SECTION 334100 - CORRUGATED POLYETHYLENE NONPRESSURE PIPE (HDPE)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install 12 inch to 36 inch corrugated polyethylene nonpressure pipe with all necessary fittings and coupling systems and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 312300	Utility Earthwork.
B.	Section 330130	Sanitary Sewer and Storm Drain System Leakage Testing.
C.	Section 333900	Precast Concrete Maintenance Holes.
D.	Section 033050	Utility Cast-in-Place Concrete.
E.	Section 034800	Precast Concrete Vaults, Utility Boxes, and Storm Water Inlets.
F.	Section 331100	Piping, General.
G.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **State of California (Caltrans) Standards:**

Section 61	Culvert and Drainage Pipe Joints.
Section 64	Plastic Pipe.

B. **Commercial Standards:**

AASHTO M 294	Specification for Corrugated Polyethylene Pipe, 36 in. Diameter.
ASTM D 2412	Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel - Plate Loading.
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins (R 1985).
ASTM D 3350	Specification for Polyethylene Plastics Pipe and Fittings Materials.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

1.5 QUALITY ASSURANCE

A. **Testing:** All materials testing shall be based upon applicable ASTM Test Methods referenced herein for the materials specified. All costs of such manufacturing inspections and tests shall be borne by the CONTRACTOR.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Corrugated polyethylene pipe shall be smooth interior wall Type S and shall be as specified in AASHTO M 294, except as otherwise specified herein. Corrugated polyethylene pipe shall be manufactured from high density polyethylene (HDPE) virgin compounds.

1. HDPE compounds used in the manufacture of corrugated polyethylene pipes shall conform to the following cell classifications as provided in ASTM D 3350:

Property	**Cell Classification**
Density	3
Melt index	2[(a)], 3 or 4
Flexural modulus	4, 5 or 6
Tensile strength	4, 5 or 6
Environmental stress crack resistance	1, 2, or 3
Hydrostatic design basis	0, 1, 2, 3, or 4
Ultraviolet stabilizer	C[(b)]

(a) The melt index for cell class factory 2 material used to manufacture pipe shall not be greater than 0.6. Rotationally-molded couplings and end fittings may be produced from material compounds having a melt index cell classification of one.

(b) HDPE resin shall contain not less than 2 +/- 1/2 percent carbon black ultraviolet stabilizer.

B. The residue from ignition of the HDPE compounds shall not exceed 30 percent as determined by ASTM D 2584, except that the muffle furnace temperature shall be 450 +/- 25 degrees C. (840 +/- 45 degrees F.)

2.2 PIPE THICKNESS, STIFFNESS AND UNIT WEIGHT

A. Wall thickness of Type S corrugated polyethylene pipe shall be the thickness of the inner liner measured between corrugation valleys.

B. The pipe stiffness shall be determined in accordance with ASTM D 2412. Pipe stiffness shall be determined for 3 test specimens for each manufactured run. Minimum pipe stiffnesses and wall thickness shall be as follows:

Pipe Diameter (in.)	Minimum Wall Thickness (in.)	Minimum Pipe Stiffness (psi)
12"	0.035	50
15"	0.035	42
18"	0.050	40
24"	0.050	34
30"	0.050	28
36"	0.050	22

The minimum pipe unit weight shall meet the requirements of Table 2 of Section 64-1.03 “Pipe Thickness, Stiffness and Unit Weight” of the Caltrans Standard Specifications.

C. The pipe unit weight shall be computed as the average weight per foot of length determined from 3 test specimens, taken from each manufactured run. Each test specimen for pipes 24 inches in diameter and less shall be a minimum length of 2 diameters. The length of each test specimen for pipes larger than 24 inches in diameter shall be one diameter or a maximum of 36 inches, whichever is less. The weight of pipe specimens shall be determined with any suitable weighing device accurate to 0.10 pound.

2.3 JOINTS

A. The joint shall be bell and spigot design and shall include a rubber gasket meeting the requirements of ASTM F-47.

Fittings used in the system shall not reduce or impair the overall integrity or function of the pipe line. Fittings may be either molded or fabricated Common Corrugated fittings including in-line joint such as tees, wyes, and end caps. Unless otherwise specified, fittings shall be installed using a joint configuration meeting the requirements of cell Class 335420C as defined and described in ASTM D3350. Only fittings supplied or recommended by the manufacturer shall be used.

B. Water tightness shall be attained by the use of approved durable, high quality, resilient joint materials designed to perform the intended function. These materials shall be neoprene expanded rubber or sheet rubber gaskets, "O" ring rubber gaskets, butyl rubber base joint sealant, or other approved resilient materials. Watertight joints shall be tested in accordance with Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

PART 3 -- EXECUTION

3.1 GENERAL

A. All laying, jointing, testing for defects and for leakage, shall be performed in the presence of the ENGINEER. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective material from the site of the WORK.

3.2 PIPE HANDLING

A. Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

3.3 INSTALLATION

A. Pipe shall be laid and jointed in accordance with the manufacturer's printed recommendations and the following provisions in order to be suitable for the purpose intended.

B. Necessary facilities shall be provided for lowering and properly placing the sections of pipe in the trench.

C. The pipe shall be laid to line and grade with the sections closely jointed.

D. Every precaution shall be taken to prevent flooding the pipe trench before backfilling operations.

E. New pipe shall be connected to existing or new drainage facilities as shown on the Drawings.

3.4 CONNECTIONS

A. Connections of HDPE to existing structures and pipes shall be as follows:

1. Connections to cast-in-place structures shall include a water-stop at mid-wall of the structure.

2. Connections to pre-cast structures shall include a water-stop at mid-wall of the structure, and opening shall be filled with cement grout in conformance with Section 036000 “Grout.”

3. Connections to existing HDPE pipe shall be made with a premium split-coupling saddle tee.

4. Connections to existing PVC shall be made with a PVC saddle with a HDPE/SDR 35 PVC adaptor.

5. Connections to existing DIP shall be made with a DIP tap and heat shrink material around the joint. Heat shrink material shall be supplied by the HDPE pipe manufacturer.

6. Connections to existing RCP shall be as shown on the Drawings, except that the PCC concrete encasement around the RCP shall be extended to cover the HDPE a point 6 inches to 12 inches beyond the RCP sleeve.

3.5 TESTING

A. Testing of corrugated polyethylene non-pressure pipe shall conform to the requirements of Section 330130 "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 334102 - REINFORCED CONCRETE PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all reinforced concrete pipe and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 312300	Utility Earthwork.
B.	Section 330130	Sanitary Sewer and Storm Drain System Leakage Testing.
C.	Section 333900	Precast Concrete Maintenance Holes.
D.	Section 033050	Utility Cast-in-Place Concrete.
E.	Section 034800	Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets.
F.	Section 331100	Piping, General.
G.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM C 76	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
ASTM C 150	Specification for Portland Cement.
ASTM C 443	Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
ASTM C 596	Test Method for Drying Shrinkage of Mortar Containing Portland Cement.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used in this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIALS

A. **Reinforced Concrete Pipe:** Reinforced concrete pipe shall conform to the requirements of ASTM Designation C 76. Cement shall conform to ASTM C150, Type II. Pipe shall be bell and spigot having O-ring rubber gaskets conforming to ASTM C 443 retained in a groove on the spigot end. All reinforcement shall be circular. **Elliptical reinforcing will not be allowed.**

B. **Cement Mortar:** Cement mortar for structures or pipe connections shall consist of a mixture of portland cement, sand, and water. Mortar shall be composed of one part of cement and 2 parts of clean, well-graded sand of such size that will pass a No. 8 sieve. Cement and sand shall first be combined in the proper proportions, and then thoroughly mixed with the required amount of water.

C. Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be allowed.

D. Concrete material shall conform to the requirements of Section 033050, "Utility Cast-in-Place Concrete."

E. **Admixtures:** No admixture shall be used in mortar unless otherwise specified or accepted in writing by the ENGINEER.

2.2 PIPE DESIGN

A. Reinforced concrete pipe shall be manufactured and provided to meet the pipe strength classifications as shown on the Drawings and in accordance with ASTM C 76, but in no case shall be less than Class III for Wall "B" or Wall "C." Class I and II pipe will not be allowed.

B. Wall "A" pipe will not be allowed

PART 3 -- EXECUTION

3.1 PIPE LAYING

A. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.

B. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Engineer. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet.

C. Care shall be used to make sure that the bottom of the pipe is in contact with the bottom of the trench for the full length of each section.

D. **Excavation:** Bell holes shall be excavated at each joint to provide full length barrel support of the pipe and to prevent point loading at the bells.

E. **Pipe Laying:** Unless otherwise required, all pipe shall be laid straight between the changes in alignment and at uniform grade between changes in grade.

F. **Rubber Gasket Joints:** The rubber gasket joint shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before it is placed in the groove at the spigot end. The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise injured or forced out of position during the closure of the joint. A feeler gauge shall be used to check the position of the rubber gasket after the joint has been assembled. Where a joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed, if necessary, the pipe re-laid and the gasket placement rechecked.

G. Pointing and bonding mortar at pipe connections to structures shall be plastic and of such consistency that it will readily adhere to the pipe and structure.

3.2 TESTING

A. Testing shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 344100 - TRAFFIC SIGNALS AND LIGHTING SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all material, equipment, and labor necessary to furnish and install all traffic signals, all street lights, all associated hardware and equipment, and all appurtenant work to provide a functional installation, complete in place and operable, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 312300 Utility Earthwork.

B. Section 311723 Traffic Stripes and Pavement Markings.

C. Section 321300 Concrete Surface Improvements

D. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

United States Department of Transportation, Manual of Uniform Traffic Control Devices

595a Federal Standard.

NEC National Electric Code.

NEMA National Electric Manufacturers Association.

B. **State of California (Caltrans) Standards:**

1. Latest version of the Standard Specifications, including (but not limited to):
   Section 86 - Signals, Lighting and Electrical Systems

2. Latest version of the Standard Plans
3. Latest version of the Traffic Manual

C. **Commercial Standards:**

UL Underwriters Laboratories, Inc.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. The CONTRACTOR shall submit the controller cabinet schematic wiring diagram and intersection sketch on one sheet, at the time the controller cabinet is delivered to the CITY for testing, or prior to any signal modifications which require modifications to the controller cabinet. The CONTRACTOR shall notify the City Maintenance Department–and City Inspector 72 hours prior to delivery of controller cabinet for testing.

C. The CONTRACTOR shall furnish a maintenance manual for all controller units; auxiliary equipment; and vehicle detectors sensor units, control units and amplifiers. The maintenance manual and the required operation manual may be combined into one manual. One set of traffic signal Drawings and traffic signal Specifications, and the maintenance manual, or combined maintenance and operation manual, for the controller shall be submitted at the time the controllers are delivered to the CITY for testing. The maintenance manual shall include, but is not necessarily limited to, the following items:

1. Manufacturer's specifications.
2. Design characteristics.
3. General operation theory.
4. Function of all controls.
5. Trouble-shooting procedure (diagnostic routine).
6. Block circuit diagram.
7. Geographical layout of components.
8. Schematic diagrams.
9. List of replaceable component parts with stock numbers.

D. The CONTRACTOR shall submit to the ENGINEER a list of equipment and materials proposed for to be used in accordance with Section 86-1.04, "Equipment List and Drawings," of the Caltrans Standard Specifications.

E. The controller cabinet and its components shall be tested and certified by the controller manufacturer prior to delivery to the CITY for testing.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. The CONTRACTOR shall arrange to have a signal technician, qualified to work on the controller and employed by the controller manufacturer or his representative, present at the time the traffic signal is turned on, when signal interconnect cable is terminated, when emergency vehicle preemption system is activated, when a new signal phase is activated, or when any modifications are required to the controller cabinet, except for termination of the field wires.

B. When video detection is used, the CONTRACTOR shall arrange to have a signal technician, qualified to work on the controller and employed by the video detection manufacturer or his representative, present at the time the traffic signal is turned on, or when any video detection is activated on an existing signal.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Traffic signals and street lights shall conform to Section 86, "Signals, Lighting and Electrical Systems," of the Caltrans Standard Specifications and Caltrans Standard Plans and as specified herein.

2.2 FOUNDATIONS

A. Portland cement concrete for standards, steel pedestals and posts shall be Class A, in conformance with City Standard Detail G-6.

2.3 STANDARDS, STEEL PEDESTALS AND POSTS

A. Standards, steel pedestals, and posts shall conform to Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Caltrans Standard Specifications and as specified herein.

B. All Traffic Signal standards and posts shall be galvanized steel. Locations of Traffic Signal and street lighting standards and posts shall be marked in the field with marking chalk for review by the ENGINEER before beginning any installation.

C. Street light standards shall be galvanized steel or spun aluminum.

D. The decorative street light standard shall be **Lumec RA41-14-BKTX, ZED Model R80A-14-TBCI-BKTX or equal**. The standard shall be aluminum with black polyester powder coat finish. All hardware shall be tamper resistant stainless steel. Anchor bolts shall be hot dipped galvanized. A 12 ½" bolt circle shall be used.

2.4 CONDUIT

A. Conduit shall conform to the provisions of Section 86-2.05, "Conduit," of the Standard Specifications and this Section.

B. Conduit and fittings to be installed underground shall be rigid non-metallic type. Conduits designated for signal interconnect shall be installed satisfying the requirements for both twisted pair and fiber optic cables use (e.g., sweeps/bends for fiber optic should be used).

C. Conduit installed in concrete base shall be the same type size and quality used for the underground conduit runs.

D. The size of conduit used shall be as shown on the Drawings, but in no case shall conduit be less than 1-1/2 inches in diameter. In addition, the CONTRACTOR may, at his option and expense, use conduit of larger size than that shown or specified, provided the larger size is used for the entire length of the run from pull box to pull box. Reducing couplings will not be allowed.

E. The fourth sentence in the third paragraph in Section 86-2.05C, "Installation," of the Caltrans Standard Specifications is amended to read as follows:

When a standard coupling cannot be used for coupling metal type conduit, a UL-listed threaded union coupling, concrete-tight split coupling, or concrete-tight set screw coupling shall be used.

2.5 PULL BOXES

A. Pull boxes shall conform to the provisions in Section 86-2.06, "Pull Boxes," of the Caltrans Standard Specifications and this Section.

B. Pull box size shall be No. 5 for traffic signals, No. 3-1/2 for street lights and hardwire interconnect, No. 6 for homeruns, and No. 6E for fiber optic communications unless otherwise shown on the Drawings. The cover shall be reinforced concrete.

C. Interconnect pull boxes shall have lids embossed with "INTERCONNECT," street light pull box lids with "STREET LIGHTING," and traffic signal pull boxes with "TRAFFIC SIGNAL."

2.6 CONDUCTORS AND WIRING

A. Wiring shall conform to the provisions in Section 86-2.09, "Wiring," of the Caltrans Standard Specifications and this Section. Splices shall be insulated by "Method B."

B. Street light conductors shall be copper type TW or THW. Conductors between pull boxes shall be No. 8 or larger and conductors in street light standards shall be No. 10 or larger unless otherwise noted on the plans.

C. The voltage drop in any street light circuit shall not exceed 4 volts. The following formula shall be used to calculate the current needed for selecting the conductor size:

$$\text{Current (amperes)} = \frac{\text{Total wattage of fixtures served x 1.5}}{\text{Service Voltage}}$$

D. Fuse holders shall be non-compression type, and shall be **BUSS HEB-AA** or equal.

E. The fiber optic cable requirements are as follows:

Fiber Optic Cable

Fiber Cable shall be all dielectric, loose tube with 12 single strand fibers per loose tube. No ribbon fiber shall be utilized. Where available, within contract, water protection tape rather than gel filling shall be utilized. Fiber and fiber cable construction shall adhere to RUS PE-90 and Bellcore GR-20. Cable shall adhere to standard industry fiber and loose tube color coding, as defined by RUS PE-90 and Bellcore GR-20. The Cable shall be constructed to provide a minimum of 30 years useful life when installed in conduit. Fiber shall be 8.3 microns (normal) diameter with mode field diameters for depressed cladding being 8.8 microns ± 0.5 microns at 1310 nm and 10.0 ±1.0 microns at 1550 nm; for matched cladding mode field shall be 9.3 microns ± 0.5 microns and 10.5 ± 1.0 microns for respective wave lengths. (Cladding types shall not be mixed during fiber deployment). The fiber shall be protected with a cladding with diameter of 125.0 ±1.0 microns.

The fiber within the cable shall have an attenuation of no greater than 0.35 dB/Km at 1310 nm and 0.25 dB/Km at 1550 nm. Water peak attenuation 1385 nm (±3 nm) shall not exceed 2.5 dB/Km. The attenuation of the fiber shall be distributed uniformly throughout its length such that there are no localized discontinuities in excess of 0.1dB at either 1310 nm or 1550 nm as determined by TIA 455-59 Fiber Optic Test Procedures (FOTP).

The Fibers shall have a maximum dispersion of 2.8 picoseconds/nanometer – km (ps/nm-km) over an optical wavelength range of 1290 to 1330 nm and a maximum value of zero dispersion slope of 0.093 ps/(km-nm^2). Dispersion tests are in accordance with TIA 455-17S FOTP. The manufacturers shall have tested for dispersion as required by Bellcore GR – 20 or RUS PE-90. New factory tests are required only if the fiber has not been pre-tested and qualified to standards.

The Construction of the cable shall follow referenced standards for construction of dielectric, loose tube fiber cable with the exception that water-blocking tape is acceptable and preferred. The dielectric strength member shall support a tensile force of 2700 Newtons during cable installation and shall protect fiber attenuation change during installation allowing no greater than 0.05 dB/Km increase over manufacturer's specified fiber attenuation.

The cable shall include a ripcord under the sheath to support easy removal of the sheaths. The sheaths shall be marked in accordance with National Electric Safety Code 350 G. The Cable Sheath shall also be permanently marked with the manufacturer's name, type cable and "Fiber Optic Cable." There shall also be sequential length markers that are accurate within 1%. Marking size shall be such as to the easily read by a technician. The Contractor shall submit cut sheets for cable approval to the Construction Manager identifying the marking size, repetition and symbol per National Electrical Safety Code (i.e., Telephone Symbol).

Cable diameter for up to 72 fibers should be approximately 13mm. Cable shall be rated for an operating temperature of -40^{0}C to +75^{0}C. The cable shall contain no metal and shall conform to the National Electric Code's definition of fiber.

Cable shall be shipped from the factory with protective wrapping and with sealed ends. The cable shall include a waterproof tag with the results of factory OTDR attenuation test as well as:

Contract Number/Identification
Manufacturer's Name/Address
Manufacturer's Part Number
Type of Cable
Number of Loose Tubes and Fiber
Beginning and Ending Length Marks
Reel Number
Ship Date
Weight of Cable and Reel

Cable shall be of a continuous length on the reels. The Cable runs are as shown on plans. Slack cable requirements shall be considered by the Contractor, based on normal industry installation practices, in computing required cable length.

12-Fiber drop cables with 12-fiber jumper cables shall be utilized from splice closures to optical transceivers located in field equipment cabinet. Due to the limited space in most of the field equipment cabinets, drop cables shall be fabricated with integrated optical jumper cables. Each jumper cable shall be 900 microns and terminated with an SC (male) connector having integral strain relief. The jumper cables shall be molded into the drop cable providing strain relief. Jumper cable construction shall comply with Bellcore GR-20. Transition from drop cable to jumper cable shall be waterproof and shall provide mechanical protection for fibers and splices.

The drop cable shall comply with the fiber cable special provisions of this document. The length of the jumper cable shall be 2 meters (minimum). The jumper cable will interface with the SC (Female) connectors on the optical transceivers installed in field equipment cabinets.

The Contractor is responsible for interfacing the SC (Male) connectors to test optical-to-electrical communications performance between optical transceiver installation locations. The Contractor is responsible for correct splicing of the drop cable onto the backbone cable in accordance with splice tables to be provided by the City. Each drop cable shall have 5 splices to the backbone cable. The Contractor is responsible for point-to-point continuity in accordance with splice tables and assuring point-to-point optical path loss (attenuation) is within specifications. Jumper cables shall be marked R-1, R-2, T-1, T-2 or R/T for video optical transceivers, which require only one fiber or spare.

Fiber Optic Splice Closures
The Contractor shall deploy splice closures compatible with the single mode fiber cable selected for deployment and which are compliant with these special provisions. The splice closure shall include a fiber organizer following the guidelines of Bellcore GR-769. The basic splice closure shall also follow the guidelines of Bellcore GR771, "Generic Requirements for Fiber Optic Splice Closures."

The construction of the splice closure shall be such that it:

- Provides a protective mechanism for organizing the fiber strands and protecting individual fiber splices
- Waterproof design supporting continued submergence in water at normal burial depths (1 meter)
- Support main fiber backbone splices to a minimum of two drop/branch cables of 12-24 fiber each.
- Any metal parts shall be protected against corrosion
- Shall be easy to disassemble and reassemble by a fiber maintenance person
- Provided with hanging provisions from the side of a pull/across box
- Permanently marked with: "Fiber Communications" or similar wording to identify its function

Splice closures to be placed in pull boxes shall be attached to the side of the pull box with nylon ties. Slack shall be provided to allow the splice closure to be removed from the pull box for maintenance.

The Contractor shall prepare and submit Record Drawings of each splice closure installed, showing each fiber enclosed, fiber color, splices, and unconnected fibers. Record drawings shall be labeled to indicate the splice closure location.

2.7 BONDING AND GROUNDING

A. Bonding and grounding shall conform to provisions in Section 86-2.10, "Bonding and Grounding," of the Caltrans Standard Specifications and this Section.

B. Street lights shall be grounded by the use of a 5/8-inch diameter by 8 foot copper weld ground rod installed in the pull box adjacent to the street light.

2.8 SERVICE

A. Service shall conform to the provisions in Section 86-2.11, "Service," of the Caltrans Standard Specifications and this Section except that the CONTRACTOR shall pay all costs and fees required by the utility company for the connection of both temporary and permanent service.

B. The traffic signal service equipment cabinet shall be Type III 120/240-volt and shall be painted with graffiti-resistant paint to match the controller cabinet color (Seafoam Green). Battery Backup System (BBS) shall be required on all new traffic signal service equipment installation. The service cabinet shall house both PG&E equipment and BBS equipment including batteries.

C. The traffic signal service enclosure shall meet the requirements of PG&E, and shall conform to Section 86-1.02, "Regulations and Code," of the Caltrans Standard Specifications. The enclosure shall be factory pre-wired and tested to meet NEMA 3R standards. A copy of the wiring diagram for the integrated system shall be enclosed in plastic and mounted inside the enclosure. Name plates shall be provided for each control component. The name plates shall be phenolic, black background with white lettering except the main breaker, which shall be red with white lettering. All name plates shall be fastened in the enclosure by screws. I.D. numerals as shown on Standard Detail ST-14A, “Standard Street Light,” shall be used to show the address for the meter below the meter window or the front of the enclosure.

D. The traffic signal service enclosure shall have a separate disconnect for the traffic signal, safety lighting, and sign lighting circuits. Separate disconnects shall be provided for any other separate circuit, such as street lighting or irrigation systems, when shown on the plans. Lighting contactors shall be mercury displacement type conforming to the functional and operational requirements of Section 86-6.07B(2), "Contactor," of the Caltrans Standard Specifications.

E. Painting shall conform to the provisions in Section 86-2.16, "Painting," of the Caltrans Standard Specifications.

F. It shall be the responsibility of the contractor to coordinate a field meeting with representatives from PG&E and notify the City inspector to ascertain the exact service connection point prior to beginning work.

2.9 UNINTERRUPTIBLE POWER SUPPLY (UPS) – BATTERY BACKUP SYSTEM (BBS)

A. A system for a fully functional BBS shall operate LED, incandescent or any combination of both lighting technologies for a period of at least two hours and run an additional two hours (minimum) on Red Flash only. The UPS/BBS shall have a minimum Power Rating of 2KVA (1500 Watts).

B. Individual batteries shall be 12V type and shall be easily replaced and commercially available off the shelf. Batteries shall be extreme temperature, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Mat/ Valve Regulated Lead Acid) batteries. Recharge time for the battery, from protective low cutoff to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.

C. Maximum transfer time due power outage shall be 150 milliseconds.

D. Batteries shall be certified (by the manufacturer) to operate normally in harsh conditions (-25C to +74C and 20% to 95% humidity).

E. Battery output voltage shall be 110 VAC and 125 VAC, pure sine wave output, $\leq$ 3% THD, 60Hz $\pm$ 5Hz.

F. BBS shall bypass the utility line power whenever the utility line voltage is outside the following voltage range: 100VAC to 130 VAC ($\pm$ 2 VAC).

G. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.

H. Batteries shall be provided with appropriate interconnect wiring and corrosion resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.

I. Battery interconnect wiring shall be via modular harness. Batteries shall be shipped with positive and negative terminals pre-wired with red and black cabling that terminates into a typical power-pole style connector. Harness shall be equipped with mating power-pole style connectors for batteries and a single, insulate plug-in style connection to inverter/charger unit. Harness shall allow batteries to be quickly and easily connected in any order and shall be keyed and wired to insure proper polarity and circuit configuration. Batter terminals shall be covered and insulated so as to prevent accidental shorting.

J. Batteries shall have a warranty for full replacement for two (2) years from the date of installation.

K. The Complete UPS system including batteries shall fit inside a Type III service cabinet with the required PG&E equipment. The Type III service enclosure shall be specifically designed for the UPS/BBS with four batteries up to 105 ah each, as required for the specified run time, and equipped with photoelectric unit mounted inside the cabinet. The service enclosure shall be painted with graffiti-resistant paint to match the controller cabinet color. Painting shall conform to the provisions in Section 86-2.16, "Painting," of the Caltrans Standard Specifications.

L. All necessary hardware for mounting (shelf angles, rack, shelving, harness, etc.) shall be included in the bid price of the UPS.

M. UPS shall be easily installed and replaced (complete turnkey system with all necessary hardware) and shall not require any special tools for installation.

N. UPS shall include a resetable front-panel event counter display to indicate the number of times the UPS was activated and a front-panel hour meter to display, the total number of hours the unit has operated on battery power.

O. UPS inverter module shall include a serial port allowing field programmability of input/output voltage values, self-testing, communication and diagnostics. Software to retrieve data, troubleshoot and program the UPS system shall be ASCII format and be included as a part of the system.

P. The UPS shall include a display (status monitor) and/or meter to indicate current battery charge status and conditions.

Q. The UPS shall have a serial port interface available to allow user programming of certain operational parameters in order to ensure compatibility with the specific intersection control equipment as deployed. The serial port interface shall be a standard RS232 serial interface (D9 connector) compatible with a PC serial comm. port and shall be mounted on the front of the UPS unit.

R. UPS Manufacturer shall provide a two (2) year factory-repair warranty for parts and labor on the UPS. Manufacturer shall provide 24 hour technical support via toll-free telephone service.

S. UPS Manufacturer shall have field service technicians trained in *Traffic Control Technology* available and that can be reached via toll-free service line.

2.10 CONTROLLER ASSEMBLIES

A. This specification sets forth the minimum requirements for a TS-2 Type 1 controller assembly with a 16 position load bay, wired for eight phases and fully operational with all the components and plug-ins, malfunction management unit, bus interface unit, cabinet power supply, load switches, flashers and detectors including the controller unit. The controller assembly shall meet all applicable sections of the NEMA TS-2 1998 Standards and Caltrans Standard Specifications and Standard Plans.

B. The controller cabinet shall be a new fully-wired Type P aluminum cabinet shall be painted powder coat (Seafoam Green), TS-2 Type 1. The cabinet shall conform to Caltrans Standard Specifications and Standard Plans. The interior of the cabinet shall be painted powder coat white. The cabinet door shall be fitted with a No. 2 Corbin lock, and stainless steel handle with a 16mm (minimum) diameter shaft and three-point latch. The lock and latch design shall not allow the handle to open the cabinet unless the lock is engaged. A locking auxiliary police door shall be included to allow limited controller function access to switch the traffic controller between normal and flash operation. The cabinet shall be "plug and play" ready with a 2070 lite controller using Apogee Version 60 NTCIP based Naztec Intersection Control Software. The cabinet layout shall be configured to provide adequate shelf space for all shelf-mounted required equipment (e.g., EVP rack, power supply, detector racks, BIU, video detection equipment, video monitor, MMU, video multiplexer, digital-optical transceiver, and controller). At least one **day before the scheduled "signal turn-on"**, the controller assemblies including video detection system, shall be fully wired, programmed, tested, and organized with no unnecessary loose cables or conductors. The wiring in the cabinet shall be ty-wrapped in a neat/orderly fashion to the satisfaction of a City traffic signal technician.

C. The controller shall be a Type 2070 with Apogee Version 60 NTCIP based Naztec Intersection Control Software, and conforming to the following specifications:

Controller

The controller shall be the "lite" version Model 2070 ATC traffic controller per California Department of Transportation's (Caltrans) specifications, and shall conform to the Transportation Electrical Equipment Specifications (TEES) dated August 2002 or newer. The controller model and manufacturer shall be registered on the Caltrans Qualified Products List (QPL). The controller shall be equipped with the following modules:

- 2070-1B
- 2070-2B
- 2070-2NZ
- 2070-3B
- 2070-4B (VME Cage Assembly)
- 2070-7A
- 2070-8

Ethernet Port

The 2070-1B shall be equipped with an ethernet port. The controller software operating on the 2070-1B shall be capable of utilizing the ethernet port for data transfers. The operating system shall allow the user FTP and Telnet access via the ethernet port.

SDLC Communications

The 2070 controller software shall be capable of communicating to TS-2 BIUs via SP3S on the 2070-2B. The 2070-2B shall be optically isolated.

2070-7A

The 2070-7A shall conform to the latest TEES specification, and shall be optically isolated.

Operating System

The 2070 controller software shall operate on the 2070-1B using Microware OS9 v3.2 or higher.

Software

The controller software shall be Apogee Version 60 NTCIP based Naztec Intersection Control Software.

D. The cabinet shall be supplied with one 8-position detector rack. It shall be wired such that no cabinet rewiring is necessary if expansion to 16-position is later necessary. The detector rack shall meet all applicable sections of the NEMA TS-2 standards. Detector input field panel shall have SRA-6LC surge arrestors installed for each loop input for lightning protection.

E. The loadbay shall be wired for full 8-phase operation and shall accommodate a minimum of 16 loadswitch positions. The loadbay shall also be wired for a 16-channel malfunction management unit. All field wiring terminals for vehicle phases, pedestrians, and overlap outputs shall be present on the loadbay panel. Penn-Union Corp.'s copper "Solder-less" lugs or approved equal shall be used with the terminal strips in the loadbay where more than one forked connector needs to be landed to the terminal screw on the load-bay. .

F. The cabinet shall be provided with the following auxiliary equipment:

- Roll out stainless steel document drawer under the second shelf. This drawer shall have a hinged top cover, and it shall be of sufficient size and strength to hold a complete set of cabinet wiring drawings and equipment programming manuals for all modules applicable to each cabinet. When the cover is closed, the drawer shall double a resting place for documents or a laptop computer.
- Thermostatically controlled ventilation fan system per Caltrans Standard Specifications.
- Fluorescent lighting fixture mounted on the inside top of the cabinet near the front edge.
- Police panel and technician test panel - This test panel shall be equipped with switches for each vehicle and pedestrian phases. The switch for each phase when activated shall trigger a call for the corresponding phase.
- The cabinet shall include a splice terminal block, dedicated for the interconnect cable. The number of termination channels shall match the pairs of wires for at least a 12-pair interconnect cable.
- The cabinet shall include empty shelf space to accommodate third party video detection processing units and data optical transceivers (fiber modems)
- The cabinet shall be equipped with fully wired Opticom phase selectors model M752, or approved equal. There shall be a termination panel to land Opticom interface cables from the detector units.

G. The cabinet shall be equipped with 2 Bus Interface Unit (BIU) cards for the load bays, plus 2 BIU cards for the detector racks. The BIU shall meet, as a minimum, all applicable sections of the NEMA Standards Publication TS2-1998. The BIU shall be rack-mountable and solid-state. The BIU unit shall be constructed with discrete component circuitry in order to allow repair and maintenance of the unit by use of standard tools. The BIU shall utilize machine tooled integrated circuit (IC) sockets for all IC's of 14 pins or greater, for ease of repair. One IC-BIU spare shall be provided with the cabinet. The use of BIU units utilizing surface mount technology (SMT) shall be acceptable, provided the vendor supply one spare unit for every two SMT-BIU supplied with the cabinet (i.e., if the cabinet comes with four SMT-BIUs, there shall be two spare SMT-BIUs).

H. The cabinet power supply shall meet, as a minimum, all applicable sections of the NEMA Standards Publication No. TS-2 1998

I. The loadswitches shall be solid state, meet all applicable sections of the NEMA TS-2 standards. Units shall be the dual indicating I/O type, and shall have indicator lights that show both the input and output side of the loadswitch. Units shall utilize an extruded aluminum housing with cooling fins for proper heat dissipation. Units supplied shall be listed on the Caltrans Qualified Product List (QPL) under Model 200 Switch Packs.

J. The flasher shall meet all applicable sections of the NEMA TS-2 standards. It shall be a Type III, dual circuit rated at 15 Amperes per circuit. LED or neon output indicators shall be utilized for each circuit. Units shall utilize an extruded aluminum housing with cooling fins for proper heat dissipation. Units supplied shall be listed on the Caltrans Qualified Product List (QPL) under Model 204 flashers.

K. The flash transfer relay shall meet all applicable sections of the NEMA TS-2 standards, and Caltrans Standard Plans & Specifications §86-4.09C(6) "Heavy Duty Relays".

L. The number of inductive vehicle detector channels provided shall match the number of detector lead in cables shown on the plans, plus 2 additional 2-channel detector units as spares. All detectors shall be configured as a rack mounted printed circuit board for insertion into a NEMA TS-2 detector rack. Detector units shall be in full compliance with NEMA standards TS-2-1998. Detectors shall be two-channel programmable with front LCD display. Detectors shall be EDI Oracle/2, Reno A&E Model C, or approved equal.

M. The MMU shall meet all applicable sections of the NEMA Standards Publication No. TS2-1998. The MMU shall be shelf-mountable, sixteen channel solid-state with an RS-232 communications port and data cable. The MMU shall be ready to transmit event log data to the City's Streetwise ATMS Central Software via controller communications. The MMU shall log and store three report categories:

- Indications, power fluctuations, cycles missed, and power outages
- Past twenty conflicting conditions
- Event trace of the past twenty events recorded in .01-second resolution. This report is required to display conditions, which led to the conflicting condition.

The MMU shall be a Naztec MMU-516, or approved equal.

N. All cabinet wiring shall be incorporated into one schematic drawing. Each cabinet shall be provided with three schematic drawings **specific** for the cabinet to be used in this specific project. Traffic signal construction plan shall also be submitted. Drawings shall indicate the intersection name and phasing. Absence of the required drawings could result in the rejection of the entire controller assembly. Cabinet testing will not proceed until the required drawings are submitted. Operational/repair manuals for each component and plug-in shall be provided with each cabinet.

O. Prior to delivery, each controller assembly shall be tested by the supplier as a complete unit with a 2070 controller under signal load for a minimum of 24 hours. Each assembly shall be delivered with a signed checklist detailing the results of the test performed on the controller assembly. The

cabinet shall be “plug and play” ready with a 2070 lite controller using Apogee Version 60 NTCIP based Naztec Intersection Control Software.

After delivery, the City will conduct a separate testing of the cabinet. If the City requires technical support during its testing period, the cabinet supplier shall provide on site technical support within 48 hours after the City makes the request.

The City of Livermore reserves the right to reject a controller assembly covered by these specifications if the assembly is found to be defective within a sixty (60) day period after shipment or if the controller assembly fails any performance test.

P. A factory certified representative from the manufacturer shall be on-site during signal turn-on for support. The factory representative if requested by the City shall assist in having the cabinet fully operational as indicated on the intersection drawings and this specification.

The supplier shall provide a maximum of four hours of technical training for City Staff within four weeks after cabinet delivery. The training session should at least include a discussion on the differences between TS2 and TS1 cabinets, identify components unique to the TS2 cabinets, and cover the trouble shooting and testing of the TS2 controller cabinet.

Q. The controller assembly including all the electronic components shall be warranted by the manufacturer against mechanical and electrical defects for a period of 1 year. The manufacturer’s warranty shall be supplied in writing with each cabinet and unit within the cabinet.

The supplier shall correct any defects in design, workmanship or material during the warranty period at no cost to the City of Livermore. All cost of labor, parts and transportation to and from the vendor shall be borne by the vendor for the duration of the warranty period. The vendor shall provide all revisions to any equipment furnished under these specifications, at no cost to the City of Livermore.

2.11 MODULATED SIGNAL DETECTION SYSTEM

A. The modulated signal detection system shall be able to interface with the CITY'S **"Opticom"** detection system as manufactured by **3M**. The controllers shall be equipped with internal circuitry to provide programmable channels of emergency vehicle preemption. The detector shall have a minimum range of 2500 feet.

B. The modulated signal detection system shall consist of **“Opticom”** phase selector model M752; **“Opticom”** detector model 721 for 1-channel or 722 for 2-channel detection; and **“Opticom”** interface cable model M138, or approved equal.

C. The controller cabinets shall be wired with a "D" connector or special function cable to provide all necessary controller connections for emergency vehicle preemption. The phase selectors or discriminators shall be wired to provide emergency vehicle preemption for the emergency vehicle phases as shown on the Drawings.

2.12 INTERNALLY ILLUMINATED STREET NAME SIGNS:

A. Internally illuminated street name signs shall conform to Section 86-6.065 "Internally Illuminated Street Name Signs" of the Caltrans Standard Specifications.

B. Internally illuminated street name signs installed on signal mast arms shall be Type A.

C. The Type A internally illuminated street name sign shall consist of extruded aluminum top, bottom, and door. The door shall open from the top. It shall be held closed by three 1/4-turn airlock fasteners. The door shall have a water tight PVC gasket. The door shall have a continuous stainless

steel hinge. The extruded aluminum doors shall have one side removable to gain access to the sign face.

D. Drip rails overhanging the sign face are required to help prevent water intrusion. Seams connecting the top and bottom to the ends and seams of the door frame shall be Heli-Arc welded to provide a weatherproof seal. All pop rivets and hex head indented sheet metal screws shall be stainless steel. The hinges of the sign mounting brackets shall be able to pivot in all directions.

E. Ballast shall be high output and shall be mounted inside on the bottom of the sign assembly. Sign shall be equipped with four 3/16-inch diameter drain holes located in the bottom of the housing, 2 at each end.

F. Internally illuminated street name signs shall be mounted using a plate bracket with serrated teeth for adjusting the mounting height. Mounting brackets shall be **Ulti-Mate- The Big Foot, or approved equal**.

2.13 VEHICLE SIGNAL FACES AND SIGNAL HEADS

A. Vehicle signal faces and signal heads shall be in conformance with Section 86-4, "Traffic Signal Faces and Fittings" of the Caltrans Standard Specifications and as shown on the Drawings.

B. Signal section housing shall be metal type and shall have 12-inch sections. Signal housings and mounting hardware shall be painted gloss black and electrically powder coated. The backplates for mast arm mounted heads shall be ventilated. All backplates shall be such that they can be removed and reinstalled without requiring the removal of the traffic signals.

C. The second sentence in the third paragraph in Section 86-4.04, "Backplates," of the Caltrans Standard Specifications is amended to read:

> Sections shall be joined using 1) aluminum rivets and washers painted or permanently colored to match the backplate, or 2) No. 10 machine screws with washer, lock washer and nut, painted to match the backplate.

D. All vehicle signals shall be 12-inch LED indications and furnished by the Contractor. This specification LED modules to be used in place of the incandescent lamp, reflector, socket, gasket, and lens assembly of the vehicle signal sections. Vehicle type LED modules shall fit in all standard, incandescent vehicle traffic signal housings. Each module shall also incorporate a printed circuit board inclusive of all of the LEDs and required circuit components, 36 inch 16 AWG wire leads with strain relief and spade terminals, a rigid housing for protection in shipping, handling and installation, and a one piece neoprene gasket. *Screw-in* type products are not allowed for vehicle signals.

E. All LED shall meet the latest ITE specifications and current Caltrans standards and measurement criteria for LED traffic signal modules, and shall conform to the following specifications:

LED (Light Emitting Diode) Traffic Signal Modules - Specifications

The following specification shall apply to all LED modules unless otherwise specified.

General Description

Ball type signals shall utilize the *LumiLeds* (1) light engine as their source of illumination.
Lenses for ball type modules shall be made of ultraviolet stabilized polycarbonate, and incorporate facets that serve to enhance the optical efficiency of the LED traffic signal module. Individual *lens-lets* are specifically not allowed. The ball type signals shall incorporate an inner lens that is sealed to the lamp housing, and serves to collimate the light emitted by the *LumiLeds* (1) light engine. An outer lens shall also be incorporated, that serves to focus the collimated light, so as to meet ITE intensity and distribution standards. Additionally, the LED shall almost perfectly, approximate to the

motorist, the appearance of an incandescent traffic signal. This means that the face of the ball LED lamp shall appear to the motorist as nearly totally uniform in illumination, and have a wide viewing angle that makes it suitable for installation on wide boulevards or single-tethered span wire. This also means that it shall not be apparent that LEDs are used as the light source for the traffic signal ball. The external lens surface for all vehicle signals shall be smooth, with no raised features, so as to minimize the collection of dirt, diesel smoke, and other particulate contaminates, and to facilitate periodic cleaning. External lens facets are not allowed. The lens shall be keyed to the housing of the LED signal module to insure the proper orientation and to avoid possible rotation during any handling. External lenses shall be hard-coated in compliance with Caltrans specifications.

The LEDs shall be mounted and soldered to a printed circuit board. The LED signal module shall be watertight when properly installed in a traffic signal housing. The LED signal module shall utilize the same mounting hardware used to secure the incandescent lens and gasket assembly, and shall only require a screwdriver or standard installation tool to complete the mounting. The LED signal module assembly shall weigh less than 5 pounds. For vehicle signals, the incandescent lamp sockets and reflectors shall be removed from the signal head housings. So as to minimize possible maintenance problems, the LED lamp module may not protrude into the signal visor area more than three-quarters of an inch in depth.

The housing of the LED signal module shall be marked 'TOP' to designate the proper orientation of the LED signal module in the traffic signal housing. The housing of red LED ball type traffic signal modules shall utilize a *partial*, *embedded and integral metal layer*, in its design and construction. Manufacturers part number, date code, and electrical characteristics of the LED signal module shall be visible on the rear of the assembly. A label shall be affixed to back of the all ball type modules, that certifies their complete compliance with the latest ITE VTCSH, Part II specification for LED traffic signal modules.

The LED traffic signal manufacturer shall be ISO 9001 certified.

Optical

The light intensity and distribution from red LED signal modules shall as a minimum, meet the July, 1998 ITE VTCSH Part II, and current CALTRANS standards and measurement criteria for LED traffic signal modules. Test data to verify the performance for red and green ball signals as meeting the July 1998 ITE VTCSH, Part II intensity requirements @ 74 degrees Centigrade, shall be supplied from either:

Lighting Sciences

7630 East Evans Road
Scottsdale, AZ 85260

ETL Testing Laboratories
3933 US Route 11
Cortland, NY 13045-0950

or, other certified **independent** test lab. The light output of all LED vehicle signal modules shall meet ITE specifications for chromaticity.

The LEDs shall be connected in series parallel strings. No more than 1% of the total luminosity of the entire signal module may be lost in the event of a single string failure. For red LED ball type signals, the failure of a single LED shall cause loss of light from only that LED. No loss of light output from the complete module assembly shall occur as a result of a single LED failure in a red LED ball lamp.

The control circuitry shall prevent the current flow through the LEDs in the off state to avoid any false indication as may be perceived by the human eye, during daylight and *evening* hours. The

LED traffic signal module shall be operationally compatible with NEMA TS - 1 and NEMA TS - 2 *conflict monitoring* parameters. The intensity of the LED signal module shall not vary by more than 10% over the allowable voltage range as specified in the electrical section below.

Red balls shall maintain required intensity, as defined by the July, 1998 ITE VTCSH, Part II intensity standards for LED traffic signal modules, over the temperature range of -40 degrees centigrade to +74 degrees centigrade, at 120 volts A.C., when new, and also after 3 years.

Electrical

Power factor shall be 90% or greater, at nominal rated voltage, at 25°C, after 60 minutes of operation. Total harmonic distortion (THD) shall be less than 20% at rated voltage, at 25°C.

All LED traffic signal modules shall be in compliance with FCC noise regulations.

The red LEDs shall utilize exclusively AlInGaP technology, either AS (Absorbing Substrate) or TS (Transparent Substrate), and shall not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 85 degrees C and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

The LED signal modules shall be connected directly to line voltage, **120 Volts AC nominal**, and shall be able to operate over the voltage range of 80 VAC to 135 VAC.

The 8” and 12” red ball units shall consume no more than a nominal 7 and 10.5 watts respectively, at 120 VAC, at 25 degrees centigrade. Maximum power consumption shall not exceed 9 and 12 watts respectively, at 120 VAC, at 25 degrees centigrade.

Red arrow type LED traffic signal modules shall be temperature-compensated so as to maintain intensity at elevated temperatures. Red arrow type LED traffic signal shall be tested and documented by CALTRANS as being in compliance with CALTRANS intensity standards for red arrows at elevated temperatures.

Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

WARRANTY

All LED traffic signal modules supplied shall be warranted for 5 years against manufacturing defects.

Red ball and red arrow traffic signal modules shall be performance warranted to be in compliance with July, 1998 ITE VTCSH, Part II, and CALTRANS minimum intensity standards for LED traffic signal modules, at 74 degrees centigrade, for a period of three (3) years.

2.14 PEDESTRIAN SIGNALS

A. Pedestrian signals shall be in conformance with Section 86-4.06 "Pedestrian Signal Faces" of Caltrans Standard Specifications.

B. Pedestrian LED shall be 16” x 18” Full Hand/Fullman. The Countdown Module shall be standard for pedestrian LED signals. Alternate pedestrian LED signals shall be approved by the Engineer. The displayed messages shall be "UPRAISED HAND" and "WALKING PERSON" symbols. The unit “counts down”, or exhibits to the pedestrian a digital numerical display, as well as the Caltrans international graphic display, to communicate how much time remains to clear the intersection. The units shall have two optional operational modes; total countdown and clearance count down. The

units shall be set to clearance count down for this project. The units shall be capable of “learning” automatically the walk time interval and the pedestrian clearance intervals whenever pedestrian timing changes are made. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. Additionally, the LED display shall almost perfectly, approximate to the pedestrian, the appearance of an incandescent pedestrian signal, or the UPRAISED HAND and WALKING PERSON symbols shall be LED filled. Outline of the symbols shall not be acceptable. The count-down display shall utilize Double LED rows.

C. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. The housing door frame shall be hinged to the housing by stainless steel pins and hinge lugs integrally cast in the housing and door frame. Pedestrian signal housings and mounting hardware shall be painted gloss black and electrically powder coated.

2.15 PEDESTRIAN AND BIKE PUSH BUTTONS

A. Pedestrian and bike push buttons shall conform to the provisions in Section 86-5.02, "Pedestrian Push Button Assemblies," of the Caltrans Standard Specifications and this Section.

B. Pedestrian and bike push button frames shall be Type B with appropriate signs. Pedestrian push button frames and switch housing shall be painted gloss black and electrically powder coated.

C. Push buttons signs shall be installed using theft-proof screws **PDL, Pro-Tech't machine screws, or equal**. An installation tool shall be furnished to the CITY by the CONTRACTOR.

D. The switching unit shall be **Synchronex, part No. ADA-2; or equal**. The switching unit shall be a precision snap-acting type, single pole, single throw unit, pressure type terminals, and rated at 120-volt AC. The switching unit shall be UL listed. The switching unit shall be such a size as to permit recessed mounting in existing standard Type B frame without any modifications to either unit.

D. The actuator shall be conical in shape with cone extending 7/16-inch to 1/2-inch beyond the bezel of the switch housing, and shall be 2 inches in diameter.

E. Pedestrian push buttons installed on traffic signal poles located in the sidewalk shall be within 5 feet of the adjacent handicap curb ramp. Pedestrian push buttons installed on traffic signal poles located behind the sidewalk shall be within 1 1/2 feet of the back of sidewalk. If a traffic signal pole cannot meet either of the above criteria, the associated pedestrian push button shall be installed on a separate pedestrian push button post.

F. The pedestrian and bike push buttons shall comply with the Americans with Disabilities Act (ADA). In the even that a conflict exists between the ADA guidelines and City Specifications, the ADA guidelines shall take precedent.

2.16 INDUCTIVE LOOP DETECTORS

A. Detectors shall conform to the provisions in Section 86-5, "Detectors," of the Caltrans Standard Specifications and this Section. Detector handholes shall be Type A. Circular loops 6 foot in diameter may be installed in lieu of 6 foot by 6 foot square loops.

B. Sensor units shall be **Detector Systems Digital Loop Model 910, or equal**.

C. Loop wire shall be Type 1 or Type 2. Loop detector lead-in cable shall be Type B or Type C. No more than four 6 foot by 6 foot loops shall be connected to each sensor unit. No splices are permitted in detector lead-in cables.

D. The CONTRACTOR shall identify loop wires by lane number, loop number, and start/finish using tie raps and permanent marker.

E. Where detector lead-in cables are connected to the terminal strips in the controller cabinet, the pressure terminal connectors shall be soldered to the detector lead in cables.

F. Hot-melt rubberized asphalt sealant shall be used to fill slots in pavement when installing loops.

2.17 VIDEO DETECTORS

This section describes the requirements for providing a complete Video Detection System. Should a Contractor propose a video detection system that does not completely satisfy all the listed requirements of this specification, the Contractor shall clearly identify which part of the specification the product does not satisfy. The City reserves the right to approve or reject products that does not meet the specifications. The system shall be capable of providing presence vehicle detection at the intersection. The video system shall be expandable without removing or replacing existing units. The video system shall be capable of monitoring all vehicles on the roadway.

Overview

Acceptable systems include that of any manufacturer, provided such equipment meets the qualifying specifications identified herein. Using standard image sensor optics, the system shall be able to detect vehicle presence with 98% accuracy under normal conditions (days and nights).

All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The detection algorithms shall have a proven record of field use at other installations for at least three (3) years of service i.e., not including prototype field trials prior to installation.

General

These video detection specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all vehicles on the roadway. The entire video detection system shall consist of the following:

- Video Image Processing unit.
- Environmentally sealed Video camera(s) with IR filter, enclosure and sunshield.
- Surge suppressor.
- 4-channel monochrome or color monitor as recommended by manufacturer for viewing the video and setting up the detection zones. A switching device and cabling shall be installed to allow viewing of up to 4 cameras on the monitor without changing cables.
- All cabling and mounting hardware
- All other necessary equipment for operation.

The system shall be fully compatible for installation in a NEMA type TS1 or TS2 traffic controller cabinet.

The controller cabinet shall be wired for a Video Detection System with appropriate number of cameras and cables as required in each specific project mounted according to the manufacturer's specifications for each direction of vehicular travel. The supplier of the equipment must meet the following requirements:

1. The Video Detection System shall be an above ground vehicle detection system that utilizes machine vision when interfaced with standard monochrome or color CCD cameras to provide complete intersection and roadway detection.

2. One chassis shall be supplied for the Video Detection System to provide a minimum of four camera inputs for vehicle detection. All cables shall be provided and wired in the controller

cabinet. All connectors and hardware must also be supplied for the required number of camera operation.

3. Each Video Detection System will include, as a minimum, monochrome or color cameras for each approach requiring video detection. Camera resolution, image size, and lens angle will be determined by the manufacturer based on optimum system performance. Each camera shall include heater, sun shield and mounting brackets, and have at least twelve user programmable detection zones.

4. The Video Detection System shall provide quick and easy configuration and setup of detection zones at the intersection shall be done by using a standard computer mouse as pointing device, and a graphical interface built into the video processor and displayed on a video monitor.

5. All delay and extension functions for an approach must be performed within the processing element of the video unit. Pulse output capability must be incorporated into the supplied software; this is used for controller density timing.

6. The units must have a minimum capability of detecting vehicles 300 feet from the stop bars of each approach.

7. The video detection system shall be wired and programmed such that during fog conditions, an alternate Max Green Timing can be used.

8. The Video Detection System shall have remote access capability to transmit video and detector information. The Video Detection System shall have the capability to remotely reconfigure detection zones, access, logging and statistics, and transmit video via phone line, twisted pair, coaxial cable, and fiber optic interconnect via an external communication port. Manufacturer shall include separate line items in their bid indicating the cost to allow communication using (a) phone line, (b) twisted pair, (c) coaxial cable, and (d) fiber optic. The cost for these items may or may not be included depending on specific project needs.

9. All software and hardware, for installation, operation, and maintenance will be supplied along with necessary technical support upon setup. A minimum of 12-month technical/field support period, and updated software revisions shall be provided to the CITY's staff at no cost. Also, training by the manufacturer shall be provide at the convenience of CITY staff.

10. The Video Detection System shall utilize standard 24 volt logic signal outputs to interface with NEMA TS1/TS2, 170/179, 2070, or 2070N controllers.

11. All equipment schematics and technical material used to completely service the equipment must accompany any equipment supplied to the CITY.

12. A factory representative shall be present during (a) initial setup, to install cabinet equipment, provide initial setup of detection zones; and (b) during the initial traffic signal turn-on to provide assistance as needed, and to ensure proper operation.

13. Luminaire arm installations shall be installed on the luminaire arm, with the camera/video manufacturers recommended brackets. Camera luminaire brackets shall provide adjustments for both vertical and horizontal positioning of the camera. Camera attachments shall be designed to securely fasten the camera to the luminaire arm. Signal mast arm installation shall utilize 6-foot risers. Miscellaneous hardware shall be stainless steel or galvanized steel.

14. The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation. The video detection supplier shall provide all documentation necessary to maintain and operate the system.

15. The video processors shall provide a minimum of 6 separate output channels of detection for each camera.

16. Cabling between the cameras and controller cabinet shall accommodate video, power, zoom and focus control from the controller cabinet.

17. Each controller cabinet shall be equipped with a monochrome monitor for viewing the video and setting up the detection zones. A switching device and cabling shall be installed to allow viewing of up to 4 cameras on the monitor without changing cables.

18. Each controller cabinet shall be equipped with terminals to allow focus and zooming from the cabinet. A device to provide focus and zooming shall be provided to the City.

19. The Video Image Processing Unit (VIP) shall be modular by design and housed in a self-contained stand-alone enclosure or card mounted in open rack suitable for shelf mounting or 19" rack mounting inside a traffic controller cabinet.

20. The system shall be fully compatible for installation in NEMA TS1 or TS2 traffic controller cabinet

21. Ambient operating temperature shall be from –35 to +55 degrees Centigrade at 0 to 95% relative humidity non-condensing.

22. Surge ratings shall be set forth in the NEMA TS1 and TS2 specifications of the standard specifications.

23. Serial communications shall be through an RS232 serial port. This port can be used for communications to a modem or laptop to upload/download detector configurations, count data and software upgrades.

24. The VIP unit shall have 1 video output (RS-170 NTSC or CCIR composite video).

25. The camera unit shall be a high resolution, 1/4" to 1/3" image format CCD camera, designed for professional video surveillance systems. Incorporating the latest in CCD technology, the video camera shall provide detailed video without lag, image retention, or geometric distortion.

26. The environmental housing shall be an aluminum enclosure designed for outdoor CCD camera installations.

Installation and Training

1. The product supplier of the video detection system shall supervise the installation and the testing of the video equipment. A factory certified representative from the manufacturer shall be on-site during installation. The factory representative shall install, make fully operational, and test the system as indicated on the intersection drawings and this specification.

2. The video detection system shall be installed and programmed such that during fog conditions, an alternate Max Green Timing will be used. The Engineer will provide the alternate timing.

3. Necessary training shall be provided by the manufacturer as required by the contracting agency for its personnel to be proficient in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be produced for a maximum of 10 persons and shall be conducted at a location selected by the City. The City shall be responsible for travel, room and board expenses for its own personnel. Training shall be paid on a per hour basis.

Warranty

The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation. The video detection supplier shall provide all documentation necessary to maintain and operate the system.

2.18 LIGHTING

A. Traffic signal lighting shall conform to the provisions in Section 86-6, "Lighting," of the Caltrans Standard Specifications and this Section.

B. The lens for all standard luminaires shall be glass or polycarbonate.

C. The luminaires on traffic signal poles shall have cut-off type lenses and Type III distribution.

D. The luminaires on standard street lights shall have photoelectric control facing north, charcoal filter, and Type III distribution, unless otherwise noted on the plans.

E. Ballast for street light luminaires shall be **NPF or HPF** for up to 150 watts, and **Autoreg** for 200 watt or larger.

F. All luminaires shall have clear high pressure sodium bulbs except for **Lumec** Luminairs which shall have coated bulbs.

G. Luminaires for decorative street lights shall be **ZED Model Z47A – 100S-120-HS-SFPH-PH8-BKTX, Lumec Model 100HPS-L23-AC3-120-SFR-HS-FN1-SFPH4-PH8/120-LMS16298A or equal**, with coded bulb, photoelectric control facing north, and house side shield.

H. Pole numbers for decorative lights shall be attached to a 2.5” x 15” x 0.020 aluminum plate and mounted on the pole by use of 1/16” rivets.

2.19 PHOTOELECTRIC CONTROL

A. Photoelectric control shall be Type V for traffic signals and Type IV for standard street lights. Photoelectric units shall be installed inside the service cabinet.

2.20 INTERCONNECT

A. The controller cabinet shall include appropriately sized terminal facilities for connection of the interconnect cable to the local controller. All required equipment and facilities for reliable communication with the master controller shall be provided. It shall be the contractor’s responsibility to establish communication between the local controllers and the central master controller unless otherwise indicated in this specification or on the plans.

B. Each controller cabinet shall contain a sufficient number of terminals of appropriate size and type to terminate and/or splice the interconnect cable.

C. Interconnect cable shall be 6 pair minimum for underground use, No. 20 twisted pairs each pair with shield and stranded tinned copper drain wire, unless otherwise shown on the plans.

D. See fiber optics specifications under Section 2.6 - Conductors and Wiring.

E. The Contractor shall be responsible for maintaining existing interconnect during construction. Any interruption of interconnectivity during the construction process due to contractor activity shall be resolved by the contractor immediately and at the contractors expense.

F. Temporary interconnect splicing shall be allowed during construction for a maximum period of 60 days. Temporary splices of interconnect shall be insulated with heat-shrink tubing of the appropriate size and shall overlap the conductor insulation at least 0.6 inches. The overall cable splice shall be covered with heat-shrink tubing, with at least 1 1/2 inch of overlap of the cable jacket.

2.21 DATA OPTICAL TRANSCIEVERS AND COPPER MODEM

The contractor shall provide an optical transceiver (if fiber optic is utilized) or copper modem (if copper twisted pair is utilized) in the controller cabinet supporting data communications between the Traffic Operation Center (TOC) communications server and the local controller.

The copper modem shall be **GDI 496** or equivalent, deployed in the controller cabinet. A copper modem shall be required at any location where interconnect cable exists. The City shall allocate copper twisted pairs as required to allow interconnection of the controller to TOC or controller to controller. The copper modems installed in the field shall be temperature hardened units with operating temperature range of 0 to 74 degrees Celsius, fully compatible with the copper modems provided by the Contractor for use in the TOC. Testing and installation shall follow the same format as the optical transceivers as applicable to a copper modem.

The optical transceiver shall be provided with four (4) female SC type, single mode connectors compliant with the fiber drop cable. An optical transceiver shall be required at any location where fiber communication exists. All optical communications will be single mode, 1310 nm unless otherwise approved by the Engineer. The optical transceiver attached to a specific circuit will support drop and insert operations on a counter rotating, single mode fiber, optical ring. The TOC optical transceiver will be the master and support polling of the attached 2070 controller to the optical ring as commanded by the attached communication server's EIA 232 channel. The optical transceiver shall comply with the following specifications:

A. Fully compatible with optical transceivers installed at the TOC.

B. Switch selectable to function as a master or slave (field controllers will be set to slave mode).

C. Provide a 10^{-9} bit error rate performance when operating over an optical path with an identical optical transceiver with a path loss of 15 dB and operating at a data rate of 57.6 Kbps, within the field environmental conditions specified.

D. Support fault tolerant, counter rotating ring operations upon loss of an optical transceiver or cut in the fiber link with automatic fault recovery no to exceed 50 msec.

E. Receive and repeat (relaunch) the received optical signal with no greater than 1µsec delay and supporting a 15 dB link budget to the next adjacent optical transceiver interconnected to the optical ring. Also drop the signal to the attached controller with no greater than a 1 µsec delay (not including attached controller's response time).

F. Include maintenance selectable anti-streaming time out (seconds) of 1, 2, 4, 8, 16, 32, 64, 128, and disabled (not time out). The controller shall set the anti-streaming time out at a time compatible with upload of all stored timing plans and controller stored count and log information to the TOC. At the end of the selected anti-streaming time, if the controller is still transmitting, the function shall terminate communications preventing a failed controller to continuously consume the data link. It is desirable that the optical transceiver logic sense if and when the attached controller stops transmitting and automatically reset the time.

G. Provide indicators (LED or equivalent) for a maintenance technician to observe the transceiver operation including data transmission and data reception and power. The optical transceiver shall also include a fault indicator.

H. The optical transceiver shall be capable of communicating a fault to the master or the master shall be capable of sensing a failure of a slave transceiver and reporting it to the TOC Maintenance Subsystem.
I. The optical transceiver shall operate over a temperature range of –40° C to +74° C with a non-condensing humidity of 95% (relative).

J. Connectors to the controller will be DB-25 (female) or RJ-45 (female). Optical connectors (4 each; TX-1, RX-1, TX-2, RX-2) will be SC type (female). Power connectors may be as defined by the manufacturer (a power terminal strip is acceptable).

K. Optical transceiver shall be fabricated from materials treated to prevent corrosion when subjected to a field controller cabinet environment as required by Bellcore GR-2836, “Generic Requirements for Assuring Corrosion Resistance of Telecommunications Equipment in Outside Plant”. Other fabrications may be approved by the Engineer.

L. Any required power converters from 115 VAC (±10%), a single phase, 60 Hz shall be included with the optical transceiver. The power converter shall support optical transceiver operations to specifications over the specified prime power tolerances of 115 VAC ± 10% single phase. The power converter shall comply with National Electric Code.

M. The optical transceiver shall comply with National Electrical Code, as related to electronic equipment safety and grounding as well as FCC requirements for electromagnetic compatibility.

N. The optical transceiver shall be manufactured to ISO 9000 quality standards (or equivalent) and pre tested at the factory for functional performance and including burn-in electrical components to prevent failures in the field from infant mortality of components. “Burn-in” shall include procedure normally accepted by the electronics industry to provide reliable products.

O. All connectors, switches, and indicators shall be permanently marked as to identify and function. Vendor supplied documentation shall be identical to the construction of the delivered and installed product. Each optical transceiver shall include a permanently attached label with product name, model number, serial number, and name/address of the manufacturer. Each optical transceiver shall include mounting provisions to secure it in the cabinet.

P. The contractor shall supply the interconnecting EIA 232 cable from optical transceiver to controller. The contractor shall interconnect the optical transceiver power adapter to 115 VAC power within the controller and include power ground in accordance with national Electric Code. Logic ground shall be isolated from earth ground. Nylon screws shall be utilized for mounting of the optical transceiver thereby insulating the transceiver chassis from earth ground. All cables shall be permanently marked as to identification (traceable to “as-built”/installed drawings) and function. All installed cables will be properly dressed and stress relief provided as may be required.

Q. The contractor shall provide all cables and connectors with protective covers to be removed only when associated cable is being connected. Any unused connector will be maintained with a protective cover.

PART 3 -- EXECUTION

3.1 GENERAL

A. Traffic signal and street light installation shall conform to Section 86, "Signals, Lighting and Electrical Systems," of the Caltrans Standard Specifications and as specified herein.

3.2 FOUNDATIONS

A. Controller cabinet foundation shall extend 18 inches above grade.

B. Foundations for decorative street lights shall be as shown on the approved Drawings based on the soil engineer's recommendations or in accordance with the Caltrans Standard Plans for a Type 15 lighting standard foundation.

C. Mortar is required between the foundation and the base plate of all traffic signal and lighting standards. Mortar shall consist of one part by volume of Portland Cement and three parts of sand per Caltrans' requirements.

3.3 CONDUIT

A. Conduit runs shown on the Drawings which are to be located behind the curbs may be installed in the street, within 2 feet of and parallel to the gutter line of the curb by the trenching method specified in Section D below.

B. After conductors have been installed, the ends of conduits terminating in pull boxes and controller cabinets shall be sealed with an approved type of sealing compound.

C. All conduit bends greater than 44 degrees shall be factory bends, and shall have a minimum radius of 18 inches. Where factory bends are not used conduit shall be bent without crimping or flattening using the longest radius possible. Bending of non-metallic conduit shall be by methods recommended by the conduit manufacturer and with equipment approved for that purpose. Conduits designated for signal interconnect shall be installed satisfying the requirements of both twisted pair and fiber optic cables use (e.g., sweeps/bends for fiber optic shall be used).

D. At locations where conduit is to be installed by jacking or drilling as provided in Section 86-2.05C, "Installation," of the Caltrans Standard Specifications, and if delay to any vehicle will not exceed 2 minutes, conduit may be installed in accordance with the City Standard Details.

3.4 PULL BOXES

A. Pull boxes in areas subject to traffic loads shall be installed on a concrete footing to withstand the traffic load. Tops of pull boxes shall be flush with the surrounding grade.

B. The bottom of pull boxes shall be bedded in Class 2 Permeable Material in conformance with Section 312300 "Utility Earthwork" as shown on the Drawings.

C. Grout in the bottom of pull boxes will not be required.

D. Where the sump of an existing pull box is disturbed by the CONTRACTOR'S operations, the sump shall be reconstructed and if the sump was grouted, the old grout shall be removed and new grout shall be placed.

E. Recesses for suspension of ballasts will not be required.

F. Where pull boxes are to be placed in areas subject to traffic loads, a steel or cast iron cover shall be used in lieu of the concrete cover.

G. Maximum pull box spacing shall be 100' for traffic signals, 200' for street lights and hardwire signal interconnect, and 800' for fiber optic communications.

H. Pull boxes shall also be installed at locations where conduits branch, adjacent to the foundation for each signal standard, lighting standard, illuminated sign, controller cabinet, or service cabinet, and at the toe of slope or at the hinge point when placed on a slope.

I. Pull boxes are to be located behind the five (5') foot sidewalks and not within the sidewalk. Where sidewalks are wider than five feet, the pull box shall be located outside of the pedestrian's general walking area such that it will not interfere with pedestrian activity. In under no condition shall pull boxes be located within pedestrian pathways unless otherwise approved by the engineer.

3.5 CONDUCTORS AND WIRING

A. Identification bands shall be placed near the ends of termination points of all conductors. All wires shall be clearly marked inside the controller cabinet designating the appropriate signal phases.

B. When signal heads for more that one phase are mounted on the same pole, the CONTRACTOR shall identify phases by tagging wires in the nearest pull box using nylon tie raps and permanent marker.

C. A 5 amp in-line fuse shall be installed on the hot leg of service in the pull box adjacent to each street light.

3.6 BONDING AND GROUNDING

A. Grounding jumper shall be attached by a 3/16-inch or larger brass bolt in the signal and street light standards or controller pedestal, and shall be run to the conduit, ground rod, or bonding wire in the adjacent pull box.

B. Equipment grounding conductors will not be required in conduit containing loop lead-in cables only

3.7 DECORATIVE STREET LIGHTS

A. Decorative street lights shall be installed in accordance with the manufacturer's recommendations.

3,8. UNINTERRUPTIBLE POWER SUPPLY (UPS) – BATTERY BACKUP SYSTEM (BBS)

A. The UPS-BBS system shall be **wired and programmed** such that when AC power is interrupted, the UPS-BBS will seamlessly enter UPS mode and provide two (2) hours of full signal operation. If AC power has not been restored within two (2) hours, the traffic signal shall operatein flashing red operation until failure for a minimum of two (2) hours or until AC power is restored.When AC power is restored, the system shall seamlessly revert back to AC power without interruption to the full signal operation.

B. The USP-BBS system shall be wired and programmed to communicate with the existing 2070 controller at the intersection through the use of special function outputs, if applicable. If available, the 2070 shall communicate with the TOC through the use of the special alarm functions to return BBS activation and other information to the TOC.

3.9 CONTROLLER CABINET ASSEMBLY

A. Interconnect cable splices in the controller cabinet and connections of the appropriate cable pairs to the controller shall be done by the controller supplier at turn-on. Interconnect cable shall be run continuously without splices between controller cabinets. Splices shall not be made in the pull boxes. Splices shall only be made in the controller cabinets on the terminal blocks provided for that purpose by the controller manufacturer. It shall be the contractor's responsibility to establish communication between local controllers and the central master controller unless otherwise indicated.

B. The base of the controller cabinet shall be sealed with a silicon caulking material.

3.10 FUNCTIONAL TESTING

A. In order to properly conduct functional testing of the controller assembly, schematic drawings **specific** for the cabinet to be used in this specific project shall be submitted with the cabinet. Traffic signal construction plan shall also be submitted. Drawings shall indicate the intersection name and phasing. Absence of the required drawings could result to the rejection of the entire controller assembly. Cabinet testing will not proceed until the required drawings are submitted. The functional test for each signal system shall consist of not less than 14 days. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until the 14 days of continuous satisfactory operations is obtained.

B. Controller and cabinets shall be delivered to the City of Livermore Maintenance Service Center at 3500 Robertson Park Road, Livermore, for pretesting no later than 45 days prior to installation. After completion of functional testing by the CITY, the CONTRACTOR shall pick up and install the equipment at the work site.

C. Before scheduling the traffic signal "Turn On," the CONTRACTOR is required to coordinate a pre-testing to be conducted by the City's Signal Maintenance Department. Seventy-two (72) hours minimum advance notice is required to schedule this pre-test. During the pre-test, the City's traffic signal maintenance staff will determine if all components of the traffic signal system are operational as designed, including the Battery Backup System and video detection system. If deficiencies are found, the CONTRACTOR shall make the necessary corrections and schedule a follow up pre-testing. Only after all the deficiencies found are corrected can the CONTRACTOR schedule the signal "Turn On." The CONTRACTOR shall provide a minimum of forty-eight (48)-hour advance notice to schedule the "Turn On".

- END OF SECTION -

SECTION 344105 - SIGNAGE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all roadside signs, street name signs, and City/private property off-street signs, and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 033050 — Utility Cast-In-Place Concrete.

B. Division 1 — General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

United States Department of Transportation, Manual of Uniform Traffic Control Devices

595-A — Federal Standard

B. **City of Livermore:**

1. Sign Ordinance
2. Zoning Ordinance

C. **State of California (Caltrans) Standards:**

1. Standard Specifications:

   Section 56 — Signs.

2. Standard Plans
3. Traffic Manual

D. **Commercial Standards:**

ASTM C 653 — Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed,) by the Hot-Dip Process.

USA — Underground Service Alert.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

1.5 UTILITY LOCATIONS

A. The CONTRACTOR'S attention is called to the fact that utilities are present in the work areas. It is the CONTRACTOR'S responsibility to notify the utility companies having facilities in the project work areas at least 48 hours prior to beginning WORK to accurately locate said utilities before beginning of underground work. Utilities may be notified by contacting USA, Underground Service Alert, at (800) 642-2444.

B. For utilities not marked by USA, such as irrigation mains and laterals or on site services, the CONTRACTOR shall contact the property owner for assistance in locating said facilities.

C. The CONTRACTOR shall be responsible for repairing, at his own cost, any damage to utilities or irrigation facilities encountered during construction.

1.6 PRIVATE PROPERTY SIGNS

A. All private property signs are subject to approval by the City of Livermore Planning Division and shall be in conformance with the Zoning Ordinance, the Sign Ordinance, and all other City of Livermore regulations.

PART 2 -- PRODUCTS

2.1 SIGNS

A. **Roadside Signs:** Roadside signs shall be of the type as shown on the Drawings in accordance with the Caltrans Traffic Manual unless as otherwise noted on the drawings. Signs shall conform to Section 56, "Signs" of the Caltrans Standard Specifications and the Caltrans “Approved Sign Specification Sheets” as modified by this Section.

B. **Sign Plates:** Sign Plates shall be 0.080 gage aluminum alloy. Sign message shall be made using engineering grade sheeting **3M or equal**. Type N markers shall be made using high intensity reflective sheeting **3M or equal**.

C. **Street Name Signs:** Street names and size of signs shall be as shown on the Drawings. Sign background shall be reflective green with white lettering.

D. **City/Private Property Off-Street Signs:** City/private property off-street signs shall have message and size of sign as shown on the Drawings.

E. All signs in street right-of-way shall have “COL” and installation date etched or stamped on back of sign with 1/4" letters at lower right corner.

2.2 POSTS

A. **Roadside Signs, Street Name Signs, and City Off-Street Signs:**

1. All posts for signs installed on City property or within the public right of way shall be square formed steel tube, telescoping metal breakaway type, **Unistrut Telespar Sign Support System or equal**, of the size and dimensions as shown on the Drawings and as specified herein.

2. All posts shall be painted green and electrically powder coated except the sleeve and anchor which shall be galvanized. The color shall be green in conformance with Federal Standard 595-A, color number 14109 (Dark Limit V).

3. Tubing shall be 12 gage strip steel, structural quality, conforming to ASTM A-570 Grade 33.

4. Galvanized tubing shall be 12 gage strip steel, structural quality, conforming to ASTM A 446 Grade A; hot-dipped galvanized with a 1.25-ounce zinc coat, interior and exterior, conforming to ASTM C 653 coating designation G90; and the corner welds shall be zinc coated after scarifying operations.

2.3 HARDWARE

A. **Roadside, Street Name, and City Off-Street Signs:** Hardware for signs installed on City property or within the public right of way, shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**. Drive rivets to be **Unistrut TL 3806 or equal**.

B. **Street Name Sign Installation on Street Lights:**

1. The cantilever bracket supports for street name signs installed on round street light standards shall conform to the requirements of **SIGNFIX Cantilever Sign System or equal**.

2. For sign blanks up to 20 inches in length with a maximum area of 2 square feet use **SIGNFIX Stainless Steel Mini Cantilever Brackets** with 5/8-inch 0.030 gauge stainless steel band and buckle **BAND-IT or equal**.

3. For sign blanks up to 42 inches in length with a maximum area of 6 square feet, use **SIGNFIX V-Back Aluminum Cantilever Brackets** with 3/4-inch 0.030 gauge stainless steel band and buckle **BAND-IT or equal**.

PART 3 -- EXECUTION

3.1 GENERAL

A. All sign locations on City property must be inspected and approved by the ENGINEER prior to installation. The CONTRACTOR shall notify the ENGINEER no later than 48 hours prior to the start of the scheduled sign installation.

B. The locations of all Off-Street signs must be approved by the Planning Division prior to start of installation of the signs.

C. All reference markings made by the CONTRACTOR shall be done with spray chalk and shall be removed by the CONTRACTOR after installation of the signs.

D. Roadside signs shall be installed 6" behind 5' monolithic sidewalk, and 18" behind face of curb where there is a separated sidewalk, 10' sidewalk or no sidewalk unless otherwise noted on plans.

E. All utilities damaged by the CONTRACTOR shall be repaired and replaced by the CONTRACTOR at its expense to the satisfaction of the ENGINEER and the owner of the utility.

3.2 INSTALLATION OF POST

A. **Roadside, Street Name, and City Off-Street Signs:** Installation of roadside, street name, and City off-street signs installed on City property shall be at the locations shown on the Drawings or as specified herein.

1. Installation shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**.

2. The square end of the anchor shall not be modified or pointed, but shall be capable of being driven into the ground by the use of an approved driving cap. The driving cap shall be

reusable and shall allow the square anchors to be manually driven into the ground with the aid of a sledge hammer or a jack hammer without deforming the anchor or the driving cap.

3.3 INSTALLATION IN EXISTING SIDEWALK

A. For signs installed in existing sidewalks a 6-inch core shall be drilled, the anchor installed, the the core filled with Class B portland cement concrete in conforming to Section 033050, "Utility Cast-In-Place Concrete." Existing surfacing other than portland cement concrete shall be replaced in kind, with the replacement matching the existing product, depth, and pattern, to the satisfaction of the ENGINEER. The sleeve shall be protected such that concrete will not enter the inside of the square post.

3.4 INSTALLATION OF SIGN

A. **Roadside, Street Name, and City Off-Street Signs:** Mounting of the sign to the pole for roadside, street name, and City off-street signs on City property shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**.

B. Mounting of Street Name Signs on street light standards using Cantilever support brackets shall be installed in accordance with the manufacturer's recommendations. Cantilever bracket system shall be installed on both the top and bottom of each sign.

C. An R26E, "Tow-Away Zone" shall be installed below each R26F sign in designated fire lanes.

- END OF SECTION -