14/20 crumb rubber granules per square foot. Sand options include 5 lbs. of 12/20 silica sand, Envirofill®, or T°Cool® per square foot.

PART 3 - EXECUTION

3.1 BASE REQUIREMENTS

- A. The base shall be angular "down to dust" 3/4" stone, leveled and compacted at a depth of 3" to 4".

3.2 PREPARATION

- A. The perimeter of the area shall be defined with a plastic nailer board, unless an acceptable surface for anchoring the turf currently exists. These nailer boards will be secured into concrete or blacktop, or held in place with rebar spikes.
- B. Cleaning: The entire surface shall be clean and free from any foreign and loose material.

3.3 INSTALLATION

- A. SafetyFoam Pro resilient subsurface padding will be laid out in 2'x4' interlocking panels over the base.
- B. Artificial Turf: The turf will be rolled out in sections, cut around the poles, and seamed together using the micromechanical seaming system as the primary bond.
- C. Securing: The turf will be secured around the perimeter. If using nailer boards, 1" staples will be used to secure the turf to the boards. Staples will be placed every 3". (See edge details).

END OF SECTION

Poured-in-Place Playground Surfacing

Section 32 18 16

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: SpectraPour Poured-in-Place Playground Surfacing System.
- B. Related Sections: Sitework Sections: Materials and Methods, Excavation, Asphalt Paving, Concrete Paving, Sub-Drainage, Storm Drainage, Fencing, Playground Equipment and Structures.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - A. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
 - B. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - C. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - D. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
 - E. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
 - F. ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.
 - G. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide a 2 layer rubber-urethane playground surfacing system which has been designed, manufactured and installed to meet the following criteria:

A. Shock Attenuation (ASTM F1292):

a. Gmax: Less than 200.

b. Head Injury Criteria: Less than 1000.

B. Flammability (ASTM D2859): Pass.

C. Tensile Strength (ASTM D412): 60 psi (413 kPa).

D. Tear Resistance (ASTM D624): 140%.

E. Water Permeability: 0.4 gal/yd²/second.

F. Accessibility: Comply with requirements of ASTM F1951.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product data and installation instructions.

C. Verification Samples: Submit manufacturer's standard verification samples of 6" x 6" minimum.

D. Quality Assurance/Control Submittals: Submit the following:

a. Certificate of qualifications of the playground surfacing installer.

E. Closeout Submittals: Submit the following:

a. Warranty documents specified herein.

1.05 QUALITY ASSURANCE

- A. Qualifications: Installer must be a direct employee of the manufacturer's installation division, having 5 years' experience with other projects of the scope and scale of the work described in this section. Certified subcontracted installation not acceptable.
- B. International Play Equipment Manufacturers Association (IPEMA) certified.
- C. Comply with ASTM F1292 and F1951 Standards.

1.06 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.07 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F and maximum ambient temperature is 105 degrees F.
- F. Exception to the temperature requirements can be made by the manufacturer of the surfacing system. Do not install in steady or heavy rain. Exceptions can be made for enclosed or tented areas.

1.08 WARRANTY

- A. Project Warranty: Standard manufacturer warranty period is 5 years from date of completion of work.
- B. Compaction and proper drainage are critical to the longevity of the SpectraPour Poured-in-Place surfacing system. Compaction and inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty. Acceptable subbase materials are concrete, asphalt, or class 2 aggregate.

PART 2 PRODUCTS

2.01 SPECTRAPOUR PLAYGROUND SURFACING SYSTEM

A. Manufacturer: SpectraTurf

1. Contact: 555 South Promenade Avenue, #103, Corona, CA 92879;
Telephone: (800) 875-5788; Fax: (951) 734-3630;
E-mail: info@spectraturf.com website: <http://www.spectraturf.com>.

B. Proprietary Products/Systems.

SpectraPour Poured-in-place playground surfacing system, including the following:

1. SpectraPour Poured-In-Place Primer:

a. Material: Urethane.

2. SpectraPour Poured-in-Place Basemat:

a. Material consists of US manufactured recycled SBR, pre-consumer or post-industrial non-tire polyurethane products, or reclaimed playground safety surfacing.

b. Basemat Thickness: [1 1/2"] [2"] [2 1/2"] [3"] [4"] [4 1/2"]

3. SpectraPour Poured-In-Place Top Surface:

a. Material: Blend of US manufactured recycled EPDM (ethylene propylene diene monomer) rubber and Aliphatic (UV_stabilized) urethane binder. Certificate of origin required.

b. Top Surface Thickness: minimum 1/2".

c. Color:

Standard Colors: Inferno Red; Shamrock Green; Cobalt Blue; **Sky Blue**;
Sandstone Beige; Pewter Gray; Jet Black

Premium Colors: **Ash Gray**; Charcoal Gray; **Lime Green**; Ivy Green;
Agave Teal; **Aquamarine**; Sapphire Blue; **Cherry Red**; Scarlett Red;
Raspberry Pink; **Lilac Purple**; **Plum Purple**; **Canary Yellow**; Honey Gold;
Citrus Orange; Chestnut Brown; **Pampus Ivory**; **Eggshell**

Aliphatic urethane is recommended for the lighter or brighter colors **notated in bold lettering**.

d. Dry Static Coefficient of Friction (ASTM D2047): 1.0.

e. Wet Static Coefficient of Friction (ASTM D2047): 0.9.

f. Dry Skid Resistance (ASTM E303): 89.

g. Wet Skid Resistance (ASTM E303): 57.

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

2.03 MIXES

A. Required mix proportions by weight:

1. Basemat: 14 - 16+% urethane (as ratio: 14% urethane divided by 86% rubber). 14% urethane, 86% rubber (based on entire rubber & urethane mix).
2. Top Surface: 20 - 22% urethane (ratio: 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions, details, and recommendations of the attenuating playground surfacing manufacturer.

3.02 EXAMINATION

A. Substrate preparation must be in accordance with surfacing manufacturer's specification. New asphalt must be fully cured – up to 30 days. New concrete varies 1-5 days weather dependent.

B. Compaction and proper drainage are critical to the longevity of the SpectraPour Poured-in-Place surfacing system. Compaction and inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty. Acceptable subbase materials are concrete, asphalt, or class 2 aggregate.

3.03 PREPARATION

A. Surface Preparation: Using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers such as playground equipment posts, curbs, or anchor that will contact the surfacing system.

3.04 INSTALLATION

A. Do not proceed with playground surfacing installation until all applicable site work, including substrate preparation, fencing, playground equipment installation and other relevant work, has been completed.

B. Basemat Installation:

1. Using screeds and hand trowels, install the basemat at a consistent uniform thickness for required fall height.
2. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
3. Do not allow foot traffic or use of the basemat surface until it is

sufficiently cured.

C. Primer Application: Using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers such as playground equipment posts, curbs, or anchor that will contact the surfacing system.

D. Top Surface Installation:

1. Using a hand trowel, install top surface at a consistent uniform minimum thickness of 1/2".
2. Allow top surface to cure for a minimum of 72 hours for aliphatic resin.
3. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
4. Do not allow foot traffic or use of the surface until it is sufficiently cured.

3.05 PROTECTION

A. Protection of the work is excluded. The installation crew will protect its work only while on site working. The Owner or Contractor is responsible for protection after the crew leaves each day and after the crew leaves the site at substantial completion of their work.

SECTION 32 3113
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Chain link fences, gates and fabrications as indicated.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 3000_ - Cast-in-Place Concrete.
3. Section 11 6813 – Playfield Equipment Primary Centers and Elementary Schools.
4. Section 11 6816 - Playfield Equipment Middle and High Schools.
5. Section 31 1000 – Site Clearing.
6. Section 31 2200 - Grading.
7. Section 31 2316 - Excavation and Fill for Paving.
8. Section 32 0117 - Pavement Repair.

1.02 SUBMITTALS

- A. Shop Drawings: Submit dimensioned plans and details indicating extent of fences, locations of gates, and details of attachment and footings. Indicate means and methods for surface preparation and finishing.
- B. Certifications: Manufacturers material certifications in compliance with the ASTM standards referenced in this Section.

1.03 REFERENCES

A. ASTM International:

1. ASTM A36 – Standard Specification for Carbon Structural Steel.
2. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.

3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
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, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
7. ASTM A392: Standard Specification for Zinc-Coated Steel Chain Link Fence Fabric.
8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
10. ASTM A824 – Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence.
11. ASTM F552 - Standard Terminology Relating to Chain Link Fencing.
12. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
13. ASTM F567: Standard Practice for Installation of Chain Link Fence.
14. ASTM F626 - Standard Specification for Fence Fittings.
15. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric.
16. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
17. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
18. ASTM F1083: Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
19. ASTM F1184: Standard Specification for Industrial and Commercial Horizontal Slide Gates.
20. ASTM F1664 – Standard Specification for Poly Vinyl Chloride (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence.

21. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction.

B. Underwriters Laboratories (UL):

1. UL 325 - UL Standard for Safety Door, Drapery, Gate, Louver, and Window Operators and Systems.

C. American Welding Society (AWS):

1. AWS D1.1 Structural Welding Code - Steel.
2. AWS D1.3 Structural Welding Code - Sheet Steel.
3. AWS D-19.0 Welding Zinc Coated Steel.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specialized in manufacturing chain link fence products with at least five years of experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products in accordance with ASTM F567 and with at least five year experience.

PART 2 – PRODUCTS

2.01 CHAIN LINK FABRIC

- A. Galvanized Chain Link Fabric: Conforming to ASTM A392, Class 2 zinc coating, 2.00 ounces minimum per square foot of uncoated wire surface, hot-dipped galvanized after weaving, and with top and bottom edges knuckled (kk). Tie wires and hog rings shall conform to ASTM F626, and shall be 9 gage and galvanized.
- B. Polymer Coated Chain Link Fabric: Galvanized fabric material, tie wires and hog rings shall be as specified on above paragraph, with polymer coating conforming to ASTM F668, Class 2b, fused and adhered. Color shall be in compliance with ASTM F934.
- C. Chain Link Fabric Requirements:
 1. Fabric for perimeter fencing and interior fencing shall be 9 gage woven wire with 2 inch mesh, unless otherwise specified.
 2. For perimeter fences 16 feet high, the upper 8 feet of fabric may be 11 gage.
 3. Fences 12 feet high or less shall be furnished with single width fabric.

4. Fabric for fencing on top of handball court shall be 9 gage wire minimum with 1 inch mesh.
5. Fabric for fencing of tennis courts shall be full height, single width, 9 gage by 1-3/4 inches mesh chain link fabric.
6. Installed fence fabric shall be free from barbs, icicles, or other projections. Fence fabric with such defects will be deemed defective Work.

2.02 STEEL FENCE FRAMEWORK

- A. Posts, Top Rails, Brace Rails and Gate Frames: Standard weight, schedule 40, hot dip galvanized, welded steel pipe conforming to ASTM F1083, Group IA Heavy Industrial Fence Framework, with a minimum yield strength of 30,000 psi. Minimum 1.8 Oz/ft² hot dipped zinc coating average for interior and exterior.
- B. Miscellaneous Metals:
 1. Structural Steel Shapes: ASTM A36.
 2. Steel Pipe: ASTM A53 Type E or S, Grade B, standard weight (Schedule 40), unless otherwise noted. Use black finish where hot dip galvanizing after fabrication is indicated.
 3. Square and Rectangular HSS: ASTM A500 Grade B or C.
 4. Steel Bolts: ASTM A307, Grade A, or F3125 with hex steel nuts per ASTM A563 and washers. Galvanized in accordance with ASTM A153.
- C. Polymer Coated Framework: PVC coating fused and adhered to the exterior zinc coating of the post or rail. PVC coating shall have a minimum thickness of 10 mils per ASTM F1043. Color shall be per ASTM F934 and shall match fabric.
- D. Schedule of Posts, Rails, Bracings and Footings: Unless indicated otherwise on the drawings, shall be of sizes indicated on the following schedule.

Item	Height	Nominal Pipe Size (inches)	Outside Diameter (inches)	Weight (pounds per foot)	Footings	
					Diameter (inches)	Depth (inches)
Top Rail, Brace Rails and Transom Rails	Up to 10'-0"	1-1/4	1.660	2.27	N/A	N/A
	10'-1" to 16'-0"	1-1/2	1.900	2.72	N/A	N/A
Line Posts	Up to 6'-0"	2	2.375	3.65	12	24
	6'-1" to 8'-0"	2	2.375	3.65	12	36
	8'-1" to 10'-0"	2-1/2	2.875	5.80	12	36

Item	Height	Nominal Pipe Size (inches)	Outside Diameter (inches)	Weight (pounds per foot)	Footings	
					Diameter (inches)	Depth (inches)
	10'-0" to 16'-0"	3	3.5	7.58	14	60
	14'-0" to 16'-0"	3-1/2	4.000	9.12	14	60
Terminal, Corner, Angle & Pull Posts	Up to 8'-0"	2-1/2	2.875	5.79	12	36
	8'-0" to 10'-0"	2-1/2	2.875	5.79	14	42
	10'-1" to 16'-0"	3	3.5	7.58	14	60
Pedestrian Gate Posts	Up to 8'-0"	2-1/2	2.875	5.79	14	36
Gate Frames	Up to 8'-0"	1-1/2	1.900	2.72	N/A	N/A
Driveway Double-Leaf Swing Gate Posts: Opening						
Up to 17'-3-1/2"	Up to 8'-0"	3 1/2	4	9.11	16	42
17'-4" to 20'-3-1/2"	Up to 8'-0"	3-1/2	4	9.11	16	42

2.03 FITTINGS

- A. Fittings shall be malleable iron conforming to ASTM A47 or ASTM F626.
- B. Post Caps: Designed to fit snugly over posts with a minimum projection of 1-1/2 inches below top of posts. Post caps shall be manufactured with a curved top.
- C. Eye Tops: Designed to fit over line posts, and for through passage of top rail.
- D. Expansion Sleeve Couplings for Top Rails: Steel, 6 inches long, designed to fit tightly on inside of rail, fitted with raised center.
- E. Rail Ends for Top Rails and Brace Rails: With holes to receive 3/8 inch bolts for securing to rail end bands.
- F. Tension Bands and Bands for Securing Rail Ends: Mild steel flats, at least 11 gage x one inch, tension bands in gates shall be 11 gage by 1 inch. Bolts for use with tension bands and rail end bands shall be galvanized machined 3/8 inch by 1 1/2-inch.
- G. Tension Bars: Mild steel flats at least 3/16 inch by 3/4 inch.
- H. Polymer Coated Fittings: In conformance with ASTM F626. Polymer coating minimum thickness 0.006 inch, fused and adhered.

2.04 TENSION WIRE

- A. 6 gage marcelled steel wire conforming to ASTM A824, Type II Class 5 zinc coated, 2.00 ounces minimum per square foot of uncoated wire surface. Wavy type wire is not acceptable.
- B. Polymer Coated: Galvanized tension wire shall be as specified on above paragraph, with polymer coating conforming to ASTM F1664. Color shall match fabric and shall be in compliance with ASTM F934.
- C. Turnbuckles for installation with Tension Wires: Eye and hook type, drop forged steel, right and left hand threads, at least 3/8 inch screw diameter with at least 4 ½-inches of take-up.

2.05 PAINT FOR GALVANIZING REPAIR

- A. Coatings for Refurbishing Galvanizing: Organic zinc-rich paint conforming to ASTM A780 or Carbomastic 15 by Carboline, or equal. Paints and coatings used on the site shall be approved by OWNER's Office of Environmental Health and Safety (OEHS).

2.06 GATES

- A. General:
 - 1. Gate framework shall be fabricated of tubular steel of sizes indicated on the drawings and conforming to ASTM F1083, Group IA, with a minimum yield strength of 30,000 psi. Joints at corners shall be miter cut and continuously welded to sides.
 - 2. Install fence fabric to side members with tension bars and tension bands as specified, spaced not more than 14 inches apart. Tension bars shall extend full height of gate. Install fence fabric to top and bottom members and to brace rail with wire ties as specified for top rails, spaced not more than 12 inches apart. Chain link fabric shall match adjacent fence system.
 - 3. Latches and Hinges: Weld gate latches and strikes to gate posts and frames. Weld OWNER provided hinges to posts. Weld 3 hinges on each post for swing gates more than 16 feet wide. Welding shall be performed before gate frames are galvanized, or welds shall be finished as specified below.
 - 4. Grind welds flush and smooth. Hot-dip galvanize fabricated parts after welding, or be protected by zinc-rich paint in conformance to ASTM A780.
 - 5. Electrically operated gates shall be manufactured and installed in accordance with the safety requirements of ASTM F2200 and UL325.
- B. Swing Gates: Galvanized steel welded fabrication in conformance with ASTM F900, fabric size and gage shall match fence. Positive locking gate latch shall be fabricated of

5/16 inch thick by 1 ¾ inch pressed steel galvanized after fabrication. OWNER will provide one inch weldable hinges only.

- C. Roll Gates: Galvanized steel welded fabrication in conformance with ASTM F900, fabric size and gage shall match fence. Positive locking gate latch shall be fabricated of 5/16 inch thick by 1 ¾ inch pressed steel galvanized after fabrication.
- D. Polymer coated gate frames and gateposts shall match the coating type and color specified for the fence framework. Moveable parts such as hinges, latches and drop rods shall be field coated using a liquid polymer touch up.

2.08 CONCRETE AND GROUT

- A. Comply with requirements of Section 03 3000, Cast-in-Place Concrete. Provide normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3,000 psi, 4-inch slump, and one inch maximum size aggregate.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications "Rapid set Cement".

2.09 FABRICATION

- A. Items to be shop fabricated shall be preassembled to greatest extent possible. Use connections that maintain structural value of joined pieces. Mark units for reassembly and installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove sharp and rough areas on exposed surfaces. Form exposed work with accurate angles and surfaces and straight edges. Form exposed connections with hairline joints, flush and smooth.
- C. Weld connections unless otherwise indicated. Weld corners and seams continuously and in accordance with requirements of AWS D1.1 Structural Welding Code. Welds shall be inspected. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- D. Galvanize fabrications in accordance with ASTM A123 and ASTM A153.

PART 3 - EXECUTION

3.01 EARTHWORK

- A. Refer to the following Sections for earthwork related work:
 - 1. Section 31 2200 - Grading.

2. Section 31 2316 - Excavation and Fill for Paving.
3. Section 32 0117 - Pavement Repair.

3.02 FRAMEWORK INSTALLATION

- A. Install fences as indicated on Drawings.
- B. Space fence posts at equal intervals between terminal, angle, corner, and gate posts, and not more than 10 feet apart measured from center to center of posts. In curved fence sections having a radius of 50 feet or less, space posts not more than 5 feet - 6 inches apart. Install posts so that top of eye of post caps are level with top of fabric.
- C. Install angle or corner posts at each change in direction of 15 degrees or more, at change of 5 percent or more in grade of fencing, and at the beginning and end of curved fence sections.
- D. Install terminal posts at ends of runs of fencing. Install gateposts on both sides of driveway and pedestrian gates. For double-leaf gates, net opening between gate posts shall be gate size as indicated on Drawings, plus 3 ½-inches; for single leaf gates, net opening shall be gate size plus 2 ½-inches.
- E. Embed posts into footing 6 inches less than the depth of the footing unless noted otherwise on drawings.
- F. Where a fence is to be installed on a curb, construct footings with top of footing level with the lower finish grade. Align posts, set plumb and true before placing footings. Remove splattered concrete from exposed pipe surfaces while concrete is still soft. In bituminous surfaced areas, install seal coat on top of concrete footings.
- G. Install fences with top rail. Top rail shall pass through eye tops and be secured at ends with rail-end fittings and bands.
- H. Install fences over 10 feet in height, in addition to top rail, with a full length horizontal mid-rail set at mid-height of fence and rigidly secured to posts with rail end fittings and bands.
- I. In fences higher than 10 feet, install brace rails at angles, corners, and terminals at 1/4 and 3/4 of fence height. Provide one horizontal brace rail in panels adjacent to terminal, angle, corner, and gateposts, install at mid-height of fence and rigidly secured to posts with rail end fittings and bands. Provide horizontal brace rails, as specified, in panels of curved sections having a radius of 50 feet or less. Brace rails are not required in fencing 4 feet or less in height.
- J. Provide a transom rail and fabric at top of pedestrian gate openings. Install transom rail 6 feet 8 inches above high point of grade at gate opening. Ends of transom rails shall be pinned or riveted to rail end fittings with 1/4 inch mild steel rivets. Pin or rivet shall go

through rail and peen. Welding on rail ends is not permitted. Where door closers are installed weld lower transom rail directly to terminal post, rail ends shall not be used.

- K. Install bottom tension wire a minimum of 3 inches from grade for fencing and secure to fence posts with ties. Provide a turnbuckle for each 150 feet of wire or fractional part thereof. Turnbuckles are not required in runs of 15 feet or less. Install ends of tension wires to posts in a manner to prevent slipping or loss of tension. Wrap should start from fence side of post. Turn end of wire around post tightly twisted at least three times around wire. At turnbuckles, wire through eye and tightly twist end at least three times around wire. Cut tail of bottom wire flush.

3.03 CHAIN LINK FABRIC INSTALLATION

- A. Install fence fabric on outward facing side of posts, except for tennis courts. Install fence fabric with top edge projecting above top rail of fence.
- B. Install bottom of fence fabric to clear finish grades, except on bituminous surface install 3/4 inch above such surface. Locally shape and trench ground surfaces where necessary to provide uniform top and bottom alignment of fence.
- C. Tightly stretch fabric and at terminal, pull corner, angle, and gateposts, secure with tension bars extending full height of fence. Secure tension bars to posts with bolted tension bands spaced not more than 14 inches apart.
- D. Bands and Ties: Install bands and ties in accordance with following schedule:

15 bands on 16 feet fence	16 ties on 16 feet fence
11 bands on 12 feet fence	12 ties on 12 feet fence
7 bands on 8 feet fence	7 ties on 8 feet fence
6 bands on 6 feet fence	6 ties on 6 feet fence
4 bands on 4 feet fence	4 ties on 4 feet fence
- E. Fasten fabric to line posts with wire ties spaced not more than 16 inches apart. Where 6 gage aluminum ties are furnished, hook the tie at both ends. Installation of hooked ties with links is not permitted.
- F. Fasten fabric to top rails, mid-rails, brace rails, with wire ties spaced not more than 18 inches apart. Bend back ends of tie wires so as not to be a hazard. At bottom tension wire, install hog rings spaced not more than 18 inches apart. Where 2 fabrics are furnished, lap the fabrics one mesh at mid-rail and tie both fabrics with 9 gage wire or 6 gage aluminum ties to midrails.

3.04 WELD GRINDING

- A. Grind field welds smooth, clean off flux and spatter, damaged galvanizing removed, burrs and projections ground off, properly prepared, then heavily coated with galvanizing repair coating. Install coating in accordance with written recommendations of manufacturer.

3.05 Not Used

3.06 INSTALLATION ON TOP OF CONCRETE WALLS

- A. Posts for fences on top of new concrete or concrete masonry walls shall be installed in 24 gage galvanized iron inserts one inch larger than the outside post diameter. Wall thickness for such installation shall be 8 inches minimum. Depth of embedment of post shall not be less than 15 inches for fence height not exceeding 4 feet. Install post plumb, true, and fill joint space with non-shrink grout, finished flush with top of wall. Remove excess grout and clean posts.
- B. Fencing on Gravity Walls: Post of fence not exceeding 8 feet high shall have a minimum of 15 inches embedment in gravity walls with a top width of 10 inches minimum and side of 1H: 4V. Where the height of gravity wall from top to bottom, within 5 feet from each side of a post, is less than 22 inches, provide concrete fence post footings and embed posts in accordance with the schedule of posts and footings as set forth in this section.
- C. Do not install footings on existing walls without the review of the ARCHITECT.

3.07 HORIZONTAL APPLICATIONS

- A. Spacing of lid joist framing members shall not exceed four feet on center. Joists shall be welded on both ends to supporting chain link framing structure or mechanically fastened to adjacent buildings, as indicated on the drawings.

3.08 Not Used

3.09 INSTALLATION OF GATES

- A. Provide gates of the sizes indicated on Drawings. Allow clearance on gates of 1-1/2 inches at bottom and one inch at top. Construct gates installed in sloping areas to conform to the grade. Provide an opening in each gate for access to locking device or padlock. Knuckle ends of fabric cut for opening to eliminate hazards.
- B. Sliding Gates and Swing Gates: Fabricate and install as indicated on Drawings. Wheel housing shall be designed to fit tightly to roll track and prevent gate from rolling over objects. Unsupported cantilever type roll gates are not acceptable. Install gate stops in accordance with the drawings. Both top and track stops are required.

3.10 COMPLETION

- A. Completed fencing shall form continuous units between points indicated with required parts, accessories, and fittings provided and installed. Clean exposed metal surfaces of cement, grout and other foreign substances.

- B. Fill in holes left by removal of existing fence footings, except in areas where grading Work is indicated or specified, to existing grade with clean earth thoroughly compacted to at least same density as adjoining soil.

3.11 PROTECTION

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

3.12 CLEANUP

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

END OF SECTION

SECTION 32 3119
ORNAMENTAL FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
 - 1. Steel picket fences and pedestrian gates as indicated on the drawings.
- C. Related Sections:
 - 1. Division 01 – General Requirements.
 - 2. Section 03 2000 – Concrete Reinforcement.
 - 3. Section 03 3000 – Cast-in-Place Concrete.
 - 4. Section 05 0513 – Hot-Dip Galvanizing.
 - 5. Section 08 7000 - Door Hardware.
 - 6. Section 10 1400 – Signage.
 - 7. Section 31 2319: Excavating and Fill for Structures.
 - 8. Section 32 1313 – Chain Link Fences and Gates.

1.02 REFERENCES

- A. American Galvanizers Association (AGA):
 - 1. Inspection of Products Hot-Dip Galvanized After Fabrication.
 - 2. Quality Assurance Manual.
- B. ASTM International:
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A-53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A385 – Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
6. ASTM A500 – Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
7. ASTM A501 – Standard Specification for Hot Formed Welded and Seamless Carbon Steel Structural Tubing.
8. ASTM A513 – Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
9. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
10. ASTM A780 – Standard Practice for of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

C. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code - Steel.
2. AWS D-19.0. – Welding Zinc-Coated Steel.

1.03 SUBMITTALS

- A. Shop Drawings: Submit plans and details indicating extent of fences, locations of gates, dimensions and details of attachment and footings.
- B. Product Data: Submit product data for galvanizing repair material indicating compliance to referenced standards.
- C. Hardware Schedule: Submit complete product data of all hardware items to be used, include manufacturer's name, catalog number, relevant dimensions, fasteners, location of item in Work, gate index number, gate dimensions.
- D. Certificates: Manufacturer's Certificates certifying that materials and galvanizing comply with referenced standards.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with a minimum of five years of documented experience.
- B. Installer Qualifications: Company specializing in the installation of the products specified in this Section with a minimum of five years of documented experience.
- C. Welders: Welders shall be AWS certified.
- D. Mockup: Build mockup to set quality standards for fabrication and installation. Mockup shall include a fence panel set between two posts. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, HANDLING AND STORAGE

- A. Deliver, handle and store fence components to protect galvanized coating from damage during delivery, unloading and installation.
- B. Store components and materials above grade on platforms, skids, or other required supports.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Members: Size and thickness as indicated on the Drawings.
 - 1. Line Posts, End Posts, and Rails: Carbon steel tubing conforming with ASTM A36, ASTM A53, or ASTM A500.
 - 2. Fence Pickets: In conformance with ASTM A513 or ASTM A36.
 - 3. Plates and Shapes: In conformance with ASTM A36.
 - 4. Perforated Sheet Metal: In conformance with ASTM A653, G90.
- B. Reinforced Concrete:
 - 1. Normal weight complying with requirements in Section 03 3000, Cast-in-Place Concrete. Compressive strength 3,000 PSI minimum at 28 days.
 - 2. Concrete Reinforcement Materials: Per Section 03 2000, Concrete Reinforcement.
- C. Accessibility Signage at Gates: Refer to Section 10 1400, Signage.

2.02 GATE HARDWARE

- A. Exit Devices: Panic Hardware on push side.

1. Precision 2108 X V4908A X 630 X 48".
 2. Mortise lock with lever handle on push and pull sides: SCHLAGE L-9070 X 32D with 06 N trim.
- B. Lockset: Schlage L-9070 x 32 D with 06 N Trim.
- C. Door Closer: 120-degree, delayed action.
1. Pull Side: L.C.N. 4040 with RW/PA arm kit.
 2. Push Side: L.C.N. 4040 XP with EDA arm.
- D. Weldable Gate Box: Keedex KBX-M0R1 10G.
- E. Hinges: Weld-on hinges by D&D Technologies or equal Brookfield Industries series W.
1. D&D Technologies VersaWeld CI3075 (round posts).
 2. D&D Technologies VersaWeld CI3950 (square posts).
 3. D&D Technologies SureClose 75108113M, 75108114M, 75108123M, 75108124M (square posts at 4'-0", high gates only).
 4. Maximum of two hinges per each ADA pedestrian swing gate with both hinges supporting the weight of the gate.
- F. Refer to Section 08 7000 Door Hardware for cylinders and keying.

2.03 FABRICATION

- A. General:
1. Fabricate items in shapes and sizes indicated on drawings in as large sections as possible to minimize assembly and field welding at project site.
 2. Form all work true to line and level with accurate angles.
 3. Exposed work shall be smooth and free of blemishes. Remove blemishes by grinding and/or sanding prior to cleaning, treating and finishing. Ease exposed edges unless otherwise indicated or specified.
 4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise damaging Work.
 5. Form exposed connections with hairline joints, flush and smooth.
 6. One end of pickets shall be flattened and trimmed to an arrowhead with a one press stroke. If indicated on drawings, pickets shall be shaped to radius indicated. Space pickets at five inches on center maximum.

7. Provide vent and drain holes per ASTM A385 for the galvanizing process. Coordinate with the galvanizer for locations and sizes.
8. Remove loose rust, mill scale, cutting, and burrs.

B. Shop Welding:

1. Weld connections as indicated on drawings. Weld corners and seams continuously and in accordance with requirements of AWS D1.1.
2. Exposed welds shall be ground, sanded smooth and flush to match and blend with adjoining surfaces. Remove welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.

2.04 GALVANIZING

- A. Hot-Dip galvanize after fabrication in accordance with Section 05 0513 Hot-Dip Galvanizing.

PART 3 – EXECUTION

3.01 FENCE INSTALLATION

- A. Install fence in accordance with manufacturer's instructions and approved installation drawings.
- B. Drill post footings to depths indicated on the drawings, shore and compact per specification Section 31 2319, Excavating and Fill for Structures.
- C. Place panel posts into drilled holes at locations indicated on drawings; set panels plumb, aligned and at correct height. Stabilize panels into position before pouring concrete footings.
- D. Concrete Footings: Install reinforcement in accordance with Section 03 2000 Concrete Reinforcement. Place concrete around posts per Section 03 3000, Cast-in-Place Concrete and vibrate or tamp for consolidation. Protect fence from concrete splatter. Maintain fence stabilized until concrete is cured.

3.02 FIELD WELDING

- A. Preparation of Weld Area of Galvanized Fabrications: Remove masking from fabrications. Remove remaining zinc coating between one inch and four inches from both sides of members to be welded, by grinding back the zinc coating, burning the zinc away or pushing back the molten zinc from the weld area.
- B. Welding: Welding and welding procedures shall be performed in accordance with American Welding Society D1.1 structural steel code for SMAW, FCAW, GMAW, GTAW processes.

- C. Welding and tacking shall be performed by AWS D1.1 Certified Welders, for the process being utilized in this fabrication, construction. Welders and tackers shall provide current certifications for each welding process to be utilized. Welders shall provide a valid picture Identification before fabrication, welding, installation and during construction.
- D. Welding shall be evaluated per AWS D1.1 weld criterion for appearance, quality, materials and recommendations, methods used in correcting welding work.
 - 1. Welding shall be in accordance with AWS D1.1 Structural Steel Code.
 - 2. Weld galvanized fabrications in accordance with AWS D-19.0.
- E. Remove welding flux immediately. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surfaces matches those adjacent.
- F. Upon completion of welding plug vent and drainage holes of galvanized fabrications with appropriate diameter zinc plugs. Push in about halfway by hand, and hammer to a tight fit. With a hand file or an abrasive tool, file excess material. Repair damaged surfaces with two coats of Carbomastic 15, by Carboline or equal product approved by OWNER's Office of Environmental Health and Safety (OEHS).
- G. Weld adjoining fence panels as indicated on drawings.

3.02 INSTALLATION OF GATES

- A. Gates shall be installed with a 1-1/2-inch clearance at bottom and 1/2" inch clearance at top, between transom panel and gate.
- B. Fabricate and install as indicated on Drawings.
- C. Install accessibility signs as indicated on the drawings.

3.03 COMPLETION

- A. Completed fencing shall form continuous units between points indicated with required parts, accessories, and fittings provided and installed.
- B. Clean exposed metal surfaces of splattered cement, grout and other foreign substances.

3.04 PROTECTION

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

3.05 CLEANUP

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

END OF SECTION

SECTION 32 33 00
SITE FURNISHINGS

GENERAL

1.1 RELATED DOCUMENTS

- A. The work of this section shall conform to the "Standard Specifications for Public Works Construction", latest edition, except as modified herein.

1.2 SCOPE OF WORK

- A. Work of this Section includes all materials, labor and equipment necessary to provide and install the Site Furnishings as shown on the drawings, as reasonably implied or as specified herein. The equipment shall be assembled on site as per manufacturer's recommendations and this section. All work and equipment provided shall be subject to approval of the Project Inspector.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Concrete: Section 03 30 00

1.4 SUBMITTALS

- A. Contractor shall submit a complete list of materials along with manufacturer's catalog data for all materials proposed for use in the work at the pre-construction conference. Proposals for substitution of those materials specified herein shall be submitted and reviewed.
- B. Manufacturer's Product Data: Submit three (3) copies of manufacturer's literature for each item of site furnishings.
- C. Shop Drawings: Manufacturer's shop Drawings shall be provided for all prefabricated items. Shop Drawings which show complete details shall be furnished in quadruplicate for all items requiring shop fabrication in accordance with Section 2-5.3 of the Standard Specifications.

1.5 GUARANTEE & LIABILITY INSURANCES

- A. Manufacturer shall guarantee all materials and workmanship for a period of one (1) year exclusive of vandalism. Manufacturer will be required to provide product liability insurance coverage in the minimum amount of \$10,000,000 per incident. Manufacturer or his representative shall inspect all installation work and provide written certification that equipment has been installed in accordance with the manufacturer's specifications.
- B. Each Manufacturer will be required to provide complete installation drawings including specifications and a replacement parts list for all products.
- C. Contractor shall provide a written guarantee on his firm's letterhead for all materials and workmanship for a period of one (1) year exclusive of vandalism. Written guarantee shall be submitted to the District at the final inspection prior to final acceptance of the work.

1.6 PROPOSED SUBSTITUTIONS

- A. Products proposed for substitutions as "equals" to those specified are subject to the approval of the District. If at the time proposed equals are delivered to the site, it is determined by the District that they are not equal to those specified, they shall be removed and products as specified shall be provided by the Contractor at no additional cost to the District.

1.7 LOCATION INSPECTION

- A. No equipment or apparatus or foundations for same shall be placed until location stakes have been inspected for recommended approval by the Landscape Architect and/or Project Inspector.

PART 2 - MATERIALS

ALL MATERIALS SHALL BE AS CALLED FOR ON PLANS

2.1 "OR APPROVED EQUIVALENT" PRODUCTS

- A. This project is a Public Works project. Sole sourcing of material is not allowed. Any reference or call out on the plans and/or in the specifications to a specific manufacturer shall be interpreted as "or approved equivalent". The District Engineer's and Landscape Architect's approval is required as to whether or not a product meets the District's standard to be an approved equivalent. **Bidders shall use the pricing for the products as specified to avoid risks of disapproval. No substitutions will be considered prior to the award of the contract.**

PART 3 - EXECUTION

3.1 LAYOUT

- A. Contractor shall stake/mark locations for all slabs equipment or apparatus or foundations for same and shall obtain the acceptance of their location from Landscape Architect and/or Park Inspector prior to commencing any digging. Locations shall be adjusted to provide minimum clear distances required from all edges of slabs, trees, irrigation heads, or other obstructions.

3.2 CONCRETE WORK

- A. All concrete foundation work shall be performed in accordance with the Standard Specifications, Section 201. Contractor shall obtain the acceptance of all forming from the Park Inspector prior to pouring any concrete. Foundations holes shall be inspected and accepted by the Inspector prior to pouring concrete.

3.3 STEEL FABRICATION AND WELDING

- A. All steel members shall be thoroughly hand cleaned and solvent cleaned to remove all rust, scale, oil, grease, and foreign material prior to welding. All welds shall be continuous fillet welds along all abutting surfaces. Sand all welds smooth. Galvanized steel shall be touched up after welding with Galvicon paint.

3.4 SITE FURNISHINGS

- A. All Site Furnishings shall be installed plumb, at a height above the finish surface as recommended by the manufacturer, or as identified in the plans. Minimum footing size shall conform to the manufacturer's recommendations. All footings shall be installed prior to placement of concrete slabs, where they occur. **No "block outs" will be permitted.**

3.5 PAINTING

- A. All items to be painted shall be properly primed prior to application of a minimum of two (2) finish coats.
- B. After installation, all site furnishings and play equipment shall be touched-up as necessary. Touch-up paint shall be as supplied by the manufacturer.

3.6 CLEAN-UP

- A. Contractor shall clean up and legally dispose of all unused materials, excess soil, and debris at regular intervals throughout the duration of the work, and as directed by the District.

3.7 PAYMENT TERMS

- A. Payment for site furnishings will be at the lump sum price bid for site furnishings. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in site furnishings as herein specified. A 10% retention shall apply to all site furnishings work.

END OF SECTION

SECTION 32 80 00

IRRIGATION

PART 1 - GENERAL REQUIREMENTS

1.1 RELATED DOCUMENTS

- A. All improvements shall comply with the Standard Uniform Building Code.

1.2 SECTION INCLUDES

- A. Work Included: Unless otherwise specified, the construction of irrigation systems shall include the furnishing, installing and testing of mains, laterals, risers and fittings, quick couplers, gate valves, back flow preventers, furnishing and installing of irrigation controllers, excavation and backfill, and all other work in accordance with the plans and specifications for a complete operating system.
1. The intent of the drawings and specification is to indicate and specify a complete and efficient irrigation system ready for use in accordance with the manufacturer's recommendations and meeting the recommended approval of the Landscape Architect. All work shall be in accordance with applicable City and County codes, DSA standards and these plans/specifications.
 2. Irrigation systems shall be constructed to the sizes and grades and at the location shown on the drawings. Lines shown on the plans are essentially diagrammatic. Locations of all heads, valves, etc., shall be reviewed by the Landscape Architect at the time of construction. Do not exceed spacing of the heads as shown on plans.
 3. The applicable provisions of the General Conditions and the Special Conditions of these specifications shall govern the work of this section as if herein written in full.
 4. The Contractor shall maintain, continuously, a competent superintendent or foreman, satisfactory to the Owner, during the progress of work, with authority to act for him in all matters pertaining to the work.
 5. Work noted as "N.I.C.", "existing" or "to be supplied and/or installed by others" is not a part of this section.
 6. The work in this section shall be coordinated with all underground utilities and trades responsible for their installation.
- B. Field Conditions: Verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces. Report to the Landscape Architect all conditions which prevent proper execution of this work.
- C. Existing Conditions:
1. Locate existing irrigation equipment within the project area. Contractor to repair any damage to equipment identified to remain in place within 48 hours of discovery.
 2. Locate utilities prior to proceeding with work. At Contractor's expense, repair any damage incurred during irrigation construction.
 3. Examine surfaces for conditions that will adversely affect execution, permanence and quality of work.
 4. Verify that grading has been completed and the work of this section can properly proceed.
 5. Exercise extreme care in excavating and working near existing utilities. Contractor is responsible for damages to utilities, which are caused by his operations or neglect. Check existing utility drawings for locations.
 6. Notify the Landscape Architect in writing, describing unacceptable conditions.
 7. Do not proceed with work until unacceptable site conditions are corrected or existing utilities are located.
 8. Verify water supply before the start of design or construction of irrigation system. Perform gallon per minute test and pounds per square inch test on existing supply line.
 9. It shall be the contracting installer's responsibility to report to the Owner's representative any deviations between the drawings, specifications, and the site. Failure to do so prior to installing of equipment and resulting in replacing and/or relocating equipment shall be done at the Contractor's expense.

- D. Permits and Fees: The contractor shall apply and pay for all necessary fees and permits required in the pursuit of his work as required by governing codes.
- E. All assemblies specified herein shall be installed in accordance with the respective details. In the absence of detail drawings or specifications pertaining to the specific items required to complete the work, the Contractor shall perform such work in accordance with the best standard practice and to the satisfaction of the Landscape Architect.
- F. Irrigation Contractor is responsible for replacing or repairing any acts of theft or vandalism during construction and the maintenance period.
- G. Permission to shut off any water lines must be obtained from the Owner. Disruption of existing systems shall be kept to a minimum.
- H. Contractor shall maintain irrigation system throughout plant establishment and maintenance period.
- I. Contractor shall provide one year guarantee.

1.3 RELATED WORK DESCRIBED ELSEWHERE

- A. Planting: Section 32 90 00

1.4 QUALITY ASSURANCE

- A. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with the latest rules of the National Electrical Code and the Electrical Safety Orders of the State of California, Division of Industrial Safety, for all electrical work and materials.
- B. Qualifications of Installers: Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the materials manufacturer's recommended methods of installation, and who shall direct all work performed under this Section.
- C. The Contractor shall not install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in equipment usage or area dimensions exist that might have been considered in the engineering. Such obstructions or differences shall be brought to the attention of the Agency's authorized representative. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary at no cost to the Owner.

1.5 SUBMITTALS

- A. General: Comply with the provisions of Section 01 32 23.
- B. The Contractor shall submit to the Landscape Architect in writing, prior to the start of any irrigation construction work, a letter stating the existing conditions (i.e., available water supply in gallon per minute, available static water pressure in pounds per square inch, etc.) have been checked and verified. The contractor shall note that no discrepancies were found between existing conditions and the information shown on the irrigation plans and specifications.
- C. Product Data: Within 45 days after award of the Contract, and before any materials of this Section have been delivered to the job site, submit to the Architect:
 - 1. A complete materials list of all items proposed to be furnished and installed under this Section.
 - 2. The manufacturer's recommended methods of installation which, when recommended for approval by the Architect, shall become the basis for review and accepting or rejecting actual installation methods used on the work when not otherwise specified or detailed.
- D. Materials and Samples: If materials are to be employed, other than designated on the plans, the Contractor shall, prior to the installation of any irrigation work, submit for recommended approval by the Landscape Architect, a list of

materials and equipment he proposes to use. The material and equipment list shall include, but not be limited to, polyvinyl chloride pipe, automatic controllers and control valves, quick coupling valves and irrigation heads.

1. Should the Contractor propose to use materials or equipment other than those listed on the plans, he shall submit samples of the make and type proposed. Samples shall be submitted a sufficient time in advance of the start of construction to allow a period of not less than seven (7) days for testing and recommended approval.
2. Recommended approval of irrigation equipment and materials shall depend on the following:
 - a. Conformance to specification requirements.
 - b. Acceptable test results and/or field performance.
 - c. Durability and low maintenance.
 - d. Availability of parts and service.
 - e. Compatibility with owner's materials inventories.

- E. Project Record Drawings: Provide separate and complete Project Record Drawings prepared in accordance with the provisions of these Specifications, Sub-section 3.09, following

1.6 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. Delivery: Polyvinyl chloride pipe shall be delivered to the work site in unbroken bundles or rolls packaged in such a manner as to provide adequate protection for the pipe ends, threaded or plain.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the recommended approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 PIPE

- A. Plastic Pipe:
1. Unless otherwise specified, the construction of lateral lines and main lines shall include excavation and backfill, the furnishing, installing and testing of pipe, tube and fittings, the furnishing and installing of anchors, thrust blocks and location wire, the improvements, line flushing and testing, and all other work in accordance with the plans and specifications.
 2. Main supply pressure lines shall be PVC; 4" and larger Class 200, 2" - 3" Class 315, 1 1/2" and smaller Schedule 40, as manufactured by Pacific Plastics, or approved equal.
 3. Lateral non-pressure lines shall be PVC. Schedule 40 polyvinyl chloride, as manufactured by Pacific Plastics, or approved equal.
 4. Irrigation Lines Sleeves shall be PVC. Schedule 40 polyvinyl chloride, as manufactured by Pacific Plastics, or approved equal.
 5. Low Voltage Control Wire Sleeves (valve wires) shall be PVC Schedule 40 polyvinyl chloride, as manufactured by Pacific Plastics, or approved equal. All exposed wires shall be sleeved in PVC Schedule 40 ULV electrical conduit with ULV Schedule 40 fittings.
 - a. Identification: All pipe shall be continuously and permanently marked with the following information: The normal pipe size, the type and schedule or class of material, the working pressure or pressure rating at 73.4 degrees F., the manufacturer's name or trade mark, and the National Sanitation Foundation (N.S.F.) seal of approval.
 6. All plastic pipe shall be guaranteed by its manufacturer to have passed, or be capable of passing, the Anhydrous Acetone Immersion Test and to be free from manufacturing defects.
- B. Identification: All pipe shall be continuously and permanently marked with the following information: The normal pipe size, the type and schedule or class of material, the working pressure or pressure rating at 73.4 degrees F., the manufacturer's name or trade mark, and the National Sanitation Foundation (N.S.F.) seal of approval.

1. All plastic pipe shall be guaranteed by its manufacturer to have passed, or be capable of passing, the Anhydrous Acetone Immersion Test and to be free from manufacturing defects..

C. Polyvinyl Chloride Pipe Fittings and Connections:

1. Polyvinyl chloride pipe fittings and connections approved for irrigation systems shall be polyvinyl chloride, Type II, Grade I, Schedule 40, high impact molded fittings, manufactured from virgin compounds.
2. The Schedule 40 fittings shall be tapered socket type, or molded thread type, suitable for either solvent weld or screwed connections.
3. Machine threaded fittings will be acceptable only if thread-stripping resistance test results are submitted and approved.
4. In line fittings, such as couplings, unions and bushings may be machined from extruded stock.
5. Plastic saddle and flange fittings will not be acceptable.
6. All fittings shall be permanently marked with the following information: The normal pipe size, the type and schedule of material, and the National Sanitation Foundation (N.S.F.) seal of approval.

D. Galvanized Pipe and Fittings:

1. All galvanized steel pipe shall be Schedule 40, threaded, coupled and hot-dip galvanized, and shall comply with ASTM A120 and A53.
2. All fittings for galvanized steel pipe shall be 150 PSI rated galvanized malleable iron, banded pattern.
3. Pipe sizes indicated on the drawings are nominal inside diameter unless otherwise noted.

2.2 VALVES

A. Ball Valves:

1. All ball valves shall be all bronze construction full port; 1/2" thru 2", Matco-Norca 759.
2. Working Pressure Rated: 200 PSI.
3. Ball valves installed underground shall be housed in a NDS Spec Grade plastic turf box.

B. Automatic Control Valves (Electric):

1. All automatic control valves (electric) shall be Rainbird products as called for on plans, electrically controlled, hydraulically operated, single seat, normally closed no equivalents or equals.
2. The valves shall be actuated by a normally closed solenoid valve operator using 24 volts, 60 cycle alternating current. The wires in the coil of the solenoid shall be embedded in an epoxy resin. The entire solenoid shall be enclosed in Spears dry splice DS-400 water proof connectors. Valves shall automatically close in event of electrical power failure.
3. All automatic control valves shall have a flow control device for manually adjusting the amount of flow of water through the valve. The flow control device shall be adjusted so that the pressure at the nozzle of the sprinkler head farthest from the automatic control valve shall be that as specified in the irrigation legend per plan. The pressure at the sprinkler head shall be measured by means of a pilot pressure gauge while the sprinkler head is operating.
4. Automatic control valves shall be constructed of glass filled nylon or stainless steel springs and screens, and composition material (neoprene) seals and seat washers.
5. All automatic control valves shall be equipped with a pet clock for manual operation control.
6. The Contractor shall furnish one valve box key for each six or less valve boxes installed.
7. All valves shall have a T.C. Christie valve marking plastic tag.

2.3 QUICK COUPLERS

- A. Quick couplers shall be as called out for on plans.

2.4 CONTROLLERS & WIRE

A. Automatic Controllers (Electric):

1. Controller shall be Calsense controller product as called for on plans.
2. All automatic controllers treated in this specification shall be for use with solenoid operated (24-volt electric), normally closed, control valves.
3. Automatic controllers shall meet the following requirements:
 - a. Be completely automatic in operation with remote control.
 - b. Shall electrically start the sprinkling cycle.
 - c. Shall electrically time the individual stations.
 - d. Shall operate on single phase, 120 volt, 60 cycle, alternating current.
 - e. Shall contain electrical circuits for pump and master valve operations.
 - f. Shall have complete operating instructions and charts indicating controller station to valve locations mounted inside the controller in full view when controller is open.
 - g. Smart irrigation controller which automatically adjusts frequency and/or duration of irrigation events in response to changing weather conditions.

B. Control Wire:

1. All control wire shall be of the Underwriter's Laboratory type UF (underground feeder), single conductor, solid copper, plastic insulated, 600 volt rated, for direct burial applications. Maximum conductor operating temperature, 60 degrees C. for both wet and dry locations. Wire composition is as follows:
 - a. Conductor -The conductors shall be solid annealed uncoated copper meeting the applicable requirements of the latest revisions of A.S.T.M. B-3.
 - b. Insulation -The insulation shall be colored plastic which meets the test requirements of I.P.C.E.A. (The Insulated Power Cable Engineer's Association) Pub. No. S-61-402, dated July 1961, Section 3.7 for 60 degrees C. polyvinyl chloride insulation. The insulation shall be flame retardant, resistant to fungus, resistant to corrosive fumes, suitable for wet locations and furnish some degree of inherent protections against mechanical abuse. Insulation thickness shall be 47 mils for AWG #14, 12 & 10, and 62 mils for AWG #8.
 - c. Color Coding - The conductor insulation shall be color coded as follows:
 - 1) All common ground wire shall be white.
 - 2) All pilot (valve control) wire shall be black.
 - 3) All spare wires shall be orange or blue.
 - d. All wire splices shall be made within a control valve box or a separate valve box. Each splice shall be made with a Spears Dri-Splice DS-100 wire connector and filled with Spears DS-300 sealant.

2.5 VALVE BOXES

- A. Valve Boxes: Remote control valve boxes shall be NDS Spec Grade, or Rainbird VB series rectangular plastic boxes with lockable covers. Valve station number shall be heat branded in two-inch-high (2") numerals on cover. Gate valve boxes shall be round plastic boxes with lockable covers marked either "Ball Valve" or "B. V." with letters cast or tooled in the cover. All valve boxes shall be green in color.

2.6 IRRIGATION HEADS

A. Irrigation Heads:

1. Sprinkler heads shall be Rainbird products as called for on plans. Sprinkler heads shall be of the types and sizes, with the diameter (or radius) of throw, pressure, discharge and any other designations necessary to determine the types and sizes, as indicated on the plans.
2. All sprinkler heads of a particular type of function in the system shall be of the same manufacture and, with the exception of shrubbery heads, shall be marked with the manufacturer's name and model number. This identification shall be visible without having to remove the sprinkler head from the system.

2.7 DRIP VALVE ASSEMBLIES

A. Drip Valve Assemblies:

1. Electric Remote Control Valves: Electric control valves with pressure regulating feature two way solenoid, pilot operated made of synthetics, non corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal, retained (mounted) without attachment to diaphragm.
2. Wye Strainer: 150 mesh screen for point to point drip.
3. Isolation Ball Valve: Ball Socket Ball Valve with thermoplastic molded one piece construction and teflon seat with EDPM cushions.

2.8 SUB SURFACE DRIP IRRIGATION

A. Drip Tubing For Subsurface Drip Tubing:

1. Nominal sized ½” low density, ultra-violet resistant, linear polyethylene tubing with internal pressure-compensating, continuous self-cleaning, integral drippers at a specified interval. The tubing shall be brown in color and conform to an outside diameter (O.D.) of 0.66” and an inside diameter (I.D.) of 0.57”. The dripline shall be capable of a discharge rate of 0.4, 0.6 or 0.9 gallons per hour (GPH) between operating pressures of 7-70 PSI for each individual dripper.
2. The individual continuous self-cleaning, pressure compensating drippers shall be welded to the inside of the tubing wall. The drippers shall be constructed of three individual pieces:
 - a. a black-colored dripper containing a filtration system on the inlet side, compensation cell, and a recessed chamber with a water outlet,
 - b. a flexible black elastomer diaphragm that allows pressure to build up within the chamber to purge sediment or other debris that may not have been captured by the disc filter.
 - c. Dripper spacings shall be available in the following on-center intervals – 12”, 18”, and 24”.
 - d. All drip tubing shall be as called out on plans. Approved manufacturer: Rainbird.

B. Pressure Regulator Valves for Subsurface Drip Tubing:

1. The pressure regulator valve(s) shall be a spring-operated piston type with an externally accessible regulation unit that can be serviced without removing the valve from the system. The valve shall be constructed from molded black plastic with six different colored tops with interchangeable springs denoting different pressure regulation and flow ranges. The regulator shall have a built-in indicator that shows when the proper outlet pressure is reached. Operating ranges for the valves shall be from 15-50 PSI in 5-PSI increments. Inlet and outlet ports of the valve shall be a combination of male/female threads.

C. Screen Filter For Subsurface Drip Tubing:

1. The screen filter body shall be molded of black plastic with male pipe threads (MPT) for both the inlet and outlet ports. A threaded cap on one end of the body shall be capable of periodic servicing by unscrewing the cap or releasing the latched band from the main filter body. On one ¾” model, a manual shut-off valve shall be co-molded to the opposing end of the removable cap as part of the main body. This device shall be capable of closing off the inlet port so the screen element can be removed when the main line is still pressurized.

D. Air/Vacuum Relief Valves for Subsurface Drip Tubing:

1. Air / vacuum relief valves shall be constructed of grey and/or black plastic with an internal sliding poppet valve that is capable of venting air or preventing vacuum. The main body shall have a ½” male pipe thread (MPT). Operating pressure range for the air/vacuum relief valve shall be 7 PSI minimum to 140 PSI maximum.

2.9 CHECK VALVES:

A. Swing Check Valves: PVC, Slip x Slip check valves, for non-pressure lateral line applications on slopes.

B. Spring Check Valves: for pop-up spray heads and spray heads on risers and ¾” for popup rotors and rotors on risers.

2.10 FLUSH VALVE ASSEMBLIES

- A. Schedule 40 Ball Valve, threaded schedule 80 nipples and fittings with polyethylene tubing for flush hose.

2.11 BUBBLERS:

- A. Bubblers shall be constructed of heavy duty plastic and be pressure compensation full circle. The bubbler shall have a 20 mesh screen to protect it from clogging.
- B. Bubblers shall be adjustable from .25 - 1.0 GPM and operate between 20-90 PSI.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspection:
 - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 - 2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the reference standards and the manufacturer's recommendations.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the Architect.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 FIELD MEASUREMENTS

- A. General:
 - 1. Trenches and other excavations for irrigation pipe and appurtenances shall be excavated true to alignment and grade, and shall be of ample size for the proper performance of installation work, review, testing and backfill.
 - 2. Where it is necessary to excavate adjacent to existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots.
 - 3. Protect all existing utilities and repair any damage to existing utilities with matching new materials, at no increase in contract price.
 - 4. Generally, piping under concrete shall be installed by jacking, boring or hydraulic driving. Where any cutting or breaking of sidewalks and/or concrete work is necessary, it shall be removed and replaced by the Contractor. Permission to cut or break sidewalks and/or concrete shall be obtained from the Architect. No hydraulic driving will be permitted under asphaltic concrete paving.
 - 5. Coordinate with planting operations, as 10" deep cross-ripping is required prior to irrigation systems installation. (cross-ripping is part of the planting work).
- B. Plastic Pipe Trenches:
 - 1. Minimum trench width shall be six (6) inches.
 - 2. Minimum trench depth below bottom of pipe shall be two (2) inches.
 - 3. Minimum cover shall be based on finished grades, unless otherwise noted on Drawings.
 - a. Lateral Line minimum cover shall be twelve (12) inches.
 - b. Main Line minimum cover shall be eighteen (18) inches.
 - c. Pipe and Wire Sleeves minimum cover shall be twenty four (24) inches.
- C. Backfill Material:
 - 1. All plastic pipe shall be bedded and encased with approved backfill material free of rocks and clods as indicated in the following table and/or shown on the plans.

Thickness Under	Thickness Above	Thickness at Side
-----------------	-----------------	-------------------

Pipe Minimum	Pipe Minimum	of Pipe Minimum
Two (2) inches	Four (4) inches	Two (2) inches

2. The balance of backfill material shall be approved soil. Unsuitable material, including clods and rocks over 2 to 2 1/2 inches in size, shall be removed from the premises and disposed of legally at no cost to the Owner.
3. Backfill material shall be sufficiently compacted under and on each side of the pipe to provide support free of voids. On slope areas over 3:1 gradient compaction shall be 85% (min) or equal to the requirements of the grading plans, whichever is greater. Pipe joints shall remain exposed until the completion of pressure and leakage test, unless authorized by the Architect. The top six (6) inches of backfill shall be free of rocks over one (1) inch, subsoil, rubbish and debris.
4. The remainder of the backfill material shall contain no lumps or rocks larger than two and one half (2 1/2) inches, nor contain rubbish and debris.
5. Backfill shall be tamped or puddled to the dry density of adjacent soil. Backfill within areas of structurally compacted soils shall be returned to the original relative density as before trenching.

D. Location Wire:

1. Location wire shall be placed on top of the four inch select backfill over all mainline (pressure bearing) pipes, except copper pipe. Wire shall be No. 12 gauge copper, new or used or an approved substitute, and shall provide a continuous electrical conductor between gate valves and control valves. Each end shall be brought to the valve sleeve and two feet of wire looped free in the trench beside the valve body. This location wire may be omitted where copper hydraulic control tubing or electric control wire follows the water main.

3.3 INSTALLATION OF POLYVINYL CHLORIDE PIPE

- A. Polyvinyl chloride pipe shall be installed in such a manner so as to provide for expansion and contraction as recommended by the manufacturer.
- B. All polyvinyl chloride pipe shall lay free in the trench with no induced strain. Where there is evidence of induced pipe strain, the Contractor shall be required to make pipe cuts and install angle fittings as necessary to eliminate the strain.
- C. When a connection is plastic to metal, a female adapter shall be used. The metal nipple shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Permatex, Type 2, or Teflon Tape.
- D. The Contractor will be required to remove and replace any fitting which induces a torque strain to the pipe.
- E. Polyvinyl chloride pipe shall be cut with a PVC pipe cutter, hand saw or hack saw with the assistance of a square and sawing vise or in a manner so as to ensure square ends. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.
- F. All plastic to plastic joints shall be solvent weld joints. Only the solvent recommended by the pipe manufacturer shall be used.
- G. The solvent weld joints shall be made in the following manner:

- Thoroughly clean the mating pipe and fitting with a clean dry cloth.

-Try the parts for fit. The parts should "dry mate" between one third and two thirds the depth of the socket. If adequate insertion is not obtained, or bottoming occurs, try another part until a satisfactory "dry fit" is obtained.

-Apply a uniform coat of solvent to the outside of the pipe with a non synthetic bristle brush.

NOTE: For PVC. Type I, 1120 1220, pipe mating surface shall first be cleaned with the application of Methyl Isobutyl Ketone (MIBK) solvent. This cleaning shall be accomplished by applying MIBK solvent to the full mating surface area and wiping off with a clean cloth, repeating the process, if necessary, until no trace of shine remains (neither streaks nor spots). The use of commercial PVC solvent cement thinners as a substitute of MIBK is not allowed.

- Apply a uniform coat of solvent weld to the fitting socket.
- Re apply a light coat of solvent weld to the pipe and quickly insert it into the fitting.
- Give the pipe or fitting a quarter turn to ensure even distribution of the solvents and make sure that the pipe is inserted to the full depth of the fitting socket.
- Hold in position for at least 15 seconds.
- Wipe off excess solvent that appears at the outer shoulder of the fitting.

3.4 INSTALLATION OF CONTROL WIRE

- A. Unless otherwise specified, the installation of control wire shall include excavation and backfill, the furnishing, installing and testing of the wires, the removal and/or restoration of existing improvements and all other work in accordance with the plans and specifications.
- B. Unless otherwise specified all neutral (common ground) wire shall be AWG #12 and all pilot (valve control) wire shall be AWG #14.
- C. At least one spare wire shall be installed from the controller clock to the most distant valve. When wire runs go in different directions from the controller clock, a separate spare wire shall be installed from the controller clock to the most distant valve in each different wire run direction.
- D. Tape and bundle all control wires at 10' o/c maximum; place wiring with 18" minimum cover. When wiring is placed in common trenches with piping, set wiring 2" from any piping.
- E. All wire splicing shall take place in the valve boxes and/or pull boxes. All splices shall be made with a mechanical connector encased in a self curing epoxy resin which provides a permanent watertight connection.
- F. All direct burial control wires shall be identified as to their respective valve number and controller clock letter in all pull boxes and at all wire termination. Spare wires and "future valve" wires, if any, shall also be identified. Labels and tags shall be used for identification which are not affected by moisture or temperatures between minus 30 degrees F. and plus 200 degrees F. The labels and tags shall be resistant to abrasion, dirt, grease, and chemicals used in lawn fertilizers and conditioners. The labels and tags shall be firmly attached to the wire in every case. The Contractor shall submit samples of the labels or tags to be used, to the Architect for recommended approval, prior to the installation of the control wire. Examples of nomenclature of tags or labels are as follows:

Neutral (common ground) wire= "Neutral" Clock "A"

Pilot (valve control) wire= "A.V. #1." Clock "A"

Spare Wire= "Spare" Clock "A"

- G. The final operating sequence of the remote control valves, within each individual controller clock, shall be as called out on drawings.
- H. Testing:
 - 1. All direct burial control wire installed shall be tested in the following manner.

- Before any backfill material is placed over the control wires in the trench, the wires shall be tested with a meter for insulation resistance. Minimum insulation resistance to ground shall be fifty (50) megohms. Any conductor not meeting this requirement shall be replaced.
 - After backfill encasement, the wires shall again be tested with a meter. The minimum acceptable insulation resistance to ground on this test shall be one (1) megohm. Any conductor not meeting this requirement shall be replaced.
- I. Provide separate common wire for each controller installed.

3.5 INSTALLATION OF VALVES

- A. General: Unless otherwise specified, the installation of the valves shall include excavation and backfill, the furnishing, installing and testing of risers, fittings and valves, the furnishing and installing of appurtenances, accessories, anchors and thrust blocks, the removal and/or restoration of existing improvements and all other work in accordance with the plans and specifications.
- B. Group control valves together as specified on the drawings with a minimum spacing of 36" between each valve box.
- C. Ball Valves: Valves installed underground shall be housed in a NDS Spec Grade plastic valve box, no equivalents or equals.
- D. Automatic Control Valves: Automatic control valves shall be set upright and housed in plastic Christy plastic valve box. The Contractor shall brand, the identification number of the valve and clock on the outside cover of the box.

3.6 INSTALLATION OF AUTOMATIC CONTROLLERS

- A. Unless otherwise specified, the installation of automatic controllers shall include the furnishing, the installing, making necessary electrical connections, the testing of controllers and connection, and all other work as called for on the plans and/or in the specifications.
- B. All electrical conduit shall be P.V.C. Sunstop ULV Schedule 40 pipe & fittings.
- C. Install controllers at 5' min. away from 3 phase power.
- D. Unless otherwise specified the installation of controllers shall be as detailed on plan.
- E. Controllers shall be tested for fourteen (14) calendar days after complete installation of the sprinkler system. System shall operate automatically in the manner shown on the drawings and/or specified herein.
- F. Controllers shall be tested for fourteen (14) calendar days after complete installation of the irrigation system. System shall operate automatically in the manner shown on the drawings and/or specified herein.

3.7 INSTALLATION OF SPRINKLER HEADS

- A. Unless otherwise specified, the installation of sprinkler heads shall include excavation and backfill, the furnishing, installing and testing of risers, fittings and heads, the furnishing and installing of anchors and thrust blocks, the furnishing and installing of cone shaped screens at base of each head, the removal and/or restoration of existing improvements and all other work shall be in accordance with the plans and specifications.
- B. Flushing: All water lines shall be thoroughly out before heads are installed.
- C. Location and arc of heads shall be adjusted, if required to eliminate any dry spots, over water or spillage on adjacent areas.

- D. All shrubbery heads shall be set to a maximum height of two (2) inches above the grade. Shrubby heads installed in all other areas shall be twelve (12) inches above finished grades unless otherwise indicated on the plans. Pop up shrub heads shall be installed as detailed.

3.8 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install drip tubing per plans and details.
- B. Install application pressure regulators in piping near device being protected, and in control-valve boxes.
- C. Install air relief valves and vacuum relief valves in piping, and in 6" round control-valve boxes.

3.9 DRAWINGS OF RECORD & TURNOVER ITEMS

- A. Record Drawings: The Contractor shall provide and keep up to date, a complete record set of bond prints which shall be corrected daily and show every change from the original drawings and specifications and the exact locations, sizes and kinds of equipment. Prints for this purpose may be obtained from the Owner. This set of drawings shall be kept on the site and shall be used only as a record set.
- B. The drawings shall also serve as work progress sheets, and the contractor shall make neat and legible annotations thereon daily as the work proceeds, showing the work as actually installed. These drawings shall be available at all times for inspections and shall be kept in a location designated by the Owner.
- C. In order to complete the record drawings in a neat, legible manner, the contractor shall employ a competent draftsman, satisfactory to the Owner's authorize representative, to indicate the necessary changes on mylar tracings procured from the Owner and deliver same to the Owner two weeks prior to the final review by the Architect.
- D. The contractor shall dimension from two (2) permanent points of reference, building corners, sidewalks, or road intersections, etc., the location of the following items:
- The routing of the sprinkler main lines
 - Connections to the existing water lines
 - Control valves and Isolation valves
 - Quick Couplers
 - Any other pertinent underground item, if so deemed by the Landscape Architect.
- E. Controller Charts:
1. Provide one controller chart for each controller supplied.
 2. Record drawings shall be recommended for approval by the Landscape Architect before charts are prepared.
 3. These charts shall be completed and reviewed prior to final observation of the irrigation system, and prior to final payment.
 4. Update and prepare new controller charts at end of the 1 year maintenance period.
 5. The chart shall show the area controlled by automatic controller and shall be no larger than the 24" x 36" original.
 6. The chart is to be a reduced drawing of the actual system. However, the chart shall only be reduced to a size which is completely legible.
 7. Chart shall be black line print and shall be colored with a different color for each station.
 8. The chart shall be mounted using Velcro, or an approved equal type of tape.
 9. When completed and recommended for approval, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils thick.
- F. Turnover Items:

1. Supply as part of this contract the following items:
 - a. Four (4) additional sprinkler heads of each type and spray pattern shown on plans.
 - b. Five (5) drip emitters of each type and (5) poly flex risers, for each 100 emitters installed on the project.
 - c. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head shown on plans.
 - d. Two (2) keys for each automatic controller.
 - e. Two (2) service manuals for equipment installed.
 - f. Two (2) quick couplers with a 3/4" bronze hose bib, bent nose type with hand wheel and two (2) quick coupler keys to match quick couplers shown on plan.
 - g. Two (2) valve box cover keys or wrenches.
 - h. Backflow device valve handles and Water Department inspection documentation.
 - i. 100' L.F. of drip tubing.

3.10 TESTS

A. Pressure Tests:

1. All pressure lines shall be tested under hydrostatic pressure of 150 pounds per square inch, and all non pressure lines shall be tested under the existing static pressure and both be proved watertight. Contractor shall provide all equipment for hydrostatic tests at no cost to the Owner.
2. Pressure shall be sustained in the lines for not less than three (3) hours. If leaks develop, the joints shall be replaced and the test repeated until the entire system is proved watertight.
3. Tests shall be observed and recommended for approval by the Landscape Architect prior to backfill.

B. Coverage Test:

1. When the irrigation system is completed, the Contractor, in the presence of the Architect, shall perform a test coverage of water afforded the planting areas, complete and adequate. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage disclosed arising from his work.
2. Contractor shall inform the Owner's representative of any deviation from the plan required due to wind, planting, soil or site conditions that bear on proper coverage; and upon approval, perform changes to provide for proper coverage at no additional cost to the Owner.

3.11 REVIEWS

A. Normal Progress Reviews: Normal progress reviews shall be requested from the Architect at least 48 hours in advance of any anticipated review. A review will be made by the Architect on each of the steps listed below. The Contractor will not be permitted to initiate the succeeding steps of work until he has received written approval to proceed by the inspector.

1. Immediately prior to the commencement of the work of the section.
2. Irrigation materials and equipment to be used.
3. After trenching and before backfill.
4. Completion of line testing, test to be made prior to backfill.
5. After placement of all heads, valves and controllers for coverage.
6. Final review and receipt of "Record Drawings"/"Controller Charts".
7. Final acceptance of project by Owner.
8. In no event shall the Contractor cover up or otherwise remove from view any work under this contract without prior approval. Any work covered prior to review shall be opened to view by the Contractor, at his expense.

B. Unprepared Review Requests: In the event the Contractor requests review of work and said work is incomplete, the Contractor shall be responsible for review cost.

C. Completion: The work will be accepted, in writing, when the whole shall have been completed satisfactorily to the Owner and the Architect. In judging the work, no allowance for deviation from the original plans and specifications will be made unless already approved by Owner, in writing, at the proper times.

1. Leave the entire installation in complete operating order, free from any and all defects in material, workmanship or finish, regardless of any discrepancies and/or omissions in plans or specifications.
2. Remove from the site all debris and rubbish resulting from the work, and leave the installation in clean condition.

3.12 GUARANTEE

- A. General: The entire sprinkler system, including all work done under this contract, shall be guaranteed against all defects and fault of material and workmanship for a period of one (1) year following the filing of the Notice of Completion. All materials used shall carry a manufacturer's guarantee of one (1) year.

Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to the Owner within ten (10) calendar days of receipt of written notice from the Owner. When the nature of the repairs as determined by the Owner constitute an emergency (e.g. broken pressure line) the Owner may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Owner by the Contractor, all at no additional cost to the Owner.

- B. Form of Guarantee: Guarantee shall be submitted on Contractors own letterhead as follows:

FORM OF GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defects in materials or workmanship which may develop during the period of one year from date of filing of the Notice of Completion and also the repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within 10 calendar days following written notification by the Owner. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT: _____

LOCATION: _____

SIGNED: _____

ADDRESS: _____

PHONE: _____

- C. After the system has been completed, the Contractor shall instruct the Owner's Department Representative in the operation and maintenance of the system and shall furnish a complete set of operating instructions.
- D. Any setting of trenches which may occur during the one-year period following acceptance shall be repaired to Owner's satisfaction by the Contractor without any additional expense to the Owner. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

3.13 MAINTENANCE

- A. Maintenance of irrigation system prior to job completion, and during the Landscape Maintenance period, shall be the responsibility of the Contractor including, but not limited to, the following:
1. Cleaning of plugged irrigation heads.
 2. Irrigation heads adjustments.
 3. Volume of water being applied (coordinate with landscape maintenance.)
 4. Programming of the controller (coordinate with landscape maintenance.)
 5. Repairing leaking valves, etc.
 6. Any other problem areas which occur after installation attributed to the irrigation system.
 7. Repair or replace equipment due to acts of vandalism, theft or pest damage.

3.14 PAYMENT TERMS

Payment for irrigation work will be at the lump sum price bid for irrigation. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in irrigation as herein specified. A 10% retention shall apply to all irrigation work.

END OF SECTION

SECTION 32 90 00

PLANTING

PART 1 - GENERAL REQUIREMENTS

1.1 RELATED DOCUMENTS

- A. The provisions of the "Standard Specifications for Public Works Construction, (SSPWC)" latest edition, shall apply except as modified herein.

1.2 SCOPE

- A. Work of this Section includes all material, equipment, and labor necessary for and incidental to completing all Landscape Planting work as indicated on the Drawings, or as reasonably implied, or as designated herein, including, but not limited to, the following.

Soil testing approvals.

Weed abatement.

Soil preparation.

Finish grading.

Preparation of all planting holes.

Furnishing and installation of all plant materials unless otherwise noted.

Furnishing and installation of all required fertilizers, planting backfill materials, top

Dressing and miscellaneous materials.

Staking and tying trees.

Providing plant establishment (30 days).

Providing landscape maintenance (90 days).

Clean up and weeding of all landscape areas.

One year guarantee.

1.3 RELATED WORK SPECIFIED ELSEWHERE

Irrigation system: Section 32 80 00

1.4 QUALITY ASSURANCE

- A. The Contractor shall provide at least one person who shall be present at all times during execution of this portion of the work, who shall be thoroughly familiar with the type of materials being installed and the proper materials and methods for their installation, and who shall direct all work performed under this Section.
- B. All plants and planting material shall meet or exceed the specifications of Federal, State and County laws requiring inspection for plant disease and insect control.
- C. Quality and size shall conform with the current edition of "Horticultural Standards" for number one grade nursery stock as adopted by the American Association of Nurserymen, and California Department of Agriculture regulations.
- D. The Applicator of all weed control materials shall be licensed by the State of California as a Pest Control Operator and a Pest Control Advisor in addition to any subcontractor licenses that are required.

- E. All materials and methods used for Weed Abatement must conform to Federal, State, and Local Regulations.

1.5 APPROVALS

- A. All irrigation system work shall be inspected for recommended approval by the Landscape Architect and/or the Owner prior to start of any work in this section.

1.6 TESTING

- A. An Agricultural Soil Suitability Report for all planting areas shall be obtained by the Contractor, after completion of rough grading, and prior to start of soil preparation work. The Contractor, at his own expense, shall submit at least four (4) composite site soil samples to a Soil Laboratory recommended by the Landscape Architect. Samples are to be taken from the top six inches (6") of soil in areas to receive planting. All test results and recommendations shall be provided to the Landscape Architect and/or the Owner. The requirements for fertilization and amendments as specified herein, may be modified as necessary prior to start of work in this section. Provide test results and recommendations to the Landscape Architect at least 60 days prior to soil preparation for planting.
- B. After the completion of soil preparation and prior to the start of any planting, soil samples shall again be taken. Quantity and methods shall be the same as previously executed. Contractor shall not commence planting until so directed by the Landscape Architect and the Owner.

1.7 SUBMITTALS

- A. Materials lists: Within forty five (45) days after award of the Contract, submit a complete list of all materials proposed to be furnished and installed under this Section, demonstrating complete conformance with the requirements specified.
 - 1. Materials list shall include the weed control materials and quantities per acre intended for use in controlling the weed types prevalent and expected on the site, as supplied by the Pest Control Advisor. Pest Control Advisor shall furnish the Landscape Contractor and Landscape Architect data to demonstrate the compatibility of the weed control materials and methods with the intended plant varieties.
 - 2. Materials list shall include nursery provided photos of trees and plant material. Each photo shall note representative height x width and box size of trees, gallon size of plants, and nursery company name/location/contact name. Quantities of each plant type shall be noted.
- B. Certificates: Deliver all certificates to the owner's inspector and to the Landscape Architect upon delivery to job site. Include:
 - 1. Quantity of commercial fertilizers used.
 - 2. Quantity of soil amendments.
 - 3. Quantity of plant material.

1.8 PRODUCT HANDLING

- A. Delivery and Storage:
 - 1. Deliver all items to the job site in their original containers with all labels intact and legible at time of Landscape Architect's review.
 - 2. Immediately remove from the site all plants which are not true to name, and all materials which do not comply with the specified requirements.
 - 3. Use all means necessary to protect plant materials before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the recommended approval of the Landscape Architect and at no additional cost to the Owner.

1.9 RESPONSIBILITY AND COORDINATION DURING WEED ABATEMENT

- A. During Weed Abatement procedures, the Landscape Contractor is responsible for the erection of all signs and barriers required to prevent intrusion into the treated areas and to notify the public.
- B. No material or methods used for Weed Abatement shall affect the landscape planting. No material or method shall render the job site unusable for more than ten (10) days from date of application.

PART 2 - MATERIALS

All materials shall conform to the requirements of Section 212 of the Standard Specifications, except as modified herein.

2.1 LANDSCAPE FINISH GRADING

- A. Site topsoil material No import soil.

2.2 NON-SELECTIVE HERBICIDES

- A. Non selective contact herbicide and/or non selective systemic herbicides (as recommended by the Pest Control Advisor).

2.3 SELECTIVE HERBICIDES

- A. Selective pre emergent herbicides ('Ronstar G' or equal or as recommended by the Pest Control Advisor).

2.4 SOIL CONDITIONERS AND FERTILIZERS

- A. Soil conditioners may include any or all of the conditioners herein specified and shall be applied at rates indicated on the plans or as determined by the Agronomical Soils Report.
- B. Shavings: Nitrogen stabilized organic amendments derived from redwood sawdust, fir sawdust or finely ground bark of fir or pine containing the following physical properties:

<u>Percent Passing</u>	<u>Sieve Size</u>
95 – 100	6.33 mm (1/4 inch)
80 – 100	2.38 mm (No. 8, 8 mesh)
0 – 30	500 Micron (No. 35, 32 mesh)

- C. Nitrogen Content - Dry weight 0.56% - 0.84%
- D. Iron Content - Minimum 0.08% dilute acid soluble Fe. on dry weight basis.
- E. Soluble Salts - 2.5 millimohos/centimeter at 25 degrees C. as determined by maximum saturation extract method.
- F. Ash - (Dry weight) 0 - 6.0%
- G. Fertilizer: Commercial fertilizers with an analysis of 5-3-1 Gro-Power Plus, 16-20-0, and 12-8-8 Gro-Power Controlled Release Nitrogen, as designated herein, or approved substitute as required by the Agronomical soils report.
 - 1. Fertilizer shall be delivered to the site in the original unopened containers, bearing the manufacturer's guaranteed analysis. Any fertilizer that becomes caked or damaged, making it unsuitable for use, will not be accepted.

2. Available from: Gro Power (213) 245-6849 or (714) 750-3830.

- H. Gypsum: To be agricultural grade gypsum and shall conform to Section 212-1.2 of Standard Specifications for Public Works Construction, Latest Edition.
- I. Iron Sulfate: Pelleted or granular form containing not less than 18.5% expressed metallic iron and shall be registered as an agricultural mineral, with the State Department of Agriculture in compliance with Article 2 - "Fertilizer Materials," Section 1030 of the Agricultural Code.
- J. Ammonium Sulfate: Granular form containing not less than 21% nitrogen and 24% sulfur and shall be registered as an agricultural miner, with the State Department of Agriculture in compliance with Article 2 - "Fertilizer Materials," Section 1030 of the Agricultural Code.

2.5 PLANTING TABLETS

- A. Fertilizer planting tablets shall be tightly compressed commercial grade planting tablets having a 12-8-8 formula, weighting 7 grams each, as "Gro Power" planter tablets or equal. The planting tablets shall be delivered to the site in the original, unopened containers, bearing the manufacturer's guaranteed analysis. Any damaged tablets will not be accepted.

2.6 PLANT MATERIALS

- A. Nomenclature: The scientific and common names of plants herein specified conform to industry standards. (Refer to list of plant materials on Drawings).
- B. Labeling: Each group of plant materials delivered to the site shall be clearly labeled as to species and variety and nursery source.
- C. Quality and Size:
 - 1. Plants shall be in accordance with the California State Department of Agriculture's regulation for nursery inspections, rules and grading. All plants shall have a normal habit of growth and shall be sound, healthy, vigorous, and free of insect infestations, plant diseases, sun scalds, fresh abrasions of the bark, excessive abrasions, or other objectionable disfigurements. All plants shall have normally well developed branch system, with vigorous and fibrous root systems which are not root or pot bound. In the event of disagreement as to condition of the plants furnished by the Contractor in containers will be determined by removal of earth from the roots of not less than two plants or more than 2% of the total number of plants of each species or variety. Where container grown plants are from several sources, the roots of not less than two plants of each species or variety from each source will be inspected. In case the sample plants reviewed are found to be defective, the Landscape Architect and the Owner may judge acceptability. Any plants rendered unsuitable for planting because of this review will be considered as samples and will be provided at the expense of the Contractor.
 - 2. The size of the plants will correspond with that normally expected for species and variety of commercially available nursery stock, or as specified in the special Conditions or Drawings. The minimum acceptable size of all plants measured before pruning with the branches in normal position, shall conform with the measurements, if any, specified on the Drawings in the list of plants to be furnished. The minimum box or container size for all plants (Trees, Shrubs, Vines, and Groundcovers) shall be as indicated on the drawings. Plants larger in size than specified may be used with the recommended approval of the Landscape Architect, but the use of larger plants will make no change in contract price. If the use of larger plants is recommended for approval, the ball of earth or spread of roots for each plant shall be increased proportionately.
- D. Rejection or Substitution: All plants not conforming to the requirements herein specified shall be considered defective, and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site of the work and replaced with new plants at the contractor's expense. The plants shall be of the species, variety, size and

condition specified herein or shown on the drawings. Under no condition will there be any substitution of plants or sizes for those listed on the accompanying plans, except with the expressed consent of the Landscape Architect.

- E. Pruning: At no time shall the tree or plant materials be pruned, trimmed or topped prior to delivery, and any alteration of their shape shall be conducted only with the recommended approval and when in the presence of the Landscape Architect.
- F. Protection: All plants at all times shall be handled and stored so that they are adequately protected from drying out, from wind burn, or from any other injury.
- G. Right of Review: The Landscape Architect reserves the right to recommend approval or rejection at any time upon delivery or during the work, any or all plant material regarding size, variety or condition.

2.7 MULCH

- A. Mulch material and depth are per plans.

2.8 TREE SUPPORTS

- A. Tree ties shall be "CINCH TIE" black rubber ties, and shall be uniform throughout the project. Or, Owner approved equal.
- B. Tree support stakes shall be minimum three inches (3") diameter lodge pole pine, copper naphthenate treated, ten feet (10') length.

2.9 JUTE NETTING

- A. Jute netting shall be new and shall be of uniform, plain weave, flame-retardant mesh. The mesh shall be dyed green and shall be made from unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Jute netting shall be furnished in rolled strips and shall meet the following requirements:
 - 1. Width 48 inches, with a tolerance of one inch wider or narrower.
 - 2. Minimum 78 warp ends per width of roll.
 - 3. Minimum 41 weft ends per yard of length.
 - 4. Weight shall average 1.22 pounds per linear yard, with a tolerance of 5 percent heavier or lighter.

PART 3 - EXECUTION

Installation shall conform to the requirements of Section 308 of the "Standard Specifications," except as modified herein.

3.1 GENERAL

- A. Prior to the start of work of this Section, all trash and deleterious materials on the surface of the ground shall be removed and legally disposed of.

3.2 WEED ABATEMENT

- A. Prior to the installation of the irrigation system, all weed growth shall be removed within the areas designated to be cleared and grubbed. Refer to plans for limit of work.
 - 1. If in the opinion of the Pest Control Advisor, perennial grasses and weeds existing in the planting areas will require control prior to removal, spray these areas per Pest Control Adviser's recommendations. Allow herbicide

to kill all weeds. Rake or hoe off all dead weeds to a depth of one to two inches (1" to 2") below the surface of the soil. Physically remove all weeds from the site.

- B. Upon completion of the irrigation system and rototilling of soil amendments into the soil and immediately preceding the installation of plant material, perform weed abatement as follows, and per Pest Control Advisors recommendation.
1. Apply Sulfate of Ammonia at the rate of five pounds (5 lbs.) per one thousand square feet (1,000 sf.) to all planting areas.
 2. Irrigate area for fourteen (14) consecutive days, to germinate existing weed seeds.
 3. Apply by spray a non selective herbicide to eradicate all existing weeds. Do not irrigate for seven (7) days after application.
 4. Remove weeds after herbicide has had time to sufficiently kill. Remove all dead weeds by rake or hoe to a depth of one to two inches (1" to 2") below the surface of the soil. Remove all weed residue and top growth and dispose of in a legal manner.

3.3 SOIL PREPARATION AND FINE GRADE

- A. Soil Preparation: Prior to spreading soil amendments and prior to installation of irrigation systems, cross-rip or otherwise till to a depth of nine inches (9") all planting areas to receive soil preparation. All rock one inch (1") and larger shall be removed to a depth of nine inches (9"). Dispose of all debris off site in a legal manner.
- B. Planting Areas: To all planting areas (shrub and groundcover), uniformly broadcast soil amendments and thoroughly incorporate to a minimum six inch (6") depth by means of a rototiller or equal.
- C. Soil Amendments are to be thoroughly incorporated at the following rates per one thousand square feet (1,000 sf.) by rototilling or other approved method:

3 cu. yds.	Nitrogen stabilized organic amendment
200 lbs.	5-3-1 Gro-Power Plus
50 bs.	Iron Sulfate*
50 bs.	Agricultural Gypsum

(Mix to be used for bidding purposes only, to be verified with Agronomical Soils Test.) Care shall be taken when using or handling Iron Sulfate to avoid contact with cement.

- D. Finish Grade:
1. Rough grade has been left within one tenth (1/10) of one foot (1') of finish grade.
 2. Work such as fine grading and light cultivation are required of all planting areas indicated on plan to prepare grades prior to planting.
 3. After approximate finished grades have been established, all soil areas shall be compacted and settled by application of heavy irrigation to a minimum depth of twelve inches (12").

3.4 EROSION CONTROL:

- A. "308-4.9.6 Jute Netting. All slope areas greater than 5 feet in height and exceeding 3:1 shall receive jute netting. Netting shall also be provided during the Plant Establishment & Maintenance Period, when and as directed by the Landscape Architect, along flow lines and other locations where erosion is evident. Jute netting shall be installed loosely, up and down the slope. The installed netting shall fit the soil surface contour and shall be held in place by 9-inch long, 11-gauge (minimum) steel wire staples driven vertically into the soil at approximately 24-inch spacing. Jute netting strips shall overlap along the sides at least 6 inches. Ends of strips shall be buried into the soil at least 6 inches. Lap all ends of rolls a minimum of 24".

3.5 FINAL GRADES

- A. After the foregoing specified deep watering, minor modifications to grade may be required to establish the final grade. These areas shall not be worked until the moisture content has been reduced to a point where working it will not destroy soil structure.
- B. Finish grading shall ensure proper drainage of the site.
- C. Finished earth berm surfaces shall be smooth and even between contours; shapes shall be to the satisfaction of the Landscape Architect.
- D. All areas shall be graded so the final grades will be one inch (1") below adjacent paved areas, sidewalks, valve boxes, clean outs, drains, manholes, etc.
- E. All shrub areas to receive mulch per plans.
- F. Surface drainage shall be away from all building foundations.
- G. Eliminate all erosion scars.
- H. The Contractor shall request a review by the Landscape Architect for recommended approval of the final grades and elevations before beginning planting operations.

3.6 TREE AND SHRUB INSTALLATION

- A. All planting and bare dirt areas are to be treated with a pre-emergent chemical (subject to approval by Landscape Architect prior to application). Chemicals are to be applied by a licensed by a Pest Control Agent at the rates recommended by the manufacturer. This treatment shall be applied at the following times during the contract: a) before planting, b) at the beginning of plant establishment period and c) at the end of the plant establishment period. No chemicals shall be applied other than in the presence of the inspector.
- B. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as reviewed by the Landscape Architect.
- C. All irrigation work shall have been reviewed by the Landscape Architect prior to beginning any planting.
- D. Installation of all plant material shall be in accordance with the details on the Planting Plans.
- E. Locations for plants and outlines of areas to be planted shall be marked on the ground by the Contractor before any plant pits are dug. All such locations shall be reviewed by the Landscape Architect and Owner/Agent. If an underground -construction or utility line is encountered in the excavation of planting areas, notify Landscape Architect so that other locations for planting may be selected.
- F. Excavation for Planting:
 - 1. Excavation for planting shall include the stripping and stacking of all acceptable topsoil encountered within the areas to be excavated for trenches, tree holes, plant pits and planting beds.
 - 2. Protect all areas from excessive compaction when trucking plants or other material to the planting site.
 - 3. All excavated holes shall have vertical sides with roughened surfaces and shall be of a size that is at least two times the width and depth of the original plant container. The holes shall be, in all cases, large enough to permit handling and planting without injury or breakage to the roots or root ball.
- G. Planting:
 - 1. No planting shall be done in any area until the area concerned has been satisfactorily prepared in accordance with these Specifications.
 - 2. No more plants shall be distributed in the planting area on any day than can be planted and watered on that day.

3. Containers shall be cut and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken, and they shall be planted and watered as herein specified immediately after the removal from the containers. Containers shall not be cut prior to placing the plants in the planting area.
4. The amended surface soil can be used for backfill around trees and shrubs; where additional quantities are required, use the following formula (thoroughly blended):

Native On Site Soil (No rock larger than 1")	6 parts
Nitrolized Wood Shavings	4 parts
Commercial fertilizer Gro-Power Plus 5-3-1	15 lbs/cy
Iron Sulfate	2 lbs/cy

For Acid Loving Plants

80% Course Peat Moss
20% Sponge Rock or Light Soil Mix

(Mix to be used for bidding purposes only, to be verified with Agronomical Soils Test).

5. Overexcavate plant pit and recompact native soil to depth of bottom of rootball.
 6. Native soil shall be placed at the bottom of each hole, and thoroughly compacted to a height that when a plant is placed in the hole, its root crown is slightly above the established final grade. Any plants which settle deeper than specified above shall be raised back to the correct level. After the plant has been placed, backfill shall be added to the hole to cover approximately one-half the height of the root ball. At this stage, water shall be added to the top of the partly filled hole to thoroughly saturate the root ball and adjacent soil.
 7. After the water has completely drained, fertilizer tablets shall be placed as indicated below:
 - 3 tablets per one gallon container.
 - 6 tablets per five gallon container.
 - 12 tablets per fifteen gallon container.
 - 14 tablets per 24" box container.
 - 17 tablets per 30" box container.
 - 20 tablets per 36" box container.
 - 23 tablets per 48" box container.
 - 30 tablets per 60" box container.
 8. The remainder of the hole shall then be backfilled.
 9. Set the tablets to be used with each plant on the top of the root ball while the plants are still in their containers so the required number of tablets to be used in each hole can be easily verified.
 10. After backfilling, an earthen basin shall be constructed around each plant. Each basin shall be of a depth sufficient to hold at least two inches (2") of water. Basins shall be of a size suitable for the individual plant. In no case, shall the basin for a fifteen (15) gallon plant be less than four feet (4') in diameter; a five (5) gallon plant less than three feet (3') in diameter; and a one (1) gallon plant less than two feet (2') in diameter. the basins shall be constructed of amended backfill material. Rake out basins prior to planting lawn areas, groundcover areas, or placing mulch layer.
- H. Pruning: Pruning shall be limited to the minimum necessary to remove injured twigs and branches, and to compensate for loss of roots during transplanting, but never to exceed one third (1/3) of the branching structure. Upon recommended approval of the Landscape Architect, pruning may be done before delivery of plants, but not before plants have been reviewed and recommended for approval. Cuts over three quarters of an inch (3/4") in diameter shall be painted with an approved tree wound paint.
- I. Staking and Tying:
1. Support stakes tall enough to support the particular tree shall be driven thirty six inches (36") into the soil. Stake shall be placed on the leeward side of the tree from the most troublesome direction, refer to details on Drawings.

2. Ties shall be placed as low on the trunk as possible but high enough so the tree will return to upright after deflection.
3. To find the proper height for tie locations, hold the trunk in one hand, pull the top to one side and release. The height at which the trunk will just return to the upright when the top is released is the height at which to attach the ties.
4. Ties are to form a loose loop around the tree trunk so that the trunk cannot work towards the support stakes.
5. One tree of each size shall be staked and reviewed by the Landscape Architect prior to continued staking.

3.7 WATERING

- A. Apply water to all planted areas during operations and thereafter, until acceptance of the work.
- B. Immediately after planting, apply water to each shrub by means of a hose. Apply water in a moderate stream in the planting hole until the material about the roots are completely saturated from the bottom of the hole to the top of the ground.
- C. Apply water in sufficient quantities and as often as seasonal conditions require to keep the planted areas sufficiently moist [not wet] at all times, well below the root system of plants.
- D. All groundcover areas shall be kept damp at all times and irrigation should be adjusted accordingly. This normally would involve four (4) to six (6) watering periods daily, each watering period (ON) regulated to just dampen the mulch without creating run off.
- E. Intervals between irrigation (OFF) sequence should be judged by the length of the time mulch remain damp. Once the mulch begins to dry out, the water (ON) sequence should be repeated.

3.8 ESTABLISHMENT AND MAINTENANCE PERIOD

- A. The Contractor shall continuously maintain all areas involved in this contract during the progress of the work and during the establishment and maintenance period until final acceptance of the work by the Owner.
- B. Plant establishment period: The contractual establishment period shall be for no less than thirty (30) continuous calendar days. The contractual establishment period begins on the first day after all planting in this project is completed and accepted and the planted areas are brought to a neat, clean and weed free condition.
 1. Any day upon which no work will be required, as determined by the Landscape Architect, will be credited as one of the plant establishment working days regardless of whether or not the Contractor performs plant establishment work.
 2. Any day when the Contractor fails to adequately maintain plantings, replace unsuitable plants or do weed control or other work, as determined necessary by the Landscape Architect, will not be credited as one of the plant establishment working days.
 3. In order to carry out the plant establishment work, the Contractor shall furnish sufficient men and adequate equipment to perform the work during the plant establishment period.
 4. Improper maintenance or possible poor condition of any planting at the termination of the scheduled establishment period may cause postponement of the final acceptance of Plant Establishment. Contractor shall bear all costs for extension of the Plant Establishment period.
- C. Plant Maintenance Period: The contractual maintenance period shall be no less than ninety (90) continuous calendar days, and shall begin at the acceptance of the Plant Establishment Period.
 1. All areas shall be kept free of debris, and all planted areas shall be weeded at intervals of not more than ten (10) days. Watering, trimming, fertilization, spraying and pest control, as may be required, shall be included in the maintenance period. Maintenance shall include pest control (squirrel, gopher, rabbits, etc.).

2. Post fertilize all groundcover areas at the end of every thirty (30) days (of maintenance) at the rate of thirty pounds (30 lbs.) per one thousand square feet (1,000 s.f.), using 5-3-1 Gro-Power. For the final feeding of all areas, use 12-8-8 Gro-Power Controlled Release Nitrogen at the rate of thirty pounds (30 lbs.) per one thousand square feet (1,000 s.f.).
3. The Contractor shall maintain the irrigation systems in a like new operating condition; adjusting head heights and spray arcs as necessary. The Contractor is responsible for proper watering of all planting areas, for providing any necessary supplemental water as may be required, and shall replace any material damaged due to improper moisture.
4. During the maintenance period, the Contractor shall be responsible for maintaining adequate protection for all planting areas. Any damaged areas shall be repaired and any plant materials replaced at the Contractor's expense.
5. The Contractor's maintenance period will be extended past ninety (90) days if these provisions are not filled.

3.9 GUARANTEE AND REPLACEMENT

- A. All plant material installed under the contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship for a period of one (1) year. Any plant found to be dead or in poor condition due to such faulty materials or workmanship, as determined by the Landscape Architect, shall be replaced by the Contractor at his expense.
- B. Any material found to be dead, missing, or in poor condition during the establishment period shall be replaced immediately. The Landscape Architect shall be the judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the contractor within five (5) days of written notification by the Owner.
- C. Replacement shall be made to the same specifications required for original plantings.
- D. Material and Labor involved in the replacing of material shall be supplied by the Landscape Contractor at no additional cost to the Owner.

3.10 REVIEWS

- A. Normal progress reviews shall be requested from the Landscape Architect at least forty eight (48) hours in advance of an anticipated inspection. A review will be made by the Landscape Architect on each of the steps listed below. The Contractor will not be permitted to initiate the succeeding steps of work until he has received written recommendation of approval to proceed by the Landscape Architect.
 1. Immediately prior to the commencement of the work on this Section.
 2. Spotting of all shrubs and trees, and minor adjustments prior to planting.
 3. Preparation of areas to receive groundcover installation.
 4. Final review, start of establishment & maintenance period.
 5. After thirty (30) day plant establishment & maintenance.
 6. Final acceptance of project/ one hundred twenty (120) day maintenance.

3.11 PAYMENT TERMS

- A. Payment for planting work will be at the lump sum price bid for planting. Payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work in planting as herein specified. A 10% retention shall apply to all planting work.

END OF SECTION

SECTION 32 0117
ASPHALT PAVEMENT REPAIR

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bituminous Surfacing Repair: Areas removed for utility trenches, heaved by tree roots, cracked areas, protruding areas where pavement meets hard surfaces, depressed areas, holes and areas around new structures, and raveled bituminous pavement.
2. Areas heaved by tree roots, cracked areas, holes and trenches, and areas around new structures.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 31 2200 - Grading.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2316 - Excavation and Fill for Paving.
5. Section 31 2319 - Excavation and Fill for Structures.
6. Section 31 2323 - Excavation and Fill for Utilities.
7. Section 31 2326 - Base Course.
8. Section 32 1216 - Asphalt Paving.
9. Section 32 1313 - Site Concrete Work.

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. Pavement Heaved By Roots: Remove pavement to limits of distortion and expose roots. Trim roots to provide at least 12-inch clearance to pavement. Coordinate with OWNER's Tree Trimming Department for recommendations and approval prior to trimming roots.
- C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.
- D. Remove raveled and depressed bituminous pavement to limits indicated or required.
- E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.
- F. 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. Conform to requirements in Section 31 2313 - Excavation and Fill; Section 31 2316 - Excavation and Fill for Paving; Section 31 2319 - Excavation and Fill for Structures; or Section 31 2323 - Excavation and Fill for Utilities, as required.

- B. 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 Section 31 2316 Excavation and Fill for Paving.

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. Utility 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 1/2 inch wide and less with RS-1 emulsion and washed plaster sand or other OEHS approved crack filler material. Cracks larger than 1/2 inch wide shall be filled with Type F/Sheet Mix 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, refer to Section 32 1216; Asphalt Paving, Article 3.02. Use Type E/School Mix and feather edge joint flush to the level of adjacent surfacing.
- C. Testing: Flood test entire area in presence of the Project Inspector. Inspect area after waiting one hour. Entire area tested shall be free of standing water or puddles in excess of 0.01 foot. Practical field measurement: 0.01 foot = two quarters stacked.
- 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 33 1100
SITE WATER DISTRIBUTION UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Site water distribution systems located outside the building perimeter, extending to an existing water line or meter.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 22 – Plumbing.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2323 - Excavation and Fill for Utilities.
5. Section 32 0117 - Pavement Repair.
6. Section 32 1313 - Site Concrete Work.
7. Section 33 3000 - Site Sanitary Sewer Utilities.

1.02 SUBMITTALS

- A. Shop Drawings: Submit site plan indicating locations of lines, valves, and related appurtenances.
- B. Product Data: Manufacturer's catalog data for materials. Include technical data for accessories, gaskets, joints and couplings.
- C. Certificates: Certificates attesting that tests set forth in referenced publications have been performed, and the performance requirements have been satisfied.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. American National Standards Institute (ANSI):
 - a. ANSI H23.1 - Seamless Copper Water Tube.
2. NSF International (NSF):
 - a. ANSI/NSF 61 Drinking Water System Components – Health Effects.

- b. ANSI/NSF 372 Drinking Water System Components – Lead Content.

- 3. American Society of Mechanical Engineers (ASME):
 - a. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - b. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - c. ASME B16.26 - Cast Copper Alloy Fitting for Flared Copper Tubes.
 - d. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings.

- 4. American Society for Testing and Material (ASTM) International:
 - a. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - b. ASTM A240 – Standard Specification for chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - c. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - d. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - e. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings.
 - f. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - g. ASTM B75 - Standard Specification for Seamless Copper Tube.
 - h. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - i. ASTM B152 – Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.
 - j. ASTM 17 – Standard Specifications for Copper Alloy Sand Castings for General Applications.
 - k. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - l. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

- m. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
 - n. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - o. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - p. ASTM D3350 - Standard Specification for Polyethylene Plastics and Fittings Materials.
 - q. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
 - r. ASTM F2206 - Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE).
 - s. ASTM F477 - Standard Specification for Elastomeric Seals for Joining Plastic Pipe.
 - t. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
5. American Water Works Association (AWWA):
- a. AWWA C104/A21.4 - Cement-Mortar Lining For Ductile-Iron Pipe and Fittings.
 - b. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings
 - c. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. AWWA C115/A21.15 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
 - e. AWWA C153/A21.53 – American National Standard for Ductile-Iron Compact Fittings for Water Service
 - f. AWWA C207 – Steel Pipe Flanges for Waterworks Service Sizes 4 In. Through 144 In.
 - g. AWWA C500 - Metal Seated Gate Valves for Water Supply Service.
 - h. AWWA C503 - Wet- Barrel Fire Hydrants.
 - i. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 inches through 24 inches (50-mm through 600-mm) NPS.

- j. AWWA C510-89 - Standard for Double Check Valve Backflow-Prevention Assembly.
- k. AWWA C511 - Reduced-Pressure Principal Backflow-Prevention Assembly.
- l. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
- m. AWWA C800 - Underground Service Line valves and Fittings.
- n. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 4 In. Through 12 In., for Water Transmission and Distribution.
- o. AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. Through 3 In., for Water Service.
- p. AWWA M23 - PVC Pipe - Design and Installation.
- q. AWWA M55 - PE Pipe - Design and Installation.
- 6. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:
 - a. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
- 7. Uni-Bell PVC Pipe Association (UBPPA):
 - a. UBPPA UNI-PUB-09 - Installation Guide for Gasketed-Joint PVC Pressure Pipe (C900).
- 8. Underwriters Laboratories Inc. (UL):
 - a. UL 246 – Standard for Hydrants for Fire-Protection Service.
 - b. UL 262 – Standard for Gate Valves for Fire-Protection Service.
 - c. UL 312 – Standard for Check Valves for Fire-Protection Service.
- 9. National Pollutant Discharge Eliminations System (NPDES):
 - a. Comply with storm water requirements of general permit for storm water discharges when flushing pipe systems including storm drains and maintaining logs.
- 10. Plastic Pipe Institute (PPI):
 - a. TN-38 – Bolt Torque for Polyethylene Flanged Joints.
 - b. TR-4 – Technical Report requirements of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis

(SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipes.

- c. TR-33 – Technical Report for Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.
- B. Provide valves from the same manufacturer.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875. No pipe, pipe fitting, or any other fitting or fixture intended to convey or dispose water for human consumption for drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of Health and Safety Code 116875. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.
- D. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the ARCHITECT.

1.04 PRODUCT HANDLING

- A. Store items above ground on platforms, skids, or other required supports.
- B. Protect materials from direct sunlight.
- C. Protect coating and linings on piping, fittings, and accessories from damage. Repair and/or replace damaged coatings or linings.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pipes, Fittings, and Joints:

P-1: Underground water service pipe sizes up to 3-inch shall be Copper water tubing, Type K hard, ANSI H23.1, ASTM B88, IAPMO IS. Manufacturer: Mueller, Cerro Brass, Cambridge-Lee, Halstead, or equal.

PF-1a: Copper Press-Connect pressure fittings, comply with ASME B16.51 with Ethylene Propylene Diene Monomer, EPDM O-Ring Seal in each end. Fittings with the sizes of 2-1/2" and larger shall have cross-section Grab Rings and separation rings.

Manufacturer: Viega, Mueller Industries, Apollo, or equal.

PF-1b: Wrought Copper - solder type ASME B 16.22.

Manufacturer: Mueller Brass, Nibco, Lee Brass, or equal.

PF-1c: Grooved end type– ASTM B75 or ASTM B152 and ASME B16.22 Wrought Copper, bronze sand casting per ASTM B584 copper alloy CDA 836 per ASME B16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyd enamel. Gaskets shall be pre-lubricated Flush seal type.

Manufacturer: Victaulic, or equal.

P-2: Underground water service pipe sizes up to 3-inch shall be high density polyethylene pipe (HDPE) with tracer wire. Pipe and fitting system shall be pressure class 333 (DR7). All material shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350 with a minimum cell classification of 445474C. HDPE pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. HDPE products shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

Pipe sizes smaller than 3" shall be manufactured to the dimensional requirements listed in ASTM D3035, and 3" Pipes shall have a manufacturing standard of ASTM F714. Pipes and fittings shall meet AWWA C901 and shall be listed as meeting NSF-61.

Installer shall be certified by manufacturer for HDPE pipe and joint installation.

Manufacturer: ISCO, JM Eagle or equal.

PF-2a: Butt Fusion HDPE Fittings shall meet the following requirement:

- a. Molded fittings shall comply with the requirements of ASTM D 3261.
- b. All fabricated elbows, tees, reducing tees and end caps shall be produced and meet the requirements of ASTM F2206.
- c. Socket fittings shall meet ASTM D 2683.
- d. Installer shall be certified by manufacturer for this type of joint installation.

Manufacturer: ISCO, JM Eagle or equal.

PF-2b: Bolted Connections- Flanges and MJ Adapters shall be fused onto the pipe and have a minimum pressure rating equal to or greater than the pipe and shall meet the following requirement:

- a. Metallic back-up rings (Van-Stone style lap joint flanges), shall have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings shall have bolt pattern that will mate with AWWA C207 Class D (generically known as 150 pound patterns).
- b. Flange assemblies shall be assembled and torqued according to PPI TN-38.
- c. Installer shall be certified by manufacturer for this type of joint installation.

P-3: Underground water service pipe sizes 4-inch and larger shall be C900 water service pipe material complying with AWWA C900, and ASTM D1784 Cell Class 12454B with tracer wire, NSF and UL listed. Piping shall be plain end or gasket bell end, pressure class 305 (DR14) with cast iron pipe equivalent outside diameter.

PF-3: Fire Water Service, Domestic Water and Irrigation Service Line Fittings, Joints and Jointing Materials shall be Ductile-iron with mechanical joints conforming to AWWA C110/A21.10 or AWWA C153/A21.53, C900 compatible, and shall have cement mortar lining conforming to AWWA C104/A21.4, standard thickness unless otherwise indicated on Drawings.

- a. Pipe joints shall be push on as specified in ASTM D3139.
- b. Joints between pipe and metal fittings, valves, and other accessories shall be mechanical joints as specified in AWWA C111/A21.11.
- c. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling installation.
- d. Gaskets for push on joints for pipe shall conform to ASTM F477.
- e. Gaskets for push on joints and compression type joints or mechanical joints for connections between pipes and metal fittings, valves, and other accessories shall be as specified in AWWA C111/A21.11.
- f. Sleeve-type mechanically coupled joints may be provided instead of push-on joints on plain-end PVC plastic joints. Comply with requirements of ASTM D3139.
- g. Comply with installation guide UBPPA UNI-PUB-09.

Manufacturer: JM Eagle, Diamond Plastics, North American Pipe, or equal.

- P-4: Aboveground water service pipe shall be Type 316L Stainless Steel, Schedule 40 water pipe, marked with manufacturer's identification and fittings. Manufacturer's representative shall instruct installers and certify them for joint installation. Piping system shall be provided with a five-year manufacturer's material warranty.

Manufacturer: Viega, or equal.

- PF-4: Type 316L Stainless Steel, Schedule 40 Press Fittings. For water service piping systems, provide with EPDM seals. Manufacturer's representative shall instruct installers and certify them for joint installation.

Manufacturer: Viega, or equal.

D. Gates Valves for PVC:

1. Non-rising stem type with resilient wedge gates or iron body bronze wedge gates and mechanical joint ends conform to AWWA C500.
2. Non-rising stem type with mechanical joints ends shall conform to AWWA C509.
3. Valves designed for a working pressure of 175 PSI shall be inside-screw type with operating nut, and resilient wedge type gate. Valve shall be provided with mechanical joints as required for the pipe to which it is intended to connect.
4. Valves with UL listing of 262 shall conform to AWWA C500. Valves shall open by counter-clockwise rotation of valve stem.
5. Stuffing boxes shall be provided with O-ring stem seals and shall be bolted and constructed to permit easy removal of parts for repair.
6. Sleeve type mechanical couplings may be provided instead of mechanical and push on joint ends.
7. Valve ends and gaskets for connection to sleeve type mechanical couplings shall conform to specified requirements for the joint or coupling.

E. Gate Valves in Valve Pits:

1. Outside screw and yoke rising stem type valves with resilient wedge gates and flanged ends shall conform to AWWA C500.
2. Outside screw and yoke rising stem type valves with flanged ends shall conform to AWWA C509.
3. Outside screw and yoke type Valves with double disc gates or split-wedge type gate and flanged ended ends shall be designed for 175 psi and conform to UL 262.

4. Provide valves with hand wheels that open by counterclockwise rotation of the valve stem.
 5. Stuffing boxes shall be provided with O-ring stem seals and shall be bolted and constructed to permit easy removal of parts for repair.
- F. Check Valves for PVC:
1. Valves shall be swing-check type conforming to AWWA C508 or UL 312.
 2. Valves shall be provided with cast iron or steel body and cover, flanged ends and clear port opening.
 3. Valves shall be designed for a working pressure of 175 PSI.
- G. Fire Hydrants:
1. Before procurement, verify approval issued by the County of Los Angeles or Fire Department having jurisdiction.
 2. Hydrants shall be wet barrel types conforming to AWWA C503 or UL 246.
 3. Only 1¾-inch pentagonal nuts are to be provided on stems and protective caps.
 4. Specified hydrants:
 - a. Clow/Rich # 850 or 860
 - b. James Jones #J3700 Fluted Spool
 - c. Equal.
- H. Valve Boxes: 14 ¾-inch by 20-inch by 12-inch cast concrete with cast iron, traffic grade cover marked "WATER" (for use over water valves).
1. Brooks 36-H MB with No. 36-T cast iron cover EISEL 363.5, or equal.
- I. Mechanical Thrust Restraint:
1. Restraint shall be incorporated into the follower gland.
 2. Restraint shall consist of individually actuated wedges that increase resistance to pull out as internal pressure or external forces increase.
 3. Gland shall be ductile iron conforming to ASTM A536.
 4. Provide twist off nuts and tee-head bolts of the same size to ensure proper actuating of restraint devices.
 5. Restraining device shall be provided with pressure rating equal to that of the pipe on which it is installed.

6. Restraining gland shall be UL listed.
 7. Mechanical thrust restraint devices shall be EBAA Iron “Megalug” or equal.
- J. Restraint Device Adapters:
1. Restrained flange adapters shall be provided instead of threaded or welded flange spool pieces on plain end of ductile iron or PVC pipe.
 2. Flange adapters shall be manufactured of ductile iron conforming to ASTM A536 and be provided with flange bolt circles compatible with AWWA C115/A21.15.
 3. Restraint of flange adapter shall consist of a multiple number of individually actuated gripping wedges to maximize restraint capability.
 4. Torque limiting actuating screws shall be provided to insure proper initial set of gripping wedges.
 5. Flange adapter shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow at least 0.6 inch of gap between end of pipe and mating flange without affecting integrity of seal.
 6. Flange adapter shall be provided with a safety factor of at least 2:1 for rated pressure.
 7. Restraint device adapters shall be EBAA Iron “Megaflange”, or equal.
- K. Tracer Wire for Nonmetallic Pipes: Tracer wires shall be continuous solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistance insulation. Blue plastic covered for domestic water and red for fire sprinkler. (Aluminum wire is prohibited). Provide in sufficient length to be continuous over each installed section of nonmetallic pipe.
- L. Pipe markers shall be a concrete plaque inscribed with the word “WATER.”
- M. Water Service Line Materials:
1. Water Service Line Piping Material: Refer to article 2.01.A within this section.
 2. Water Service Line Appurtenances:
 - a. Corporation stops shall be ground key type; manufactured of bronze conforming to ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint or flared tube compression type joint connection. Threaded ends for inlet and outlet of corporation stops shall conform to AWWA C800; coupling nut for connection to flared copper tubing and shall conform to ASME B16.26.

- b. Goosenecks shall be type K copper tubing. Joint ends for goosenecks shall be as required for connecting to corporation stop and service line. Where multiple gooseneck connections are required for individual service, connect goosenecks to service line through brass or bronze branch connection; the total clear area of branches shall be at least equal to clear area of service line. Length of goosenecks shall be as indicated or required.
 - c. Curb or service stops shall be ground key, round way, inverted key type; bronze, conforming to ASTM B61 or ASTM B62; and rated at 150 psi. Ends shall be as required for connection to service piping. Arrow shall be cast into body of curb or service stop indicating direction of flow.
 - d. Gate valves 2.5-inch and larger shall be MSS SP-80, Class 150, solid wedge, or resilient wedge gate, and non-rising stem. Valves shall be provided with flanged end connections. Provide hand wheel operators if easily accessible. Provide operating nut if inside a vault, pit or valve box.
 - e. Gate valves in valve pits 2-inch, and smaller shall be MSS SP-80, Class 150, bronze, solid wedge, inside screw, rising stem. Valves shall be provided with flanged end connections or threaded end connections with union on one side of valve and hand wheel operator.
 - f. Valve boxes shall be provided at each gate valve installed underground. Valve boxes shall be a size suitable for valve on which it is installed.
- N. Water meter will be installed by water purveyor for the area, unless noted otherwise.
- O. Strainers:
- STR-1 Description: Wye type with Monel or Stainless Steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blow out piping, same size as blow out plug:
- 2-inch and smaller: C.M. Bailey #100-A, bronze, 250 pound, or ductile iron with fusion bonded epoxy coating.
- 2 ½-inch and larger: Watts 77F-DI-FDA-125 pound, or other ductile iron fusion bonded epoxy coated flanged strainer, conforming to ASTM A312 for the strainer body, and ASTM A240 for the stainless steel strainer element. (No iron body strainer shall be used on potable water that is not fusion bonded epoxy coated inside and out.)
- C.M.Bailey, Armstrong, Wilkins, Watts, or equal.

STR-2 “Y” pattern, cast iron bodies, 125 psi, Monel screen 16 square. mesh. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2-inch, flanged ends for 2 ½-inch and larger perforations, in accordance with the following:

Bailey #100, Armstrong, Rp & C , Keckley, or equal.

STR-3 Bucket type, flange, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations (mounted above grade for water service). All sizes, for lines serving fire sprinkler risers:

Bailey #1, Zurn 150 Series, Rp 7 C, Watts 97fb-Fsfe, or equal.

STR-42” and larger: Watts 077-F-SS Stainless steel flange type strainer, or equal conforming to ASTM A312 for strainer body, ASTM A240 for the SS strainer element and ASTM A36 for base flange material.

P. Backflow Preventer Assemblies:

1. Assembly shall be provided with flanged connections, ductile iron with fusion bonded epoxy coated construction, bronze, or stainless steel.
2. Backflow preventer shall be suitable for cold water working pressure of 175 psi.
3. Internal parts shall be designed for replacement without removing valves from line.
4. Double check backflow preventer assembly shall consist of two independently acting spring cam or poppet style check valves, 2 shut-off valves and 4 test cocks. Check valve shall be designed to provide drip tight closure against reverse flow, low pressure drop at maximum flow capacity. Spring-loaded checks shall cause valve to seal against a higher inlet pressure than outlet pressure when there is no flow.
5. Double check backflow preventer assembly shall meet AWWA Standard C510-89. Assembly shall be Ames 2000ss, Febco 850, Watts 709, Wilkins 350, or equal.
6. Reduced pressure backflow preventer assembly shall consist of two check valves located between two shut-off valves with an area of reduced pressure between two check valves and a relief device arranged to discharge to atmosphere.
 - a. Comply with AWWA Standard C511.

- b. Fluctuation in piping pressure shall not cause cycling. Backflow preventer shall automatically maintain low pressure zone to positively prevent backflow of water into system. Assembly shall automatically indicated failure of any part vital to backflow prevention by the continuous discharge relief device.
 - c. Reduced pressure backflow preventer assembly shall be Cla-Val Model RP-4, or equal.
- 7. Backflow prevention assemblies (devices), shall be tested and certified by a certified backflow tester, and a test report shall be provided to the water agency having jurisdiction. Testing shall be performed in the presence of the Project Inspector.

PART 3 - EXECUTION

3.01 EXCAVATION, BACKFILLING AND COMPACTING

- A. Conform to requirements in Section 31 2323 - Excavation and Fill for Utilities or Section 31 2313 - Excavation and Fill.

3.02 PIPE INSTALLATION

- A. Project site water lines shall terminate approximately 5 feet from buildings, unless otherwise indicated on Drawings. Temporarily cap or plug terminals for future connection to building.

3.03 CLEARANCES OF WATER LINE

- A. Building or Structures: Two feet.
- B. Parallel to Sewer Line:
 - 1. Water line 4-inch or less in diameter shall not be installed in a common trench with the building sanitary drain unless the bottom of the water line is at least 12 inches above the top of the building sanitary drain or where the water line is installed on a solid shelf excavated on one side of the common trench with a minimum clear horizontal distance of 12 inches from the building sanitary drain.
 - 2. Water lines 6-inch and larger in diameter shall be separated from the Project site sanitary sewer, receiving more than one building sanitary drain or acid pipeline, in accordance with the requirement of the State of California, Human and Welfare Agency, Department of Health Services.
- C. Crossing Sewer Line:
 - 3. A water line shall be separated from sanitary sewer in accordance with the requirements of the State of California Administrative Code, Title 22, Section 64630(e)(2).

2. Install water line a minimum of 12 inches clear, above or below a sanitary sewer.
 3. A water line 6-inch or greater in diameter, crossing under a Project site sanitary sewer line, shall be installed with joints located at least 10 feet away from each side of the sanitary sewer line.
 4. A water line 6-inch or greater in diameter, crossing over a Project site sanitary sewer line, shall be installed with joints located at least 4 feet away from each side of a purple pipe or sanitary sewer line.
- D. Install water lines no closer than 10 feet horizontally clear from the edge of sewage leach fields, seepage pits, and septic tanks.

3.04 PIPE INSTALLATION AND JOINING

- A. Install all piping and fitting systems according to the manufacturer requirement.
- B. Remove fins and burrs from pipe and fittings.
- C. Clean piping, fitting, valves, and accessories before installing. Maintain items in a clean condition.
- D. Provide proper facilities for lowering sections of pipe into trenches. Do not drop into piping, fittings, or other materials into trenches. Accurately cut pipe and install without springing or forcing. Replace any piping or fitting that does not provide sufficient space for proper installation of joining material.
- E. Blocking or wedging between bells and spigots is not permitted. Install bell and spigot pipe with bell end pointing in the direction of flow.
- F. Install piping to the lines and grades indicated or required. Low points and dips are not permitted. Support piping at proper elevation and grade with secure and uniform supports. Wood support blocking is not permitted. Where sand cement slurry will not be furnished for backfill, install piping so that full length of each section of pipe and each fitting will solidly rest on pipe bedding. Excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated or required for installation. Provide proper allowances and devices for expansion and contraction of piping and systems.
- G. Maintain trenches free of standing water until pipe joints have been installed.
- H. At the end of each day close open ends of pipe with temporary caps of the same material as the pipe.
- I. Do not install piping when trench or weather conditions prevent proper installation.

3.05 INSTALLATION OF TRACER WIRE AND PIPE MARKERS

- A. Tracer Wire: Install continuous length of tracer wire for full length of each run of nonmetallic pipe. Fasten wire to top of pipe in such a manner that it will not be displaced during construction operations. Wire shall be fastened to pipe at not greater

than 20-foot intervals. Wire shall terminate above finished grade with a 12-inch lead taped around each riser. Provide a tracer wire to grade under a permanent marker where straight-line transitions of metallic to non-metallic pipe are installed.

- B. Underground Pipe Markers: Provide markers at grade where non-metallic pipe is installed and for each horizontal change in direction.

3.06 CONNECTIONS TO EXISTING WATER LINES

- A. After Project Inspector has inspected installation, perform connections to servicing water lines. Schedule service shutdown for connecting new system at a time causing minimum disruption.

3.07 INSTALLATION OF HDPE WATER SERVICE LINE

- A. All HDPE pipe and fittings shall be cut, joined, and installed in accordance with the manufacturer's recommendations. Joining, and laying of polyethylene pipe shall be accomplished by personnel experienced and certified in working with polyethylene pipe systems.

- B. Jointing:

1. All HDPE pipe shall be joined to itself by the heat fusion process which produces homogeneous, seal, leak tight joints. Tie-ins between sections of HDPE pipe shall be made by butt fusion whenever possible.
2. The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F 2620.
3. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all training and qualification records for that individual, including compliance to any code requirements for fusion/bonder operators.
4. All HDPE fusion equipment operators shall be qualified to the procedure used to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project approved by manufacturer. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

- C. Installation:

1. Buried HDPE pipe and fittings shall be installed in accordance with AWWA Manual of Water Supply Practices M55 Chapter 8. The Design Window identified in AWWA M55 Chapter 5 shall be considered acceptable design and installation conditions.
2. Unless required by design documents, no thrust blocks shall be placed in the HDPE pipe system since the fused system is fully restrained.

3. All appurtenances (tees, elbows, services, valves, etc.), must be independently supported and shall not rely on the pipeline and its connections for this support. Excessive stresses may be encountered when appurtenances are inadequately supported.

3.08 INSTALLATION OF C900 PLASTIC WATER SERVICE LINE

- A. Unless otherwise indicated, install pipe and fittings as specified and in accordance with UBPPA UNI-B-09 and AWWA M23, Chapter 7, "Installation".
- B. Jointing:
 1. Provide push on joints with elastomeric gaskets specified for this type of joint, furnishing either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push on joint connections, provide pipe with push on joint ends furnished with factory installed bevel; for push on joint connections to metal fittings, valves and other accessories, square cut spigot end off pipe end.
 2. Provide push on joint lubricant recommended by manufacturer.
 3. Install push on joints for pipe-to-pipe connections in accordance with UBPPA UNI-PUB-09 and AWWA M23, Chapter 7, "Installation."
 4. Install push on joints for connection to fittings, valves, and other accessories in accordance with requirements of UBPPA UNI-PUB-09 and with applicable requirements of AWWA C600.
 5. Compression-type joints/mechanical-joints with gaskets, glands, bolts, nuts and internal stiffeners shall be installed in accordance with the requirements of UBPPA UNI-PUB-09 and AWWA C600 and Appendix A to AWWA C 111/A21.11.
 - a. Square cut spigot off end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.
 6. Sleeve-type mechanical couplings shall be provided in strict accordance with coupling manufacturer's recommendations using internal stiffeners as specified for compression-type joints.
- C. Provide mechanical thrust restraint devices for anchorage and piping unless thrust blocks are indicated on the Drawings. Thrust blocks shall be installed in accordance with the requirements of UBPPA UNI-PUB-09 except that size and location of blocks shall be as indicated. Thrust blocks shall be provided as specified in Section 32 1313 - Site Concrete Work.

3.09 INSTALLATION OF VALVES

- A. Provide gate valves conforming to AWWA C500 and UL 262 in accordance with AWWA C600 for valve and fitting installation and with recommendations of AWWA C500 Appendix "Installation, Operation, and Maintenance of Gate Valves".
- B. Provide gate valves conforming to AWWA C600 in accordance with AWWA C509 for valve and fitting installation and with recommendations of AWWA C500 Appendix "Installation, Operation, and Maintenance of Gate Valves".
- C. Provide gate valves on PVC water service lines in accordance with AWWA M23 Chapter 7, "Installation."
- D. Provide check valves and fittings in accordance with applicable requirements of AWWA C600 unless noted otherwise on the Drawings.
- E. Provide gate and check valve joints as specified for the type of joints between pipe and fittings.

3.10 INSTALLATION OF HYDRANTS

- A. Install hydrants according to requirements of AWWA C600 for hydrant installation and as indicated. Provide joints as specified for the type of joints between pipe and fittings.
- B. Install hydrant with a 6-inch key gate valve between 4 and 10 feet from the hydrant.

3.11 INSTALLATION OF BACKFLOW PREVENTERS

- A. Install reduced pressure backflow preventers to comply with RULE 16D of LADWP in the jurisdictional boundaries of Los Angeles Department of Water and Power.

3.12 INSTALLATION OF STRAINERS:

- A. Strainers shall be installed on each water line downstream of the meter, above grade at the pressure regulating station. When a pressure regulating station (assembly) is not provided, "wye" type flange strainer shall be provided, with a shut off valve on the inlet and the outlet side.
- B. If the water line is serving fire sprinkler risers or hydrants, then an approved fire service strainer shall be used: Watts 97DB-FSFE, or equal.

3.13 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. For complete requirement and procedure refer to section 22 1000, article 3.12.

3.14 ELECTROLYSIS PREVENTION

- A. A minimum 6-inch long brass nipple shall be installed at locations specified or as required. Flanges shall be provided with a complete insulating component consisting of; gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at locations indicated or as required. Dielectric fittings are prohibited.

- B. Where steel or cast iron below grade connects to copper or brass piping above grade, the transition from steel or cast iron pipe to copper or brass pipe shall be installed in an above grade accessible location.
- C. Underground connections between dissimilar metals shall be in accessible yard boxes.
- D. Above ground dielectric connections shall be exposed.

3.15 ABANDONING WATER LINES AND STRUCTURES

- A. Water lines and appurtenances to be abandoned in place shall be cut and removed from areas where new Work is being installed.
- B. Cap or plug abandoned existing drain lines below grade in a yard box and according to CBC.

3.16 TESTS AND INSPECTIONS

- A. Provide labor, equipment, materials, test equipment and incidentals required for performing required field tests.
- B. Tests shall not be performed for five days after concrete thrust blocks have been installed.
- C. Testing Procedure: Water service lines shall be tested in accordance with applicable specified standard.
 - 1. Test water service lines in accordance with applicable requirements of AWWA C600. No leakage is permitted.
 - 2. Pressure testing: Before pressure test, fill portion of piping being tested with water for a minimum of 24 hours. Provide hydrostatic pressure of at least 50 psi greater than the maximum working pressure of tested system, but no less than 200 psi hydrostatic test pressure for system piping of 2-inch in diameter and larger. Provide and maintain hydrostatic test pressure for at least two hours to ensure no leakage of any portion of piping or appurtenances under pressure test.

3.17 CLEANING

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

3.18 PROTECTION

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

END OF SECTION

SECTION 33 3000
SITE SANITARY SEWER UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Building Sanitary Sewer Lateral.
2. Closed-circuit television inspection of sewer laterals.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 22 – Plumbing.
3. Section 31 2313 - Excavation and Fill.
4. Section 31 2323 - Excavation and Fill for Utilities.
5. Section 32 0117 - Pavement Repair.
6. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

- A. Shop Drawings: Submit site plan denoting locations of lines, valves, and appurtenances.
- B. Product Data: Manufacturer's catalog data for materials. Include technical data for accessories, gaskets, joints and couplings.
- C. Certificates: Certificates attesting that tests set forth in referenced publication have been performed and the results required by design have been met.
- D. Closeout Submittal: Submit three DVD's and/or thumb drive of Closed-circuit television inspections performed. Include the following information:
 1. Electronic Media Recordings: Visual and audio record of the entire length of pipe. For existing laterals identify problem areas, such as roots, cracks, fractures, broken pipe, and other unusual conditions found.

2. Digital Photographs of the pipe condition, connections, points of interest and defects found. Indicate distance of defects to a point of reference such as face of building or mainline.
3. Inspection Log: Provide written report including:
 - a. Date and time of inspection.
 - b. Name of School, Project, CONTRACTOR, and operator name.
 - c. Location, material and size of pipe.
 - d. Description of defects found.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 1. Standard Specifications for Public Works construction, current edition.
 2. California Plumbing Code, CPC, current edition.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Pipeline: Building or Project Site Sanitary Sewer and Vent: Minimum 5 feet away from building boundaries. For piping within 5 feet from building boundaries, and interior piping refer to Division 22 plumbing sections.
1. PVC (Poly Vinyl Chloride) Schedule 40 DWV Pipe, Conforming to ASTM D2665, ASTM F794, and ASTM F1866. Installer of PVC Schedule 40 DWV piping system shall carry ASTM D2855 and ASME B31.3 qualification. Installer shall provide proof of these qualifications to IOR prior to commencing work. Manufacturer: Charlotte pipe and foundry, Spears Manufacturing Company, Harvel Plastics Inc., or equal.
 - a. PVC primer and solvent for chemical weld of pipe and fittings shall be as recommended by pipe manufacturer. Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. The safety placards must be visible. Blue or red hot glue shall not be used.
 - 1.) Primer: Weld-On P-70 by IPS, Conforming to ASTM F656.
 - 2.) Cement: Weld-On 711 (gray) by IPS, Conforming to ASTM D2564.

2. Vitrified clay extra strength piping with plain ends. Comply with ASTM C700. Install with mechanical compression couplings. Joints shall comply with ASTM C425. Installation shall be in accordance with ASTM C12.

Manufacturer: Mission Clay Products, or equal.

3. Acid waste and vent pipeline from building to Sampling Box: Refer to Division 22 for corrosive waste and vent piping.

- B. Cleanout Assemblies: Cleanout plug shall be line size.

1. In covered concrete-paved floors: Iron body with UPC recognized plug, top, and adjustable sleeve, cut-off ferrule, polished brass/nickel/bronze, and secured Scoriated cover:

- a. Square:

J.R.SMITH	ZURN	JOSAM	OR EQUAL
4053	Z1400-SZ	57008-Z-1-SQ	

- b. Round:

J.R.SMITH	ZURN	WADE	JOSAM	OR EQUAL
4033	Z1400-BZ	W-6000	57008-Z-1	

2. Outside covered concrete-paved floors: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferrule, UPC recognized brass type plug, scoriated tractor type cover:

J.R.SMITH	ZURN	OR EQUAL
4233	Z1402-HD	

3. In yard boxes: Raised threaded head brass plug and Cast Iron Body Cleanout.

J.R.SMITH	ZURN	WADE	JOSAM	OR EQUAL
		8590A		

- C. Yard Boxes: 14 1/2-inch by 19 3/4-inch by 12-inch, cast concrete, with cast-iron hinged locking traffic cover with the word "SEWER," embossed on the cover in one inch high upper case lettering.

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover	OR EQUAL
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- D. Concrete, Mortar and Related Materials: Conform to Section 32 1313 - Site Concrete Work, unless noted otherwise.

- E. Metal Covers, Frames and Accessories:

1. Conform to Section 206 – Miscellaneous Metal Items of the Standard Specifications for Public Works Construction.
 2. Metal Covers and Frames: Vandal-resistant design and construction.
 3. Hot-dip galvanize steel parts after fabrication and prior to assembly in accordance with Section 210 – Paint and Protective Coating of the Standard Specifications for Public Works Construction.
- F. Bedding Materials: Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.

PART 3 – EXECUTION

3.01 SANITARY SEWER INSTALLATION

- A. Install sanitary sewers in a uniform alignment and slope to the point of connection as indicated. Before trench excavation, verify size, material, depth, and location of the point of connection. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe.
- B. Pipe slope shall not be less than $\frac{1}{4}$ inch per foot or 2 percent unless pipe inverts are indicated. Where invert elevations are indicated, install pipe at a uniform slope between inverts.
- C. Join pipes and fittings as recommended by the manufacturer.
- D. PVC schedule 40 DWV pipe and fittings shall be solvent welded. PVC pipe ends shall be cut ninety (90) degrees and Beveled from 10° - 15° with a proper beveling tool, cleaned and cleared of cutting burrs prior to cementing. Use approved reaming tool. Pipe ends shall be wiped clean and free of dirt, moisture, oil, and other foreign material with a rag. Primer shall be applied until the surface of the pipe and fitting is softened. Cement shall be applied with a light coat on the inside of the fitting and two heavier coats on the outside of the pipe. Pipe shall be inserted into the fitting and given a quarter turn while inserting if possible to help seat the cement while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 minute after assembly. Excess cement shall be wiped from the outside of the pipe.

3.02 CLEARANCE OF SANITARY SEWERS

- A. Buildings or Structures: Two feet.
- B. Parallel to Water Line:

1. Building sanitary drain, is not permitted to be installed in a common trench with a potable water line unless the bottom of the water line is at least 12 inches above the top of the sanitary sewer.
2. In addition, the potable water line shall be installed on a solid shelf excavated on one side of the common trench with a minimum clear horizontal distance of 12 inches from the sanitary sewer or building sanitary drain.
3. Project site sanitary sewer, receiving more than one building sanitary drain or acid pipeline, shall be separated from a potable water line in accordance with the requirements of the California Health, and Human Services Agency: Department of Public Health.

C. Crossing Water Line:

1. Building sanitary drain shall be installed a minimum of 12 inches below the potable water line.
2. Project site sanitary sewer shall be separated from the potable water main in accordance with the requirements of the State of California Administrative Code, Title 22, Section 64630(e)(2).

3.03 MANHOLES

- A. Provide manholes in accordance with the Standard Plans for Public Works Construction, unless otherwise indicated.
- B. Adjust manholes in accordance with the sub-section 302-5.8 Manholes (and other structures) of the Standard Specifications for Public Works Construction.

3.04 CLEANOUTS

- A. Provide cleanout at the upper terminal for each sanitary pipeline, at intervals not exceeding 100 feet in straight run and any fraction thereof and for each aggregate horizontal change in direction exceeding 135 degrees.
- B. Install required cleanouts before back filling of horizontal pipelines.
- C. In unpaved and asphalt-paved areas, install cleanouts in yard boxes 2 inches below the yard box cover.
- D. In concrete-paved areas, extend cleanouts flush with finish grade.
- E. In traffic areas, install countersunk cleanout plugs where raised heads protrude.

3.05 ABANDONED SEWERS AND STRUCTURES

- A. Plug or cap every abandoned sanitary sewer within 5 feet of the property line in a code required manner.
- B. Demolish abandoned sanitary structures such as cesspool, septic tank, sewage pit, and manholes to a minimum depth of 5 feet below the finish grade, including removal of sewage. Disconnect any piping. After inspection, completely fill with earth, sand, gravel, cement-sand slurry, or other required material.

3.06 TESTING

- A. After installation, test each sanitary drain and/or sewer and each section between successive manholes for either infiltration or exfiltration. Test shall be conducted in accordance with Section 306 - Underground Conduit Construction of the Standard Specifications for Public Works Construction.
- B. Where excessive ground water is encountered test the pipeline for infiltration.
- C. When infiltration or exfiltration exceeds allowable amounts as set forth in the Section 306 formula, perform repairs or replacements as necessary to comply with the required limits.

3.07 CLOSED-CIRCUIT TELEVISION INSPECTION

- A. Coordinate with OAR time and date of inspection. The Project Inspector shall be present during the CCTV inspection.
- B. Prior to calling for inspection the storm and waste piping must be clean by hydro-jetting, clear, and running and not impacted by large amounts of waste water, ponding, debris and any defects during inspection and review.
- C. The CCTV camera head must be appropriately sized to fit the storm and sewer waste piping internally.
- D. Perform internal closed-circuit television inspection of lateral from the building to the public mainline. Record sewer in its entirety with no breaks or interruptions. Move camera at a speed no greater than 60 feet per minute, stopping for a minimum of ten seconds to record pipe connections, defects, and areas of concern.
- E. Locate and repair all defective sections.
- F. Maintain technical quality, sharp focus and distortion free picture. Pan, tilt, and rotate as necessary to best view and evaluate connections, defects and areas of concern.
- G. Closed-circuit Television Equipment: As a minimum equipment shall include:

1. Television camera specially designed for pipe inspections, and operative in 100 percent humidity conditions.
2. Camera and television monitor capable of producing minimum 470H-line resolution color video picture.
3. Camera capable to inspect laterals as small as three inches up to 70 feet from sewer mainline.
4. Camera lighting shall be suitable to allow clear picture of inner wall at least ten feet in front.
5. The camera shall be equipped with SONDE locator capability.

H. Defective Work:

1. New Laterals: Defective Work found shall be repaired at CONTRACTOR's expense. Perform a new closed-circuit television inspection at no cost to OWNER.
2. Existing Laterals:
 - a. If roots, sludge, or sediment material or other defect not related to the Work of this project impedes inspection, withdraw camera, restart inspection from opposite end and notify OAR of defects found.
 - b. If obstruction or stoppage was caused by Work related to this project, remove obstruction at no cost to OWNER. Perform a new closed-circuit television inspection at CONTRACTOR's expense.

3.08 PROTECTION

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

3.09 CLEANUP

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

END OF SECTION

SECTION 33 4000
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes storm drainage piping; sub-surface drains; metal covers, grates and frames; catch basins; box culverts; manholes, and BMPs.
 - 1. Best Management Practices (BMPs):
 - a. Proprietary Detention BMPs - Precast Concrete.
 - b. Cartridge Media Filters.
 - c. Hydrodynamic Separation Devices.
 - d. Catch Basin Inserts.
 - e. Downspout Filters.
 - f. Stormwater Interceptors.
 - g. Proprietary Retention/Infiltration BMPs – Polypropylene or Polyethylene.
 - h. Proprietary Retention/Infiltration BMPs – Precast Concrete.
 - i. Proprietary Biotreatment Devices.
 - 2. Closed-circuit television inspection of storm drain lines.

1.02 RELATED REQUIREMENTS

- A. Division 01 - General Requirements.
- B. Section 01 3593 - Off-site Improvement Procedures.
- C. Section 01 3596 - Off-site Improvement Procedures (B-Permit).
- D. Section 01 7416 - Storm Water Pollution Prevention Plan.
- E. Section 01 7417 – BMP Implementation Plan.
- F. Section 01 7418 – Water Pollution Control.
- G. Section 22 1000 - Plumbing.
- H. Section 31 2313 - Excavation and Fill.

- I. Section 31 2323 - Excavation and Fill for Utilities.
- J. Section 32 0117 - Pavement Repair.
- K. Section 32 1313 - Site Concrete Work.
- L. Section 32 1343 – Pervious Concrete Pavement.

1.03 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials.
- B. ASME: American Society of Mechanical Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. BMP: Stormwater Best Management Practice.
- E. CBC: California Building Code.
- F. CCTV: Closed-Circuit Television.
- G. DET: Detention BMP.
- H. DWV: Drain, Waste, and Vent.
- I. FILT: Filter BMP.
- J. GS: Gravity Separator.
- K. HDPE: High Density Polyethylene.
- L. IAPMO: International Association of Plumbing and Mechanical Officials.
- M. IOR: Inspector of Record.
- N. NPS: Nominal Pipe Size.
- O. OAR: OWNER's Authorized Representative.
- P. PE: Polyethylene.
- Q. Post Construction BMP: Devices installed by the CONTRACTOR for storm water management to be left on site after construction completion.
- R. PP: Polypropylene.
- S. PVC: Poly Vinyl Chloride.
- T. RET: Retention.
- U. SDR: Standard Dimensions Ratio.

- V. VEG: Vegetative.
- W. OWNER: Inglewood Unified School District.
- X. SWPPP: Storm Water Pollution Prevention Plan.

1.04 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. ASHTO M 252: Geotextile Specification for Highway Applications.
 - 2. AASHTO M 294: Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
 - 3. AASHTO M 330: Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
- B. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A888: Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 2. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
 - 3. ASTM C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - 4. ASTM C564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - 5. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 6. ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 7. ASTM C858: Standard Specification for Underground Precast Concrete Utility Structures.
 - 8. ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
 - 9. ASTM D2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 10. ASTM D2665: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

11. ASTM D2855: Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
12. ASTM D3034: Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
13. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
14. ASTM D448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
15. ASTM F1866: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings.
16. ASTM F2306: Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
17. ASTM F2418: Standard Specification for Polypropylene Corrugated Wall Stormwater Collection Chambers.
18. ASTM F2764: Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.
19. ASTM F2787: Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers.
20. ASTM F2881: Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications.
21. ASTM F2922: Standard Specification for Polyethylene Corrugated Wall Stormwater Collection Chambers.
22. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
23. ASTM F656: Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
24. ASTM F794: Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

C. Cast Iron Soil Pipe Institute (CISPI):

1. CISPI 301: Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

2. CISPI 310: Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. The International Association of Plumbing and Mechanical Officials (IAPMO):
1. IAPMO IS 6: Hubless Cast Iron Sanitary and Rainwater Systems - Installation Standards.
- E. Standard Specifications for Public Works Constructions (Greenbook):
1. Section 202: Masonry Materials.
 2. Section 206: Miscellaneous Metal Items.
 3. Section 207: Pipe.
 4. Section 208: Pipe Joint Types and Materials.
 5. Section 210: Paint and Protective Coatings.
 6. Section 306: Underground Conduit Construction.

1.05 SUBMITTALS

- A. Shop Drawings: Submit site plan denoting locations of lines, valves, and appurtenances.
- B. Product Data: Manufacturer's catalog data for all required materials. Include technical data for accessories, information concerning gaskets, joints and couplings.
- C. Certificates: Certificates attesting that tests set forth in referenced publication have been performed and the results required by design have been met.
- D. Closeout Documents: At Substantial Completion submit to the OAR two CD's and one hard copy of the documents indicated in paragraphs 1 through 5 below:
1. Maintenance Log: Provide Microsoft Excel Spreadsheet including the following information:
 - a. Maintenance log and upkeep records of the installed Post Construction BMPs. Include the following headers as a minimum: "Date of Service", "Location of BMP", "Type of Maintenance or Service", "Notes", "Next Scheduled Preventive Maintenance Due", and "Inspector Signature".
 - b. Maintenance Requirements: Include the following headers as a minimum: "BMP Description", "Location of BMP and Map Grid Location" and "Type of Maintenance or Service Needed", i.e.; weekly, monthly, quarterly, etcetera. "Stock No.", "Manufacturer Contact Information", along with "Frequency" namely: weekly, monthly, quarterly, etcetera and "Special Instructions".

2. **Maintenance Manuals:** Provide Maintenance Manual for storm drainage BMP components installed along with requirements, replacement or maintenance schedule and plans with the location of each BMP component. This manual shall include product information cut sheet, shop drawings, vendor information for each component and warranty.
3. **Record drawings:** 'As-Built' site plan(s) showing Post Construction BMP. Provide a copy of marked record set with red pencil identifying any variations from design documents.
4. **Training Documentation:**
 - a. OWNER attendees sign off training sheet.
 - b. Two DVD's of materials covered in the training and components installed.
5. **Post-Construction BMP Maintenance Plan:** Submit complete Plan per Attachment "A", edit per As-Built conditions and provide missing information.
6. **Records of Closed-Circuit Television Inspection:** At Substantial Completion submit to the OAR three DVD's of Closed-circuit television inspections performed. Include the following information:
 - a. **Electronic Media Recordings:** Visual and audio record of the entire length of pipe. For existing laterals identify problem areas, such as roots, cracks, fractures, broken pipe, and other unusual conditions found.
 - b. **Digital Photographs** of the pipe condition, connections, points of interest and defects found. Indicate distance of defects to a point of reference such as face of building or mainline. Provide the Digital Photographs after fixing the defective pipes.
 - c. **Inspection Log:** Provide written report including:
 - 1) Date and time of inspection.
 - 2) Name of School, Project, CONTRACTOR, and operator name.
 - 3) Location, material and size of pipe.
 - 4) Description of defects found and attempts to fix them.

1.06 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic products, pipes, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle all products according to manufacturer's written rigging instructions.

1.08 TRAINING OF OWNER PERSONNEL

- A. At Substantial Completion and when the storm drainage system is fully operational, knowledgeable representatives from the CONTRACTOR and manufacturer(s) of the components specified and installed at the site shall provide up to 8 hours of training. Date, time and location for the training shall be coordinated through the project OAR. Have OWNER attendees sign off training sheet and provide a copy to the OAR.
- B. Training period shall cover but not be limited to the following:
 - 1. Explain the operation of storm drainage system and its design intent.
 - 2. Explain the maintenance requirements of every component of the system.
 - 3. Provide recommendations of practices to minimize or eliminate negative impact on the system.
 - 4. Provide maintenance schedule as recommended by the manufacturers for every component and review it with OWNER's Maintenance and Operations staff.
 - 5. Conduct a site walk, identify every component of the system and demonstrate its operation.
 - 6. Training shall be conducted with the use of Maintenance log and Maintenance manual.

1.09 SURPLUS MATERIALS

- A. Provide enough additional materials for each component of BMP that requires replacement or service during the first year.

1.10 ATTACHMENTS

- A. The following attachments are included at the end of Section 33 4000:
 - 1. Attachment "A" - Post-Construction BMP Maintenance Plan.
 - 2. Attachment "B" – Post-Construction Water Balance Calculator.

PART 2 – MATERIALS AND PRODUCTS

2.01 PIPING MATERIALS

- A. General: Minimum 5 feet away from building boundaries. For piping within 5 feet from building boundaries, and interior piping refer to Division 22 plumbing sections. Provide piping system in conformance with Section 207 - Pipe and Section 208 - Pipe Joint Types and Materials of the Standard Specifications for Public Works Construction. All Soil-tight pipes shall be provided with joints that are function of opening size, channel length, and backfill particle size. A backfill material containing a high percentage of fine-graded soils requires investigation for the specific type of joint to be used to guard against soil infiltration, including the requirement for fabric-wrapped joints.
- B. Nonreinforced Concrete Pipe (CP): ASTM C14, with bell-and-spigot ends and gasketed joints with ASTM C443 rubber gaskets.
- C. Reinforced Concrete Pipe (RCP): ASTM C76, with bell-and-spigot ends and gasketed joints with ASTM C443 rubber gaskets.
 - 1. Approved manufacturers: Thompson Pipe Group, or equal.
- D. Cast Iron Soil Pipe (CIP):
 - 1. Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO IS 6.
 - 2. Cast iron soil coupling: Hubless, heavy-duty with neoprene gaskets, stainless steel corrugated shields, and 4 bands of stainless-steel clamps. IAPMO, ASTM C564 and CISPI 310.
 - 3. Approved manufacturers: American Foundry, Mission Rubber Company, Tyler, or equal.
- E. Corrugated, Dual Wall, High Density Polyethylene Drainage Pipe (HDPE):
 - 1. Corrugated PE Drainage Pipe and Fittings NPS 4 to NPS 10: AASHTO M 252, Type S (double-wall) with smooth waterway for coupling joints.
 - 2. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294 or ASTM F2306, Type S (double-wall) with smooth waterway for coupling joints.
 - 3. Approved manufacturer: ADS, Hancor, JM Eagle, or equal.
- F. Corrugated, Dual or Triple Wall, Polypropylene Pipe (PP):
 - 1. Corrugated PP Drainage Pipe and Fittings NPS 12 to NPS 60: ASTM F2764, ASTM F2881, or AASHTO M 330, Type S (double-wall) or Type D (triple-wall), for respective diameters. Provide coupling joints with smooth waterway.
 - 2. Approved manufacturers: ADS, Prinsco, or equal.
- G. PVC (Poly Vinyl Chloride) Schedule 40 DWV Pipe:
 - 1. Conform to ASTM D2665, ASTM F794, and ASTM F1866.

2. Installer of PVC Schedule 40 DWV piping system shall carry ASTM D2855 and ASME B31.3 qualification. Installer shall provide proof of these qualifications to IOR prior to commencing work.
3. Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. The safety placards must be visible.
4. Blue or red-hot glue shall not be used.
5. Approved manufacturers and products:
 - a. Pipe: Charlotte pipe and foundry, Harvel Plastics Inc., JM Eagle, Spears Manufacturing Company, or equal.
 - b. Primer: Weld-On P-70 by IPS, Conforming to ASTM F656.
 - c. Cement: Weld-On 711 (gray) by IPS, Conforming to ASTM D2564.

H. PVC (Poly Vinyl Chloride) SDR-35 Pipe, 6" through 15":

1. Conform to ASTM D3034.
2. Gasketed Joints: Elastomeric gasket joints conforming to ASTM D3212.
3. Gaskets: Chloroprene conforming to ASTM F477.
4. Approved manufacturers: Charlotte pipe and foundry, Harvel Plastics Inc., JM Eagle, Spears Manufacturing Company, or equal.

2.02 BEDDING MATERIAL FOR PIPE

- A. General: Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.
- B. Approved manufacturers and products:
 1. Propex Fabrics, Inc.: Geotex 451.
 2. TenCate Geosynthetics Americas: Mirafi 140N.
 3. US Fabrics, Inc.: 120NW.
 4. Equal products.

2.03 PERFORATED SUBSURFACE DRAIN PIPE

- A. Perforations shall be symmetrically located within a maximum arc of 160 degrees. Perforations shall provide a total open area of at least 0.3 square inches per linear foot of pipe, with a minimum of one perforation per linear foot, except for joint areas. Perforation shall be either holes or slots. Hole diameters of 1/4-inch minimum to 1/2-inch

maximum. Width of slots of 1/8-inch minimum to 5/16-inch maximum with slot length not exceeding 5 inches.

- B. Aggregate Around Perforated Pipe shall be 6 inches of gravel containing no particles finer than a 1/2-inch to 3/4-inch sieve opening size.

2.04 STORMWATER TREATMENT SYSTEMS /BMPS

- A. DET-1: Proprietary Detention BMPs – Reinforced Precast Concrete, approved manufacturers and products:
 - 1. Jensen Precast: Precast-Concrete-Detention-Reservoir.
 - 2. Oldcastle Precast Inc.: Storm Capture-Detention.
 - 3. Storm Trap: Single-Trap-Detention.
 - 4. Equal products.
- B. FILT-2: Cartridge Media Filters, approved manufacturers and products:
 - 1. Baysaver Technologies Inc.: Bayfilter.
 - 2. Contech: Storm Filter.
 - 3. OldCastle Precast Inc.: Perk Filter.
 - 4. Equal products.
- C. GS-1: Hydrodynamic Separation Devices, approved manufacturers and products:
 - 1. ADS-Baysaver Technologies Inc.: Barracuda S Series.
 - 2. Contech: CDS.
 - 3. Hydro International: First Defense HC (High Capacity).
 - 4. Jensen Precast: JDS.
 - 5. Oldcastle Precast Inc.: DVS.
 - 6. Equal products.
- D. GS-2: Catch Basin Inserts, approved manufacturers and products:
 - 1. AbTech Industries: UUF DI-DO.
 - 2. ADS-FlexStorm: FlexStorm Pure or Catch-it.
 - 3. Aquashield Inc.: Aqua-Guardian.
 - 4. Ecosense International: EcoSense International's Catch Basin Insert.

5. EnviroPod Inc.: LittaTrap.
 6. Oldcastle Precast Inc.: FLoGard, or GISB.
 7. UltraTech International Inc.: Ultra-Drain Guard.
 8. Equal products.
- E. GS-3: Downspout Filters, approved manufacturers and products:
1. Oldcastle Precast Inc.: FLoGard +Plus.
 2. Equal products.
- F. GS-5: Stormwater Interceptors, approved manufacturers and products:
1. Jensen Precast: JPHV-stormwater-interceptors-with-bypass.
 2. Oldcastle Precast Inc.: Storm Capture Detention.
 3. Oldcastle Precast Inc.: NSBB, Nutrient Separating Baffle Box.
 4. Storm Trap: Single-Trap-Detention.
 5. Equal products.
- G. RET-4: Drywells
1. Pre-Cast Liner: Reinforced 4000 PSI concrete. 48" I.D., 54" O.D.
 2. Overflow/Riser Pipe: Minimum 6" I.D. Schedule 40 Poly Vinyl Chloride (PVC) solid wall with debris shield.
 3. Drainage Screen: Minimum 6" I.D., Schedule 40 PVC slotted screen with 0.120-inch slots continuous, with a minimum of 160 slots per foot.
 4. Rock: Clean washed rock uniformly graded between 3/8" and 1-1/2".
 5. Absorbent: Hydrophobic petrochemical sponge with minimum four (4) quart capacity used in all chambers.
 6. Approved manufacturers and products:
 - a. Torrent Resources: MaxWell.
 - b. Equal products.
- H. RET-7a: Proprietary Retention/Infiltration BMPs – Polypropylene or Polyethylene
1. Molded PP or PE with open bottom. Thermoplastic Corrugated Wall Chambers (Chambers): Provide in conformance with ASTM F 2418 "Standard Specification for Polypropylene Corrugated Wall Stormwater Collection Chambers", ASTM F 2922 "Standard Specification for Polyethylene Corrugated

Wall Stormwater Collection Chambers”, and ASTM F 2787 “Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers”.

2. Filtering Material: ASTM.D448, washed, crushed stone or ¾” to 2” gravel. For more information refer to plans, and manufacturer installation manual.
 3. Filter Mat, applicable to isolator/main row: Geotextile woven or spun filter fabric, in one or more layers. For more information refer to plans, and manufacturer installation manual.
 4. Provide non-woven geotextile fabric around the entire system to prevent migration of fines into the rock voids. For more information refer to plans, and manufacturer installation manual.
 5. Pipe Systems: Perforated manifold, header, and lateral piping complying with AASHTO M 252 for NPS 10 and smaller, AASHTO M 294 for NPS 12 to NPS 60. Include proprietary fittings, couplings, seals, and filter fabric.
 6. Approved manufacturers and products:
 - a. ADS - Storm Tech: MC3500, MC4500, SC740 or DC780.
 - b. Contech: ChamberMaxx.
 - c. NDS: StormChambers SC34 or SC44.
 - d. Prinsco: HydroStor HS180 or HS75.
 - e. Triton: S22 or S29.
 - f. Equal products.
- I. RET-7b: Proprietary Retention/Infiltration BMPs – Reinforced Precast Concrete, approved manufacturers and products:
1. Jensen Precast: Precast-Concrete-Arches.
 2. Oldcastle Precast Inc.: Storm Capture Infiltration.
 3. StormTrap: Single-Trap-Infiltration.
 4. Equal products
- J. VEG-6: Proprietary Biotreatment Devices, approved manufacturers and products:
1. BioClean: Modular Wetlands System.
 - a. Infiltration media shall be ARCOSA.
 2. Contech: Filterra Bioretention Systems.

- a. Infiltration media shall be Filterra Media consist of a combination of natural sand, gravel, and organic materials.
- 3. DeepRoot Urban Landscape: Silva Cell 2.
- 4. Oldcastle: BioPod Underground.
 - a. Infiltration media shall be StormMix.
- 5. StormTree: Tree Filter System.
 - a. Grates shall be Hot-dip galvanize steel.
 - b. Infiltration media shall be CocoGro Coir Fiber.
- 6. Equal products.

2.05 MANHOLES

- A. Provide round reinforced concrete manhole with an H-20 traffic rated hatch & solid cover of minimum 30-inch in diameter with holes of maximum ½-inch in diameter.

2.06 MISCELLANEOUS MATERIALS

- A. Metal Covers, Grates, Frames and Accessories:
 - 1. Conform to Section 206 - Miscellaneous Metal Items of the Standard Specifications for Public Works Construction.
 - 2. Hot-dip galvanize steel parts after fabrication in accordance with Section 210 - Paint and Protective Coatings of the Standard Specifications for Public Works Construction.
 - 3. Grates and Frames:
 - a. Vandal-proof design and construction.
 - b. ADA compliant, in conformance to CBC 11B-302.3.
 - c. Rated for vehicular traffic on areas intended for use by motor vehicles.
 - d. Hot-dip galvanized.
- B. Concrete, Mortar and Related Materials: Conform to Section 32 1313 - Site Concrete Work.
- C. Manhole Brick Mortar, Grout, and Plaster: Conform to Standard Specifications for Public Works Construction, Section 202 - Masonry Materials.

- D. Underground Concrete Structures: Shall be precast and rated for H-20 traffic loading and applicable soil loads. The materials and structural design of the devices shall be per ASTM C857 and ASTM C858.

2.07 NAMEPLATES

- A. Stainless steel or aluminium nameplate permanently fastened to BMP showing the following information:
 1. BMP ID number and BMP type.
 2. Next service day followed by a 1-inch by 4-inch long blank space.
 3. Manufacturer name, model number, telephone number and stock ID number.
 4. Installation or production date.
 5. 1-inch by 4-inch blank space for OWNER's use.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. CONTRACTOR shall arrange for a preconstruction meeting with the manufacturer's representative to review the basic principles for proper installation of Underground BMP type products prior to any installation.
- B. Underground Concrete modules shall be installed in accordance with manufacturer's instructions and the current ASTM C891 procedures.

3.02 EXCAVATION, BACKFILLING AND COMPACTING

- A. Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.

3.03 INSTALLATION OF PIPE

- A. Conform to Section 306 - Underground Conduit Construction of the Standard Specifications for Public Works Construction.
- B. Non-ferrous drainpipe installed with less than 12 inches of cover to finish grade shall be provided with a 4-inch thick concrete pipe encasement.

3.04 DRAINAGE APPURTENANCES

- A. Catch basins, junction chambers, manholes, box culverts, outlet chambers and other drainage structures: Construct as indicated on Drawings and as specified in Section 32 1313 - Site Concrete Work, and in compliance with the Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction.

- B. Ensure that Post Construction BMP have a visible identifying manufacturer tag with product identification, manufacturer contact information, date of last service and date of next service due.
- C. Provide storm drain stencil per City or County requirements as applicable.

3.05 STORMWATER TREATMENT SYSTEMS/BMPs

- A. Storm Tech: MC3500, MC4500, SC740 or DC780.
- B. RET-4: Drywells
 1. The drilled holes shall be the diameter shown on the plans. The holes shall be drilled in a manner to maintain maximum permeability of soils.
 2. The drainage pipe, drainage screen, and filter fabric sleeve shall be suspended during backfilling operations. The drainage pipe shall extend to within 2 feet of the total depth of the drywell. The rock backfill shall be placed to prevent buckling and breakage of the drainage pipe, screen, and filter fabric.
 3. The overflow/riser pipe shall be installed within the drywell chamber to create a sump with depth per project detail (6' minimum).
 4. The pre-cast liner shall be centered in drilled shaft and the sections carefully aligned to maximize the bearing surfaces of the liner walls.
 5. The ring and grate shall be set to the rim elevation shown on the plans or to match existing grades and shall be secured to the cone with mortar.
 6. Upon completion of each drywell, a lay of UV stabilized Mirafi® 100X fabric shall be placed over the grated inlet and banded in place. The fabric shall not be removed until after paving the landscaping operations are completed.

3.06 CLOSED-CIRCUIT TELEVISION INSPECTION

- A. Coordinate with OAR time and date of inspection. Project Inspector shall be present during the CCTV inspection.
- B. Clean laterals by hydraulic jet.
- C. Perform internal closed-circuit television inspection of lateral from the building to the public mainline. Record drain line in its entirety with no breaks or interruptions. Move camera at a speed no greater than 30 feet per minute, stopping for a minimum of ten seconds to record pipe connections, defects, and points of interest.
- D. Maintain technical quality, sharp focus and distortion free picture. Pan, tilt, and rotate as necessary to best view and evaluate connections, defects and points of interest.
- E. Minimum Requirements for Closed-circuit Television Equipment:

1. Television camera specially designed for pipe inspections, and operative in 100 percent humidity conditions.
2. Camera and television monitor capable of producing minimum 470H-line resolution color video picture.
3. Camera capable to inspect lines as small as three inches up to 70 feet from storm drain mainline.
4. Camera lighting shall be suitable to allow clear picture of inner wall at least ten feet in front.

F. Defective Work:

1. New Lines: Defective Work found shall be repaired at CONTRACTOR's expense. Perform a new closed-circuit television inspection at no cost to OWNER.
2. Existing Laterals:
 - a. If roots, sludge, or sediment material or other defect not related to the Work of this project impedes inspection, withdraw camera, restart inspection from opposite end and notify OAR of defects found.
 - b. If obstruction or stoppage was caused by Work related to this project, remove obstruction at no cost to OWNER. Perform a new closed-circuit television inspection at CONTRACTOR's expense.

3.07 ABANDONED DRAINAGE LINES AND STRUCTURES

- A. Cap or plug existing drain lines that are cut and abandoned and remove existing drainage structures that are abandoned.

3.08 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- B. Maintain Post Construction BMP after installation and keep a maintenance log to be turned over to OAR at Substantial Completion.

3.09 PROTECTION

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

END OF SECTION