

MERCED COMMUNITY COLLEGE DISTRICT

PROJECT MANUAL


MERCED COLLEGE GREENHOUSE COMPLEX

DSA APPLICATION 02-121754

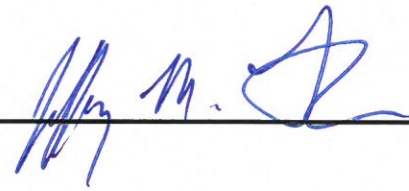
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Civil 



Electrical 

EXPIRES: 06/30/24

IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT

APP: 02-121754 INC:

REVIEWED FOR

SS FLS ACS

DATE: 02/21/2024

SECTION 00 01 10
TABLE OF CONTENTS

DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 10 - TABLE OF CONTENTS

DIVISION 01 -- GENERAL REQUIREMENTS

01 11 00 - SUMMARY OF WORK

01 32 26 - CONSTRUCTION FORMS

01 71 23 - FIELD ENGINEERING

01 73 29 - CUTTING AND PATCHING

01 74 00 - CLEANING DURING CONSTRUCTION & FINAL CLEANING

DIVISION 26 -- ELECTRICAL

26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

26 05 53 - IDENTIFICATION OF ELECTRICAL SYSTEMS

26 20 00 - LOW VOLTAGE TRANSFORMERS

26 24 16 - PANELBOARDS

26 27 26 - WIRING DEVICES

26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

26 51 00 - INTERIOR LIGHTING

26 56 00 - EXTERIOR LIGHTING

DIVISION 31 -- EARTHWORK

31 11 00 - SITE CLEARING

31 20 00 - EARTHWORK: EXCAVATION, FILLING AND GRADING

31 22 22 - SOIL MATERIALS

31 23 33 - TRENCH EXCAVATION AND BACKFILL

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 11 26 - AGGREGATE BASE COURSE

32 12 16 - SOIL STERILIZATION

32 12 17 - ASPHALT PAVING

32 13 13 - SITE CONCRETE IMPROVEMENTS

32 13 15 - CONCRETE REINFORCEMENT

32 15 40 - CRUSHED STONE SURFACING

32 33 10 - TACTILE/DETECTABLE WARNING SURFACE TILE

DIVISION 33 - UTILITIES

33 12 00 - WATER UTILITIES

33 40 00 - STORM DRAINAGE

END OF SECTION 00 01 10

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General Conditions and Supplemental General Conditions and other Division 01 General Requirements, apply to this Section.

1.02 PROJECT DESCRIPTION:

- A. Project Name: Merced College Greenhouse Complex
- B. Project Location: Merced Community College District, 3600 M Street, Merced California, 95348
- C. Owner: Merced Community College District
- D. Civil Engineer: Blair, Church & Flynn, 451 Clovis Ave, Suite 200 Clovis, CA 93612
- E. Electrical Engineer: Thoma Engineering, 3562 Empl St., San Luis Obispo, CA 93406

1.03 THE WORK CONSISTS OF:

- A. Installation of owner furnished shade structure, greenhouse, and metal storage building.
- B. Construction of two (2) greenhouse buildings, two (2) loafing barns, and material storage yard.
- C. Utility improvements including gas, electrical, and domestic water tp serve the proposed greenhouse buildings.
- D. Site improvements including concrete sidewalk and stabilized decomposed granite surfacing and exterior lighting.
- E. Grading and storm drain improvements.

1.04 CONTRACT

- A. The Work will be constructed under a single general construction contract.

1.05 CONTRACTOR'S USE OF PREMISES

- A. Contractor may be required to share use of Project site during construction period with contractors performing work under other contracts for construction of the overall Project and shall coordinate construction operations with those of other contractors. Designated areas will be established for the shared use of the Contractor, and contractors performing work under other

contracts. Contractor's use of premises is limited only by Owner's right to perform work or to obtain other contractors on portions of the Project.

- B. Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.
- C. Keep driveways and entrances serving the premises clear and available to the Owner and the public at all times. The Contractor is to provide and maintain free and clear access to areas throughout the site for emergency services. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
- D. Repair and replace damaged existing site improvements to remain such as curbs, parking lot paving, roadways, site vegetation, turfgrass, and utilities.

1.06 WORK UNDER OTHER CONTRACTS

- A. Contractor shall cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work of those contracts or work under this Agreement.

1.07 COORDINATION OF SYSTEM START-UP

- A. Coordinate with Division 01 Specifications

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 11 00

SECTION 01 32 26 - CONSTRUCTION FORMS

PART 1 GENERAL

1.01 SUMMARY

- A. Contractor to provide all forms as required by the Engineer for administrative procedures and other related items necessary to document the Project as required by the contract documents, including but not limited to those forms provided under this specification section.

1.02 SUBMITTALS

- A. Submit in accordance with the specification section 01 33 00 - SUBMITTALS

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULE OF FORMS

- A. Submittal Transmittal
- B. Request for Information (RFI)
- C. Change Order Request (COR)
- D. Contractor's Usage Agreement for Electronic Files
 - 1. The language from this document shall be copied onto the Contractor's letterhead

END OF SECTION 01 32 26

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Supplemental General Conditions and other Division 01 General Requirements, apply to this Section.

1.02 DESCRIPTION

- A. Layout and install the Work to the lines and grades indicated and specified.
- B. Retain and pay expenses of a qualified engineer or land surveyor to establish on the site the required reference points and benchmarks, establish building lines and elevations, check structural steel framework for plumbness, and establish on steel frame the required basic grid lines from which Work of other sections shall be laid out.

1.03 QUALIFICATIONS OF ENGINEER OR SURVEYOR

- A. The engineer or land surveyor shall be licensed in the State of California and shall be acceptable to the Owner.

1.04 PROJECT SURVEY REQUIREMENTS

- A. Establish lines and levels; at a minimum, locate and layout:
 - 1. Site Improvements
 - 2. Batter boards for structures.
 - 3. Building foundations, column locations.
 - 4. Controlling lines and levels required for electrical work.
- B. From time to time verify layouts to ensure accuracy.

1.05 RECORDS

- A. Maintain a complete, accurate log of control and survey Work as it progresses.

1.06 SUBMITTALS

- A. Submit name and address of civil engineer and land surveyor.
- B. Upon request, submit documentation to verify accuracy of field engineering Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 71 23

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General Conditions and Supplemental General Conditions and other Division 01 General Requirements, apply to this Section.

1.02 SUMMARY:

- A. This Section specifies administrative and procedural requirements for cutting and patching.
- B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- C. Refer to Divisions 2 through 40 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- D. Requirements of this Section apply to electrical installations. Refer to Division 22 through Division 28 Sections for other requirements and limitations applicable to cutting and patching electrical installations.

1.03 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after Installation of other Work.

1.04 SUBMITTALS:

- A. Cutting and Patching Methodology: Where approval of procedures for cutting and patching is required before proceeding, submit a methodology describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the methodology:
 1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
 2. Describe anticipated results in terms of changes to in-place construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 3. List products to be used and firms or entities that will perform work.
 4. Indicate dates when cutting and patching is to be performed.
 5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

- B. Construction Managers approval: Obtain approval of cutting and patching methodology before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.
- C. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations signed and sealed by a structural engineer licensed to practice in the State of California to show how reinforcement is integrated with the original structure.
- D. Review of the Contractor's submittal by the Engineer to proceed with cutting and patching does not waive the Engineer's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.05 QUALITY ASSURANCE:

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
- B. Obtain approval of the cutting and patching methodology before cutting and patching the following structural elements:
 1. Foundation construction.
 2. Structural concrete.
 3. Equipment supports.
 4. Piping, duct work, vessels and equipment.
 5. Operational and Safety Limitations: Do not cut and patch operational elements or safety related components in a manner that would result in reducing their safety to perform as intended, or result in increased maintenance, or decreased operational life or safety.
- C. Obtain approval of cutting and patching methodology before cutting and patching the following operating elements or safety related systems:
 1. Primary operational systems and equipment.
 2. Control systems.
 3. Communication systems.
 4. Electrical wiring systems.
- D. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 1. Equipment supports.
 2. Piping, ductwork, vessels, and equipment.
 3. Noise- and vibration-control elements and systems

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and action before proceeding, if unsafe or unsatisfactory conditions are encountered
- B. Before proceeding, meet at the site with parties involved in cutting and patching, including electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.02 PREPARATION:

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Take all precautions necessary to avoid cutting existing pipe, conduit or duct work serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE:

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

- B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with original installer's recommendations.
1. In general, where cutting is required use hand of small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine that is appropriate for the work to be done.
 4. Comply with requirements of applicable Sections of Division 31 where cutting and patching requires excavating and backfilling.
 5. By-pass utility services such as pipe and conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap valve or plug and seal the remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
 6. Patch with durable seams that are as invisible as possible. Comply with tolerances.
 7. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 8. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to break of plane in a manner that will eliminate evidence of patching and refinishing.
 9. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coat.

3.04 CLEANING:

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit, and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

SECTION 01 74 00 - CLEANING DURING CONSTRUCTION & FINAL CLEANING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract including General Conditions and supplementary conditions and Division 01 specification sections apply to this section.

1.02 SUMMARY

- A. This section includes the following:
 - 1. At all times maintain areas covered by the Contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations, including dirt and dust.
 - 2. Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws. Do not burn or bury rubbish or waste materials on project site. Do not dispose of volatile wastes, such as mineral spirits, oils or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.
 - 3. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

1.03 CLEANING DURING CONSTRUCTION

- A. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
- B. Wet down dry materials and rubbish to prevent blowing dust.
- C. Provide containers for collection and disposal of waste materials, debris, and rubbish.
- D. Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public access roads to the site of any material falling from the haul trucks.

1.04 SITE CLEANING PRIOR TO LANDSCAPING

- A. Remove concrete, concrete wash, stucco splatter, gunite overspray, and all other wastes and debris prior to final grading and landscaping.

1.05 FINAL CLEANING

- A. At the completion of work and immediately prior to final inspection, clean the entire project site as follows.
- B. Clean, sweep, wash, and polish all work and equipment including finishes.

- C. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces, polish surfaces.
- D. Repair, patch, and touch up marred surfaces to match adjacent surfaces.
- E. Broom clean paved surfaces; rake clean landscaped areas.
- F. Remove from the site all temporary structures and all materials, equipment, and appurtenances not required as a part of, or appurtenant to, the completed work.

END OF SECTION 01 74 00

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section Includes:

1. Materials and equipment shall be furnished and installed in support of electrical work described in these plans and specifications including but not limited to, raceways, boxes, enclosures, feeders, branch circuiting, supports, terminal cabinets, sleeves, gutters, panels, transformers, lighting fixtures, controls, relays, contactors, in order to complete and make fully functional the systems described.
2. Lighting systems, both interior and exterior as shown on the plans and as specified herein, including controls, occupancy sensors, lumen sensors, photocell controls, lamps, supports, fasteners, straps, and miscellaneous mounting hardware and support structures for such equipment.
3. HVAC and plumbing electrical: Conduit, conductors and terminations for all line voltage power, line voltage controls and fusible and/or non-fusible safety disconnect switches for HVAC equipment, including but not limited to air conditioners, furnaces, fans, heat pumps, cooling towers, system pumps, condensing units. Provide protective equipment unless otherwise noted, etc. including protective devices.
4. Plumbing Electrical: Conduit, conductors and terminations for plumbing equipment with power requirements including necessary fusible and/or non-fusible safety disconnect devices. Provide motor starters where required unless provided by mechanical specification.
5. Power and Lighting Distribution: Furnish and install power and lighting distribution systems including but not limited to panels, feeders, transformers, branch circuits, devices, fixtures, disconnect switches, contactors, controls, etc. for a complete working system.
6. Data systems infrastructure including all boxes, raceways, cable tray, wire basket tray, dedicated branch circuits, sleeves and penetrations, etc. as described and as shown in plans, risers, specifications, EIA/TIA standards and/or required for a complete and operating system.
7. Allocation of time to adequately train the Owner on the use and operation of all systems installed within the facility or on the property. Minimum two week advance notice shall be coordinated with the Owner and his representatives. Training shall be as outlined in individual system specifications identified to follow.

B. Related Sections Under Other Divisions:

1. Mechanical Wiring: Control circuit wiring, energy management controls and interlocks for mechanical equipment shall be installed by Mechanical Contractor.

2. Painting of electrical equipment where exposed and required by the Architect to be painted as described elsewhere in the specification.
3. Irrigation System: Provide all line voltage (50 volts or above) connections to irrigation system equipment, time clocks and or powered satellite controls. Coordinate locations of this work with the Landscape Contractor.
4. Pole Bases: Contractor shall be responsible to furnish light standard concrete pole bases, rebar, bolt templates and anchor bolt kits for a complete installation. Concrete, rebar, excavation shall be by Contractor in accordance with all parts of this specification.
5. HVAC Control Raceway: Raceways, boxes, and control wiring for thermostats, temperature sensors and control components specified within the mechanical specifications, shall be furnished and installed as required by Division 25 and installed in accordance with the minimum wiring methods allowed for branch circuit wiring in Division 26 (the DDC systems/EMS systems and components are installed in accordance with Division 25).
6. Security System: Shall be installed by Owner's vendor. Contractor shall provide conduits, boxes, stubs to accessible ceilings, dedicated circuit(s) for alarm panel, access control system (key pads, electric locks), etc. as shown and/or required by the Owner's vendor.

1.3 SYSTEM DESCRIPTION

- A. The electrical plans indicate the general layout and arrangement; the architectural drawings and field conditions shall determine exact locations. Field verify all conditions and modify as required to satisfy design requirements as well as code minimums. Maintain all required working clearances as described in CEC Article 110 as well as other applicable articles.
- B. Discrepancies shall be brought immediately to the attention of the Architect for clarification. The Architect shall approve any changes. Prior to rough-in, refer to architectural plans that shall take precedence over electrical plans with respect to locations.

1.4 SUBMITTALS AND SHOP DRAWINGS

- A. Before construction, submit in (accordance with the General Conditions of this Specification) a complete list of all materials proposed to be furnished and installed under this section. Any material procured without review and approval of the engineer and/or owner's representative will solely be at the contractor's risk.
- B. Manufacturers' specifications, catalog cuts and shop drawings as required to demonstrate compliance with the specifications. Identify specific intended use for each component where submittal may be ambiguous. Submit entire bound submittal at one time; partial submittals will not be accepted. At a minimum, submittals will be required for the following:
 1. Distribution equipment including main switchboards, distribution switchgear, transformers, distribution panels and breakers, motor controls, distribution and branch circuit panels, grounding, transient voltage surge suppressors, etc.
 2. Electrical equipment including disconnects, fuses, raceways, straps and racks, fittings, conductors, boxes, gutters, devices, plates, etc.
 3. Lighting equipment including fixtures, lamps, mounting accessories, color charts (where required), etc.

4. Lighting control equipment including low voltage switching system, accessories, occupancy sensing equipment, time clocks, contactors, photocells, lumen sensors, etc.
 5. Conduit including all fittings, etc.
 6. Wiring and cable, terminations, etc.
 7. Fire rating penetration materials, details, etc.
- C. The intent of these specifications is to establish a standard of quality for materials and equipment. Therefore, some items are identified by manufacturer or trade name designation. Substitutions shall be subject to the Architect's approval. Samples of the proposed and substitute materials may be required for inspection prior to approval. Costs, if any, for evaluation of substitutions shall be the Contractor's responsibility. The decision of the Architect shall be final. Where the substitution will affect other trades, coordinate all changes with those trades concerned and pay any additional costs incurred by them as a result of this substitution. Approval of substitutions shall not relieve the Contractor from providing an operational system in accordance with all applicable codes and ordinances.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage of equipment for the job is the responsibility of the Electrical Contractor and shall be scheduled for delivery to the site, as the equipment is required. Damage to the equipment delivered to the site or in transport to the job shall be the responsibility of the Electrical Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be new and bear the label of or be listed by a nationally recognized testing laboratory. The quality and suitability of all materials shall conform to the standards and practices of this trade.
- B. Supplied materials shall be of a current manufactured product line. Discontinued products are not acceptable. Where products are identified on the contract documents by part number, supply the current product model or series which meets the specification and intended use of the specified component.

2.2 SUPPORTING DEVICES

- A. Hangers: Kindorf B-905-2A Channel, H-119-D washer, C105 strap, 3/8" rod with ceiling flange.
- B. Concrete Inserts: Kindorf D-255, cast in concrete for support fasteners for loads up to 800 lbs.
- C. Pipe Straps: Two-hole galvanized or malleable iron.
- D. Luminaire Chain: Campbell Chain 75031, 90-lb. test with steel hooks.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Professionalism and appearance of installations shall be in accordance with accepted practices of this trade. Installation methods shall conform to manufacturers' specifications and recommendations. The Contractor shall man the job with qualified journeymen and helpers in this trade for the duration of the job. It is the Contractor's responsibility to communicate with and keep the job superintendent apprised of changes or clarifications, etc.
- B. Employment of any person on any job in the capacity of an electrician is not permitted unless such person has qualified for and holds a valid Journeyman Electrician Pocket Card or General Journeyman Electrician Certificate issued by the State of California Division of Apprenticeship Standards except, Contractor may employ electrical helpers or apprentices on any job of electrical construction, new or existing, when the work of such helpers or apprentices is performed under the direct and constant personal supervision of a journeyman electrician holding a valid Pocket Card accepted by the State of California Division of Apprenticeship Standards.
1. Each Pocket Card carrying journeyman electrician will be permitted to be responsible for the quality of workmanship for a maximum of one helper or apprentice during any same time period, provided the nature of work is such that good supervision can be maintained and the quality of workmanship is the best, as expected by Owner and implied by the latest edition of the National Electrical Code.
 2. Before each journeyman electrician commences work, deliver to Owner at the project site, a photocopy of the journeyman's valid Pocket Card.
- C. Materials shall be installed in accordance with the manufacturers' specification and recommendations. They must conform to the approval AHJ adopted codes and standards, but not less than the 2022 CEC and all applicable codes and standards, including but not necessarily limited to California Code of Regulations Title 24, NFPA, National Electrical Manufacturers Association, ANSI, CBC, and any other adopted ordinances of applicable agencies having jurisdiction. Refer to general conditions of specifications.
- D. Electrical Contractor shall lay work out in advance in order to avoid unnecessary cutting, chasing, and drilling of floors, walls, ceilings and other surfaces. Work of this nature shall be carefully done so as not to damage work already performed by other trades. Any damage which results must be properly repaired at no extra cost to the Owner. Such alterations shall not depreciate the integrity of the structure. Approval for cuts or penetrations in structural members shall be by the Architect.
- E. Supporting Devices:
1. Verify mounting height of all luminaires or items prior to installation when heights are not detailed.
 2. Install vertical support members for equipment and luminaires, straight and parallel to building walls. Provide independent supports to structural member for electrical luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over furred or suspended ceilings.
 3. Do not use other trade's fastening devices as supporting means for electrical equipment, materials or luminaires. Do not use supports or fastening devices to support other than one particular item.

4. Support conduits within 18" of outlets, boxes, panels, cabinets and deflections. Maximum distance between supports not to exceed 8' spacing.
 5. Securely suspend all junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from the floor above or roof structure to prevent sagging and swaying.
 6. Provide seismic bracing per UBC requirements for this building location.
 7. Supporting Devices: Safety factor of 4 required for every fastening device or support for electrical equipment installed. Support to withstand four times weight of equipment it supports. Bracing to comply with seismic design category "SDC" per Structural Engineer.
- F. Coordinate work with other trades as required to eliminate any delays during construction. Coordinate changes with other prime contractors to avoid construction conflicts.
- G. Engineer's Field Observation: Site visits during construction for field observations and reports will be conducted by electrical engineer when directed by the Architect. A list of items that need to be addressed will be submitted to the Architect for forwarding to the Contractor. A written response to all items shall be submitted for Owner's review once complete. When Electrical Engineering representative performs a field observation, the Electrical Contractor shall be present and available to remove equipment covers as needed.
- H. Drawings of Record: Provide a full and accurate set of field record drawings marked up in a neat and understandable manner submitted to the Owner Representative, Construction Manager, or Architect upon completion of the work and prior to issuance of a certificate of completion. The drawings shall dimension all electrical facilities including but not limited to underground conduit, vaults, boxes as well as conduit routing scaled to within 12" of actual field conditions and shall be kept up to date on a daily basis reflecting changes or deviations. Electrical facilities shall be accurately drawn on the plan to scale. Refer to the general conditions of these specifications for additional requirements. Record drawings shall be required to identify both horizontal and vertical dimensions to visible and fixed points such as concrete, asphalt, buildings, sidewalks, etc.
- I. Identification: Provide engraved laminated plastic nameplates for all switchboards, panelboards, fire alarm terminal cabinets, telephone and cable television backboards, main devices, control panels, time clocks, contactors and safety disconnect switches accurately identifying each device. Labels shall be attached to the equipment by means of screws or rivets. Self-adhering labels will not be acceptable. Refer to Section 26 05 53, IDENTIFICATION OF ELECTRICAL SYSTEMS.
- J. Safety: The Electrical Contractor is responsible to maintain equipment in a safe and responsible manner. Keep dead front equipment in place while equipment is energized. Conduct construction operations in a safe manner for employees as well as other work persons or anyone visiting the job site. Provide barriers, trench plates, flags, tape, etc. The Contractor shall hold all parties harmless of negligent safety practices that may cause injury to others on or near the job site.
- K. Guarantees: Equipment and labor shall be guaranteed and warranted free of defects, unless otherwise stated to be more restrictive, for a period of one year from the date of final acceptance by the Owner. A written warranty shall be presented to the Architect at the time of completion prior to final acceptance. Equipment deemed to be damaged, broken or failed should be repaired or replaced at no additional cost to the Owner. Materials or system requiring longer

than a one-year warranty as described herein shall be separately warranted in separate letters of guarantee stating the duration of warranty.

- L. Operating and Installation Manuals: Provide two copies each of manuals, operating and installation instructions for equipment indicated in submittal packages. Instruct the Owner's representative as to the operation and location of equipment necessary to allow them to operate the facility upon final acceptance. This instruction period shall be prearranged with the Owner's representative prior to occupancy of the facility and the weeks prior to training scheduled.

END OF SECTION 26 05 00

SECTION 26 05 19 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wires and cables.
 - 2. Connectors.
 - 3. Lugs and pads.

1.3 SYSTEM DESCRIPTION

- A. Provide wires, cables, connectors, lugs, strain reliefs, racking insulators for a complete and operational electrical system.

1.4 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Provide product data for the following equipment:
 - 1. Wires.
 - 2. Cables.
 - 3. Connectors.
 - 4. Lugs.
 - 5. Splice Kits.
 - 6. Strain Relief Fittings.
 - 7. Cable Racking and Insulators.
- C. Provide the insulation cable testing report in the project closeout documentation, refer to Closeout Requirements in the General Conditions portion of this specification.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of the CEC, latest adopted version with amendments by local Authority Having Jurisdiction (AHJ).
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wires and Cables: General Cable, Okonite, Southwire, or approved equal.
- B. Connectors: Burndy, IlSCO, Thomas & Betts, or approved equal.
- C. Wire connectors shall be minimum 75 degree centigrade rated and properly sized for the number of conductors being connected, terminated, spliced etc. All above grade connectors shall be solderless lug or plastic wire nut type, screw on, pressure cable type (wire nut or spring nut type), 600 volt, 105 degree C, with skirt to cover all portions of stripped wires. Connector shall be U.L. rated for number and size of conductors being joined together as a splice.
- D. Splices:
 - 1. Branch Circuit Splices: Ideal, Scotch-Lock, 3M, or approved.
 - 2. Feeder Splices: Compression barrel splice with two layers Scotch 23 and four layers of Scotch 33+ as vapor barrier.
 - 3. Screw Terminal Lugs.
 - 4. Kearney Split Bolt.

2.2 WIRES AND CABLES FOR LINE VOLTAGE SYSTEM AND CONTROLS. WIRE AND CABLE SHALL BE:

- A. Copper, 600 volt rated throughout. Conductors 14AWG to 10AWG, solid or stranded. Conductors 8AWG and larger, stranded.
- B. Phase color to be consistent at all feeder terminations; A-B-C, top to bottom, left to right, front to back. Phasing tape shall be permitted on sizes #6 and larger.
- C. Color Code Conductors as Follows:

PHASE	208 VOLT	240 VOLT DELTA	480 VOLT
A	Black	Black	Brown
B.	Red	Orange (High Leg)	Orange
C.	Blue	Blue	Yellow
Neutral	White	White	White w/ colored strip
Ground	Green	Green	Green
Isolated Ground	Green w/yellow trace	Green w/yellow trace	N/A
- D. All conductors shall be copper unless otherwise noted. Minimum size for individual conductors shall be #12 AWG unless otherwise noted. Sizes #8 AWG and larger shall be stranded conductor. Individual conductors shall be insulated with type, XHHW, THW, THHN/THWN 600-volt insulation unless otherwise noted. Control, signal, communication conductors shall be as dictated by the vendor of that equipment or as specified here-in. Proper insulation type shall be used for the proper environmental application (i.e., waterproof, wet location, plenum, temperature rated). If a condition exists where the application is uncertain, contact the Engineer for direction. Contractor is responsible to follow specific cabling requirements described in other sections of this specification relative to various communications and controls systems as

well as the respective riser diagrams shown on plans. If a discrepancy occurs, communicate such discrepancy to the Architect and Engineer immediately for resolution.

- E. Insulation types THWN, THHN or XHHW. Minimum insulation rating of 90C for branch circuits.
- F. Refer to signal and communications specification sections for cable requirements.

2.3 CONNECTORS

- A. Copper Pads: Drilled and tapped for multiple conductor terminals.
- B. Lugs: Indent/compression type for use with stranded branch circuit or control conductors.
- C. Solid Conductor Branch Circuits: Spring connectors, wire nuts, for conductors 18 through 8AWG.

2.4 LUGS AND PADS

- A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: Conductors shall not be installed until after conduit systems are permanently in place. Use an approved non hardening type wire pulling lubricant if lubricant is to be used. Maintain all conduits and wire pulls free from foreign material. If due to field conditions, more than a total of 300 degrees of bend are required; a pull box shall be furnished and installed for ease of installation. Said pull boxes must be sized and rated for the appropriate application and must remain easily accessible upon completion of the project (approval of the location shall be obtained from the Architect prior to installation). Show these pullboxes on the field record drawings. Conductors installed in underground raceways on site shall be duct sealed and taped where they exit the raceway to prevent the entrance of foreign material and moisture after the conductors are installed. Proper drainage shall be provided for underground pull and splice boxes.
- B. Insulation: Use proper insulation types where temperature and environment are a factor.
- C. Splices at or below grade level shall be made with wet location rated and approved mechanical connectors and shall be encapsulated in epoxy or plastic molded poured kits. The connections must be assured to be watertight. Splices at or below grade shall always be avoided and minimized. Prior approval is required for feeder splices below grade. Submit proposed materials and exhibit showing location of intended splices for Engineer's review and approval prior to commencing with the work.

- D. Labeling: All conductors in panels, switchboards, terminal cabinets, vaults, pull boxes, and junction boxes shall be labeled with tape number markers indicating circuit number and identifying system. All labeling shall be permanent. In manholes and vaults, provide embossed brass tags identifying system serviced and function. See Section 26 05 53 IDENTIFICATION OF ELECTRICAL SYSTEMS.
- E. All conductors, wiring, cable where installed below floor, slab or underground shall be considered wet locations, and shall be rated accordingly. Non waterproof cabling is not allowed in any below grade or wet application.
- F. Cables routed together in cable tray shall be stacked, organized and tie wrapped together in a neat and workman like manner. Random cable routing is not acceptable.
- G. Cable and conductors routed through pull boxes and vaults shall be properly supported on porcelain or equal insulators mounted on steel rack inserts. Bend radius of cable or conductor shall not be less than six times the overall cable diameter.
- H. Wires and Cables:
 - 1. Conductor Installation:
 - a. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
 - b. Install conductors with care to avoid damage to insulation.
 - c. Do not apply greater tension on conductors than recommended by manufacturer during installation.
 - d. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation.
 - 2. Conductor Size and Quantity:
 - a. Install no conductors smaller than 12AWG unless otherwise shown.
 - b. Provide all required conductors for a fully operable system.
 - 3. Provide dedicated neutrals (one neutral conductor for each phase conductor) in the following single phase circuits:
 - a. Dimmer controlled circuits.
 - b. Isolated ground circuits.
 - c. Ground fault and arc fault protected circuits where a GFI and arc fault breakers are used in panelboards.
 - d. Other electronic equipment which produces a high level of harmonic distortion including but not limited to computers, printers, plotters, copy machines, fax machines, where indicated.
 - 4. Conductors in Cabinets:
 - a. Cable and train all wires in panels and cabinets for power and control neatly and uniformly. Use plastic ties in panels and cabinets.
 - b. Tie and bundle feeder conductors in wireways of panelboards.
 - c. Hold conductors away from sharp metal edges.
 - d. Connectors: Retighten mechanical type lugs and connectors for conductors to equipment prior to Notice of Completion.

3.2 FIELD QUALITY CONTROL

- A. Tests:

1. Test conductor insulation on feeders of 400 amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below.
2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit report with operating and maintenance manual.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section Includes:
 - 1. Grounding and bonding requirements of electrical installations for personnel safety and to provide a low impedance path for possible ground fault currents as described in CEC Article 250.
 - 2. “Grounding electrode system” refers to all electrodes required by CEC, as well as including made, supplementary, lightning protection system and telecommunications system grounding electrodes.
 - 3. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.
- B. Related Work:
 - 1. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
 - 2. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be permitted to be identified per CEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes No. 10 AWG and smaller shall be ASTM B1 solid bare copper wire.
- C. Conductor sizes shall not be less than what is shown on the drawings and not less than required by the CEC, whichever is greater.

2.2 GROUND RODS

- A. Copperclad steel, 5/8" diameter by 10' long, conforming to UL 467 unless otherwise noted on drawings and details.
- B. Quantity of rods shall be as required to obtain the specified ground resistance or additional rods shall be driven to obtain specified resistance or less.

2.3 SPLICES AND TERMINATION COMPONENTS

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the CEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, fire sprinklers, plumbing piping, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per CEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 - 2. Provide a supplemental ground electrode and bond to the grounding electrode system.

- C. Service Disconnect: Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
 - 1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
 - 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. Transformers:
 - 1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
 - 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to nearest component of the grounding electrode system and the ground bar at the service equipment.
- F. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor sized per CEC.
 - 2. Non metallic conduit systems shall contain an equipment grounding conductor.
 - 3. Metal conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, power and lighting branch circuits.
- H. Boxes, Cabinets, Enclosures, and Panelboards:
 - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
 - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

- L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.4 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.5 TELECOMMUNICATIONS SYSTEM

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.

3.6 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 25 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met and test results shall be submitted to the Owner with final close out documents.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE Standard 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the IOR prior to backfilling. The Contractor shall notify the IOR 24 hours before the connections are ready for inspection.
- D. Furnish a copy of tests to Owner at completion of project.

3.7 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 8' in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

END OF SECTION 26 026

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Conduit and fittings.
2. Outlet boxes.
3. Weatherproof outlet boxes.
4. Junction and pull boxes.
5. Cabinets, termination cabinets.
6. Gutters.
7. Concrete boxes and vaults.
8. Fiberglass or composite boxes and vaults.

B. Related Work:

1. Installation of all wire, cable, conductor, boxes/gutters, pull ropes, fiber optic cable raceway, conduit, innerduct, cable sleeve and duct as described on the plans and/or as specified here-in. This scope shall include pathways to be installed underground on site and offsite, underslab, above grade, both concealed and exposed, overhead concealed and exposed as appropriately applied. Raceways/boxes shall be installed in accordance with their intended and allowed uses and as specified here-in whichever is more restrictive. Size and capacity of all raceway/boxes shall be as specified here-in or as depicted on the drawings, but shall not be less than that required by code. Larger raceway sizes may be specified than code would permit. The specifications shall govern.
2. Listed products for termination, coupling, extending, benching supports of raceways shall be used.
3. Raceways/boxes described by this section shall include, but not be limited to, power for site utilities and lighting, site and building communications, controls, fire alarm, security, access control, sound systems, data system, energy management systems, power distribution, lighting, lighting controls, video, CATV, voice communications, intercom, nurse call, HVAC and other building low voltage/communications systems controls as may be required. Raceways, boxes and duct paths required for utility companies shall be installed per plans unless utility company requirements are more restrictive at which time those requirements shall take precedence.
4. Protection of and cleanliness of pathways and raceways must be assured during the construction process in order to eliminate the possibility of debris entering the conduit, duct, pathway resulting in decreased wire capacity and potential damage to installed conductors and cables.
5. Pathways are shown in a diagrammatic way and are generally accurate as to routing, however, it is the Contractor's responsibility as a means and methods process to

- coordinate with all other trades that require space within a building. The Contractor shall obtain approval for installation of raceways routing through structural footings, retaining walls, columns, beams, purlins, grade beams, etc.
6. It is the Contractor's responsibility to insure that all raceway and boxes systems penetrate fire assemblies and sound rated assemblies in an approved manner using the appropriate and listed products for the purpose.
 7. Trenching and backfilling for all underground conduit systems installed by the Electrical Contractor shall be the responsibility of the Contractor. Conduits shall have minimum cover requirement of 36" below finish grade with the exception of site lighting conduits which may be 24" below finish grade minimum. More stringent depth requirements may be imposed by the local agency and utility company and shall be adhered to, and / or this specification or as detailed on the plans. Joint trenching may be utilized where practicable and where permitted by this specification. Concrete, native material and sand shall be used as backfill material and shall be compacted in accordance with and coordinated with the grading and site preparation requirements. Conduits shall rest in a minimum of 4" bed of sand prior to backfill and compaction. Locations of existing underground (UG) utility systems shall be determined by calling Underground Service Alert (USA) at least 48 hours prior to any excavation.
 8. Minimum conduit size shall be 1/2" except if plan shows or code requires larger size. Exception: Use minimum 3/4" for underslab and below grade applications outside of building exterior walls.
 9. All electrical, control, communications systems shall be installed in conduit system. This shall include but not be limited to all systems described in Section B.3 above, except for voice and data systems which shall be installed as described on these plans and as specified here-in but shall not be less than the recommendations of EIA/TIA standards.
 10. All line voltage wiring within the building shall be installed in metallic conduit.
 11. All conduit, concrete pads, underground concrete or fiberglass substructures shall be furnished and installed with the approved materials and type for the application. Provide proper traffic control during construction as well as barriers and protection of all excavations and trenching.
 12. Empty or future conduits shall be properly plugged with plastic caps or inserts with a 3/8" polyethylene pull rope. Plastic or "duct" tape will not be acceptable.
 13. Exterior installations: After conductors are installed, seal conduit ends to prevent entrance of foreign material using pliable duct seal, caps or waterproof expanding foam.
 14. All low voltage systems including intercom, fire alarm, public address, Voice / Data and Direct Digital Control (DDC) systems, etc. shall be in dedicated conduit systems.
 15. Underground conduits entering building shall have the open end of conduit within building above the elevation of the conduit outside the building such that water cannot enter building through conduit. If such a condition exists, a pull box outside of building footprint shall be installed in conduit route before conduit enters building whereby top of pull box is below finish floor of building and moisture may exit box before entering building.
 16. No single conduit run of any type shall exceed 300 degrees of radius bend from termination box to termination box.
 17. Separate Raceway System: Provide a separate dedicated raceway system for each system installed, do not combine different systems into a raceway or cable tray system, unless otherwise noted or allowed.
 18. Spare, Future Conduits: Conduits labeled conduit only, spare, or for future use, shall be provided with a pullrope, capped at each end, labeled as spare with destination marked, and turned over to the Owner in an unused state. Contractor shall not utilize these conduits for the installation of cabling or conductors as part of this scope of work.

Contractor to verify and install at no additional cost to the Owner, additional conduits as required for the installation of the systems being installed.

19. Outlet System: Provide electrical boxes and fittings as required for a complete installation. Including but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts, covers and all other necessary components.
20. Code Compliance: Comply with CEC as applicable to construction and installation of electrical boxes and fittings and size boxes according to CEC 312, 314 and 366 except as noted otherwise.
21. Outlets to be flush mounted: Maintain integrity of insulation and vapor barrier. Unless otherwise noted, flush mount all outlet boxes.
22. Provide putty pads of proper type around outlet boxes and/or as detailed on plan to meet sound transmission restrictions and fire ratings of walls.

1.3 SUBMITTALS

- A. Provide Shop Drawings and Product Data for the Following Equipment:
 1. Conduit and fittings.
 2. Outlet boxes.
 3. Weatherproof outlet boxes.
 4. Junction and pull boxes.
 5. Cabinets, termination cabinets.
 6. Gutters.
 7. Concrete boxes and vaults.
 8. Fiberglass or composite boxes and vaults.
 9. Raceways

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or other independent and nationally recognized testing firm.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Heavy wall Rigid Non-Metallic Conduit, shall be PVC schedule 40 manufactured in accordance with NEMA Standard TC-2, UL-651 and WC 1094A specifications.
- B. Extra heavy wall non-metallic conduit, shall be PVC schedule 80 manufactured in accordance with NEMA Standard TC-2, UL-651 and WC 1094A specifications.
- C. Galvanized Rigid Steel (GRS) conduit shall be hot dipped galvanized, zinc coated and shall comply with Underwriters Laboratories UL-6, ANSI Specification C-80.1 and Federal Specification WW-C-581E.

- D. Electrical Metallic Tubing (EMT) shall be zinc coated, with a protective coating applied to the inside surface and shall comply with Underwriter Laboratories UL-797 ANSI Specification C-80.3 and Federal Specification WW-C-563A.
- E. Flexible Metal Conduit (FMC) shall be continuous wound reduced wall galvanized steel produced to UL standards.
- F. Liquid tight flexible metal conduit shall have a thermoplastic cover over a galvanized steel core containing an integral copper ground in sizes to 1 1/4" and shall be in compliance with UL standards and CEC Article 350.
- G. Manufacturers:
 - 1. Outlet Boxes: Bowers, Raco, Steel City or equal.
 - 2. Weatherproof Outlet Boxes: Bell, Red Dot, [Carlton] or equal.
 - 3. Junction and Pull Boxes: Circle AW, Hoffman, Wireguard or equal.
 - 4. Box Extension Adapter: Bell, Red Dot, [Carlton] or equal.
 - 5. Conduit Fittings: O-Z Gedney, Thomas & Betts, or equal.
 - 6. Vaults: Christy, Brooks, Utility Vault or equal.
 - 7. Heavy wall rigid non-metallic conduit, Carlon, Certainteed, R&G Sloane or equal.
 - 8. Extra heavy wall non-metallic conduit, Carlon, Certainteed, R&G Sloane or equal.
 - 9. Galvanized Rigid Steel (GRS) conduit shall be hot dipped galvanized, zinc coated and shall comply with Underwriters Laboratories UL-6, ANSI Specification C-80.1 and Federal Specification WW-C-581E.
 - 10. Electrical Metallic Tubing (EMT) shall be zinc coated, with a protective coating applied to the inside surface and shall comply with Underwriter Laboratories UL-797 ANSI Specification C-80.3 and Federal Specification WW-C-563A.
 - 11. Flexible Metal Conduit (FMC), Alflex, American Flexible Conduit or equal.
 - 12. Liquid tight flexible metal conduit, Anacanda (type UA), Electri-flex Liqueatite or equal.
 - 13. Masonry Boxes, outlets in concrete, Raco Series 690 or equal.
 - 14. Exterior In-Grade Boxes for Non-Utility Company, Precast concrete or polymer concrete, Utility Vault and Christy.

2.2 OUTLET BOXES

- A. NEMA 1 gutter, junction and pull boxes shall be fabricated from code gage steel finished in grey enamel with screw cover fronts and concentric knockouts in all sides.
- B. NEMA 3R gutter, junction and pull boxes shall be fabricated from code gage galvanized steel with screw cover fronts and concentric knockouts in the bottom only. Any penetrations to the side, top or back shall be weatherproofed in an approved manner such as "MYERS" gasketed type hub or equal.
- C. Steel outlet boxes and plaster rings shall be galvanized rigid assemblies, either one piece pressed or factory welded construction containing the size and number of knockouts required. Steel outlet boxes shall be manufactured, sized and installed in accordance with CEC Article 314. Device Outlet: Installation of one or two devices at common location, minimum 4" square, minimum 1 1/2" deep. Single or 2 gang flush device plaster ring. Raco Series 681 and 686 or equal.

- D. Luminaire Outlet: minimum 4" square with correct plaster ring depth, minimum 1 1/2" deep with 3/8" luminaire stud if required. Provide proper depth plaster ring on bracket outlets and on ceiling outlets.
- E. Multiple Devices: Three or more devices at common location. Install 1 piece gang boxes with 1 piece device plastering. Install one device per gang unless otherwise allowed.
- F. Construction: Provide galvanized steel interior outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. Boxes shall be properly secured to the structure such that they are flush with the finish surface. Boxes shall be made structurally secure by means of the proper fastening devices.
- G. Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, plaster rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

2.3 WEATHERPROOF OUTLET BOXES

- A. Construction: Provide corrosion-resistant cast iron, with zinc finish, weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, zinc, galvanized finish.
- B. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner. Weatherproof boxes in wet locations as described in CEC 406.8 (B) shall be provided with a "while-in-use" cover; red dot 'CK' Series of aluminum die-cast construction, NEMA 3R, with lacquer finish.

2.4 JUNCTION AND PULL BOXES

- A. Construction: Provide galvanized sheet steel junction and pull boxes, with screw-on covers; of the type shape and size, to suit each respective location and installation; with welded seams and equipped with steel nuts, bolts, screws and washers.
- B. Location:
 - 1. Install junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
 - 2. Install junction boxes and pull boxes as required to facilitate the installation of conductors and limiting the accumulated angular sum of bends between boxes, cabinets and appliances to 300 degrees.
 - 3. Locations: Junction boxes shall be located only where necessary and only in equipment rooms, closets, and accessible attic and underfloor spaces. A horizontal distance of 24" shall separate outlet boxes on opposite sides of occupancy separation walls, fire-rated walls or partitions.

4. Labeling: Junction box covers shall be marked with indelible ink indicated the circuit numbers passing through the box.

2.5 BOX EXTENSION ADAPTER

- A. Construction: Diecast aluminum or cast iron with gasket.
- B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

2.6 CONDUIT FITTINGS

- A. Requirements: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and plastic conduit bushings of the type and size to suit each respective use and installation.
- B. Steel boxes may allow for field knock-out modifications, but shall in all other ways conform to code requirements.

2.7 EXTERIOR IN-GRADE BOXES FOR NON-UTILITY COMPANY USE SHALL BE:

- A. Precast concrete or polymer concrete type with full bottoms and draining into gravel drywell. Open bottom splice/pull boxes 24" x 36" and smaller shall be open bottom, with minimum 12" of gravel below for drainage.
- B. Flushmount in hardscape and 1" above grade in softscape.
- C. Provided with correct traffic type lid, i.e., full vehicular, intermediate incidental vehicular or pedestrian-rated as applicable stamped with "ELECTRIC", "LIGHTING", "COMMUNICATIONS", etc. cover identification as shown on the drawings or as applicable. All boxes or vaults located in streets, driveways, sidewalks wider than 8', and turf areas where mowing takes place shall be traffic rated.
- D. Provided with brass hold-down bolts in cover.
- E. Provided with necessary box extensions to gain proper depth.
- F. Seal all conduit in underground boxes with duct seal after conductors have been installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Conduit systems listed below are for use in installations where they are permitted to be used by CEC and/or other occupancy restrictions. The below installation methods do not intend to suggest that these materials be installed in conflict with any applicable code. Special attention to applications shall be made in building types such as Educational, Health Care, wet location,

hazardous locations, assembly occupancy and multi-story, but not limited to these. Requirements which are more restrictive than the CEC may be called for by the drawings and / or these specifications. These requirements must be adhered to. The Electrical Contractor shall be responsible to use the proper conduit system for the application. Exposed conduit is not allowed below ceilings or above slab of floor, without the permission and approval of the Architect. All conduits shall be concealed except in electrical and telecommunication rooms or where shown to be surface mounted. Exposed conduit (where allowed) shall be run square and plumb with building lines in an approved manner. Spacing of support shall be a minimum as provided for in the CEC. All exposed conduit mounted below 8' above finished grade shall be strapped at a minimum of 5' spacing.

- B. Non-Metallic Rigid Conduit shall be used in concrete slabs, below concrete slabs on grade, or underground outside of a building slab or foundation. Maintain minimum depth requirements and cover with appropriate fill material. Minimum 4" of bedding and cover of backfill material 1/4" size grain and smaller maximum. Conduit shall be heavy wall Schedule 40 or 80, rigid PVC only. Rigid utility P&C duct shall not be used in any application. Properly sized grounding conductors shall be installed per CEC article 250, in all non-metallic conduit branch circuit and feeder runs. PVC conduit shall be formed or field bent only with the use of properly approved bending tools such as to not decrease the internal bore of the conduit. All conduits shall be cut square and reamed of burrs. Approved and compatible glue shall be used on all PVC fittings to attain watertight joints. All non-metallic conduit runs over 150' in length and over 1 1/4" trade size conduit shall utilize galvanized rigid steel elbows.
- C. Galvanized Rigid Steel (GRS) conduit shall be used where exposed less than 8'-0" above finished grade to 18" below finished grade and where subject to physical damage. Conduits shall be cut square and reamed to remove burrs and sharp edges. Strap conduit below 8' above grade at 5' intervals. Unless otherwise noted, threadless setscrew and threadless weathertight fittings may be used in lieu of threaded fittings. All threaded ends entering a junction box of any type shall require one locknut on the inside and one on the outside of the enclosure and be provided with a plastic bushing or grounding bushing where necessary for proper grounding. Where exposed to moisture, a watertight hub or other approved method shall be required. All conduits shall be stubbed up straight and uniform into junction boxes, panels, cabinets, etc., and shall be (GRS) properly supported and strapped. All GRS conduit located below grade, shall be tape wrapped.
- D. Electrical Metallic Tubing (EMT) shall be used as allowed by code and as permitted by this specification. It shall not be in contact with soil or the concrete slab on the ground floor of any structure. Connectors and couplings shall be diecast, insulated set screw type where installed in indoor dry locations not subject to moisture. Where the potential for moisture is present, including interior spaces of Greenhouses, compression type weathertight listed fittings are required. One hole conduit straps are permitted from 1/2" to 1" and two hole conduit straps are required for size 1 1/4" and larger. EMT shall not be allowed in areas subject to severe physical damage. Install copper ground wire sized per CEC 250-122 in all EMT conduits.
- E. Flexible conduit may be used where concealed in building construction or above dropped ceilings, but shall meet the following criteria: No individual circuit path from distribution panel to last device shall exceed a cumulative length of 30' of flexible conduit from start to end. Flexible conduit shall not exceed a total directional change of 270 bending degrees in any one run between conduit terminations. Squeeze type or Jake type steel flex fittings of a grounding type are required. Flexible conduit must be supported in accordance with CEC. Where exposed to the weather, moisture, or spray down flexible conduit shall be of the liquidtight type. Fittings

shall be manufactured for use with liquidtight flexible conduit. All motor connections shall be made with liquidtight flex. Flexible conduit may not be used where exposed except for last 2' of equipment connection and unless otherwise noted or approved. A copper ground wire sized per CEC 250-122 shall be installed in all flexible conduit runs. Flexible conduit may not be used exposed. Weatherproof liquid tight conduit shall not be used at roof level for equipment connections with lengths exceeding 24' nor shall it be used to circumvent a rigid conduit system in a horizontal direction. Connect recessed lighting fixtures to conduit runs with a maximum of 6' of flexible metal conduit extending from junction box to fixture. "Master" "Slave" fixtures are permitted to use manufactured flexible cable of longer dimension up to 12' between "Master" and "Slave" only and only as a U.L. listed system component.

- F. Underground conduits and transition to above grade/slab shall be as follows:
1. PVC elbows allowed if top of elbow is minimum 18" BFG or below top of slab, otherwise GRS elbows are required.
 2. GRS elbows are required if conduit run is 150' or greater.
 3. GRS risers are required from elbow below grade to equipment (device, outlet, panel, cabinet, etc.) above grade.
 4. GRS elbows/risers to be PVC coated or 10 MIL taped wrapped (1/2" lapped) to 3" above finish grade or top of slab.
- G. Conduit Supports: Conduit runs may be supported by one-hole and two-hole straps or supports as manufactured by Unistrut, Minerallac, Caddy or equals. Supports may be fastened by means of anchors, shields, beam clamps, toggle bolts, or other approved methods appropriate for the application and size of conduit. Pipe nailers (J-hooks) may only be used for 1" conduit and smaller and only in wood frame construction. Conduit support methods are subject to review by the engineer and authority having jurisdiction for adequacy. Installations deemed inadequate shall be corrected by the contractor at no cost to the Owner.
- H. Bends and offsets shall be made with approved tools for the type of conduit being utilized. Bends shall be made without kinking or destroying the smooth bore of the conduit. Parallel conduits shall be run straight and true with bends uniform and symmetrical. Minimum radii shall be per CEC 344-24.
- I. Conduit Stub-outs below grade shall be capped with plastic cap, and identified by placing a pull box marked with correctly identified utility such as "Elec", "Tel", etc. Dimension for exact location on field record drawings. Provide lids for proper field application (i.e. traffic, incidental, pedestrian).
- J. Conduit Seals: Where below grade conduits enter structure through slab or retaining wall of building or basement, seal the inside of each conduit as follows:
1. Provide damming material around conductors 3" into conduit.
 2. Fill 3" of conduit with 3M #2123 sealing compound.
 3. Wrap conductors where they exit the conduit with 3M #2229 "Scotch Seal" mastic tape. Lap tape to approximate diameter of the raceway and wrap outside of conduit opening with (minimum) one turn.
 4. Use conduit sealing bushings type CSB (O-Z/Gedney) or equal.
 5. Empty conduits shall be sealed with standard non-hardening duct seal compound and then capped to prevent entrance of moisture and gases and to meet fire resistance requirements.
 6. Provide cable drip loop minimum 12" high.

- K. Marker tape: Place plastic yellow marker tape at 12" above buried conduits. Label tape "CAUTION: ELECTRICAL LINES BELOW" or similar wording.
- L. Electrical and communications systems raceways routed underground shall not occupy the same trench as plumbing utilities such as sewer, water, storm drain, gas or other wet or dry gaseous utility system. A minimum of 12" of undisturbed earth is required. Where utilities must cross in closer proximity to each other due to physical constraints, 6" minimum crossing distances are allowed, however 18" on all sides of a utility crossing must be concrete encased.
- M. Conduits, routed below footings, slabs, grade beams, columns, and other structural elements shall be installed in strict compliance with structural details and criteria shown on structural plans. Clearances below structural elements and sleeves through structural elements must be carefully planned to avoid conflict and must be approved by the structural engineer if conflict arises.
- N. Location: Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
- O. Anchoring: Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
- P. Special Application: Provide weatherproof outlets for locations exposed to weather or moisture.
- Q. Knockout Closures: Provide knockout closures to cap unused knockout holes where blanks have been removed.
- R. Mount outlet boxes, unless otherwise required by ADA, or noted on drawings, the following distances above the finished floor:
 - 1. Receptacles, Telephone, TV & Data outlets. (measured to bottom of outlet box): +15".
 - 2. Outlet above counter (measured to top of outlet box): +46".
 - 3. Control (light) Switches. (measured to top of outlet box): +48".
 - 4. Fire Alarm Manual Pull Stations, T-stats. (measured to top of outlet box): +48".
 - 5. Fire Alarm Visuals: the lower of +80" to bottom of lens, or 6" below ceiling.
 - 6. Other Outlets: As indicated in other sections of specifications or as detailed on drawings.
- S. Coordinate all electrical device locations with the architectural floor plan and interior and exterior elevations to prevent mounting devices within elements that they may conflict such as cabinetry, mirrors, planters, etc.
- T. Size outlet and junction boxes to minimum wire fill space requirements. Upsize box as required to allow ease of wire installation and device installation.
- U. Outlet and junction boxes in fire rated walls shall be gauged and spaced so as not to exceed the maximum penetration allowed by the assembly without compromising the fire rating. If a conflict arises relative to a specific condition, the contractor shall follow the requirements of the fire authority and ask for guidance from the design team. At no time should a larger box be installed prior to resolution of conflict.

END OF SECTION 26 05 33

SECTION 26 05 53 – IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section Includes:

- 1. Nameplates and warning signs where specified herein and as shown on contract documents including the following:
 - a. Nameplates and warning signs permanently installed on all electrical equipment and devices including, but not limited to, the following items:
 - 1) Enclosures for transformers, control, panels, pullboxes, cabinets, motors.
 - 2) Enclosures for all separately enclosed devices including, but not limited to, disconnect switches, circuit breakers, contactors, time switches, control stations and relays, and lighting control panel.
 - 3) Wall switches not within sight of outlet controlled.
 - 4) Special systems such as, but not limited to, telephone, fire alarm, warning and signal systems. Identification shall be at each equipment rack, terminal cabinet, control panel, annunciator and pullbox.
 - 5) Devices mounted within and part of equipment including circuit breakers, switches, control devices, control transformers, relays, indication devices and instruments.
- 2. Conductor and Cable Identification.

B. Related Work:

- 1. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- 2. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- 3. Section 26 24 16, PANELBOARDS.
- 4. Section 26 28 16, ENCLOSED SWITCHES AND CIRCUIT BREAKERS.
- 5. Section 26 24 14, DISTRIBUTION SWITCHBOARD.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABEL DESIGNATIONS

- A. Equipment labels indicating equipment designations both emergency and normal. Designation data per drawings or to be supplied with shop drawings approval.
- B. Panelboard labels showing panel designation, voltage, phase and source.
- C. In accordance with CEC 110.16, provide arc flash protection warning labels on all switchboards, panelboards, distribution panels, transformers, safety switches, transfer equipment, etc. Labels shall be per ANSI Z535.4 guidelines.

2.2 MATERIALS

- A. For Labels: Three layer laminated plastic or micarta with engraved white letters over black background.
- B. For Emergency Equipment: Use engraved white letters over red background.
- C. For Warning Signs: Minimum 18 gauge steel with red lettering on white porcelain enamel finish.
- D. Arc flash labels shall be provided as required by CEC Article 70E.
- E. Conductor tape number markers: ABB Thomas and Betts WM-0-45 Series non-fading permanent adhesive.

PART 3 - EXECUTION

3.1 MOUNTING

- A. Equipment labels shall be mounted by self-tapping, threaded screws and bolts, or by rivets. Adhesive types are not acceptable unless specifically noted in this section.
- B. Conductor tape markers shall be consistently placed for ready conductor identification.

3.2 HEIGHTS ON LABELS

- A. Panelboards, Switchboards and Control Centers and Special Systems Enclosures: 1/4" identify equipment designation; 1/8" identify voltage rating and source.
- B. Individual Circuit Breakers, Switches, and Motor Starters in Panelboards, Switchboards, and Motor Control Centers: 3/16" identify circuit and load served, including location of equipment.
- C. Enclosed Circuit Breakers, Enclosed Switches, and Motor Starters: 3/16" identify load served.

- D. Transformers: 3/16" identify equipment designation; 1/8" identify primary and secondary voltages, primary source and secondary load. Include location of primary source or secondary load if remote from transformer.

END OF SECTION 26 05 53

SECTION 26 22 00 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section Includes:
 - 1. Dry type general purpose transformers rated 600 volts and below.
- B. Related Work:
 - 1. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
 - 2. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
 - 3. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical rating, impedance, dimensions, weight, mounting details and materials, decibel rating, terminations, temperature rise, no load and full load losses, and connection diagrams.
 - 3. Complete nameplate data including manufacturer's name and catalog number.
- C. Manuals:
 - 1. Submit, simultaneously with the shop drawings, companion copies of complete operating and maintenance manuals including technical data sheets and wiring diagrams.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements) form a part of this specification to the extent referenced.
- B. National Fire Protection Association (NFPA):
 - 1. 70-2010 California Electrical Code (CEC)

- C. National Electrical Manufacturers Association (NEMA):
 - 1. ST 20-1992 Dry-Type Transformers for General Applications
 - 2. TP-1-1996 Energy Efficient Transformers

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE DRY TYPE TRANSFORMERS

- A. Unless otherwise specified, dry type transformers shall be in accordance with NEMA, CEC and as shown on the drawings. Transformers shall be UL listed or labeled. All transformers shall comply with NEMA TP-1 energy efficiency standards as adopted by the State of California. Efficiency shall be tested in accordance with NEMA DOE-2016.
- B. Dry type transformers shall have the following features:
 - 1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers shall not be accepted unless otherwise stated.
 - 2. Rating and winding connections shall be as shown on the drawings.
 - 3. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.
 - 4. Insulation systems:
 - a. Transformers 30 KVA and larger: UL rated 220 degree C system having an average maximum rise by resistance of 115 degree C in a maximum ambient of 40 degree C.
 - b. Transformers below 30 KVA: Same as for 30 KVA and larger or UL rated 185 degree C system having an average maximum rise by resistance of 115 degree C in a maximum ambient of 40 degree C.
 - 5. Core and coil assemblies:
 - a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
 - b. Cores shall be grain oriented, non-aging, silicon steel.
 - c. Coils shall be continuous windings without splices except for taps.
 - d. Coil loss and core loss shall be optimum for efficient operation. NEMA TP-1 type.
 - e. Primary and secondary tap connections shall be brazed or pressure type.
 - f. Coil windings shall have end fillers or tie downs for maximum strength.
 - g. Terminals shall be rated 75 degrees C minimum.

- 6. Certified sound levels determined in accordance with NEMA, that do not exceed the following:

Transformer Rating	Sound Level Rating
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

- 7. Nominal impedance shall be as permitted by NEMA.
- 8. Single phase transformers rated 15 KVA through 25 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All transformers rated 30 KVA and larger shall have two, 2-1/2 percent full capacity taps above, and four, 2-1/2 percent full capacity taps below normal rated primary voltage.
- 9. Core assemblies shall be grounded to their enclosures by adequate flexible ground straps.
- 10. Enclosures:
 - a. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
 - b. Ventilation openings shall prevent accidental access to live components.
 - c. Thoroughly clean and paint at the factory with manufacturer's prime coat and standard finish.
- 11. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagram and sound level indicated on it.
- 12. Dimensions and configurations shall conform to the spaces designated for their installations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the CEC, and as shown on the drawings.
- B. Install the transformers with adequate clearance at a minimum 6 inches or more from wall and adjacent equipment for air circulation to remove the heat produced by transformers and as recommended by the manufacturer to achieve U.L. listing.
- C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.
- D. Use liquidtight flexible metal conduit to contain the conductors from the transformer to the raceway system.
- E. Transformers shall be secured to meet CBC seismic zone 4 requirements.

END OF SECTION 26 22 00

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section Includes:
 - 1. Panelboards.
- B. Related Work:
 - 1. Division 09 “PAINTING”: Identification and painting of panelboards.
 - 2. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
 - 3. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
 - 4. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
 - 5. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Underwriters Laboratories, Inc. (UL):
 - 1. No. 50 Enclosures for Electrical Equipment
 - 2. No. 67 Panelboards
 - 3. No. 489 Molded Case Circuit Breakers and Circuit Breaker enclosures
- C. National Fire Protection Association (NFPA):
 - 1. No. 70-2016 California Electrical Code (CEC)
- D. National Electrical Manufacturers Association (NEMA):
 - 1. No. PB-1 Panelboards.
 - 2. No. AB-3 Molded Case Circuit Breakers and Their Application.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Panelboards shall be in accordance with UL, NEMA, NEC, CEC and as shown on the drawings. Approved manufacturers are Eaton, Square D, Seimens, ABB/General Electric.
- B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.
- C. All panelboards shall be dead front safety type. Arrange sections for easy removal without disturbing other sections.
- D. All panelboards shall be completely factory assembled with molded case circuit breakers. All factory wiring shall be checked for correct tightness and visually inspected to insure that bussing and terminations have not become loose in transit to job site.
- E. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings. Refer to single line diagram and panel schedules on drawings. Terminals shall be minimum 75 degree rated. Back fed main circuit breakers are not allowed. Main circuit breakers shall be vertically mounted.
- F. Panelboards shall have the following features:
 - 1. Nonreduced size copper bus bars, and connection straps bolted together and rigidly supported on molded insulators. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of branch circuit devices.
 - 2. Full size neutral bar, mounted on insulated supports.
 - 3. Ground bar and isolation ground bar (where called for in panel schedule) with sufficient terminals for all grounding wires. Buses braced for the available short circuit current.
 - 4. All breakers and phase bus connections shall be arranged so that it will be possible to substitute a 2-pole breaker for two single pole breakers, and a 3-pole breaker for three single pole breakers, when trip is 30 amps or less and frame size is 100 amperes or less, without having to drill and tap the main bus bars at bus straps. Where used for heating and air conditioning, and refrigeration equipment, use only HACR type U.L. listed circuit breakers.
 - 5. Design interior so that protective devices can be replaced without removing adjacent units, main bus connectors, and without drilling or tapping.
 - 6. Where designated on panel schedule as "space", include all necessary bussing, device support and connections. Provide blank cover for each space.
 - 7. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side with cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
 - 8. Series rated panelboards are not permitted.
 - 9. Label all panels in accordance with Section 26 05 53, IDENTIFICATION OF ELECTRICAL SYSTEMS.
 - 10. Recessed panel space conduit: Provide (1) $\frac{3}{4}$ inch spare conduit stubbed to accessible ceiling space and/or interstitial space below floor for every (5) spaces and spares indicated on panel schedules.

- G. Panelboards serving as building mains shall be "service entrance rated" and UL Listed as "service equipment".

2.2 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panels shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL standard for outdoor applications.
2. All ventilated openings in panelboards and switchboards, shall be furnished with dust filters to prevent entrance of dust and debris.
3. Cabinets for panelboards may be of one piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide necessary hardware for "in" and "out" adjustment of panel interior.
5. Cabinets for two section panelboards shall be arranged side by side, and shall be the same height. Flush mounted cabinets should be 1 1/2" apart and coupled by conduit nipple if necessary.
6. Gutter size in panel boxes, on all sides, shall be in accordance with the CEC. Penetrations through gutter to live area of the panelboard shall incorporate approved non-metallic-grommet type of insulation to protect wire passing through.

B. Trims:

1. Fabricate trim of sheet steel consisting of frame with door attached by concealed hinges. Provide flush or surface trim as shown on the drawings.
2. Flush trims shall overlap the box by at least 3/4" all around.
3. Surface trim shall have the same width and height as the box.
4. Flush or surface trims shall not have ventilating openings.
5. Secure trims to back boxes by indicating trim clamps.
6. Provide a welded angle on rear of trim to support and align trim to cabinet.
7. Provide separate trims for each section of multiple section panelboards. Trims and doors of sections shall be of the same height.

C. Doors:

1. Provide doors with flush type latch and manufacturer's standard lock. Doors over 48 inches in height shall have a vault handle and a three-point catch, arranged to fasten door at top, bottom, and center.
2. In making switching devices accessible, doors shall not uncover any live parts.
3. Provide concealed hinges welded to the doors and trims.
4. For lighting or power contactors incorporated in panelboards, provide separate doors for the contactors.
5. Provide keyed alike system for all panelboards.
6. Provide a directory card, metal holder, and transparent cover. Permanently mount holders on inside of doors.

D. Painting:

1. Thoroughly clean and paint trims and doors at the factory with primer and manufacturer's standard finish.

2.3 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

- A. Breakers shall be UL listed and labeled, in accordance with the CEC, as shown on the drawings, and as specified.
- B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.
 - 1. Molded case circuit breakers for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated.
 - 2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame or less. Magnetic trip shall be adjustable from 3 times to 10 times for breakers with 600 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.
- C. Breaker features shall be as follows:
 - 1. Integral housing of molded insulating material.
 - 2. Silver alloy contacts.
 - 3. Arc quenchers and phase barriers for each pole.
 - 4. Quick-make, quick-break, operating mechanisms.
 - 5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
 - 6. Electrically and mechanically trip free.
 - 7. An operating handle which indicates ON, TRIPPED, and OFF positions.
 - a. Line connections shall be bolted.
 - b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as indicated on the drawings, and as shown on the electrical system protective device study as required. The interrupting rating shall not be less than the minimum identified requirement.
 - 8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.

2.4 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.
- B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with CEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes and layout of cabinets within the designated spaces. All equipment must

be dimensioned in order to physically fit in the spaces provided and to comply with all code required clearances.

- C. Install a typewritten schedule of circuits in each panelboard. Include the room numbers (as finally described by the Owner) and items served on the cards. Obtain final room numbers from Architect prior to creating schedule.
- D. Mount the panelboard so that maximum height of the top circuit breaker above finished floor shall not exceed 78 inches.
- E. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- F. Circuit numbers shall correspond to the approved panel schedule. Provide as-built drawings showing the actual circuit numbers being used for each device on each branch circuit if changes are required.
- G. Verify depth of all flush mounted enclosures in walls to be certain wall depth will accommodate panel depth prior to installation.
- H. All openings in switchgear and panelboards that are unused shall be sealed with bolts and washers. Use caulking where holes or openings cannot be sealed by way of a washer, or bolts or conduit seals.
- I. Contractor shall include the services of an independent testing company to test GFI circuit breakers in distribution and main panelboards.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section Includes:
 - 1. Wiring devices.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Related Work:
 - 1. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
 - 2. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
 - 3. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
 - 4. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc.
 - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature (this feature does not substitute for a grounding conductor terminated on grounding strap of device). Terminal screws shall be brass, brass plated or a copper alloy metal.
 - 2. Receptacles shall be of a screw terminal type, "pressure type quick wire" terminations are not allowed.
 - 3. 15 ampere and 20 ampere, 125-volt and 250-volt non-locking receptacles shall be tamper resistant type receptacles unless the application is specifically listed as an exception to CEC 406.12.
 - 4. Receptacles shall be "wet rated" when used in an exterior location.
- B. Duplex receptacles shall be commercial grade single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall

have bussing break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.

1. Bodies shall be white in color. Contractor to verify device color with Architect prior to procurement.
 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
 3. Controlled receptacles; installed per requirements of 2016 BUILDING ENERGY EFFICIENCY STANDARDS / Efficiency Standards, California Code of Regulations, Title 24, Part 6. SECTION 130.5 (d) – ELECTRICAL POWER DISTRIBUTION SYSTEMS as Circuit Controls for 120-Volt Receptacles and / or Controlled Receptacles. Shall be provided with an approved means of including a permanent and durable marking identifying the controlled receptacles or circuits to differentiate them from uncontrolled receptacles or circuits. Where shown on associated floor plans, and or required by the Standards; a duplex noted to be controlled shall be 'split-wire', so the top outlet shall be switched and the bottom outlet shall be unswitched. A double duplex (fourplex) noted to be controlled: one of the duplex receptacles shall be controlled and the other duplex receptacle shall be unswitched.
 4. Duplex Receptacles on Emergency Circuit: Receptacle bodies shall be red in color. Wall plates shall also be powder coat painted red finish. Cover shall be labeled with panel and circuit number.
 5. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit suitable for mounting in a standard outlet box.
 - a. Ground fault interrupter shall be commercial grade and consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. It shall be rated for operation on a 60 Hz, 120 volt, 20-ampere branch circuit. Device shall meet CEC requirements. Device shall have a minimum nominal tripping time of 1/30th of a second. Devices shall meet UL 943.
- C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete and match with appropriate cord grip plug. Devices shall meet UL 231.
- D. Weatherproof Receptacles: Shall consist of a listed weather resistant duplex receptacle, mounted in box with a gasketed, while in use weatherproof, cast metal cover plate and cap receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. Approved manufacturers: Intermatic WP10 Series, Thomas & Betts/Red Dot 2CK Series, or engineer approved equal.

2.2 SWITCHES AND DIMMERS

- A. Toggle switches shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles color to match receptacle device color unless otherwise specified.
1. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and be of a screw terminal type.
 2. Shall be color coded for current rating, listed by Underwriters Laboratories, Inc., and meet the requirements of NEMA WD 1, Heavy-Duty and UL 20.
 3. Ratings:
 - a. 120 volt circuits: 20 amperes at 120-277 volts AC.

- b. 277 volt circuits: 20 amperes at 277 volts AC.
 - 4. The switches shall be mounted on the strike plate side of doors.
 - 5. Incorporate barriers between switches with multi-gang outlet boxes where required by the CEC.
 - 6. All toggle switches shall be of the same manufacturer.
- B. Dimmers: Wall-mounted incandescent dimmers shall be specification grade with capability of raising and lowering the lighting from completely off to full intensity.

2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel.
- B. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD1.
- C. For receptacles or switches ganged together, wall plates shall be a single ganged plate.
- D. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.
- E. Surface mounted boxes, NEMA1, shall be industrial grade raised galvanized steel covers. In shop areas all receptacles shall be dust proof and or waterproof where applicable.
- F. Waterproof device covers shall be cast iron, 4-corner screw type, for FS and FD type mounting. Device covers shall be zinc galvanized finish. Weatherproof covers shall be lockable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Switches installed in hazardous areas shall be explosion proof type in accordance with the CEC and as shown on the drawings.
- B. Installation shall be in accordance with the CEC, NECA "Standard of Installation", and as shown as on the drawings.
- C. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also be connected to the green equipment grounding conductor.
- D. General: Devices shall be of the type specified herein. All devices shall be installed with "pigtailed" leads from the outlet box. No device shall be used in the "feed through" application. Screw terminals shall be used to connect all devices to the circuit and shall be grounded by means of a ground wire where grounding terminals are provided in the device.
- E. Installation: Devices and plates shall be installed in a "plumb" condition and must be flush with the finish surface of the wall where boxes are recessed.

- F. Mounting heights: All control and convenience devices shall comply with California Code of Regulations Title 24 and ADA with respect to accessibility requirements. Mounting heights indicated on plans shall have precedence.
- G. Install switches with the off position down.
- H. Clean debris from outlet boxes.
- I. Provide extension rings as required to bring outlet boxes flush with finished surface or casework.
- J. Test each receptacle device for proper polarity.

END OF SECTION 26 27 26

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section Includes:
 - 1. Disconnect and safety switches where shown on the contract drawings and specified herein.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Related Work:
 - 1. Section 26 05 53, IDENTIFICATION OF ELECTRICAL SYSTEMS.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Approved Manufacturers: Eaton, ABB/General Electric, ITE-Siemens and Square-D.
- B. Disconnect Switches: Provide with devices enabling the switch to be locked in the open or closed positions.
- C. Manual Motor Switches: Tumbler type rated 3HP, 240 Volts with or without overload heaters as required to protect equipment served.
- D. Externally Operable Safety Switches: To have quick-make, quick-break mechanism, capable of switching 10 times switch rating, with cover interlock to prevent opening with switch in ON position and defeat mechanism for maintenance.
- E. Switches: Shall be general duty (GD) for 240 volt and below and heavy duty (HD) for 277/480 volt type unless otherwise indicated. Provide NEMA 1 enclosures for interior locations and NEMA 3R enclosures for exterior or wet locations. Provide with number of poles, ampacity, voltage and HP rating, fusible or nonfusible as indicated. Copper blades shall be visible in off position.

- F. Fusible Switches: Equip them with rejection clips for UL Class R fuses. Switches having a dual rating when used with dual element fuses shall have a rating so indicated and shall be confirmed by equipment vendor being connected.
- G. 600 Amperes or Less Fuses: UL Class RKI with a minimum interrupting rating of 200,000 Amperes, Bussmann "Low-Peak Type" or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Locations: Install switches, disconnects and safety where indicated on the Contract Drawings or as required by CEC.
- B. Fastenings: Securely fasten switches to structural members or unistrut support as directed by the manufacturer.
- C. Manual Motor Switches: Install flush mounted in finished areas.
- D. Manual Motor Switches: Install surface mounted in equipment rooms and non-finished areas. Where installed above inaccessible ceilings provide access panels.
- E. Label all disconnect switches in accordance with Section 26 05 53, IDENTIFICATION OF ELECTRICAL SYSTEMS.
- F. Fuse: All fuses shall be as indicated on the plan or as required by the equipment. Verify fuse size with equipment manufacturer requirements, prior to installation. Use current limiting fuses as indicated on plan. Provide one spare fuse cabinet in each electrical room with one complete set of spare fuses for all sizes of main fuses, subpanel fuses, HVAC equipment fuses and fire alarm.
- G. Terminals shall be minimum 75 degree rated.

END OF SECTION 26 28 16

SECTION 26 51 00 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section Includes:
 - 1. Interior lighting systems, including luminaires, ballasts, lamps and emergency lighting equipment.
- B. Related Work:
 - 1. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
 - 2. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
 - 3. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
 - 4. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
 - 5. Section 26 56 00, EXTERIOR LIGHTING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting, details, materials, terminations, wiring and connection diagrams, photometric data, ballasts, luminaires, lamps and controls.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. American National Standards Institute (ANSI).

- D. Aluminum Association Inc. (AA).
- E. Illuminating Engineering Society of North America (IESNA).
- F. National Electrical Manufacturers Association (NEMA).
- G. National Fire Protection Association (NFPA).
- H. Underwriters Laboratories, Inc. (UL).

1.5 DEFINITIONS

- A. Lighting terminology used herein is defined in IES
- B. Exception: The term “driver” is used herein to cover both drivers and power supplies, where applicable.
- C. Clarification: The term “LED light source(s)” is used herein per IES to cover LED package(s), module(s), and array(s).

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be in accordance with CEC, UL, ANSI, and as shown on the drawings and specified.

2.2 LIGHTING FIXTURES (LUMINAIRES)

- A. Shall be in accordance with NFPA 70, UL 1598 and shall be as shown on drawings and as specified. All luminaires shall have been certified to the California Energy Commission by its manufacturer to comply with the efficiency standards as per California Code of Regulations Title 24, Part 6, Section 111 referencing the Appliance Efficiency Regulations in Title 20. Post certification with building permit.
- B. Sheet Metal:
 - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
 - 2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - 3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
 - a. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.
- C. Luminaires shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers.

- D. Recessed fixtures shall be of the type approved for the ceiling and insulation conditions and appropriate for the installation location. Insulation must be held back from the fixture to provide manufacturers' recommended clearances for proper operation. Thermal tripping shall be the installer's responsibility to correct. Where installed in fire rated ceilings, coordinate installation of fire rated enclosures around the ceiling penetrations. Fixtures shall contain the proper through wiring capacity for that which is shown on the plans.
- E. Recessed fixtures shall be provided with the appropriate trims and hardware compatible with the ceiling type shown. Plaster frames are required where plaster or gypsum board ceilings are encountered.
- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:
 - 1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking.
 - 2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise specified on the drawing.
 - 3. Exterior finishes shall be as shown on the drawings.
- H. Provide all lighting fixtures with a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- I. Recessed fixtures shall be manufactured specifically for specified lamps with drivers integral to the fixture. Assemblies designed to retrofit fixtures are prohibited except when described in this fashion. Fixtures shall be designed for lamps as specified.
- J. Provide wire lamp guard on all exposed lamp fixture/luminaires.
- K. Provide fixtures with a U.L. listing for shower or shower rating above shower or tub areas.

2.3 LED LUMINAIRE REQUIREMENTS

- A. General Requirements:
 - 1. Luminaire shall have an external label per ANSI C136.15
 - 2. Luminaire shall have an internal label per ANSI C136.22.
 - 3. Luminaires shall start and operate in -20°C to +40°C ambient.
 - 4. LED light source(s) and driver(s) shall be RoHS compliant.
- B. Shielding: All lens material shall be 100% virgin acrylic, .125" minimum thickness, unless otherwise indicated in the fixture schedule. Diffusers shall comply with UBC 5209.
- C. Slimline and magnetic ballasts shall not be allowed.

2.4 LED DRIVER

- A. Driver
 - 1. Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperatures as indicated.
 - 2. Shall accept the voltage or voltage range indicated, and shall operate normally for input voltage fluctuations of plus or minus 10 percent. Consistent with NEMA SSL 1.
 - 3. Shall have a minimum Power Factor (PF) of 0.90 at full input power and across specified voltage range.

- B. Electromagnetic interference
 - 1. Shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
 - 2. Shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

- C. The following shall be in accordance with corresponding sections of ANSI C136.37
 - 1. Wiring and grounding
 - 2. All internal components shall be assembled and pre-wired using modular electrical connections.
 - 3. Mounting provisions
 - 4. Terminal blocks for incoming AC lines
 - 5. Latching and hinging
 - 6. Ingress protection

2.5 LAMPS

- A. Provide lamps for all luminaires.

- B. LED LIGHT SOURCE
 - 1. Minimum Color Rendering Index (CRI): 60.
 - 2. Correlated Color Temperature (CCT)
 - a. CCT shall be as listed in Table 1 below:

<u>Table 1. Allowable CCT</u>	
<u>Manufacturer-Rated Nominal CCT (K)</u>	<u>Allowable LM-79 Chromaticity Values Measured CCT (K)</u>
2700	2580 to 2870
3000	2870 to 3220
3500	3220 to 3710
4000	3710 to 4260
4500	4260 to 4746
5000	4745 to 5311
5700	5310 to 6020
6500	6020 to 7040

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation and furnishing of lighting fixtures shall be in accordance with the CEC, manufacturer's instructions and as shown on the drawings or specified. Fixtures damaged in transit and storage prior to completion shall be replaced at Contractor's expense.
- B. Align, mount and level the lighting fixtures uniformly.
- C. Avoid interference with and provide clearance for equipment. Where the indicated locations for the lighting fixtures conflict with the locations for equipment, change the locations for the lighting fixtures by the minimum distances necessary as approved by the Architect. The Architectural reflected ceiling plan will take precedence over electrical plans.
- D. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings.
- E. Lighting Fixture Supports:
 - 1. Contractor shall provide support for all of the fixtures independent of suspended ceilings. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 - 4. Hardware for recessed fluorescent fixtures:
 - 5. Fixtures shall be supported as detailed on drawings and as required by DSA standards.
 - 6. Installation: Fixtures shall be securely mounted on ceilings and walls with appropriate fastening devices. "Drop-in" type T-bar fixtures shall be secured with #12 gauge safety "earthquake wires" as described by California Code of Regulations Title 24 Part 2, Chapter 47. "Earthquake clips" will be required for fastening to the T-bar system in addition to safety wire. Surface mounted fluorescent fixtures shall be solidly screwed or clipped into framing above drywall with 4-#10 sheet metal screws into each fixture. Provide blocking for screw supports behind all surface mounted lighting fixtures weighing more than 15 lbs.
 - 7. Surface mounted lighting fixtures:
 - a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts shall be minimum ¼-20 bolt, secured to structural ceiling. Non-turning studs may be attached to the building structure by 12 gauge safety hangers.
 - 8. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
 - 9. Single or double pendent mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box, mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure and be allowed to swing to a 45 degree angle.
 - 10. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved

device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

- F. Furnish and install the specified lamps for all lighting fixtures as part of this project.
- G. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- H. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- I. At completion of project, relamp all fixtures which have failed/burned-out lamps. Clean all fixtures, lenses, diffusers and louvers that have accumulated dust/dirt during construction.
- J. Provide unswitched leg of interior lighting branch circuit to integral emergency battery pack light fixtures, exit signs and night lights as applicable per lighting plans.
- K. Wallmount fixtures in walkway areas shall not project more than 4 inches from wall when projection occurs lower than 80 inches.

END OF SECTION 26 51 00

SECTION 26 56 00 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of exterior luminaires, controls, poles and supports.

1.2 RELATED WORK

- A. Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- C. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 51 00, INTERIOR LIGHTING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Shop Drawings:
 - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaires, effective projected area (EPA), lamps and controls.

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. American Concrete Institute (ACI).

- D. American National Standards Institute (ANSI).
- E. Aluminum Association Inc. (AA).
- F. Illuminating Engineering Society of North America (IESNA).
- G. National Electrical Manufacturers Association (NEMA).
- H. National Fire Protection Association (NFPA).
- I. Underwriters Laboratories, Inc. (UL).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Poles: Do not store poles on ground. Store poles so they are at least one foot above ground level. Do not remove factory-applied pole wrappings until just prior to installation of pole.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be in accordance with CEC, UL, ANSI, as shown on the drawings and as specified.

2.2 POLES

- A. General:
 - 1. Poles shall be steel or aluminum as specified in fixture schedule and as shown on the drawings. Finish shall be as approved by the Architect. Assume custom color for bidding.
 - 2. The pole and arm assembly shall be designed for wind loading of 100 miles per hour, with an additional 30 percent gust factor, supporting luminaire(s) having the effective projected areas indicated as per manufacturer data.
 - 3. Poles shall anchor-bolt type designed for use with underground supply conductors. Poles shall have gasketed handhole with a minimum clear opening of 2.5" x 5". Handhole cover shall be secured by stainless steel captive screws.
 - 4. Provide a steel grounding stud opposite hand hole openings.
- B. Provide a base cover matching the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
- C. Hardware: All necessary hardware shall be 300 series tamperproof stainless steel.
- D. Types:
 - 1. Aluminum: Provide aluminum poles manufactured of corrosion resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys, and Alloy 356-T4 (3,5) for ASTM B108-01 cast alloys. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed

to prevent electrolysis when used with copper ground wire. Base covers for aluminum poles shall be cast from 356-T6 aluminum alloy in accordance with ASTM B108-01.

2. Steel: Provide steel poles having minimum 11-gage steel with minimum yield/strength of 48,000 psi and iron-oxide primed factory finish. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.3 FOUNDATIONS FOR POLES

- A. Foundations shall be cast-in-place concrete.
- B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and all accessories specified under wind conditions as specified in this section.
- C. Place concrete in spirally wrapped treated paper forms for round foundations, and construct forms for square foundations.
- D. Rub-finish and round all above-grade concrete edges to approximately 1/4" radius unless otherwise detailed.
- E. Concrete shall have 3000 psi minimum 28 day compressive strength.
- F. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings and meet ACI 318. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- G. Install a copperclad ground rod, not less than 5/8" diameter by 8' long in pullbox adjacent to each fixture. Where rock or layered rock is present, drill a hole not less than 2" in diameter and 6' deep, backfill with tamped fine sand and drive the rod into the hole. Bond the rod to the pole with not less than number 6 AWG bare copper wires. The method of bonding shall be approved for the purpose.
- H. After leveling of pole grout base solid between plate and footing with dry pack concrete for vibration reduction.

2.4 LUMINAIRES

- A. UL 1598 and ANSI C136.17. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat and safe cleaning and relamping.
- B. Light emitting diode (LED)-based solid state lighting (SSL) products shall be factory tested in accordance to the International Engineering Society (IES) LM-79 recommendations and meet ANSI C78.377-2008 standards.
- C. LED light sources shall be factory tested in accordance to IES LM-80 recommendations.
- D. LED-based SSL product shall incorporate an external heat sink, integral to the luminaire.
- E. IESNA HB-9 and RP-8 light distribution pattern types shall be as indicated on the drawings.

- F. Incorporate associated ballasts and drivers within the luminaire housing.
- G. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. Attach the frame to the luminaire housing by hinges or chain.
- H. Pre-wire internal components to terminal strips at the factory.
- I. Bracket mounted luminaires shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.
- J. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- K. LED-based SSL luminaires shall be manufactured specifically for LED lamps with drivers integral to the luminaire housing.

2.5 LAMPS

- A. Luminaires shall be listed for the lamp specified on the associated electrical plans. Install the proper lamps in every luminaire installed.
- B. Lamps shall be clear or coated as recommended by luminaire manufacturer to provide for maximum luminaire efficiency in fixture used.

2.6 LED-BASED SOLID STATE DRIVERS

- A. Shall be listed by either U.L. or equal listing agency and comply with IEEE C.62.41-1991, Class A operation.
- B. Provide a minimum power factor of 0.9.
- C. Minimum operating temperature appropriate for outdoor environments.
- D. Shall operate at a frequency greater than or equal to 120Hz.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the CEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Poles:
 - 1. Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit elbow. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

2. After the poles have been installed, shimmed and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 3/8" inside diameter, through the grout tight to the top of the concrete base for moisture weeping.
 3. Attach pole base cover to pole flange with set screws.
- C. Foundation Excavation: Depth shall be as indicated on drawings. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6" maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.
- D. Photocell Switch Aiming (where applicable): Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm or set adjustable window slide for proper footcandles photocell turn-on.

3.2 GROUNDING

- A. Ground noncurrent-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or alloyed connectors suitable and listed for this purpose.

END OF SECTION 26 56 00

**SECTION 31 11 00
SITE CLEARING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Provide all material, labor, equipment and services necessary to completely clear and demolish all materials, accessories and other related items necessary to complete the Project as indicated by the Contract Documents.
- B. RELATED SECTIONS:
 - 1. Contract General Conditions and Division 1, General Requirements
 - 2. Section 31 20 00 - EARTHWORK: EXCAVATION, FILLING AND GRADING
 - 3. Section 31 22 22 - SOIL MATERIALS
 - 4. Section 31 23 33 - TRENCH EXCAVATION AND BACKFILL

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. In accordance with Specification Section GENERAL REQUIREMENTS, and the following:
 - a. Materials and equipment used for this project shall comply with the current applicable regulations of the California Air Resources Board [CARB] and the Environmental Protection Agency [EPA].
- B. Meetings:
 - 1. Minimum agenda shall be to discuss coordination of upcoming work, review the work progress, discuss field observations, identification of any potential problems which may impede planned progress; corrective measures to regain projected schedule; and maintenance of quality and work standards.
 - 2. Meetings shall include Pre-Clearing and Demolition Meetings.
 - 3. Participants (or designated representative of) invited to attend each of the above meetings shall be as follows:
 - a. Contractor.
 - b. Owner.
 - c. Engineer.
 - d. Testing Laboratory.
 - e. Local Governing Authorities as applicable.
 - f. Utility Representatives as applicable.
 - g. Owner's Inspector.
 - h. Clearing and Demolition Subcontractor.
 - i. Other subcontractors, as appropriate (including any accessory subcontractors).

1.04 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Dust Control
 - 1. Contractor shall comply with all requirements of the San Joaquin Valley Air Pollution Control District (SJVAPCD) for construction activity related to this project.

2. A Dust Control Plan, as required by the SJVAPCD, may be required for this project. Contractor shall be responsible for preparing said Dust Control Plan, submitting to the SJVAPCD for review and approval, and paying all SJVAPCD review and permitting fees related to the Dust Control Plan.
 3. No construction activity related to this project may begin until Contractor has secured an approved Dust Control Plan, if one is required.
 4. Contractor shall be solely responsible to implement all requirements of the Dust Control Plan throughout the life of this contract.
 5. Should fines or fees be levied against the Project for violations of the Dust Control Plan and/or related SJVAPCD regulations, Contractor shall be responsible to pay all said fines or fees and to implement all mitigation measures required by SJVAPCD in order to bring the construction activity into compliance with SJVAPCD regulations. The costs for any such fines or fees shall be included in the lump sum price bid for work under this contract and no additional payment will be made therefor.
- B. Existing Conditions:
1. Examine site and compare it with the drawings and specifications. Thoroughly investigate and verify conditions under which the work is to be performed. No allowance will be made for extra work resulting from negligence or failure to be acquainted with all available information concerning conditions necessary to estimate the difficulty or cost of the work.
 2. Conduct work so as not to interfere unnecessarily with adjacent roads, streets, drives, walks or occupied facilities.
 - a. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and Authorities having jurisdiction.
 - b. Provide alternate routes around closed or obstructed traffic ways if required by Authorities having jurisdiction.
 3. Locate and identify utilities.
 - a. Call a Local Utility Locator Service (USA – “Underground Service Alert” – [800] 227-2600) for the task of locating any applicable utilities in the area where the Project is located.
 4. Carefully remove items indicated to be salvaged and store on Owner’s premises at the Owner’s direction.

PART 2 PRODUCTS

2.01 (NOT APPLICABLE)

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordination:
1. Coordinate work under this specification section with work specified under other sections to ensure proper and adequate interface of work.
- B. Protection:
1. Protect and maintain all benchmarks and survey control points from disturbance during clearing and demolition operations.
 2. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties.
 3. Furnish and install temporary protection/barrier fencing surrounding the limits of demolition.
 4. Protect trees, plant growth, and features not specifically designated for removal. Locate and clearly flag trees and vegetation to remain or to be relocated.

5. Protect existing improvements designated to remain from damage during construction.
 - a. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.02 CONSTRUCTION

- A. Shrub and Weed Removal:
 1. Remove weeds and rooted topsoil to a minimum four (4) inch depth and temporarily stockpile as needed for re-use in finished grading of landscape areas. Remove excess material from the site.
 2. Where existing vegetation is to be replaced by new materials, remove contaminated or excess soil from the site and legally dispose of off-site.
- B. Existing Site Improvements Removal:
 1. Remove existing above and below grade improvements as necessary to facilitate new construction.
 - a. Remove concrete slabs, sidewalk, curbs, mow strips, gutters, and fence post footings.
 - 1) Neatly saw-cut length of existing pavement to remain before removing existing pavement unless existing full-depth joints coincide with line of demolition. Saw-cut faces vertically.
 - b. Remove indicated utility improvements within the limits of construction.
 - 1) Excavate for and disconnect utilities designated to be removed. Seal or cap off underground.
 - 2) Coordinate removal and/or relocation of utilities with the appropriate utility agencies.
 - c. Where existing underground utilities, irrigation pipes, wells, leach fields, or underground tanks are encountered, they must be removed or moved to a point at least 5 feet horizontally outside the proposed building and 3 feet horizontally outside the concrete flatwork or pavement construction areas. All resultant cavities must be backfilled with engineered fill.
 - d. Remove concrete slabs, foundations, and utilities within building footprint.
- C. Existing Utilities to Remain or be Relocated:
 1. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - a. Notify Architect and the Owner not less than seven (7) days in advance of proposed utility interruptions.
 - b. Arrange to shut off indicated utilities with utility companies and Owner.
- D. Disposal:
 1. Legally dispose of all debris (surplus soil materials, unsuitable topsoil, obstructions, demolished materials, waste materials, trash, etc.) resulting from clearing, grubbing, demolition and from construction. Disposal of all materials shall be at a location secured by the Contractor off of the Owner's property.

END OF SECTION 31 11 00

SECTION 31 20 00 - EARTHWORK: EXCAVATION, FILLING AND GRADING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Excavating soil and other material for surface improvements.
 - 2. Placing fill.
 - 3. Compaction of existing ground and fill.
 - 4. Preparation of subgrade for other improvements.
 - 5. Grading of soil.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 01, General Requirements
 - 2. Section 31 11 00 - SITE CLEARING
 - 3. Section 31 22 22 - SOIL MATERIALS
 - 4. Section 31 23 33 - TRENCH EXCAVATION AND BACKFILL

1.03 REFERENCES

- A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18-inch (457 mm) Drop.

1.04 DEFINITIONS

- A. Utility: Any buried or above ground pipe, conduit, cable, associate device or appurtenances, or substructure pertaining thereto.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Information indicating the source of all import material, the fill material type and where it is to be used, and approval of the District's Inspector of Record for incorporation of import material into the Work.
- B. Material Test Reports:
 - 1. Classification of Soils
 - 2. Compaction Characteristics of Soils
 - 3. Density and Unit Weight of Soils in Place.

4. Imported fill shall be tested and approved by the Owner's Geotechnical Engineer prior to import to the site, including testing for compliance with Department of Toxic Substances Control (DTSC) guidelines. Said testing and certification documents shall be paid for by the Owner.

C. Project Closeout: In accordance with Specification Section PROJECT CLOSEOUT.

1. Drawings indicating the extent and depth of all engineered fill, and overexcavation and recompaction. This information shall be a part of the Project "As-Built" and Project "Record" Documents in accordance with the Specification Section PROJECT DOCUMENTS.

1.06 QUALITY ASSURANCE

A. Installer:

1. Qualifications:

- a. Engage an experienced Installer who has successfully completed three (3) projects of similar scope and size to that indicated for this project within the past 5 years.

B. Regulatory Requirements:

1. In accordance with Specification Section REGULATORY REQUIREMENTS and the following:

- a. CARB Materials and equipment used for this Project shall comply with the current applicable regulations of the California Air Resources Board [CARB]
- b. CM City of Merced, codes and Ordinances
- c. EPA Environmental Protection Agency.
- d. CAL/OSHA Comply with all provisions of the Construction Safety Orders and the General Safety Orders of the California Division of Occupational Safety and Health, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground excavations.
- e. DTSC Comply with all recommendations of the California Department of Toxic Substance Control (DTSC) regarding soil testing for potential contaminants.

C. Certificates:

1. Installer's certification that all Earthwork installation meets or exceeds the requirements of this specification.
2. Contractor's certification (on Contractor's letterhead paper) that the Earthwork materials and installation meets or exceeds the requirements of this specification.

D. Meetings:

1. Pre-Installation: Schedule prior to the start of work.
 - a. Coordinate the work with other work being performed.
 - b. Identify any potential problems, which may impede planned progress and proper installation of work regarding quality of installation and warranty requirements.
2. Progress: Scheduled by the Contractor during the performance of the work.

- a. Review for proper installation of work progress.
- b. Identify any installation problems and acceptable corrective measures.
- c. Identify any measures to maintain or regain project schedule if necessary.
- 3. Completion: Scheduled by the Contractor upon proper completion of the work.
 - a. Inspect and identify any problems which may impede issuance of warranties or guaranties.
 - b. Maintain installed work until the Notice of Substantial Completion has been filed.

1.07 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Provide required notification to the Owner and Geotechnical Engineer or the Engineer of Record so that a representative from the Owner's Geotechnical Engineering consultant can be present for all excavation, filling and grading operations to test and observe earthwork construction.
- C. Verify that the location of existing utilities has been indicated at work site by utility authorities, by Owner, and as specified on the Plans.

1.08 EXISTING CONDITIONS

- A. Existing Conditions:
 - 1. Examine the site and verify conditions with the Drawings and Specifications. Contractor shall familiarize himself with existing site conditions and any changes that have occurred at the site since the preparation of the contract documents and shall be responsible to account for any such changes in the price bid for this work.
 - 2. Thoroughly investigate and verify conditions under which the Work is to be performed.
 - 3. Locate and identify utilities:
 - a. Call a Local Utility Locator Service (USA - "Underground Service Alert" – [800] 227-2600) for the task of locating any applicable off-site and on-site utilities in the area where the Project is located.
 - b. Contractor to provide 3rd party utility locating within the limits of the project work area
 - 4. No allowance for Extra Work will be granted resulting from negligence or failure to meet requirements of this Section.
- B. Where subsurface work involves more than the normal depth of excavation required for the removal and/or construction of surface improvements (surface improvements such as concrete flatwork, paving, landscaping, signs, etc.), the engineer will have made a diligent attempt to indicate on the plans the location of all main and trunk line utility facilities which may affect the Work. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until located and exposed by the Contractor.
- C. Under similar circumstance, service laterals and appurtenances will have also been shown where information was available as to their location. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale

undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until located and exposed by the Contractor.

- D. Determine exact location of existing buried utilities by:
 - 1. Utilizing a 3rd party utility locator, mark on ground or pavement surface the alignment and extent of the facilities and the probable location of existing utilities using construction plans and existing surface features.
 - 2. Requesting Underground Service Alert (USA) to indicate location of existing buried facilities (phone 1-800-227-2600). Provide USA a minimum of two (2) working days notice of request for locations and notify Owner of said request concurrently.
 - 3. Confirm exact location of existing utilities by hand methods of excavation, or by use of vacuum equipment.
- E. At proposed work location, expose by hand methods (or vacuum equipment) all existing utilities along the route of the proposed work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand (or vacuum equipment) methods to locate all existing facilities as indicated on the plans, and/or as indicated on the ground by USA or Contractor's 3rd party utility locator.
- F. Provide Field Engineering to record the location of all utilities encountered. Where locational conflicts exist between existing utilities and the planned location of facilities to be constructed under this Contract, submit detailed information to the Engineer for review and direction.
- G. Maintain all existing utility mains and service lines in constant service during construction of the Work.
- H. Where service disruptions are allowed, minimize the length of such disruptions by proper scheduling and diligent pursuit of the work, and coordinate the timing of any such disruptions in advance with the District.
- I. Existing soils are considered to have a highly corrosive potential to buried metal objects.
- J. Existing soils are considered to have a low expansion potential.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Dust control: Perform work in a manner as to minimize the spread of dust and flying particles. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of other on-site work.
 - 1. All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, or vegetative ground cover.
 - 2. All land clearing, demolition, grubbing, scraping, excavation, land leveling, grading, and cut and fill activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by pre-soaking.
 - 3. When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions or at least six inches of freeboard space from the top of the container shall be maintained.

4. All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at least once every 24 hours when operations are occurring. The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions. The use of blower devices is expressly forbidden.
 5. Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/ suppressant.
 - a. Contractor shall comply with all requirements of the San Joaquin Valley Air Pollution Control District (SJVAPCD) for construction activity related to this project.
 - b. A Dust Control Plan, as required by the SJVAPCD, may be required for this project. If required, Contractor shall be responsible for preparing said Dust Control Plan, submitting to the SJVAPCD for review and approval, and paying all SJVAPCD review and permitting fees related to the Dust Control Plan.
 - c. If a dust control plan is required, no construction activity related to this project may begin until Contractor has secured an approved Dust Control Plan.
 - d. Contractor shall be solely responsible to implement all requirements of the Dust Control Plan throughout the life of this contract.
 - e. Should fines or fees be levied against the Project for violations of the Dust Control Plan and/or related SJVAPCD regulations, Contractor shall be responsible to pay all said fines or fees and to implement all mitigation measures required by SJVAPCD in order to bring the construction activity into compliance with SJVAPCD regulations. The costs for any such fines or fees shall be included in the lump sum price bid for work under this contract and no additional payment will be made therefore
- B. Burning: No burning will be allowed on-site.
- C. Rain: Work under this section shall not be started or maintained under threat of rain, unless the work is not affected by the rain.
- D. Do not place fill during weather conditions which will alter moisture content of fill materials sufficiently to make compaction to the specified densities difficult or impossible.
- E. When reference is made to SWPPP (Storm Water Pollution Prevention Plan), if any within this Project Manual, then comply with all environmental protection requirements included therein.
- F. In accordance with EPA, CARB and CM.
- G. Protection:
1. Protect cut and fill areas to prevent water running into excavation. Maintain areas free of water. Remove seeping water immediately by pumps. Provide dewatering as necessary.
 2. Protect cut slopes from erosion due to precipitation and other sources of runoff.
 3. Protect utilities to remain within the construction area and special construction. If utility lines are uncovered (water, electric, sewer, etc.) not shown on the drawings during excavation of site, notify the Architect promptly for its review and action.
 4. Do not permit access to undeveloped portions of the site, nor to areas that are outside of the limits of grading.

- H. Before being brought onto the site, all import soil must be sampled, tested and approved by Owner's Geotechnical Engineer. All import material must comply with DTSC recommendations and guidelines for environmentally clean soil suitable for school construction. Import testing will be provided and paid for by the Owner.

1.10 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of GENERAL CONDITIONS and DIVISION 1, GENERAL REQUIREMENTS.
- B. Accurately record actual locations of utilities encountered including depth and horizontal location, as measured from permanent site features.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill in Turf or Other Planting Areas: Type S2 or S3 per Division 31 Specification Section 31 22 22 - SOIL MATERIALS
- B. Fill in Non-planting Areas: Type S1, S2 or S4 per Division 31 Specification Section 31 22 22 - SOIL MATERIALS.
- C. Imported material: Type S3, S4 or S5 per Division 31 Specification Section 31 22 22 - SOIL MATERIALS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site conditions.

3.02 PREPARATION

- A. Layout of Work:
 1. Contractor shall be responsible for all lines and grades. Layout shall be provided by a California registered Land Surveyor or Civil Engineer, at Contractor's expense.
 2. Check all benchmarks, monuments and property lines and verify locations.
 3. Locate and maintain all grade stakes.
 4. Monuments moved or displaced during grading operation are to be replaced by a California Registered Civil Engineer or Surveyor, at Contractor's expense.
- B. Locate, identify, and protect existing above and below grade utilities from damage.

- C. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- D. Protect existing structures, fences, curbs, sidewalks, paving and other improvements to remain from damage from excavation equipment and vehicular traffic.
- E. Employ equipment and methods appropriate to the work site.
- F. Protect excavated areas from drainage inflow and provide for drainage of all excavated areas.
- G. Comply with all provisions of the Construction Safety Orders and General Safety Orders of the California Division of Industrial Safety, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground in excavations.

3.03 SITE STRIPPING:

- A. Reference is made to Specification Section 31 11 00 - SITE CLEARING.
- B. Within the areas of planned surface improvements and structures, the near surface soils containing vegetation, roots, organics, or other objectionable material must be stripped and removed from the site. Upon approval of the Geotechnical Engineer, suitable materials stripped from the site may stockpiled and incorporated into the finish fill for planting areas.
- C. All areas to receive surface improvements shall be stripped to remove turf, shrubs, trees and other vegetation, along with associated root systems, concrete, wood, metal, rubbish and other unsuitable debris, and any loose, saturated or unconsolidated soil material. Minimum stripping depth is expected to be 4-inches below existing site grades. Stripping shall continue to the depth required to expose acceptable basement soils that are free from deleterious which are not suitable for Engineered Fill, as required by the Geotechnical Engineer.

3.04 EXCAVATION

- A. Following clearing and stripping operations, excavate planned construction areas as specified in this Section.
- B. Within the area of the planned building improvements plus at least 5 feet horizontally beyond the perimeter of these improvements, the subgrade must be over-excavated at least 48 inches below the stripped subgrade surface or at least to 12" below the footing, whichever is lower.
- C. Areas of exterior concrete slabs on grade located outside the building pad over-excavation limits, should be prepared by scarification of the upper 12-inches below existing grade or 12-inches below the bottom of the recommended aggregate base section, whichever is greater. The zone of subgrade preparation should extend a minimum of 3 feet beyond these improvements. These soils should be moisture conditioned to slightly above optimum and compacted as engineered fill.
- D. Areas of asphalt concrete improvements should be prepared by scarification of the upper 12-inches below existing grade or 12-inches below the recommended base section, whichever is

greater. These soils should be moisture conditioned to slightly above optimum and compacted as engineered fill.

- E. Provide additional excavation as required to conform to the lines, grades and cross-sections shown on the plans.
- F. When excavating through tree roots, perform work by hand and cut roots, where authorized, with a saw. Remove all roots 1/4" in diameter and greater.
- G. Remove excess soil not to be used as fill in the Work from the site. Unless requested by Owner to be deposited at a site designated by Owner on the property, obtain a disposal site and legally dispose of said excess material, all at no additional cost to the Owner.
- H. Areas disturbed by demolition must be excavated to expose undisturbed soils.
- I. Excavated soils free of deleterious substances (organic matter, demolition debris, tree roots, etc.) and with less than 3% organic content by weight, may be returned to the excavations as Engineered Fill.

3.05 FILLING AND COMPACTING

- A. Once clearing, stripping and over-excavation operations are complete, scarify the surface to receive fill material or improvements to a depth of 8-inches, moisture condition to at least 2% above optimum moisture content, and compact to a minimum of 90% of maximum dry density (relative compaction) based on ASTM Test Method 1557.
- B. Place and compact soil to finish subgrade of improvements to be placed thereon, or to finished surface grade where no improvements are to be placed thereon.
- C. All fill required shall be placed as Engineered Fill.
- D. The Contractor shall be solely responsible for securing an acceptable source of import material as required to grade the site. Reference is made to 31 20 00 1.09.H
- E. On-site soils are suitable for re-use as Engineered Fill, providing they are cleansed of excessive organics (less than 3 percent by weight, ASTM D2974), debris, and fragments larger than three (3) inches in maximum dimension and meet the requirements of soil Type S4, Division 31 Specification Section SOIL MATERIALS.
- F. Engineered Fill shall be moisture conditioned to within 2% of optimum moisture, placed in uncompacted layers not exceeding eight (8) inches in thickness, and compacted as specified, based on ASTM Test Method D1557.
 - 1. Non-vegetative surface improvement areas (structures and site concrete improvements) - To a minimum of 92% of maximum dry density (relative compaction).
 - 2. Vegetative surface improvement areas (turf and planters) - Below top twelve (12) inches - to a minimum of 90% of maximum dry density (relative compaction). Top twelve (12) inches - 85% of maximum dry density (relative compaction).
 - 3. Pavement areas: to a minimum 95% of maximum dry density (relative compaction) in top twelve (12) inches.

- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Additional lifts shall not be placed if the previous lift did not meet the required dry density or relative compaction, or if soil conditions are not stable.
- I. Conform fill to the lines, grades and cross-sections shown on the plans.
- J. Fill materials to conform to Division 31 Specification Section SOIL MATERIALS.
- K. Provide, at no additional cost to Owner, imported soil material conforming to the requirements of Division 31 Specification Section SOIL MATERIALS, as needed to attain finished grades of Work.
- L. Utilize equipment which will not disturb or damage existing utilities and other improvements.

3.06 PREPARATION OF SUBGRADE FOR SURFACE IMPROVEMENTS

- A. Where concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvements, or a layer of said surface improvements, are to be constructed on the soil surface, prepare the subgrade for said improvements in accordance with this section.
- B. Scarify the soil as specified and remove and dispose of (off the project site) all rocks, hardpan chunks or otherwise unsuitable material over 3-inches in size.
- C. Thoroughly moisture condition and compact as described above.
- D. Prior to commencing construction of surface improvements, pass a test roller of size and weight as approved by the Owner over the subgrade to establish the extent of soft or spongy areas requiring repairs.
- E. Conform finished subgrade surface to the lines, grades and cross-sections shown on the plans.

3.07 FINE GRADING

- A. Fine grade all finished surfaces to the lines, grades and cross-sections shown on the plans, and to blend to hard surface improvements.
- B. Rake and smooth all finished surfaces not to receive hard surface improvements.
- C. Use suitable stockpiled or imported topsoil for the top 12-inches of areas to receive landscape improvements.
- D. Import topsoil meeting the requirements of Division 31 Specification Section SOIL MATERIALS, as required to complete finish grading.
- E. Topsoil may not be used in areas requiring Engineered Fill.

3.08 TOLERANCES

- A. Top surface of Subgrade for Non-Vegetative Surface Improvements or Layers thereof: Plus or minus 0.02 foot from planned elevation.
- B. Top surface of Subgrade for Vegetative Surface Improvements or for Bare Ground - Plus or minus 0.05 foot of planned elevation, or as required for finish surface to match adjacent improvements or ground.

3.09 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of GENERAL CONDITIONS and/or DIVISION 1, GENERAL REQUIREMENTS.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest.
- D. All retesting required as a result of failure of initial test will be performed by Owner's testing agency, at the expense of the Contractor.

3.10 PROTECTION

- A. Protect graded areas from traffic, freezing, erosion, and all other sources of damage. Keep free of debris and trash.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed work becomes eroded, rutted, settled, or where it is damaged by subsequent construction operations or weather.
- C. Where settlement occurs prior to acceptance of the work, remove and replace surface improvements, excavate, replace, and re-compact in accordance with these specifications, and restore the surface improvements.

3.11 CLEANING

- A. Remove all surplus or unsatisfactory soil material, trash, and debris, and legally dispose of off of the Owner's property.

END OF SECTION 31 20 00

SECTION 31 22 22 - SOIL MATERIALS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

A. SECTION INCLUDES

- 1. Excavated (and re-used) materials and imported materials.

1.03 RELATED SECTIONS:

- A. Section 31 20 00 - Earthwork: Excavation, Filling and Grading.
- B. Section 31 23 33 - Trench Excavation and Backfill.

1.04 SUBMITTALS

- A. Samples: Submit, in air-tight containers, 10 lb. sample of Type S3, S4 and S5 fill to inspector.
- B. Soil Analysis: Submit for Type S3, S4 and S5 soils to be imported.
- C. Materials Source: Submit location of imported materials source. Provide materials from same source throughout the work. Change of source requires approval.
- D. For imported soil, obtain Geotechnical Engineer and District approval prior to importing.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. Soil Type S1: Excavated and reused material, graded; free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Soil Type S2: Excavated and reused material, graded; free of roots, lumps greater than one inch, rocks larger than 1/2 inch, debris, weeds and foreign matter.
- C. Soil Type S3: Imported topsoil, friable loam; reasonably free of roots, rocks larger than 1/2 inch, debris, weeds, and foreign matter.

- D. Soil Type S4: Imported borrow, suitable for purposes intended, meeting the following characteristics:
 - 1. Maximum Particle Size: 3"
 - 2. Percent Passing #4 Sieve: 60-100
 - 3. Percent Passing #200 Sieve: 20-50
 - 4. Expansion Index: <20
 - 5. Plasticity Index: <9
 - 6. R-Value (in paved areas): >50
 - 7. Low Corrosion Potential:
 - a. Soluble Sulfates: <1,500 mg/Kg
 - b. Soluble Chlorides: <300 mg/Kg
 - c. Soil Resistivity: >5,000 ohm-cm

- E. Soil Type S5: Imported sand. Natural river or bank sand (sand equivalent greater than 30), washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

2.02 SOURCE QUALITY CONTROL

- A. Inspection of imported soil will be performed by the Geotechnical Engineer, at source of import and prior to being delivered to the site.

PART 3 EXECUTION

3.01 STOCKPILING

- A. Stockpile excavated or imported material onsite at location designated by project inspector.
- B. Stockpile excavated or imported material in sufficient quantities to meet project schedule and requirements.

3.02 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. Dispose of excess material off-site.

END OF SECTION 31 22 22

SECTION 31 23 33 - TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

A. SECTION INCLUDES

1. Excavating trenches, holes and pits for constructing the Work.
2. Backfill and compaction.
3. Providing suitable bedding and backfill material, as specified herein.

B. RELATED SECTIONS

1. Contract General Conditions and Division 01, General Requirements.
2. Section 31 11 00 - SITE CLEARING
3. Section 31 20 00 - EARTHWORK: EXCAVATION, FILLING AND GRADING
4. Section 31 22 22 - SOIL MATERIALS

1.03 REFERENCES

- A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

1.04 DEFINITIONS

- A. Utility: Any buried or above ground pipe, conduit, cable, associate devices or appurtenances, or substructure pertaining hereto.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Installer:
 - a. Engage an experienced Installer who has successfully completed three (3) projects of similar scope and size to that indicated for this project within the past 5 years.

B. Regulatory Requirements:

1. In accordance with Specification Section REGULATORY REQUIREMENTS and the following:

- a. CARB Materials and equipment shall comply with the current applicable regulations of the California Air Resources Board [CARB]
- b. CM City of Merced
- c. EPA Environmental Protection Agency
- d. CAL/OSHA Comply with all provisions of the Construction Safety Orders and the Federal Safety Orders of the California Division of Occupational Safety and Health, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground excavations.

C. Certificates:

- 1. Installer's certification that all trench backfill installation meets or exceeds the requirements of this specification.
- 2. Contractor's certification (on Contractor's letterhead paper) that the trench backfill materials and installation meets or exceeds the requirements of this specification.

D. Meetings:

- 1. Pre-Installation: Schedule prior to the start of work.
 - a. Coordinate the work with other work being performed.
 - b. Identify any potential problems, which may impede planned progress and proper installation of work regarding quality of installation and warranty requirements.
- 2. Progress: Scheduled by the Contractor during the performance of the work.
 - a. Review for proper installation of work progress.
 - b. Identify any installation problems and acceptable corrective measures.
 - c. Identify any measures to maintain or regain project schedule if necessary.
- 3. Completion: Scheduled by the Contractor upon proper completion of the work.
 - a. Inspect and identify any problems which may impede issuance of warranties or guaranties.
- 4. Maintain installed work until the Notice of Substantial Completion has been filed.

1.06 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Verify that the location of existing utilities have been indicated at work site by utility authorities.

1.07 EXISTING UTILITIES

- A. Where subsurface work involves more than the normal depth of excavation required for the removal and/or construction of surface improvements (surface improvements such as concrete work, paving, landscaping, signs, etc.), the Engineer will have made a diligent attempt to indicate on the plans the location of all main and trunkline utility facilities which may affect the Work. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until located and exposed by the Contractor.

- B. Under circumstance similar to 31 23 33/1.07A, service laterals and appurtenances will have also been shown where information was available as to their location. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until located and exposed by the Contractor.
- C. Determine exact location of existing buried utilities by:
 - 1. Utilizing a 3rd party utility locator, mark on ground or pavement surface the alignment and extent of the proposed facilities and the probable location of existing utilities using construction plans and existing surface features.
 - 2. Requesting Underground Service Alert (USA) to indicate location of existing buried facilities (phone 1-800-227-2600). Provide USA a minimum of two (2) working days notice of request for locations, and notify Owner of said request concurrently.
 - 3. Locate exact location of existing utilities by hand methods of excavation, or by use of vacuum equipment.
- D. At proposed work location, expose by hand methods (or vacuum equipment) all existing utilities along the route of the proposed work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand (or vacuum equipment) methods to locate all existing facilities as indicated on the plans, and/or as indicated on the ground by USA or Contractor's 3rd party utility locator.
- E. Provide Field Engineering per Contract General Conditions and Division 01 to record the location of all utilities encountered. Where locational conflicts exist between existing utilities and the planned location of facilities to be constructed under the Contract, submit detailed information to the Owner's Inspector and Engineer for review and direction.
- F. Maintain all existing utility mains and service lines in constant service during construction of the Work.
- G. Where service disruptions are allowed, minimize the length of such disruptions by proper scheduling and diligent pursuit of the work.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Fill Type S1, S2, S4 and S5, as specified in Division 31 Specification Section SOIL MATERIALS.

2.02 WARNING TAPE

- A. 6" wide warning tape shall be installed over all of the pipelines as shown on the details.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- B. Protect existing structures, fences, sidewalks, curbs, and other improvements from excavation equipment and vehicular traffic.
- C. Maintain and protect above and below grade utilities which are to remain.
- D. Comply with all provisions of the Construction Safety Orders and General Safety Orders of the California Division of Industrial Safety, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground in excavations.

3.02 EXCAVATION

- A. Excavate soil required to locate existing utilities and install the work.
- B. Use hand methods of excavation to locate existing utilities, and to excavate trenches, pits and holes in congested areas.
- C. Employ equipment and methods appropriate to the work site. Small mechanical excavators may be used only in areas where there is sufficient space so as not to damage adjacent improvements, and where the locations of all existing utilities have been determined by hand methods of excavating.
- D. Cut trenches just wide enough to enable installation and proper bedding and backfill, and to allow inspection.
- E. Do not interfere with the 2:1 bearing splay of foundations.
- F. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose material.
- G. Excavate trenches, pits or holes bottoming in hardpan to a minimum of 6 inches below the grade for the bottom of the pipe and any couplings, and then backfill to the pipe grade with Type S2 or S5 material, containing sufficient moisture to allow compaction to 90% maximum dry density (relative compaction). Soil Type S2 shall meet requirements of Type S5. No additional payment will be made for such over-excavation and refill.
- H. In all trenches or excavation sites where a firm foundation is not encountered, such as soft, spongy, or otherwise unsuitable material, remove the material to a minimum of 12 inches, or to a depth determined by the Engineer, below the bottom of the proposed pipe or structure, and backfill the space with Type S2 or S5 material containing sufficient moisture to allow compaction to 90% maximum dry density (relative compaction). Soil Type S2 shall meet requirements of Type S5. No additional payment will be made for such additional excavation or backfill.

- I. Excavate trenches to provide the design grade of the facility, or as directed by the Engineer.
- J. Stockpile excavated material to be returned to trench adjacent thereto in location which will not be detrimental to existing improvements, or pedestrian or vehicular traffic. Remove from site all unsuitable or excess material not to be used.
- K. When excavating through tree roots, perform work by hand and cut roots, where authorized, with a saw.
- L. Remove excess soil not used as backfill from the work site. Obtain a disposal site off of the Owner's property and legally dispose of said excess material, all at no additional cost to the Owner.
- M. If water is encountered during excavations, provide all dewatering measures necessary to construct improvements shown.
- N. Contractor shall make all provisions necessary, including but not limited to, shoring or sloping back trench walls as required to address sandy soils. The cost of these provisions shall be included in the lump sum amount bid for this work and no separate payment will be made therefore.

3.03 PROTECTION OF EXCAVATIONS

- A. Provide all shoring and bracing as required and those codified in local, state and federal safety regulations.
- B. Prevent water, caving or sloughing ground from entering excavations.
- C. Maintain excavations free of water.

3.04 BACKFILLING

- A. Provide type S2 or S5 pipe bedding as required by Plans and compact to 90% maximum dry density (relative compaction). Soil Type S2 shall meet requirements of Type S5.
- B. After installation of pipes and appurtenances and placement of pipe bedding material, backfill trenches and excavations to finished grade, or subgrade in areas to receive surface improvements
- C. Backfill trenches above pipe bedding material and to within 24 inches of finish subgrade with Type S1, S2, S4, or S5 soils, except that that top 12 inches shall be type S2, S3, S4 or S5 soils.
- D. Employ a placement method that does not disturb or damage existing or proposed pipes or other Utilities or Improvements.
- E. Place and compact all soil backfill in continuous layers not exceeding 8 inches in loose uncompacted thickness, moisture condition to at least 3% above optimum moisture content.

- F. Maintain optimum moisture content of fill materials to attain required compaction.
- G. Backfill final 12-inch thickness to finish subgrade in areas to receive concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvement, with Type S2, S4, or S5 soils.
- H. Backfill final 12-inch thickness to finish subgrade in areas to receive sod, other vegetation, or bare soil, with Type S2 or S3 soils.
- I. Compact backfill below the top 12-inches to 90% maximum dry density (relative compaction).
- J. In areas to receive buildings, structures, or concrete flatwork, compact the top 12-inches to 90% maximum dry density (relative compaction).
- K. In areas to receive asphalt concrete pavement or concrete pavement subject to vehicular traffic, compact the top 12-inches to 95% maximum dry density (relative compaction).
- L. In planting areas, compact the top 12-inches to 85% maximum dry density (relative compaction).

3.05 TOLERANCES

- A. Top Surface of Backfill under Paved or Concrete Areas: Plus or minus 0.02 feet from required elevations.
- B. Top Surface of General Backfilling: As required for finish surface to match adjacent improvements or ground.

3.06 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of General Conditions and/or Division 01.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate work does not meet specified requirements, recompact, and retest. Retests required due to failure of initial tests shall be paid for by the Contractor.

3.07 PROGRESS AND PROSECUTION

- A. Backfill any excavation opened in any day on that same day.

END OF SECTION 31 23 33

SECTION 32 11 26 - AGGREGATE BASE COURSE

P1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
- B. Provide all material, labor, equipment and services necessary to install aggregate base surfacing as indicated by the Contract Documents.

1.03 RELATED SECTIONS

- A. All Division 00 Specification Sections
- B. All Division 01 Specification Sections
- C. Section 31 20 00 – Earthwork: Excavation, Filling, and Grading.
- D. Section 31 23 33 – Trench Excavation and Backfill.
- E. Section 32 12 16 – Soil Sterilization.
- F. Section 32 12 17 – Asphalt Paving.
- G. Section 32 13 13 – Site Concrete Improvements.

1.04 REFERENCES

- A. SSCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any state furnished materials

1.05 QUALITY ASSURANCE

- A. Provide and install in accordance with SSCDOT.

1.06 SUBMITTALS

- A. Submit data sheets from supplier to document compliance with SSCDOT requirements.
- B. Certificates of compliance for material.
- C. Load tags for delivered material.

1.07 COORDINATION

- A. Coordinate with other work, including subgrade preparation and soil sterilization.
- B. Coordinate installation schedule with Owner's use of the premises and with other contractors working at the site.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base: Unless specified otherwise on Plans, Class 2, 3/4 Inch Maximum per Section 26 of SSCDOT.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify quantities required.
- B. Verify that subgrade has been placed and compacted per Contract Documents
- C. Verify gradients and elevations of subgrade are correct.

3.02 INSTALLATION OF AGGREGATE BASE COURSE

- A. Install in conformance with SSCDOT Section 26, Aggregate Bases.
- B. Thickness - As shown on construction drawings.
- C. Spreading and Compacting - In accordance with Section 26, SSCDOT. Base course shall be moisture conditioned to within 2% of optimum moisture, placed in uncompacted layers not exceeding six (6) inches in thickness, and compacted as specified, based on ASTM Test Method D1557. The relative compaction of each layer of compacted base material shall be not less than 95 percent.

- D. The completed surface shall be thoroughly compacted, free from ruts, depressions, and irregularities, true to grade and cross-section.
- E. Lines and grades for the installation of aggregate base shall be set by a California licensed Land Surveyor or Civil Engineer, at Contractor's expense.

3.03 TOLERANCES

- A. Compacted thickness of aggregate base: Not less than the thickness specified on the Plans.
- B. Finished Surface: Within 0.02 foot of planned grade per Section 26, SSCDOT. No more than 50% of the finish surface shall be above or below the specified grade for aggregate base.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by the Owner's inspector, under provisions of Division 01.

3.05 PROTECTION

- A. Immediately after placement and compaction, protect surface from mechanical injury.
- B. Protect completed surface until surfacing layers are in place.

END OF SECTION 32 11 26

SECTION 32 12 16 - SOIL STERILIZATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work specified in this section.

1.02 SECTION INCLUDES

- A. Furnish and install soil sterilant under all asphalt paving.

1.03 RELATED SECTIONS

- A. Section 31 20 00 - Earthwork: Excavation, Filling, and Grading
- B. Section 31 23 33 - Trench Excavation and Backfill
- C. Section 32 11 26 – Aggregate Base Course
- D. Section 32 12 17 – Asphalt Paving
- E. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to the work of this section.

1.04 STANDARDS

- A. In accordance with the following:
- B. CCR-T21 California Code of Regulations, Title 21 Public Works.
- C. California Building Code, California Code of Regulations,
 - 1. Title 24, Part 2, CCR-T24.
- D. United States Department of Agriculture.
- E. Environmental Protection Agency.
- F. City of Merced
 - 1. All applicable Environmental Regulations and Standards.

1.05 QUALITY ASSURANCE

- A. Provide licensed operator to apply soil sterilant.

- B. All products shall comply with the current EPA laws at time of application. Should the products listed become unavailable because of changes in the law, submit substitute products for review by the Owner.

1.06 SUBMITTALS

- A. Submit in accordance with Specification Section SUBMITTAL PROCEDURES.
- B. Certificates of application.
- C. Certificates of compliance for material.

1.07 COORDINATION

- A. Coordinate with other work, including subgrade preparation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Soil Sterilant: Bayer Oust XP, weed and grass preventer, or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that site is ready for application.

3.02 PREPARATION

- A. Identify installation locations.
- B. Employ equipment and methods appropriate to the work site.

3.03 APPLICATION

- A. Thoroughly water soak surface to be treated. Avoid excessive water runoff.
- B. Apply sterilant solution over surface to receive pavement or surfacing prior to the start of pavement or surfacing installation.

- C. Apply in spray form, at rate as allowable by State of California and the manufacturer's recommended application rate.
- D. Take all precautions to limit soil sterilant solution to areas immediately under proposed pavement or surfacing. Use shields as necessary, and do not apply under windy conditions.

3.04 FIELD QUALITY CONTROL

- A. Field inspection will be performed under Specification Section QUALITY REQUIREMENTS.

END OF SECTION 32 12 16

SECTION 32 12 17 - ASPHALT PAVING

P1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Provide all material, labor, equipment and services necessary to completely install all pavement materials, accessories and other related items as required by the Contract Documents.

1.03 RELATED SECTIONS:

- A. All Division 00 Specification Sections
- B. All Division 01 Specification Sections
- C. Section 31 22 00 - Earthwork: Excavation, Filling, and Grading
- D. Section 31 23 33 - Trench Excavation and Backfill
- E. Section 32 11 26 - Aggregate Base Course.
- F. Section 32 12 16 - Soil Sterilization.

1.04 REFERENCES

- A. SSCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any state furnished materials.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SSCDOT.
- B. Mixing Plant: Conform to SSCDOT.
- C. Installation Criteria: Asphalt concrete shall show no evidence of cracking, uneven settlement, improper drainage, or untoward junctions with adjoining or existing surfaces. Work displaying such conditions shall be corrected under the Contractor's guarantee of all work.

1.06 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Mix design
- C. Certificates of compliance for material.
- D. Load tags for delivered material.

1.07 COORDINATION

- A. Coordinate with other work, including subgrade preparation, aggregate base placement and soil sterilization.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt-concrete when atmosphere temperature is less than 50 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Paint Binder: In accordance with SSCDOT Section 94, Asphaltic Emulsions.
- B. Asphalt-Concrete: Type A in accordance with Section 39, SSCDOT, ½ inch or ¾ inch maximum aggregate (medium) as indicated on the Plans. The asphaltic concrete shall be compacted to an average relative compaction of 97 percent, with no single test value being below a relative compaction of 95 percent based on a 50 blow Marshall maximum density. Use asphalt binder performance grade PG 64-10.
- C. Seal Coat: Asphalt based seal coat shall be "Ace Seal" as manufactured by Asphalt Coatings Engineering, Wasco, California, or approved equivalent

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify quantities required. New asphalt-concrete paving is required at all locations shown on the plans, and where existing asphalt-concrete paving to remain is removed or damaged by the Project excavation or related work.

- B. Verify that subgrade or base material has been compacted to required relative compaction and is dry.
- C. Verify gradients and elevations of base are correct.
- D. Verify that subgrade or base material has been sterilized per Section 32 12 16 SOIL STERILIZATION.

3.02 AGGREGATE BASE

- A. Where shown on the construction plans, place and compact aggregate base course per Section 32 11 26 AGGREGATE BASE COURSE.
- B. Where shown on the construction plans, place asphalt on compacted earth subgrade per Section 31 20 00 EARTHWORK: EXCAVATION, FILLING AND GRADING and Section 31 23 00 TRENCH EXCAVATION AND BACKFILL.
- C. A soil sterilant shall be applied over the entire area which is to be paved in accordance with Section 31 12 16 SOIL STERILIZATION

3.03 PREPARATION – PAINT BINDER

- A. Apply paint binder to existing asphalt-concrete or concrete surfaces which will be in contact with asphalt-concrete surfacing.
- B. Rate of application for all surfaces against which asphalt concrete is to be placed shall be no less than 0.02 and no more than 0.05 gallons per square yard. All vertical concrete surfaces which will be in contact with asphalt concrete surfacing and all areas now in place which will be covered with new surfacing materials and feathering operations shall be coated with a paint binder applied at the rate of 0.05 gallons per square yard.

3.04 INSTALLATION OF ASPHALTIC-CONCRETE

- A. Install in conformance with SSCDOT Section 39, Asphalt-Concrete.
- B. Thickness - As shown on construction plans. Where thickness exceeds 3 inches, place in no less than 2 layers with top layer no thicker than one inch. Asphaltic concrete shall be laid to the thickness designated on the Plans. The plan thickness is to be considered as a minimum thickness. The Contractor shall lay the asphaltic concrete to a depth required to insure that, after compaction, the in place compacted thickness is equal to or greater than the specified plan thickness.
- C. The Contractor shall provide to the Engineer the truck delivery weight tags for the asphaltic concrete material. The quantity delivered shall be equal to or greater than the calculated in place quantity based on the specified thickness and area to be paved as designated on the construction plans and based on a unit density of the asphaltic concrete of 141 pounds per cubic feet.

- D. Asphalt type: PG 64-10
- E. Compaction Equipment - In accordance with Section 39, SSCDOT. At small difficult areas, equipment may be altered as approved by Engineer.
- F. The completed surface shall be thoroughly compacted, free from ruts, depressions, and irregularities and to be true to grade and cross-section.

3.05 TOLERANCES –GENERAL

- A. Finished Surface: within 0.02 foot of planned grade.
- B. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Not less than specified.

3.06 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01.
- B. Pavement shall comply with the following:
 - 1. Water shall not be able to accumulate at any point and the surface shall be free to drain to drainage inlets or gutters.
 - 2. The paving contractor shall water flood the surface with the use of a water truck. If, after 30 minutes on a 70 degree F day, “bird baths” are evident in a depth more than 0.01 foot, the paving contractor and the Owner’s representative will determine the best method of correction.
 - 3. A 10 foot straightedge shall be used to check for high spots and ridges. High spots and ridges out of compliance shall be reduced by a remedy determined by the paving contractor and the Owner’s representative.
- C. Should a section of the work be not acceptable on the basis of inadequate compaction and/or the mixture becomes loose and broken, mixed with dirt, out of tolerance, or in any other way defective, it shall be repaired or removed and replaced with fresh mixture and immediately compacted to conform to the surrounding area to the satisfaction of the Owner.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury.
- B. Protect sealed surface until it is cured.

END OF SECTION 32 12 17

SECTION 32 13 13 - SITE CONCRETE IMPROVEMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. All material, labor, equipment and services necessary to completely install exterior Portland cement flatwork, cast-in-place concrete, and architectural flatwork concrete, accessories and other related items, slabs, ramps and sidewalks and walkways, curb and gutter, mowstrips, and other miscellaneous concrete items of the form and dimensions shown on the plans and necessary to complete the project, and in accordance with the requirements of the Standard Specifications as modified and supplemented by these Special Provisions
 - 2. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specifications sections, apply to the work of this section.
- B. RELATED SECTIONS:
 - 1. Section 31 20 00 - Earthwork: Excavation, Filling, and Grading
 - 2. Section 32 11 26 - Aggregate Base Course.
 - 3. Section 32 13 15 - Concrete Reinforcement

1.03 REFERENCES

- A. SSCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any state furnished materials.
- B. ACI standards, including but not limited to #304, 305, 306, 308, 309 and 347.
- C. ASTM standards, including but not limited to #C-33, C-39, C-94, C-136, C-143, C-150, and C-309.

1.04 SUBMITTALS

- A. Submit under provisions of Specification Section SUBMITTALS.
 - 1. Certificates of compliance for materials and mix designs.
 - 2. Load tags for delivered material.
 - 3. Strength testing as required by the approving agency.
 - 4. Application instructions for the architectural finish materials.
 - 5. Accessories and manufacturer's installation specifications.

1.05 QUALITY ASSURANCE

- A. Furnish concrete materials conforming with SSCDOT.
- B. Perform work in accordance with SSCDOT, unless noted otherwise herein.

PART 2 PRODUCTS

2.01 MIXES

- A. Mix Design and Proportions in accordance with SSCDOT:
 - 1. Mix designs with Fly Ash content no greater than 15 percent of the total weight of cementitious materials shall be proportioned by SSCDOT.
 - 2. Provide a maximum of 4 percent air entrainment, unless noted otherwise.
 - 3. Owners Testing laboratory shall review all mix designs before submittal.
 - 4. All concrete shall have the following minimum compressive strengths in accordance with ACI 318 and SSCDOT at 28 days and shall be proportioned within the following limits:
 - a. Site Concrete: Use for exterior concrete slabs on grade including, but not limited to sidewalks, curbs, gutters, mow strips, utility appurtenances and miscellaneous site improvements.
 - 1) Strength: 3,000 psi at 28 days
 - 2) Maximum Aggregate Size: 1-inch
 - 3) Cement Type: Type I/II/IV/V
 - 4) Cement Content: 5.5 sacks/yd minimum
 - 5) Max Water/Cement Ratio: Per SSCDOT
 - 6) Admixture Per SSCDOT
 - b. Slurry Backfill: Use for backfill of over-excavated trenches, encasement of all penetration, and site utility piping.
 - 1) Maximum Aggregate Size: 3/8-inch
 - 2) Cement Type: Type I/II/IV/V
 - 3) Cement Content: 2.0 sacks/yd minimum

PART 3 EXECUTION

3.01 PREPARATION

- A. Subgrade shall conform to the requirements of Division 31 Specification Section EARTHWORK: EXCAVATION, FILLING AND GRADING. The District may elect to verify compacted subgrade elevations by measurement made from adjacent existing improvements or by a template supported by forms.

3.02 GENERAL CONCRETE

- A. Concrete placement shall conform to the applicable requirements of Standard Specification Sections 51 and 90. Concrete shall not be placed when the air temperature in the shade at the project site exceeds 95° F or is below 45° F, or when the temperature of the concrete exceeds 85° F.
- B. After the concrete has been placed, it shall be struck off to proper section and compacted with a grid of parallel metal bars until a layer of mortar not less than 3/8 inch thick has been brought to the surface. All exposed concrete surfaces shall receive a medium broom finish applied transversely to the line of pedestrian traffic or to the longest dimension of the concrete, as applicable.
- C. General concrete surfaces shall be cured by the curing compound method and shall be protected in accordance with the provisions of Subsections 90-1 and 90-2 of the Standard Specifications.

3.03 PROTECTION OF CONCRETE

- A. The Contractor shall be responsible for the condition of all concrete work until such time as all work has been completed and is accepted by the District. The Contractor shall limit vehicular travel across concrete until such time as the concrete has achieved strength sufficient that it can support traffic without damage. In no case, however, will vehicles be allowed to travel across new concrete improvements until seven calendar days have passed since the concrete was placed.

3.04 CONCRETE JOINTS

- A. Expansion joints and weakened plane joints shall be constructed at the locations shown on the plans or as directed by the Engineer. Where joint locations are not specified on the plans, expansion joints shall be constructed at maximum intervals of 30 feet, and weakened plane joints shall be constructed at maximum intervals of 10 feet.
- B. Expansion joints shall be considered as weakened plane joints for the purpose of spacing weakened plane joints. Expansion joints shall be tooled with a 1/4 inch maximum radius edger, and shall be filled with 3/8 inch pre-formed expansion joint filler.

3.05 CONCRETE FINISHES

- A. Where concrete is being installed adjacent to or near existing concrete improvements, match the finish of similar concrete surfaces (i.e. new sidewalks shall match existing sidewalks, new curbs shall match existing curbs, etc.).
- B. Sidewalks and Mowstrips: Medium sweat finish or medium broom finish perpendicular to the direction of travel.
- C. Curbs: Trowel smooth and finish with a light brush.

- D. Gutters: Medium broom finish parallel with curb or direction of flow.
- E. Drive approaches and wheelchair ramps: medium broom finish, perpendicular to the direction of travel.

3.06 INSTALLATION OF ACCESSORIES

- A. Strictly comply with manufacturer's instructions and recommendations and approved details. Securely anchor work to substrate.

3.07 REPAIR AND CLEAN-UP

- A. Contractor shall legally remove all trash, debris, containers and excess materials from the site on a periodic basis, and shall keep the work broom clean until Owner's acceptance.
- B. The Contractor shall be held responsible for the repair and/or replacement of new or existing improvements damaged as a result of this work to the satisfaction of the Owner.
- C. The Contractor shall provide roll-off bins for wash-out of ready mix concrete trucks and pumpers. Do not allow concrete debris or cement water onto soils scheduled for landscape planting.

END OF SECTION 32 13 13

SECTION 32 13 15 - CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Deformed reinforcing bars for site concrete improvements.
- B. RELATED SECTIONS
 - 1. Section 32 13 13 - Site Concrete Improvements.

1.03 SUBMITTALS

- A. Submit in accordance with Specification Section SUBMITTALS and the Contract General Conditions.
 - 1. Mill test certificates identifying chemical and physical analysis of each load of reinforcing steel delivered. If mill test reports are not available and the quantity of steel for a structure exceeds 5 tons, provide a laboratory test to prove yield strength and bending.
 - 2. Drawings and placing diagrams for each grade slab including dowels and corner bars.
 - 3. On the placing diagrams, show all openings for pipelines and architectural features. Include additional reinforcing at openings and corner bar arrangements at intersecting beams, walls, and footings.
 - 4. Coordinate placing diagrams with the concrete placing schedule.

1.04 PRODUCT DELIVERY

- A. Deliver reinforcement to project site in bundles marked with tags indicating bar size and length.
- B. Store on wooden supports above ground surface.

PART 2 PRODUCTS

2.01 BARS

- A. Bars shall be deformed billet steel conforming to ASTM A 615, Grade 60. Mixing of steel grades will not be allowed.

2.02 BAR SUPPORTS

- A. Bar support shall be concrete or metal chairs, spacers or hangers. Reinforcing bars shall not be supported by forms.

2.03 TIE WIRE

- A. Tie wire shall be annealed steel wire of not less than 16-gauge.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Position reinforcement in accordance with the drawings, secure with wire ties or suitable clips at all intersections, and support by an adequate number of concrete or metal chairs, spacers, or metal hangers such that reinforcing bars do not sag more than one quarter of an inch (1/4") between supports. Do not place reinforcement or supports in contact with the forms. Bend tie wires away from the forms in order to provide the specified concrete coverage. To secure reinforcement in position, the Contractor may elect to locate bars additional to those shown on the drawings, but at no additional cost to the Owner.
- B. Set reinforcing dowels and anchor bolts in place prior to placing concrete. Do not press them into the concrete after the concrete has been placed.

3.02 SPLICES

- A. Splice bars only at locations shown on the drawings. Where splices are not detailed, lap bars 72 bar diameters.

3.03 CLEANING

- A. Remove dirt, form oil, excessive rust, cement coating from previous pours, and foreign matter that will reduce bond with concrete.

3.04 PROTECTION DURING CONCRETING

- A. Keep reinforcing steel in proper position during concrete placement.

END OF SECTION 32 13 15

SECTION 32 15 40 - CRUSHED STONE SURFACING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish and install decomposed granite surfacing which includes:
 - 1. Sub-grade Preparation
 - 2. Base Preparation
 - 3. Edge restraint
 - 4. Stabilizer
 - 5. Compaction
 - 6. Cleanup

- B. Related work:
 - 1. Section 312200: Earthwork
 - 2. Section 312222: Soil Materials
 - 3. Section 321216: Soil Sterilization
 - 4. Section 321126: Aggregate Base

- C. Definitions: The word Architect as used herein shall refer to the Landscape Architect or the Owner's authorized representative.

1.02 SUBMITTALS:

- A. Procedure: Submittals shall be provided in accordance with Division 1 requirements.

- B. Submit aggregate sieve analysis, product specifications and a one pint representative sample of the proposed decomposed granite, with named source.

PART 2 PRODUCTS

2.01 DECOMPOSED GRANITE

- A. Decomposed granite is referred to by the abbreviation (D.G.), or referred to as disintegrated granite. All decomposed granite for non-vehicular surfaces shall conform to the following grading requirements:

SIEVE DESIGNATION	% PASSING
3/8 INCH	100
NO. 4	90-100
NO. 8	75-80
NO. 16	55-65

SIEVE DESIGNATION	% PASSING
NO. 30	40-50
NO. 50	25-35
NO. 100	15-20
NO. 200	10-15

- A. All decomposed granite for vehicular surfaces shall conform to the following grading requirements:

SIEVE DESIGNATION	% PASSING
1/2 INCH	95-100
3/8 INCH	90-95
NO. 4	65-80
NO. 8	43-63
NO. 16	40-49

SIEVE DESIGNATION	% PASSING
NO. 30	30-40
NO. 50	20-27
NO. 100	10-18
NO. 200	10-12

- A. The portion of D.G retained on the no. 4 sieve shall have a maximum percentage of wear of 50 at 500 revolutions as determined by AASHTO T96.
- B. The portion passing a No. 40 sieve shall have a maximum liquid limit of 25 and maximum plasticity index of 7 as determined by AASHTO T89 and AASHTO T90, respectively.
- C. The sand equivalent shall be in the range of 35-55. The R-value shall be a minimum of 71.
- D. Crushed aggregate screenings shall be free from clay lumps, vegetative matter and deleterious material.
- E. D.G. shall be tan or grey in color.

2.02 SOIL BINDER

- A. Binder shall be a non-toxic, colorless, odorless, organic powder that binds D.G. screenings consisting of 95% Psyllium with a minimum 70% Mucilliod content. The binder shall be "Stabilizer" as manufactured by Stabilizer Solutions Inc., (800) 336-2468, FAX: (602) 225-5902, or equal.

2.03 EDGING

- A. Aluminum edging: 3/16" x 5 1/2", manufactured from 6063 extruded aluminum alloy of T-6 hardness with interlock system and 5 stake punch outs fabricated in each strip. Stakes 12" long, lock 1/2" below top of edging.
1. Finish: Black anodized

PART 3 EXECUTION

3.01 SUBGRADE AND DECOMPOSED GRANITE PREPARATION AND COMPACTION

- A. Subgrade under all D.G. shall be scarified to a minimum depth of 12", graded and compacted to 90% maximum dry density (relative compaction).
- B. Aggregate base under D.G. surfacing shall be in conformance with Section.
- C. After subgrade preparation or base installation, sterilize base or subgrade receiving D.G. surfacing per Specification Section SOIL STERILIZATION.
- D. Minimum compaction for pedestrian use D.G. surfaces shall be 85% maximum dry density (relative compaction), and 90% maximum dry density (relative compaction) for vehicular use. The Contractor shall provide one compaction test for every 2,000 square feet or fraction thereof.
- E. The finish grade shall be even between the headers with no humps or depressions greater than +/- 0.25" after the compaction.

3.02 SOIL STABILIZER AND DECOMPOSED GRANITE INSTALLATION

- A. Soil stabilizer shall be thoroughly mechanically blended per the manufacturer's recommendations with the D.G. screenings prior to transport to the job site.
 - 1. For vehicular and/or pedestrian use, the stabilizer shall be mixed at a minimum rate of 15 lbs. of Stabilizer product per ton of D.G. aggregate.
 - 2. For tree well use, the stabilizer shall be mixed at a minimum rate of 8 lbs. of Stabilizer product per ton of DG aggregate.
 - 3. Premixed Stabilizer and D.G. material can be obtained locally by contacting the stabilizer manufacturer and obtaining the location of a local vendor.
 - 4. Drop spreading of the Stabilizer product over raked D.G. screenings and mixing stabilizer by rototilling is NOT ACCEPTABLE.
- B. Place the premixed stabilizer product on the pre-soaked subgrade in maximum 2" lifts. Rake smooth to the desired grade and cross slope.
- C. After placement and raking, water the Stabilized D.G. to achieve full depth moisture penetration of the placed product. Apply 25 – 45 gallons per ton to achieve the proper full depth moisture penetration.
- D. After 6 – 72 hours for activation, roll the Stabilized D.G material with a 2 to 5 ton double drum roller to achieve finish grade and initial compaction without separation, plowing or any other physical compromise of the aggregate. Utilize a hand tamp at edges, around benches, and sign posts. Do not use a vibratory wacker plate or vibratory roller to compact the Stabilized D.G.
- E. Finish surface elevation:

1. Compacted finish surface of DG shall be flush with headers, paving, mowstrips and/or curbs, unless otherwise indicated.
 2. Compacted finish surface of DG shall be two inches above finish grade in adjacent shrub/ground cover planting areas, unless otherwise indicated.
 3. Compacted finish surface of DG shall be one-half inch above finish grade in adjacent sodded turfgrass planting areas, unless otherwise indicated.
 4. Compacted finish surface of DG shall be flush to finish grade in adjacent seeded or sprigged turfgrass planting areas, unless otherwise indicated.
- F. Lightly spray the surface after compaction operations. Allow the finished surface sufficient time to dry prior to use.
- G. Finished surface shall be smooth, uniform and solid with 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 surface after installation, but may appear after use and according to environmental conditions. Pathway shall remain stable underneath loose granite on top with a “natural” look. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.

3.03 CLEANUP

- A. After all stabilization operations are completed, remove trash, excess materials, empty containers and rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a smooth condition throughout the site.
- B. The D.G. surface shall be dragged and a final dressing performed within 48 hours prior to final acceptance.

END OF SECTION 32 15 40

SECTION 32 33 10 - TACTILE/DETECTABLE WARNING SURFACE TILE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Tactile/Detectable Warning Surface Tile where indicated.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's literature describing products, installation procedures and routine maintenance.
- B. Samples for Verification Purposes: Submit two tile samples minimum, 6 inch by 8 inch of kind proposed for use.
- C. Shop drawings are required for products specified showing fabrication details; composite structural system; plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.
- D. Material Test Reports: Submit test reports from qualified independent testing laboratory indicating that materials proposed for use are in compliance with requirements and meet the properties indicated. All test reports shall be conducted on Surface Applied tactile tile system as certified by a qualified independent testing laboratory.
- E. Maintenance Instructions: Submit copies of manufacturer's specified maintenance practices for each type of tactile tile and accessory as required.

1.04 QUALITY ASSURANCE

- A. Provide Surface Applied tactile tiles and accessories as produced by a single manufacturer.
- B. Installer's Qualifications: Engage an experienced Installer certified in writing by tactile manufacturer as qualified for installation, who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
- C. Americans with Disabilities Act (ADA): Provide tactile warning surfaces that comply with detectable warnings on walking surfaces section of Americans with Disabilities Act (Title 49 CFR TRANSPORTATION, Part 37.9 STANDARDS FOR ACCESSIBLE TRANSPORTATION FACILITIES, Appendix A, Section 4.29.2 DETECTABLE WARNINGS ON WALKING SURFACES.

- D. 2022 California Code of Regulations (CCR): Provide only approved DSAAC detectable warning products as provided in the California Code of Regulations (CCR). Title 24, Part 1, Articles 2, 3 and 4 and Part 2, Section 205 definition of “Detectable Warning”. Section 11B-406 for “Curb ramps, blended transitions and islands” and Section 11B-705 for “Detectable warnings and detectable directional texture”.
- E. Detectable Warning Texture: Division of the State Architect (DSA Access Compliance) approved products shall be used, compliance with 2022 CBC Section 11B-705.1, IRs 11B-2, 11B-3 and 11B-4 and the California Accessibility Reference Manual.
 - 1. Truncated Domes: provide raised Detectable Warnings with diameter of 0.9 inch at base tapering to 0.45 inch at top, height of 0.2 inch, with center-to-center spacing of 2.35 inches and corner domes spaced at 0.896 inch from the corner edges of tile. Provide raised truncated domes in a square grid (in-line) pattern.
 - a. Truncated Dome: shall contrast visually with adjoining surfaces, light-on- dark or dark-on-light. Material used to provide contrast shall be integral part of walking surface. Warning surface shall differ from adjoining surface in resiliency or sound to cane contact.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy wrappings and tile type shall be identified by part number.
- B. Tiles shall be delivered to location at building site for storage prior to installation.

1.06 SITE CONDITIONS

- A. Environmental Conditions and Protection: Maintain minimum temperature of 40°F in spaces to receive tactile tiles for at least 48 hours prior to installations, during installation, and for not less than 48 hours after installation. Store tactile tile material in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 40°F in areas where work is completed.
- B. The use of water for work, cleaning or dust control, etc. shall be contained and controlled and shall not be allowed to come into contact with the passengers or public. Provide barricades or screens to protect passengers or public.
- C. Disposal of any liquids or other materials of possible contamination shall be made in accordance with federal state and local laws and ordinances.
- D. Cleaning materials shall have code acceptable low VOC solvent content and low flammability if used on the site.

1.07 EXTRA STOCK

- A. Deliver extra stock to storage area designated by engineer. Furnish new materials from same manufactured lot as materials installed and enclose in protective packaging with appropriate identification for Surface Applied tactile tiles. Furnish not less than two (2) percent of the supplied materials for each type, color and pattern installed.

1.08 WARRANTY (DETECTABLE WARNINGS AND DIRECTIONAL TEXTURE)

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of detectable warnings and directional surface products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Shape, color fastness, confirmation, sound-on-cane acoustic quality, resilience, and attachment will not degrade significantly.
 - b. Degrade significantly means that product maintains at least 90 percent of its approved design characteristics, as determined by the authority having jurisdiction.
 - 2. Warranty Period: Five years from date of Final Completion.
 - 3. Authority: California Building Code Section 11B, Division of the State Architect Interpretation of Regulations (IR) 11 B-2, 11B-3 11B-4.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Engineered Plastics Inc., Armor Tile.
 - 2. ADA Solutions, Inc., North Billerica, MA.
- B. Detectable Warning Texture: Division of the State Architect (DSA/Access Compliance) approved products shall be used, compliance with CBC Section 11B-705.1, IRs 11B-2, 118-3 and 11B-4 and the California Accessibility Reference Manual.
 - 1. Truncated Domes: provide raised Detectable Warnings with diameter of 0.9 inch at base tapering to 0.45 inch at top, height of 0.2 inch, with center-to-center spacing of 2.35 inches and corner domes spaced at 0.896 inch from the corner edges of tile; Provide raised truncated domes in a square grid (in-line) pattern.
 - a. Truncated Dome: shall contrast visually with adjoining surfaces, light-on- dark or dark-on-light. Material used to provide contrast shall be integral part of walking surface. Warning surface shall differ from adjoining surface in resiliency or sound to cane contact.
 - 2. Detectable Warning Texture (Truncated Domes): Plastics/Composites: Armor Tile, ADA Tactile Systems by Engineered Plastics Inc., North Billerica, or equal.

- C. The Vitrified Polymer Composite (VPC) Surface Applied Tactile Tile specified is based on Armor-Tile manufactured by Engineered Plastics Inc. Existing engineered and field tested products which are subject to compliance with requirements, may be incorporated in the work and shall meet or exceed the specified test criteria and characteristics.
- D. Color: Yellow conforming to Color No. 33538 of SAE AMS-STD-595A. Color shall be homogeneous throughout the tile.

2.02 MATERIALS

- A. Fasteners: Color matched, corrosion resistant, flat head drive anchor: W diameter x 1 3/4" long, or manufacturer's recommended fasteners.
- B. Adhesive and Sealant: Manufacturer's recommended adhesive and sealant.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Surface Applied: The following installation instructions shall be used for tactile warning tiles installed at existing concrete surfaces.
 1. During all surface preparation and tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.
 2. The application of all tile, adhesives, mechanical fasteners, and caulking shall be in strict accordance with the guidelines set by their respective manufacturers.
 3. Ensure that surfaces being prepared and fabricated to receive the tiles are constructed correctly and adequately for tile installation. Review design drawings with the Contractor prior to the construction and refer any and all discrepancies to Engineer.
 4. Set the tile true and square to the curb ramp area as detailed in the design drawings, so that its location can be marked on the concrete surface. Use thin permanent marker. Remove tile when done marking its location.
 5. The surface to receive the detectable warning surface tile (not recommended for asphalt) is to be mechanically cleaned with diamond cup grinder or shot blaster to remove any dirt or foreign material. This cleaning and roughening of the concrete surface should include at least 4 inches around the perimeter of the area to receive the tile, and also along the cross pattern established by the corresponding areas on the backside of the tile. Those same areas should then be cleaned with a rag soaked in Acetone.
 6. Immediately prior to installing the detectable warning surface tile, the concrete surfaces must be inspected to ensure that they are clean, dry, free of voids, curing compounds, projections, loose material, dust, oil, grease, sealers and determined to be structurally sound and cured for minimum of 30 days.
 7. Using Acetone, wipe the backside of the tile around the perimeter and along the internal cross pattern, to remove any dirt or dust particles from the area to receive the adhesive.
 8. Apply the adhesive on the backside of the tile, following the perimeter and internal cross pattern established by the tile manufacturer. Sufficient adhesive must be placed on the

prescribed areas to have full coverage across the 2" width of the adhesive locator. A 3 x 4 foot tile will typically require an entire tube of adhesive.

9. Set the tile true and square to the curb ramp area as detailed in the design drawings.
10. Standing with both feet applying pressure around the molded recess provided in the tile, drill a hole true and straight to a depth of 3W using the recommended diameter bit. Drill through the tile without hammer option until the tile has been successfully penetrated, and then with hammer option to drill into the concrete.
11. Immediately after drilling each hole, and while still applying foot pressure, vacuum, brush or blow away dust and set the mechanical fastener as described below, before moving on to the next hole.
12. Mechanically fasten tiles to the concrete substrate using a hammer to set the fasteners. Ensure the fastener has been placed to full depth in the dome, straight, and flush to the top of dome. Drive the pin of the fastener with the hammer, taking care to avoid any inadvertent blows to the truncated dome or tile surface. A plastic deadblow or leather hammer is recommended.
13. Working in a sequence that will prevent buckles in the tile, proceed to drill and install all fasteners in the tile's molded recesses.
14. Following the installation of the tiles, the perimeter caulking sealant should be applied. Follow the perimeter caulking sealant manufacturer's recommendations when applying. Tape all perimeter edges of the tile and also tape the adjacent concrete back 1/2" from the tile's perimeter edge. Tool the perimeter caulking with a plastic applicator or spatula to create a straight edge in a cove profile between the tile and adjacent concrete. Remove tape immediately after tooling perimeter caulking sealant.
15. Do not allow foot traffic on installed tiles until the perimeter caulking sealant has cured sufficiently to avoid tracking.
16. If installing adjacent tiles, note the orientation of each tile. Careful attention will reveal that one of the long edges of the tile is different than the other, in regard to the tiny dotted texture. You may also note a larger perimeter margin before the tiny dotted texture pattern begins. Consistent orientation of each Tile is required in order that the truncated domes on adjacent tiles line up with each other.
17. In order to maintain proper spacing between truncated domes on adjacent tiles, the tapered edge should be trimmed off using a continuous rim diamond blade in a circular saw or mini-grinder. The use of a straightedge to guide the cut is advisable. All cuts should be made prior to installation of the tiles.
18. If installing adjacent tiles, care should be taken to leave a 1/8 inch gap between each. If tiles are custom cut to size, and if pre-molded recesses (to receive fasteners) are removed by the cut, then any truncated dome can be center-drilled with a 5 inch through hole, and countersunk with a suitable bit, to receive mechanical fasteners. New holes should be created no closer to the edge of the tile than any of the other perimeter fastener pre-molded recesses. Care should be taken to not countersink too deeply. Fasteners should be flush with the top of the truncated dome when countersunk properly.
19. Adhesive or caulking on the surface of the Tile can be removed with Acetone.

B. Wet Set: The following installation instructions shall be used for tactile warning tiles installed at new concrete surfaces.

1. During all surface preparation and tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

2. The application of all tile, adhesives, mechanical fasteners, and caulking shall be in strict accordance with the guidelines set by their respective manufacturers.
3. Ensure that surfaces being prepared and fabricated to receive the tiles are constructed correctly and adequately for tile installation. Review design drawings with the Contractor prior to the construction and refer any and all discrepancies to Engineer.
4. Set the tile true and square to the curb ramp area as detailed in the design drawings.
5. Immediately prior to installing the detectable warning surface tile, the wet concrete surfaces must be inspected to ensure that it is clean and free of debris.
6. Do not remove protective plastic covering on detectable warning tile product until tile is installed and concrete is fully cured.
7. Slowly press the detectable warning tile into the wet concrete until the base of the truncated domes is flush with the adjacent concrete. Do not stand on the tile during installation. Tap the detectable tile with a rubber mallet as required to ensure all edges are flush with concrete. Install anchors into wet concrete as specified per manufacturer's recommendation and ensure that the anchors are flushed with the detectable tile surface. Provide weight to the detectable tile surface if "floating" occurs after tile placement. All detectable tile edges shall be flush with adjacent concrete.
8. While the concrete is workable, a 1/8" deep troweled edge shall be installed around the tile perimeter. Finish the concrete as required per specifications. Ensure concrete edge do not have any low areas that collect water.
9. Set the tile true and square to the curb ramp area as detailed in the design drawings.
10. If installing adjacent tiles, note the orientation of each tile. Careful attention will reveal that one of the long edges of the tile is different than the other, in regard to the tiny dotted texture. You may also note a larger perimeter margin before the tiny dotted texture pattern begins. Consistent orientation of each Tile is required in order that the truncated domes on adjacent tiles line up with each other.
11. In order to maintain proper spacing between truncated domes on adjacent tiles, the tapered edge should be trimmed off using a continuous rim diamond blade in a circular saw or mini-grinder. The use of a straightedge to guide the cut is advisable. All cuts should be made prior to installation of the tiles.
12. Remove protective plastic sheeting after all post-installation treatments are complete and the concrete has cured.

3.02 CLEANING AND PROTECTING

- A. Protect tiles against damage during construction period to comply with tactile tile manufacturer's specification.
- B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.
- C. Clean tactile tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean tactile tile by methods recommended by manufacturer.

END OF SECTION 32 33 10

SECTION 33 12 00 - WATER UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Pipe and fittings for on-site domestic piping.
- B. Valves and valve boxes.
- C. Accessories.

1.02 RELATED SECTIONS

- A. Contract General Conditions and Division 1 Specifications.
- B. Section 31 11 00 - Site Clearing.
- C. Section 31 20 00 - Earthwork: Excavation, Filling, and Grading
- D. Section 31 22 22 - Soil Materials.
- E. Section 31 23 33 - Trench Excavation and Backfill.
- F. Section 32 13 13 - Site Concrete Improvements.

1.03 REFERENCES

- A. ASTM Test Method D1557.
- B. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- C. ANSI/AWWA C110 - Ductile Iron and Grey-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
- D. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- E. ANSI/AWWA C500 - Gate Valves, 3-inch through 48-inch NPS, for Water and Sewage Systems.
- F. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water.
- G. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and Class 200.

- H. ASTM D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
- I. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

1.04 SUBMITTALS

- A. Submit in accordance with Specification Section SUBMITTALS and the Contract General Conditions.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Contract General Conditions and Division 1 Specifications.
- B. Accurately record actual locations of piping mains, valves, connections and appurtenances, referenced to permanent surface features.
- C. Identify and describe discovery of uncharted utilities or utilities found at locations different than indicated on plans.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with product manufacturer's recommendations and these Contract Documents.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle all products required.

PART 2 PRODUCTS

2.01 WATER PIPE

- A. Ductile Iron Pipe (for iron pipe larger than 3 inches in diameter, above ground): ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, thickness Class 50, with cement - mortar lining and seal coating per ANSI/AWWA C104/A21.4.
 - 1. Fittings: ANSI/AWWA C110/A21.10, ductile iron.
 - 2. Joints: Flanged.

- B. PVC Pipe (for pipe 3 inches and smaller, underground): ASTM D1785, Schedule 40.
 - 1. Fittings: ASTM D 2464, Schedule 80 PVC (ASTM D 2466, Schedule 40 PVC for pipes 1-1/2 inches and smaller).
 - 2. Joints: ASTM D 2855, solvent weld.
- C. PVC Pipe (for pipe 4 inches and larger, underground): ANSI/AWWA C900 Class 305.
 - 1. Fittings: ANSI/AWWA C111, ductile iron.
 - 2. Joints: ASTM D 3139 compression gasket ring.
- D. Locator Tape: Tape shall be an inert material such as polyethylene plastic with a metallic core, and highly resistant to alkalis, acids, or other chemical components likely to be encountered in soils. The tape shall be bright colors for contrast with the soils with identifying print in black letters. The tape shall be six inches wide and be printed "CAUTION - WATER LINE BELOW".

2.02 VALVES - UP TO 2 INCHES (50 MM)

- A. Use full port ball valves for 2 inches and smaller and resilient wedge gate valves for 2-1/2 inches and larger size.
- B. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends.

2.03 GATE VALVES - 2-1/2 INCHES (63 MM) AND OVER

- A. ANSI/AWWA C509, Iron body, bronze trim, non-rising stem with square nut or control handle wheel, resilient single wedge, threaded or flanged.

2.04 VALVE BOXES

- A. Precast concrete with cast iron lid marked for service Christy No. G5 or approved equal.
- B. Valve boxes shall have a minimum 6 inch wide by 4 inch (6" inches in vehicular areas) thick concrete collar.

2.05 ACCESSORIES

- A. Concrete for Thrust Blocks and Valve Box Surface Collars: Concrete type specified in Specification Section SITE CONCRETE IMPROVEMENTS.
- B. Valve Boxes and Covers: Christy No. G5 traffic box, or approved equal. Cover marking shall read "Water". A one-piece PVC riser extension shall be provided as necessary to allow unobstructed access to valve operating nut.
- C. Solvent Cement and Primer for PVC Pipe and Fittings: Per ASTM F656 and ASTM D2564.
- D. Non-Firming Anticorrosion Wrap: Trenton Wax-Tape #1 or approved equal for application on belowground metal surfaces, pipe, or fittings in corrosive soils.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions. All plot dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and report any variations to the Engineer.
- B. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. Carefully investigate the structural and finished conditions affecting all work, and plan work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Unless dimensions are shown, drawings are generally diagrammatic and indicative of the work to be installed in the most direct and workmanlike manner, so that conflicts between water systems, planting, and architectural features will be minimized.
- C. Do not install the facilities as indicated on the drawings when it is obvious in the field that unknown obstructions might not have been considered in the engineering. Such obstructions or differences should be brought to the attention of the Engineer before proceeding.

3.02 PREPARATION

- A. Prepare for pipe installation by assembling all needed materials.
- B. Cover all PVC pipe during storage.

3.03 BEDDING

- A. Excavate trench, pit or hole in accordance with Specification Section TRENCH EXCAVATION AND BACKFILL.
- B. Where trench or pit has been overexcavated, place bedding material at bottom of excavations, level soil materials in continuous layers not exceeding 8-inches loose uncompacted depth.
- C. Backfill around sides and to a level 12-inches above the top of pipe with bedding sand, tamped in place.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.04 INSTALLATION - PIPE AND FITTINGS

- A. Install pipe at locations and depths indicated on plans.
- B. Install pipe, fittings, and associated materials in accordance with manufacturer's recommendations.

- C. Route pipe in straight line, whenever possible. All changes in direction of pipes shall be made with fittings, not by bending.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Form and place concrete for thrust blocks at each elbow, tee, angle or other significant change of direction in loose-joint pipe, per detail on plans.
- F. Establish elevations of buried piping to ensure not less than 30-inches of cover, except at connections to existing lines, which may be shallower or deeper, or where shown otherwise on plans.
- G. When two water pipes are to be installed in same trench, maintain a minimum 4-inch horizontal clearance between pipes.
- H. Backfill trench or other excavation in accordance with Specification Section TRENCH EXCAVATION AND BACKFILL.

3.05 INSTALLATION - VALVES

- A. Set valves on solid bearing.
- B. Where valves are installed below finish surface grade, center and plumb valve box and any necessary extensions over valve. Set box cover flush with finished grade.
- C. Pour concrete collar around top of valve box per detail on plans.
- D. Furnish and install valves and valve boxes in addition to those shown on plans as required for isolation of lines for construction and disinfection, while minimizing disruption of service to buildings, at no additional cost to the Owner.

3.06 INSTALLATION - THREADED CONNECTIONS

- A. Assemble all plastic and galvanized steel threaded pipe and fittings using an approved Teflon tape applied to the male threads only. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved Teflon tape will be required.
- B. At all plastic (PVC) pipe connections, work the ductile iron connections first. Connections shall always be plastic into steel, never steel into plastic.
- C. A non-hardening sealant and lubricant similar to Permatex #51 or LASCO blue pipe sealant may be used in lieu of Teflon tape. Apply sealant to clean male threads brushing into grooves and to the first three threads of the female threads.

3.07 PRESSURE TESTING OF SITE WATER PIPING SYSTEM

- A. General: Unless otherwise directed, tests shall be witnessed by Inspector. Work to be concealed shall not be covered until prescribed tests are made. Should any work be covered before such tests, the Contractor shall, at his expense, uncover, test and repair his work and that of other contractors to original conditions. Leaks and defects shown by tests shall be repaired and entire work re-tested. Tests may be made in sections, however, all connections between sections previously tested and new section must be included in the test.
- B. Water Piping: Pressure test all onsite water piping systems in accordance with AWWA Standard C605, "Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings". The pressure testing process shall be performed in cooperation with the authority having jurisdiction and witnessed by the Owner's Inspector. The constructor shall supply an affidavit of compliance to the Owner as required by AWWA Standard 605. Maintain 150 PSIG water pressure for a duration of four (4) hours. There shall be no drop in pressure during test except that due to ambient temperature changes. Flush all lines prior to pressure test.
- C. Backflow Preventer: All backflow preventers shall be tested according to manufacturer's recommendations and the USC Cross Connection Control and Hydraulic Research Manual latest edition and per local AHJ requirements. Testing shall be performed by an AWWA Certified Backflow Prevention Assembly Tester. Contractor shall provide written certification to the Architect showing the date in which the backflow preventers were tested and confirmation that unit passed all test requirements.

3.08 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect all domestic water piping systems in accordance with AWWA Standard C651, "Disinfecting Water Mains", and in accordance with administrative authority. Disinfection process shall be performed in cooperation with health department having jurisdiction and witnessed by the Owner's Inspector. During procedure, signs shall be posted at each water outlet stating, "Chlorination - Do Not Drink". After disinfection, water samples shall be collected for bacteriological analysis. Certificate of Bacteriological Purity shall be obtained and delivered to the Owner by the Owner's Inspector.

3.09 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the Contract General Conditions and Division 1 Specifications.
- B. Compaction testing of bedding and backfill will be performed in accordance with ANSI/ASTM D1557.

- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest. Any retests required due to failure of initial tests shall be paid for by the Contractor.

END OF SECTION 33 12 00

SECTION 33 40 00 - STORM DRAINAGE

P1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY:

- A. This section includes the following:
 - 1. Provide all materials, labor, equipment and services necessary to furnish and install Storm Drainage System, accessories and other related items necessary to complete the Project as indicated by the Contract Documents unless specifically excluded.
- B. RELATED SECTIONS:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 00 and 01 sections, apply to this work.
 - 2. Section 31 22 22 – Soil Materials
 - 3. Section 31 23 33 – Trench Excavation and Backfilling.
 - 4. Section 32 13 13 – Site Concrete Improvements.

1.03 REFERENCES

- A. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
- B. ANSI/ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- C. ANSI/ASTM C478 Precast Reinforced Concrete Manhole Sections.
- D. ASTM D1557

1.04 DEFINITIONS

- A. Bedding: Fill placed under, around, beside and directly over pipe, prior to subsequent backfill operations.
- B. Utility: Any buried or above ground pipe, conduit, cable, associate device or appurtenances, or substructure pertaining thereto.

1.05 SUBMITTALS

- A. Submit under provisions of Division 01.

- B. Certificates of compliance for material.
- C. Product Data: Provide data indicating pipe, accessories, and associated equipment to be furnished.
- D. Submit manufacturer's data and/or fabrication drawings for all pipes, and appurtenances installed under this Section. No items shall be incorporated into the work until submittals are approved by the Architect/Engineer

1.06 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Verify that the location of existing utilities have been indicated at work site by utility authorities and Owner's personnel.
- C. Coordinate work with other project work.

1.07 EXISTING UTILITIES

- A. The Engineer has made a diligent attempt to indicate on the plans the location of all main and trunkline utility facilities which may affect the Work. In most cases, however, the only available information relative to the existing location of said facilities was small scale undimensioned plats. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- B. Service laterals and appurtenances have also been shown where information was available as to their location. In most cases, however, the only available information relative to the existing location of said facilities was small scale undimensioned plats. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. At new work location, expose by hand methods all existing utilities along the route of the new work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand methods to locate all existing facilities as indicated on the plans, and as indicated at the work site by Owner's personnel.
- D. Maintain all existing utility mains and service lines in constant service during construction of the Work

1.08 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01.
- B. Accurately record actual locations of utilities encountered.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforced Concrete Pipe for pipe larger than fifteen (15) inches: ANSI/ASTM C76, Class 3, with rubber gasket joints per ANSI/ASTM C443.
- B. Storm drainage sewer pipeline shall be polyvinyl chloride (PVC) pipe for storm sewer conforming to ASTM designation 3034, SDR 35, with elastomeric gasket joints per ASTM D 3212 for pipe fifteen (15) inches or less.
- C. Storm drainage pipeline shall be polyvinyl chloride (PVC) pipe for storm sewer conforming to ASTM D1785, Schedule 40, for pipe three (3) inches or less.
- D. Poured in Place Concrete: Specification Section SITE CONCRETE IMPROVEMENTS.
- E. Mortar: Composed of one part, by weight, portland cement (Type II low alkali per ASTM C150), 2 parts, by weight, sand, and water.
- F. Manhole Frames, Covers and Grates: Cast Iron per ASTM A48, Class 25.
- G. Soil Fill for Concrete Pipe Bedding Envelope: Specification Section TRENCH EXCAVATION AND BACKFILL.
- H. Catch basins and drain inlets shall be constructed as per detail drawing.
- I. Concrete collar shall be constructed as per detail drawing.
- J. Cleanout shall be precast concrete with cast iron lid marked for service Christy G5 or approved equal and constructed as per detail drawing.
- K. All metallic pipe, fittings and appurtenances in contact with soil shall be coated or wrapped with an approved material, as required to protect it from corrosive soil.
- L. Locator Tape: Tape shall be an inert material such as polyethylene plastic with a metallic core, and highly resistant to alkalis, acids, or other chemical components likely to be encountered in soils. The tape shall be bright colors for contrast with the soils with identifying print in black letters. The tape shall be six inches wide and be printed "CAUTION – STORM SEWER LINE BELOW".

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site conditions.

3.02 PREPARATION

- A. Identify location of proposed storm drainage facilities to be constructed. Expose connection points to existing system.
- B. Locate, identify, and protect existing above and below grade utilities from damage.
- C. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- D. Protect existing structures and other improvements to remain from damage from excavation equipment and vehicular traffic.
- E. Employ equipment and methods appropriate to the work site.
- F. Protect excavated areas from drainage inflow, and provide drainage to all excavated areas. Dewater existing drainage basins and existing drainage pipeline systems as necessary to accomplish the work.
- G. Comply with safety requirements as they pertain to excavations, per Specification Section EARTHWORK.
- H. Remove all interfering surface and subsurface improvements authorized for removal.

3.03 EXCAVATION

- A. Excavate soil required to locate existing utilities and install the work.
- B. Excavate trenches and pits per Specification Section EARTHWORK.
- C. Excavate trenches and pits to allow installation and construction of the storm drainage facilities to the alignment, grades, depths and cross-sections as indicated on the construction plans.
- D. Excavate trench to depth which is 6 inches below the outside bottom of the pipe barrel to be placed therein.
- E. Cut trenches just wide enough to allow the installation of the pipe and pipe bedding as indicated on the plans. Minimize trench width above the pipe.
- F. Provide protection to public per Division 01.

3.04 INSTALLATION AND BEDDING OF STORM DRAIN PIPE

- A. Install the pipe and fittings to the lines and grades shown on the construction plans.
- B. Install pipe and fittings in accordance with the manufacturer's recommendations, and these specifications.

- C. Unless otherwise approved by the Engineer, lay all pipe upgrade from structure to structure, with bell or socket ends of pipe upgrade.
- D. Excavate suitable bell (or socket) holes in the bedding material, so that the bells do not bear on the subgrade or bedding. Provide uniform bearing of pipe barrel on bedding material.
- E. Ensure that all joints are properly "homed" and are watertight.
- F. Bed concrete pipe in backfill or sandfill soil envelope, and compact to a minimum of 90% relative compaction. Place and compact the bedding material under, around and over the pipe, filling the trench cavity and extending from the bottom of the trench (6 inches below the outside bottom of the pipe barrel) to a level 12 inches above the outside top of the pipe barrel.

3.05 INSTALLATION OF STORM DRAINAGE STRUCTURES AND APPURTANCANCES

- A. Install storm drainage structures as indicated on the construction plans, in accordance with the manufacturer's recommendations, and as specified herein.
- B. Construct poured-in-place concrete per Specification Section SITE CONCRETE IMPROVEMENTS.
- C. Key top of poured-in-place concrete bases for structures to receive the tongue of precast riser sections.
- D. Construct cleanout, outfall structure per detail drawing.

3.06 BACKFILLING TO FINISHED GRADE AND FINISHED GRADING

- A. Place and compact backfill per Specification Section TRENCH EXCAVATION AND BACKFILL.
- B. Conform finished surface to the lines, grades and cross-sections shown on the plans, or as otherwise directed by the Inspector.
- C. In areas to receive paving or a significant thickness of sealing material, temporarily set manhole frame and cover below finish grade, then return after final surfacing and/or pavement sealing and bring manhole frame and cover to final grade, as shown on the plans.
- D. Fine grade all finished soil surfaces disturbed to the lines, grades and cross-sections shown on the plans.
- E. Rake and smooth all finished dirt surfaces.

3.07 TOLERANCES

- A. Pipe laying tolerances:
 1. Above grade: Not to exceed 1/4-inch above planned grade.

2. Below grade: Not to exceed 1/2-inch below planned grade.
 3. Alignment: Not to exceed 2 inches from planned alignment, if gradual and regular over a distance of 20 feet.
- B. Structure finish grade tolerance: Within 1/4 inch of planned grade, but must match adjacent improvements.

3.08 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01.
- B. Compaction testing of bedding and backfill will be performed in accordance with ASTM D 1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest at no additional cost to Owner.

END OF SECTION 33 40 00