

**SECTION 49 SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS
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SECTION 49 SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS

49-1 GENERAL

Signals, lighting and electrical systems must be constructed or installed as shown or specified in the Contract, these Specifications, the applicable State Plans, and the applicable provisions of the State Specifications.

49-1.01 Definitions

Definitions for signals, lighting and electrical systems must be as specified in the State Specifications, and the following:

Programmed Visibility Signal Head—A type of signal head that can be optically programmed to restrict visibility of indication(s) to only those areas or lanes designated.

Signal Standard—Any pole that supports signal head(s).

Street Light Standard—The pole, and mast arm if required, that supports the luminaire.

49-1.02 Abbreviations

Abbreviations for signals, lighting and electrical systems must be as specified on State Plans, and the following:

I/C—Interconnect Cable

L.C.—Lower Case

PG&E—Pacific Gas & Electric Company

SMUD—Sacramento Municipal Utility District

U.C.—Upper Case

49-1.03 Regulation and Code

Electrical equipment must conform to the following standards wherever applicable: the International Municipal Signal Association (IMSA) and The National Electrical Code (NEC), as amended by the County, and the standards cited in the State Specifications.

49-1.04 Equipment List and Drawings

If requested by the Agency, the Contractor must submit for review sample articles of the material proposed for use. After review, said sample articles will be returned. The Contractor must include on the equipment list and on the equipment itself the installation location of material supplied. This must be done by the use of street names, the alphabetical letter designation used on the Plans, or a location as otherwise noted on the Plans. Equipment lists and drawings must conform to the State Specifications.

The equipment and materials proposed for use on any project must be approved by the Agency before starting work.

In conformance with the requirements in Section 11-3, "Record Drawings", of these Specifications, the Contractor must maintain record drawings that must show in detail the construction changes of all traffic signal and streetlight wiring, conduits, standards, and associated equipment. In particular, the record drawings must accurately depict the location and depth of conduits, location of standards, pull boxes, wiring changes, and all applicable manufacturer's operation and maintenance information.

49-1.05 Ordering of Signal and Lighting Equipment

The Contractor must place the order for long lead-time signal and lighting equipment not provided by the Agency within 5 Calendar Days after the date of the Notice to Proceed or within 5 Calendar Days after the start of the Contract Time, whichever comes first. The Contractor

must submit a copy of the equipment order to the Agency. Liquidated damages, as set forth in Section 8-10, "Liquidated Damages for Delay", of these Specifications, apply in case of failure to comply. No extension of time will be allowed for delay in delivery of traffic signal poles, street light standards, luminaries, or traffic signal equipment. The Agency hereby guarantees payment for long lead-time equipment ordered prior to execution of the Contract.

The Contractor must furnish the Agency with a statement from the vendor(s) that the order for the electrical material required for the contract has been received and accepted by the vendor(s). The statement must be furnished within 10 Calendar Days after receiving notice that the Contract has been executed for the Agency. The statement must give the date that the electrical equipment will be shipped.

49-1.06 Maintaining Existing and Temporary Electrical Systems

Maintaining existing and temporary electrical systems must conform to Section 86-1.06, "Maintaining Existing and Temporary Electrical Systems", of the State Specifications, except that paragraphs 11, 12, and 13 do not apply.

Existing electrical systems, including traffic signals, traffic signal vehicle and pedestrian detection facilities, traffic signal/Intelligent Transportation System (ITS) communication and monitoring facilities, street lighting facilities, flashing beacons and sign illumination facilities, or approved temporary replacements thereof, must be kept in effective operation for the benefit of the traveling public during the progress of the Work, except when shutdown is permitted to allow for alterations or final removal of the systems.

The Contractor must notify the Agency at least 2 Working Days prior to performing any work on existing systems, including any work that may take vehicle detectors out of service or may reroute traffic off of existing vehicle detectors.

The Contractor must notify the Agency at least 2 Working Days prior to any operational shutdown of traffic signals, traffic signal/ITS communications, street lighting or other electrical systems or facilities.

Traffic control to direct traffic during the shutdown of a traffic signal system must be provided by the Contractor at the Contractor's expense. The Contractor must submit a traffic control plan to the Agency for review and approval a minimum of 5 Working Days prior to a shutdown of a traffic signal. Traffic signal shutdowns are limited to Monday through Thursday, excluding holidays, from 9:00 a.m. to 3:00 p.m., or as specified in the Special Provisions.

Where a facility requires continuous lighting, the shutdown time must be limited to one-half (1/2) hour as scheduled by the Agency, unless otherwise specified in the Special Provisions or permitted by the Agency. The shutdown of lighting systems must not interfere with the regular lighting schedule, unless otherwise permitted by the Agency.

Traffic signal equipment, ITS equipment, traffic signal/ITS communications and other existing electrical systems taken out of service must be repaired or replaced within 24 hours, except as otherwise specified in the Special Provisions or as provided herein.

Vehicle detectors and pedestrian push buttons must remain in operation at all times during the progress of the Work on an existing actuated traffic signal system, except as otherwise specified in the Special Provisions or as provided herein.

Metal objects (such as manhole frames and lids, valve boxes, bore casings, etc.) must not be installed within 72 inches of a traffic loop.

Vehicle detectors taken out of service must be repaired or replaced within 72 hours. New vehicle detectors for rerouted traffic must be installed within 72 hours. Where work site conditions do not permit the installation of permanent vehicle detectors within the 72 hour period, temporary vehicle detectors that provide detection for every lane of every approach, must be installed, at the Contractor's expense, as directed by the Agency. Permanent vehicle detectors must be installed as soon as work site conditions permit.

If the Contractor does not restore vehicle loop detector operation within a 72 hour period,

the County may perform the repairs and deduct the cost of the repairs from payments due the Contractor.

Unplanned disruptions to the traffic signal system will result in impacts to the traveling public, increase fuel consumption, vehicle operating costs, pollution, and other inconveniences and harm. If the Contractor fails to maintain existing electrical systems, including damage to existing vehicle loop detection, in accordance with the Contract and these Specifications within the time frame specified above, the Agency reserves the right to perform maintenance and emergency service necessary to ensure continuous traffic signal operation. All expenses incurred by the Agency in implementing this option will be deducted from payments due the Contractor.

49-1.07 Scheduling of Work

Scheduling of work must conform to Section 86-1.07, "Scheduling of Work", of the State Specifications, except that paragraph 9 does not apply.

Functional tests can start on any Working Day except Monday, Friday, or the day preceding or following a legal holiday.

49-1.08 Safety Precautions

Attention is directed to Section 6, "Legal Relations and Responsibilities", of these Specifications. Before starting work on existing series street-lighting circuits, the Contractor must obtain daily a safety circuit clearance from SMUD. By-pass switch plugs must be pulled, "Men at Work" and other required construction signs posted, and lockouts installed at switch boxes before any work is done.

49-1.09 Inspection

Prior to backfilling conduit trenches or placing concrete foundations, the Contractor must notify the Agency and request inspection of all conduits and foundation forms.

All conduits, conduit couplings, conduit bends and ground bushings must be in place and properly tightened and secured, and all anchor rods, anchor bolts and ground rods must be in place in the foundation form prior to the request for inspection. Wire must not be pulled in conduits until inspection, backfilling and foundation concrete placement are completed. Stub ends of all conduits must have approved caps and ground bushings installed prior to backfilling or placing concrete for foundations.

The Contractor must not backfill, enclose, or otherwise cover up any electrical work prior to inspection or testing. Should any of the work be backfilled, enclosed or covered up, the work must be exposed by the Contractor, at the Contractor's expense, for such inspection or testing.

49-1.10 Signal Turn-On

Traffic signals must not be turned on until all signal heads, pedestrian heads, backplates, luminaries, detectors, push buttons, signs, and striping have been installed. The Contractor must give written notice of intentions of signal turn-on at least 3 Working Days prior to actual turn-on time so that Agency forces can accomplish the proper signing. The written notice must be given to both the Traffic Signal and Street Light Manager (875-5327) and the Signs and Markings Manager (875-5133), and is to allow for a review of the signal prior to turn-on. Agency personnel may request, and must be granted, a new turn-on date and review, pending the results of their initial review.

Prior to actual turn-on time, the Contractor must uncover all Agency-installed signs that have been installed prior to signal turn-on and are covered. Turn-ons must take place between 11:00 a.m. and 2:00 p.m., Monday through Thursday, except that signal turn-ons are not to be scheduled for the day before a holiday and no two-signal turn-ons on the same Contract are to be scheduled for the same day. All work done by the Contractor to accomplish these objectives is included in the price paid for the intersection, and no additional compensation will be allowed.

49-1.11 Contractor Supplied Equipment

The Contractor must supply all traffic signal poles, the service can with battery backup, all detector equipment external to the wired traffic signal cabinet and all other material and equipment not specifically identified as “County Supplied” on the contract plans or in the Special Provisions. The Contractor must supply all of the equipment specified in Section 49-5.02, “Emergency Vehicle Detector Cable, Detectors, and Phase Selectors” of these Specifications.

49-2 MATERIALS AND INSTALLATION

49-2.01 Trench Excavation and Backfill

Unless otherwise shown or specified in the Contract, trench excavation and backfill must conform to Section 19, “Trench Excavation, Bedding, and Backfill”, of these Specifications, and restoration of surfaces must conform to Section 14, “Restoration of Surfaces”, of these Specifications. Trenching for signals, lighting and electrical systems may be made by earth saw trenching in accordance with the provision of Section 49-2.02, “Earth Saw Trenching”, of these Specifications.

Unless otherwise permitted in writing by the Agency, all surplus excavated material must be removed and disposed of the same day the surplus material is excavated.

The Contractor must contact Underground Service Alert a minimum of 48 hours before any excavation work begins. The Contractor must outline the excavation area in white.

49-2.02 Earth Saw Trenching

Trenching for signals, lighting, and electrical systems may be made by earth saw trenching. Trenches to be made by this method must be cut by a machine that will produce smooth edge cuts in the pavement and will move at a speed in excess of 4 feet per minute while cutting pavement. The trenching machine must be shielded to prevent loose material from being thrown away from the machine.

The minimum trench depth must be that which is necessary to provide for 9 inches minimum cover between the top of the conduit and the finished pavement grade and extend through the pavement structural section. The trench section must conform to Standard Drawing 4-64.

Loose material deposited on the pavement behind the cutting machine must be removed from the pavement immediately and the pavement cleared to allow the passage of traffic. Only those traffic lanes occupied by the cutting machine and the cleanup operation can be closed and they must be opened as soon as the work has moved sufficiently to clear them.

The conduit must be placed in the bottom of the trench and the trench must be backfilled with portland cement concrete to match the existing pavement surface within areas that are to receive an asphalt concrete overlay as part of the same contract, and to within 1 inch of the pavement surface of existing pavements that are not to receive an asphalt concrete overlay as part of the same contract.

The concrete must be Class “C” concrete conforming to Section 50-5, “Portland Cement Concrete”, of these Specifications, with 1-inch maximum size aggregate and 1-inch slump, with a maximum calcium chloride content of 3 percent of the cement content. For electrical work, concrete must be Class “B” concrete conforming to said Section 50-5, “Portland Cement Concrete”, of these Specifications. The concrete must be tamped or vibrated to provide a dense material free of voids and rock pockets.

The sides of the trench above the concrete backfill must be coated with an asphaltic emulsion and the remaining depth of the trench must be backfilled with asphalt concrete placed in one layer. The asphalt concrete must conform to Section 23, “Asphalt Concrete”, of these Specifications, and must be manufactured with 1/2 inch maximum-sized rock. The asphalt concrete must be compacted to produce a uniform dense mixture with a surface elevation slightly higher than the adjacent pavement.

Once work is started on a trench, all work necessary to complete that trench, with the exception of the 1 inch permanent asphalt concrete surfacing, must be completed the same day. This includes cutting, placing of conduit or cable, removing all spoils from work site, barricades, maintaining a clean road surface for the safety of vehicular and pedestrian traffic, and backfilling trench with concrete.

The permanent asphalt concrete pavement replacement must be completed no later than 1 Working Day following placement of the concrete backfill. Seal coats in accordance with Section 14-3.03, "Seal Coats", of these Specifications must be placed to the full width of the pavement replacement plus 12 inches on each side of trench, except that seals must not overlap concrete curb and gutter.

Trenching in the medians must be as specified above, except that the requirement to complete the trench on the same day does not apply. In addition, median trenches may be backfilled to the surface of the median with concrete colored to match the color of the median surface.

49-2.03 Removing and Replacing Improvements

Sidewalks, sprinklers and irrigation systems, curbs, gutters, portland cement concrete and asphalt concrete pavement, underlying material, lawns and plants, and any other improvements removed, broken or damaged by the Contractor's operations, must be replaced or reconstructed with the same kind of material as found on the Work or with materials of equal quality. The new work must be left in a serviceable condition.

Whenever a part of a square or slab of existing concrete sidewalk, curb, gutter, or driveway is broken or damaged, the entire square, section, or slab must be removed or as directed by the Agency and the concrete reconstructed as above specified or as directed by the Agency.

The outline of all areas to be removed in portland cement concrete sidewalks, curbing, and driveways must be cut to a minimum depth of 2 inches with an abrasive type saw prior to removing the material. Cuts must be neat and true along score lines or constructed joints, with no shatter outside the removal area. Cuts must not extend beyond the limits of the removal area.

49-2.04 Foundations

Foundations must conform to the State Specifications, and these Specifications. Foundations must conform to the sizes and shapes shown on the Plans, the Standard Drawings, or the State Plans, or as otherwise detailed in the Contract, as applicable. The Contractor must provide anchor bolts for all foundations unless otherwise specified in the Special Provisions. Anchor bolts must be positioned so that between 2 and 4 threads will be visible above the top nuts after the pole has been erected and plumbed. Rigid non-metallic conduit is allowed in traffic signal and street light foundations.

All traffic signal poles and street light poles and pull boxes must be located outside the limits of sidewalk ramps, unless shown on the plans to be located on a wider than standard curb incorporated into the rear portion of the sidewalk ramp. All traffic signal pole and street light foundations must be located so that no existing conduit, pipe or other underground utility facility conflicts with the entire volume of the pole foundation. If a conflict with an existing street light conduit or an existing traffic signal conduit exists, the Contractor must relocate the existing conduit out of the area of conflict. If a potential conflict with any underground utility facility other than street light or traffic signal conduit exists, the Contractor must bring the potential conflict to the attention of the Agency. The Agency may direct the adjustment of the signal foundation location in accordance with Section 49-2.05 of these Specifications. Conformance with these provisions as required to complete the Work, including relocation of existing street light and/or traffic signal conduits, is considered incidental to and included in the payment for traffic signal or street light installation and no additional compensation will be made.

All traffic signal poles with pedestrian push buttons must be located in sidewalk or pedestrian pad areas. Poles located in sidewalk areas must be located such that the back of the pole's base flange must be within the sidewalk area and within one inch of the back of the sidewalk.

All traffic signal and street light poles and pull boxes must be located outside the limits of sidewalk ramps.

49-2.05 Standards, Steel Pedestals and Posts

Standards, steel pedestals, and posts must conform to the State Specifications, and these Specifications. Standards with an outside diameter greater than 12 inches must be round. Street light standards must be galvanized steel and must conform to Standard Drawing 5-16 (Type B) or 5-3 (Type A). The type of street light standard will be indicated in the Contract.

49-2.05.A NOT USED

49-2.05.B Placement of Standards, Enclosures, Posts and Associated Devices

The Contractor is advised that traffic signal and pedestrian facilities in corner rounding areas are difficult to describe accurately on the Plans. These traffic signal and pedestrian facilities must be field adjusted to conform to the following rules:

1. Pedestrian heads and crosswalks must be located such that pedestrian heads are **not** located behind the respective stop bar.
2. Pedestrian push buttons must be located within 5 feet of their respective crosswalks, measured perpendicular to the crosswalk lines.
3. Sidewalk ramps and crosswalks must be located such that the ramp pan falls entirely within the crosswalk lines.
4. Poles, push button posts, controller cabinets, interconnect terminal cabinets, and service enclosures must be located to leave a minimum of 4 feet of clear sidewalk width.
5. High (mast arm mounted) signal heads with all-left arrow indications must be located at least 2 feet into the controlled left turn only lane. If field conditions make this impossible, a programmed visibility head may be used and the extra cost compensable.

Any field adjustment needed to meet the above described criteria of location of crosswalks, signal poles, ramps, and pull boxes is incidental and no additional payment will be made. All field adjustments must be coordinated with the Agency in the field.

49-2.05.C Final Location of Traffic Signal Poles

The Contractor must pothole the pole location area for utility conflicts. If the site is found to be unsuitable, the Contractor must re-pothole in the vicinity, as approved by the Agency, until a suitable location is found. Unused pothole areas must be restored to their original or better conditions. The pothole and restoration work is included in the contract lump sum price paid for individual traffic signal and no additional payment will be made.

49-2.06 Conduit

Conduit must conform to the State Specifications, and these Specifications. Unless otherwise shown or specified in the Contract, conduit must be rigid non-metallic. Rigid non-metallic conduit must be electrical grade and be Schedule 40 or better.

Traffic signal conduits, including traffic interconnect conduits, are shown on the Contract Plans to scale, unless otherwise noted on said Plans. Conduit shown to be installed out of paved areas must be installed out of paved areas. Any conduit shown on the plans to be placed at a specific location, either by dimensions, offsets, or by other means, must be installed at the specified location. Conduits shown to be installed across any street, or across any portion of any street, must be installed such that the alignment of the conduit between the pull boxes and/or cabinets at either end of the conduit run must be a straight line.

Pole risers must be 2-inch Schedule 80 rigid non-metallic conduit unless otherwise specified.

Schedule 40 rigid non-metallic conduit must be used in signal, street light, controller, and service enclosure foundations. Install end bell fittings on all non-metallic conduits of 1 inch and larger trade size.

All conduit systems, new or existing, must be blown out with compressed air.

Conduits terminating in standards or enclosures must emerge from the foundation vertically, ± 5 degrees in any direction.

A solid No. 10 THW copper wire with green insulation must be installed in all conduits that are to receive future conductors. All wires placed in conduits for future use at any one traffic signal location and for any traffic signal interconnect system must be spliced to be electrically continuous.

All rigid non-metallic conduit must be connected with the appropriate adhesive.

After conductors have been installed, the ends of conduits terminating in pull boxes, interconnect cabinets, controller cabinets, and service enclosures must be sealed with an approved sealing compound.

All empty conduits must be identified with their destination/termination point, and sealed with plugs approved for the purpose.

Conduit placed under sidewalks may have 6 inches of cover, if the conduit trench is backfilled with concrete.

Conduit may be installed in paved areas of streets as specified in Section 49-2.02, "Earth Saw Trenching", of these Specifications. Conduit placed in existing paved areas must be placed in a trench 2 inches wider than the outside diameter of the conduit to be installed, but no wider than 6 inches. Conduit depth must not exceed 14 inches or conduit trade diameter plus 10 inches, whichever is greater, except that at pull boxes the trench may be hand dug to the required depth. The top of the installed conduit must be a minimum of 9 inches below finish grade. Provide 4-inch minimum width warning tape at least 6 inches above buried conduit.

49-2.07 Pull Boxes

Pull boxes must conform to the State Specifications, these Specifications, and the Standard Drawings.

As required on Standard Drawings 5-20B and 5-34, covers must be factory-marked to indicate the contents of the pull box. Metal covers must be marked by method "c" as described in the State Specifications

Pull boxes must be installed at the locations shown on the Plans and as required by these Specifications. With the exception of traffic signal interconnect conduit for conduit runs exceeding 200 feet, pull boxes must be spaced at maximum 200-foot intervals unless indicated otherwise. The maximum spacing of pull boxes for traffic signal interconnect conduit is 500 feet. The Contractor, at the Contractor's expense, may install additional pull boxes to facilitate the Work.

The bottom of pull boxes installed in unimproved areas or in sidewalk areas must be bedded on 6 inch minimum layer of 3/4 inch crushed rock.

The maximum allowable depth of pull boxes 26 inches as shown on Standard Drawings 5-20B and 5-34.

49-2.08 Conductors

Conductors must conform to Section 86-2.08, "Conductors and Cables", of the State Specifications, and these Specifications. Section 86-2.08B, "Conductor Identification", of the State Specifications is amended to require the Contractor to use a different color-coded wire for each street lighting circuit with continuous color maintained throughout each circuit. The "Conductor Table" of said Section 82-2.08B is amended to include the following:

CONDUCTOR TABLE					
Conductor Use	Signal Phase Or Function	Identification			
		Insulation Color		Label Designation	Conductor Size
		Base	Stripe		
Irrigation Control	Underground-Line 1	Black	None	IR1	As Req'd.
	Neutral	White	None	IRN	As Req'd.
Neutral	Traffic Signals	White	None	TSN	As Req'd.
Neutral	Street Lighting	White	None	None	As Req'd.
Traffic Signal Communications	As Required	As Req'd	As Req'd.	Per Special Provisions	As Req'd.
Highway (Street) Lighting Pull Box to Luminaire	As Required	As Req'd	As Req'd.	None	As Req'd.
Multiple Highway (Street) Lighting	As Required	As Req'd	As Req'd.	None	As Req'd.
Emergency Vehicle Preemption	As Required	Black or As Req'd	As Req'd.	Per Special Provisions	As Req'd.
Inductive Loop Detector Circuits	Vehicle Detection	As Req'd	None	Per Section 86-5.01A of State Specifications	As Req'd.

The second paragraph of Section 86-2.08C, "Circuit Conductors" of the State Standard Specifications is deleted and replaced with the following:

At any point, the minimum thickness of any TW, THW, USE, RHH or RHW insulation must conform to the requirements of the latest edition of the National Electrical Code.

49-2.08.A Signal Interconnect Cable

Signal interconnect cable must conform to the "International Municipal Signal Association, Specification No. 20-2, Polyethylene-Insulated, Polyethylene Jacketed Communication Cable", except that the signal interconnect cable must be supplied without electrical shielding. The cable must consist of 20 twisted pairs of No. 20 AWG solid copper conductors.

Prior to delivery of the cable, the Contractor must furnish the Agency with a certified report, in an Agency-approved form, of the tests made on the cable to show compliance with the Contract. In addition, the Agency may request samples for testing upon delivery of the cable to the work site, and, at Agency expense, test the samples for compliance with the Contract.

Cables are only to be installed under dry conditions. Each end of the cable must be properly sealed against moisture intrusion and must be protected against damage.

Cable must be installed in conduit between termination points. Termination points are identified as controller cabinets, interconnect terminal cabinets, or master controller building. A minimum of 5 feet of slack cable must be left coiled at each termination point and in each pull box. The ends of all cables must be taped and made waterproof by dipping in an approved sealer prior to being installed in conduit and prior to being left overnight. Unless otherwise specified or directed by the Agency, splicing of interconnect cable is not allowed.

After field testing of the cable by the Contractor, termination of cable will be made by Agency forces unless otherwise specified.

49-2.08.B Interconnect Cable Testing After Installation

Signal interconnect cable must be tested in accordance with these Specifications.

The interconnect cable must be installed and ready for cable testing 20 Working Days prior to anticipated use of said cable.

Each insulated conductor in each length of completed cable, with all other insulated conductors grounded, must have an insulation resistance of not less than the following:

Cable Lengths, Feet	500	1000	1500	2000
Megohms	500	250	160	125

The tests must be made using a 500-volt megohm meter applied for 1 minute. The test may be terminated as soon as the measurement demonstrates that the specified value has been met or exceeded for a period of 1 minute.

The direct current (D.C.) resistance of each pair must be measured by connecting each pair together at one end of the cable and measuring loop resistance at the other end. The maximum allowable resistance is 0.01012 OHMS per linear foot ±10 percent for a single #20 AWG conductor.

If the cable being tested fails any one or more of the above tests, the Contractor must replace the defective cable. No extension of time or compensation will be allowed for replacement of cable. All tests and corrections of failures must be documented and must be available for future reference.

All electrical tests must be made after the cable has been installed in the conduit. The conduit must also be filled with water.

49-2.09 Wiring

Wiring must conform to Section 86-2.09, "Wiring", of the State Specifications, except that the first sentence of Section 86-2.09 and the first paragraph of Section 86-2.09F, "Fused Splice Connectors", do not apply, and these Specifications.

Conductors must not be pulled into and through conduits until after pull boxes are set to grade, drain rock sumps installed, and the conduits bonded and cleaned out with the appropriate size swab or blown out with compressed air.

On 600-volt conductor splices of solid or stranded conductor sizes #14 AWG to #6 AWG, the Contractor has the option to use either crimp-type connectors or spring-type connectors of three-part construction. The three-part construction must consist of a zinc-coated free expanding steel spring enclosed in a steel shell, with an outer jacket of polyvinyl chloride. The outer jacket must have a flared skirt, be flexible, and be able to withstand 105 degree C temperature continuously. Each splice must have the spring connector sized in accordance with the manufacturer's recommendations for the number of conductors and gages being spliced. Wire strip lengths must be in accordance with the manufacturer's recommendations. After the spring connector has been applied to the connection, the splice must be coated by submersion with a corrosive-resistant, solvent-resistant, sealing, bonding and flexible electrical coating, having at least 100-volt/mil electrical strength. Upon coating of the splice, the flared skirt end must be positioned in an upright alignment and maintained in place until the electrical coating is dry.

The use of heat shrinkable tubing will only be permitted for splicing of detector loop conductors and detector lead-in cables in accordance with Section 49-5.01.C, "Splicing Details", of these Specifications.

In the handhole section of each luminaire pole, a fused disconnect splice connector must be installed in each ungrounded conductor between the line and the ballast.

Luminaires with up to 200-watt bulbs must have 6 amp fuses installed. Luminaires with 250 to 400 watt bulbs must have 10 amp fuses installed. All fuses must be midget ferrule type, rated at 600 volts, and fast blowing.

49-2.10 Bonding and Grounding

Bonding and grounding must conform to Section 86-2.10, “Bonding and Grounding”, of the State Specifications.

For bonding purposes in all non-metallic type conduits, a No. 6 copper wire must be run continuously in circuits used for series lighting, and a No. 10 copper wire must be run continuously in all other circuits. Where non-metallic conduit is to be installed for future conductors, a green No. 10 THW copper wire must be installed in these conduits. Equipment bonding and grounding conductors are not required in conduits that contain only loop lead-in cable or signal interconnect cable or both.

Grounding jumper must be attached by a 3/16 inch or larger brass bolt in the standard or pedestal and must be run to the metallic conduit, ground rod, or bonding wire in the adjacent pull box. The grounding jumper must be visible and accessible after the cap has been poured on the foundation.

49-2.11 Service

Electrical service installation and materials must conform to these Specifications.

Each service enclosure (or “can”) must be fabricated from 14 gauge Type 304D stainless steel and must conform to the requirements for cabinets fabricated from stainless steel as specified in the State Specifications, and these Specifications.

The mounting brackets must be 10 gauge Type 304D stainless steel. All welds must be of highest quality and ground smooth and finished so that grind marks are not visible.

The enclosure must be rain-tight and dust-tight. For new construction, anchor bolts must be inside the service enclosure. For modification construction, anchor bolts must be inside or outside the service enclosure as shown on the Plans.

A hinged dead front plate with cutouts for the handles of the breakers and the switch must be provided. A hinged outside door equipped with a heavy duty draw latch and 2 heavy duty hasps suitable for padlocking must be provided for the service section. The dead front panel on the service enclosure must have a continuous stainless steel piano hinge.

The enclosure must have no screws, nuts, or bolts on the exterior, except utility sealing screws. All screws, nuts, bolts, and washers must be stainless steel. All hinges and hinge pins must be stainless steel.

No surface of the enclosure can be deflected inward or outward more than 1/16 inch, measured from the intended plane of the surface.

Service enclosures must be factory wired and conform to NEMA Standards. All control wiring must be stranded copper, No. 14 AWG THHN/THWN rated for 600 volts. Wiring must be arranged so that any piece of equipment can be removed without disconnecting any wiring other than the leads to the equipment being removed. All wiring must be marked with permanent clip sleeve wire markers. Felt, pencil, or stick back markers will not be acceptable. A copy of the wiring diagram for the service enclosure and a typewritten circuit directory must be enclosed in plastic and mounted on the inside of the front door.

All circuit breakers, contactors, and wire must be listed by UL or ETL. The enclosure must conform to the NEMA 3-R standard.

The terminal lugs or strips must be copper or alloyed aluminum. All terminals must be compatible with either aluminum or copper conductors.

The service enclosure must have provisions for the installation of up to a total of 16 single-pole circuit breakers, including brass links and mounting hardware. Branch circuit panel must use loop wiring rated for 125 amperes with THHN/THWN insulation. All copper wiring used for main bussing must be No. 2 AWG THHN/THWN and rated for 125 amperes.

Nameplates of a reasonable size identifying the control unit therein must be installed on the dead front panel. Nameplates must be black laminated plastic with white characters, and must be fastened by screws.

The entire service enclosure must be constructed with the highest quality workmanship and must meet all applicable codes, and must bear a factory applied label of approval by a recognized testing laboratory.

Complete shop drawings on all substitutions must be submitted to the Agency for approval prior to fabrication. If the proposed substitute is rejected or if the submittal is not made within a reasonable time, the specified equipment must be furnished.

The Contractor must protect and lock the service enclosure during construction. When the Work has been accepted for maintenance, each enclosure must be locked with a Contractor-supplied master lock that will accept a Type 2214 key.

Street light "ON" and "OFF" control will be by photoelectric cell. All conduits and wires must be furnished and installed by the Contractor.

49-2.11.A Metered Service (120/208 Volt, 120/240 Volt)

The metered electrical service will be served from SMUD facilities as shown on the Plans. Unless otherwise specified, service must be wired for 120/208 volts or 120/240 volts, three-wire and single phase as shown on the Plans.

New service enclosures must be supplied and installed as shown on the Plans.

The service enclosure must consist of a separate metering section and a service section. The metering section must be complete with SMUD approved meter socket, steel socket cover, and manual circuit closing device.

The meter section must have a removable cover with the top and front sections welded together so that it is rain-tight and padlockable. The meter section must include provisions to allow SMUD to lock and seal the meter section.

The service enclosure must be fabricated in accordance with the dimensions shown on Standard Drawing 5-32.

The following equipment must be mounted in each metered service enclosure:

1. Two 2-pole, 120-volt alternating current main breakers with 100-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. Each main breaker must have an internal common trip. Each pole must have individual "ON-OFF" control and handle tie for common operation. Breakers must be Westinghouse Quicklag C or approved equal.
2. One single-pole, 120-volt alternating current branch circuit breaker for control circuit with 15-ampere trip and a rating of 10,000-amperes AIC at 120/240 volts. Breaker must be Westinghouse Quicklag C or approved equal.
3. Two single-pole, 120-volt alternating current branch circuit breakers for traffic signals, each with 60-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. Breakers must be Westinghouse Quicklag C or approved equal.
4. Minimum six, single-pole, 120-volt alternating current branch circuit breakers for street lighting, each sized per the Special Provisions and the Standard Drawings (minimum 30-ampere trip), and with a rating of 10,000 amperes AIC at 120/240 volts. Breakers must be Westinghouse Quicklag C or approved equal.
5. Minimum two, 3-pole, normally open, 60-ampere mercury displacement lighting contactors. Coil voltage must be 120 VAC, 60 cycle. Mercury displacement lighting contactors must be Dayton Electric Manufacturing Co., Model Number 3X753E, or approved equal.
6. One oil tight "Hand-Off-Auto" selector switch.
7. One solid copper neutral bus.
8. Incoming terminals (landing lugs).
9. Solid neutral terminal strip.

10. Terminal strips for conductors within the cabinet.

49-2.11.B Metered Service with Encapsulated Step-Down Transformer (277/480 Volt to 120-240 Volt)

The metered electrical service will be served from SMUD facilities as shown on the Plans. Unless otherwise specified, service must be wired for 277/480 volts, four-wire and three phase as shown on the Plans.

New service enclosures must be supplied and installed as shown on the Plans.

The service enclosures must consist of a separate metering section and a service section. The metering section must be complete with SMUD-approved three-phase meter socket, steel socket cover and manual circuit closing device.

The meter section must have a removable cover with the top and front sections welded together so that it is rain tight and padlockable. The meter section must include provisions to allow SMUD to lock and seal the meter section.

The service enclosure must be fabricated in accordance with the dimensions shown on Standard Drawing 5-33.

Mounted in each metered service enclosure must be the following equipment:

1. One 2-pole, 277/480-volt alternating current main breaker with 100-ampere trip and a rating of 14,000 amperes AIC at 277/480 volts. The main breaker must have an internal common trip. Each pole must have individual "ON-OFF" control and handle tie for common operation. Breaker must be Westinghouse Quicklag GHC or approved equal.
2. Minimum six, single-pole, 277/480-volt alternating current branch circuit breakers for street lighting, each sized per the Special Provisions and the Standard Drawings (minimum 30-ampere trip), and with a rating of 14,000 amperes AIC at 277/480 volts. Breakers must be Westinghouse Quicklag GHC or approved equal.
3. One single-pole, 120-volt alternating current branch circuit breaker for control circuit with 15-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. Breaker must be Westinghouse Quicklag C or approved equal.
4. One single-pole, 120-volt alternating current branch circuit breaker for traffic signals, with 50-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. The breaker must be Westinghouse Quicklag C or approved equal.
5. One 2-pole, 120-volt alternating current branch circuit breaker for intersection safety lighting, with 15-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. The breaker must have an internal common trip. Each pole must have individual "ON-OFF" control and handle tie for common operation. The breaker must be Westinghouse Quicklag C or approved equal.
6. Minimum three, 3-pole, normally open, 60-ampere mercury displacement lighting contactors. Coil voltage must be 120 VAC, 60 cycle. Mercury displacement lighting contactors must be Dayton Electric Manufacturing Co., Model Number 3X753E, or approved equal.
7. One oil tight "Hand-Off-Auto" selector switch.
8. One solid copper neutral bus.
9. Incoming terminals (landing lugs).
10. Solid neutral terminal strip.
11. Terminal strips for conductors within the cabinet.
12. One single-phase transformer rated at 5KVA. Primary must be 277 volts and secondary must be 120volts. This transformer to be metered and must supply the traffic signal power.
13. One single phase transformer rated at 2 KVA. Primary must be 480 volts and secondary must be 120/240 volts. This transformer to be unmetered and must provide the power for intersection safety lighting and the control circuit.

14. Provide primary transformer protection per the NEC.

49-2.11.C Unmetered Service (120/208 Volt, 120/240 Volt)

The unmetered electrical service will be served from SMUD facilities as shown on the Plans. Service must be wired for 120/208 volts or 120/240 volts, three-wire and single phase as shown on the Plans. The Contractor must connect the luminaires to the circuits shown on the Plans.

New service enclosures must be supplied and installed as shown on the Plans.

The service enclosures must be fabricated in accordance with the dimensions shown on Standard Drawing 5-30.

The following equipment must be mounted in each unmetered service enclosure:

1. One, 2-pole, 120-volt alternating current main breaker with 100-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. The main breaker must have an internal common trip. Each pole must have individual "ON-OFF" control and handle tie for common operation. Breaker must be Westinghouse Quicklag C or approved equal.
2. One single-pole, 120-volt alternating current branch circuit breaker for control circuit with 15-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. Breaker must be Westinghouse Quicklag C or approved equal.
3. Minimum six single-pole, 120-volt alternating current branch circuit breakers for street lighting, each sized per the Special Provisions and the Standard Drawings (minimum 30-ampere trip), and with a rating of 10,000 amperes AIC at 120/240 volts. Breakers must be Westinghouse Quicklag C or approved equal.
4. Minimum two 3-pole, normally open, 60-ampere mercury displacement lighting contactors. Coil voltage must be 120 VAC, 60 cycle. Mercury displacement lighting contactors must be Dayton Electric Manufacturing Co., Model Number 3X753E, or approved equal.
5. One oil tight "Hand-Off-Auto" selector switch.
6. One solid copper neutral bus.
7. Incoming terminals (landing lugs).
8. Solid neutral terminal strip.
9. Terminal strips for conductors within the cabinet.

49-2.11.D Unmetered Service (277/480 Volt)

The unmetered electrical service will be served from SMUD facilities as shown on the Plans. Service must be wired for 277/480 volt, four-wire and three phase as shown on the Plans. The Contractor must connect the luminaires to the circuits shown on the Plans.

New service enclosures must be supplied and installed as shown on the Plans.

The service enclosures must be fabricated in accordance with the dimensions shown on Standard Drawing 5-30.

The following equipment must be mounted in each unmetered service enclosure:

1. One 2-pole, 277/480-volt alternating current main breaker with 100-ampere trip and a rating of 14,000 amperes AIC at 277/480 volts. The breaker must have an internal common trip. Each pole must have individual "ON-OFF" control and handle tie for common operation. Breaker must be Westinghouse Quicklag GHC or approved equal.
2. One single-pole, 277-volt alternating current branch circuit breaker for control circuit with 15-ampere trip and a rating of 14,000 amperes AIC at 277/480 volts. Breaker must be Westinghouse Quicklag GHC or approved equal.
3. Minimum six single-pole, 277-volt alternating current branch circuit breakers for street lighting, each sized per the Special Provisions and the Standard Drawings (minimum 30-ampere trip), and with a rating of 14,000 amperes AIC at 277/480 volts. Breakers must be Westinghouse Quicklag GHC or approved equal.
4. Minimum two 3-pole, normally open, 60-ampere mercury displacement lighting contactors. Coil voltage must be 277 VAC, 60 cycle. Mercury displacement lighting

contactors must be Mercury Displacement Industries (MDI), Part Number 360NO-277V, or approved equal.

5. One oil tight "Hand-Off-Auto" selector switch.
6. One solid copper neutral bus.
7. Incoming terminals (landing lugs).
8. Solid neutral terminal strip.
9. Terminal strips for conductors within the cabinet.

49-2.11.E Unmetered Service with Encapsulated Step-Down Transformer (277/480 Volt to 120/240 Volt)

The unmetered electrical service will be served from SMUD facilities as shown on the Plans. Unless otherwise specified, service must be wired for 277/480 volts, four-wire and three phase as shown on the Plans.

New service enclosures must be supplied and installed as shown on the Plans.

The service enclosure must be fabricated in accordance with the dimensions shown on Standard Drawing 5-31.

Mounted in each unmetered service enclosure must be the following equipment:

1. One 2-pole, 277/480-volt alternating current main breaker with 100-ampere trip and a rating of 14,000 amperes AIC at 277/480 volts. The main breaker must have an internal common trip. Each pole must have individual "ON-OFF" control and handle tie for common operation. Breaker must be Westinghouse Quicklag GHC or approved equal.
2. One single-pole, 120-volt alternating current branch circuit breaker for control circuit with 15-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. Breaker must be Westinghouse Quicklag C or approved equal.
3. Minimum 10 single-pole, 120-volt alternating current branch circuit breakers for street lighting, each sized per the Special Provisions and the Standard Drawings (minimum 30-ampere trip) and with a rating of 10,000 amperes AIC at 120/240 volts. Breakers must be Westinghouse Quicklag C or approved equal.
4. One single-pole, 120-volt alternating current branch circuit breaker for receptacle with 20-ampere trip and a rating of 10,000 amperes AIC at 120/240 volts. Breaker must be Westinghouse Quicklag C or approved equal.
5. Minimum three, 3-pole, normally open, 60-ampere mercury displacement lighting contactors. Coil voltage must be 120 VAC, 60 cycle. Mercury displacement lighting contactors must be Dayton Electric Manufacturing Co., Model Number 3X753E, or approved equal.
6. One oil tight "Hand-Off-Auto" selector switch.
7. One solid copper neutral bus.
8. Incoming terminals (landing lugs).
9. Solid neutral terminal strip.
10. Terminal strips for conductors within the cabinet.
11. One single-phase transformer rated at 10KVA. Primary must be 480 volts and secondary must be 120/240 volts.
12. Provide primary and secondary transformer protection per the NEC.

49-2.11.F Service Can and Battery Backup Unit (BBU)

At each location for which a new traffic signal service can is shown to be installed, the Contractor must supply and install a Metered Service Enclosure with Battery Backup (120/240 V) in accordance with Standard Drawing 5-41 and as specified in this section.

49-2.11.F.(1) Enclosure Specifications:

Anodized 1/8 inch aluminum, weatherproof enclosure must house Uninterrupted Power Supply (UPS) and batteries. Enclosure must be TIG welded construction with welding materials

specifically designed for the material to be welded. Enclosure must have fully framed side hinged outer doors with swaged close tolerance sides for flush fit with drip lip and closed cell neoprene flange compressed gaskets. Front door must incorporate a full-length piano hinge, pad-lockable draw latch (center area on door-latch side), and two pad lockable welded-in place vandal-proof tabs (one upper area, one lower area on door-latch side, rated at 2000 lbs. each). There must be no exposed nut, bolts, screws, rivets or other fasteners on the exterior of the enclosure. Maximum cabinet dimensions 46 inches high by 20 inches wide by 9 inches deep. Weight 250 pounds with batteries. UPS must be mounted in an interior tilt out housing with 800 pound rated stops. Battery connectors must be Anderson Connectors with silver plated contacts. Batteries must be installed in fixed position framed trays for seismic safety and be readily accessible for maintenance. Batteries must be mounted allowing airflow front and back. Enclosure can include two transfer bypass switches, one for UPS bypass the second for auxiliary generator (optional). All switches must be panel mounted on interior dead front panel board. UV resistant plastic laminated nameplates must identify all controls and major components. A plastic covered wiring diagram will be attached to the inside of the front door. All components must be factory wired and conform to required NEMA, NEC, and UL standards. A chassis ground point must be provided. Panel must be UL 508 Industrial Control Panel rated.

49-2.11.F.(2) UPS Panel Minimum Features:

- The UPS system must be Tesco 27-000/22-000BBS1400XI-22UPS or approved equal.
- UPS bypass and UPS isolation switch.
- Deadfront safety panel board with all switches, indicating fuses, plugs, and isolation fuses for each battery pre-wired with phenolic nameplates.
- All nameplates must be screwed on phenolic engraved type.
- All wire terminating lugs must be full wrap around type.
- All batteries must be captive spaced from external captive sides in earthquake proof buckets.
- Cabinet ventilation must be by (qty. 4) 4 inch by 1/4 inch louvers top and bottom with encapsulated bug screens, cleanable filters and a 100 cfm fan to completely exchange air 25 time minimum per minute.
- All DC terminals and connections must incorporate safety covers such that the safety covers are in place for every normal maintenance mode.
- Event Counters & Total Run Time Counter.

49-2.11.F.(3) UPS Unit Minimum Specifications:

UPS unit must provide a true sine-wave output with minimum 1400 Volt-Amp continuous capacity. UPS must provide for utility service isolation when in operation. The minimum rating for wattage output will be 950 watts. The UPS must be capable of running an intersection with LED lights (for Run Time consult manufacturer). The unit must operate off-line, with transfer time of 2 ms or less, with battery condition indicator, with automatic test provisions, and with hot-swappable batteries (all batteries in system). UPS will automatically recharge batteries from full discharge to 95% capacity within 6 hours. UPS will provide on-line operation for a minimum input of 92 to 145 VAC, provide full load output of 120VAC – 10% / +4% at 60 Hz +/- 0.05% over a temperature range of -37 degrees C (optional adder) to +74 degrees C and be a UL Approved Design. The UPS unit must be delivered with maintenance manuals and schematic diagrams.

49-2.11.F.(4) UPS Unit Minimum Features:

- 1400VA 950 Watts
- Surge energy withstand 480 Joules, 6.5kA
- Common mode clamping 0 ns < 5ns typical UL 1449
- Conditioned power – Computer quality

- Transient lighting protection – 160 Joules
- Transfer to battery time – 2 ms
- Retransfer to utility – 2 ms
- Each battery must be 24 volts @ 18 AH with heavy duty Anderson plugs and isolated fused (deadfront panel mounted 30 amp) connections to the UPS for greater system reliability and ease of maintenance. Series wiring is unacceptable.
- Fan cooling must be fused for locked rotor current.
- Cooling air must be ducted to cool the front and back of each battery with air space on all four sides and top of battery.
- UPS covers must be 60% open on both sides to diminish the environmental effects of extreme temperatures.
- Includes a RS232, DB9 Computer Interface Port.
- Low voltage safety design at 24v DC. (Higher voltage DC systems are unacceptable).

49-2.11.F.(5) UPS Communications Module:

Smart Slot Relay I/O Module:

- Input #1 Turn the UPS on.
Input #2 Turn the UPS off.
Input #3 Start the UPS self-test.
Input #4 Shut down the UPS (when on battery).

- Output #1 The UPS is on-battery (during a power failure, self-test or run time calibration).
Output #2 UPS has a low battery – Programmable.
Output #3 The protected load is not receiving power from the UPS.
Output #4 Replace the UPS batteries.
Output #5 The UPS is overloaded.
Output #6 Any UPS fault or self-test failure.

49-2.11.F.(6) Batteries:

Batteries must be maintenance-free, type AGM/VRLA (Absorbed Glass Mat / Valve Regulated Lead Acid), such as APC Smart-UPS RMXL or approved equal. Batteries must be independently pre-wired and individually fused. Batteries must be furnished with heavy-duty 50-amp rated silver-plated Anderson connectors. Batteries must be equipped with a 100-amp internal fuse. Batteries must be lightweight for personnel safety and protection plus ease of installation and maintenance. Batteries with a weight of over 26lbs are not acceptable.

49-2.11.F.(7) Enclosure Temperature Compensation:

Operating temperature must be between -37 and +74 degrees C.

49-2.11.F.(8) Power System Analyzer and Conflict Resolution Module:

The UPS must incorporate an integrated Power System Analyzer and Conflict Resolution Module. The Analyzer must evaluate and make limited adjustments to the incoming utility power and will automatically transfer load to the UPS battery back-up power if utility power is lost. When utility power becomes available, the system must provide automatic UPS failure detection and automatically isolate the failed UPS and transfer the load back to utility power. Once the failure has been corrected, the system must return to the normal operation. At a minimum, the system must include the following:

Triple Bypass System for Offline UPS:

1. SPACT – Smart Power Analyzer with Conflict Monitor Isolation and Transfer Module.
2. PCM – Power Conflict Monitor

3. The PCM is a totally redundant failsafe system. The PCM monitors load bus power available continuously. If load bus power fails for 5ms the PCM will transfer and isolate the UPS and guarantee that commercial power will be locked on.
4. Watchdog Timer – Redundant 5 ms delay and hard transfer to utility power.
5. The outboard Smart Transfer Switch must not interrupt the normal controller function. Transfer time must be 2ms.
6. Onboard Smart I/O module will execute lockout of battery back up system upon Smart detection of any inverter UPS fault. If UPS resets itself, it will automatically be available for backup.

Smart Battery Charger:

Must charge from shut off discharge to 95% fully charged in less than 6 hours. Batteries must be ambient enclosure compensated to less than 120 degrees F. The battery charger must utilize Smart Cell Technology to extend battery life.

49-2.11.F.(9) Warranty:

Manufacturers must provide a 2 year factory-replacement parts warranty on the Battery Backup System. Batteries must be warranted for full replacement for 2 years. The warranty is included in the total lump sum price paid for the traffic signal modification.

Supply and installation of service can with battery backup unit is included in the lump sum price paid for traffic signal installation and no additional payment will be made.

49-2.12 Testing

Testing must conform to Section 86-2.14, “Testing”, of the State Specifications, except that the third paragraph of Section 86-2.14C, “Functional Testing”, does not apply, and these Specifications.

Any fault in any material or in any part of the installation revealed by testing must be replaced or repaired by the Contractor, at the Contractor’s expense, in a manner approved by the Agency, and the same test must be repeated until no fault appears.

Attention is directed to the additional requirements in the Contract regarding notifications, scheduling, and approval of testing for traffic signal and street lighting work.

New or modified street lighting work must be tested with lamps being energized for 24 hours continuously. The tests of the street lighting are to identify the light distribution patterns, determine the acceptability of the ballasts, fixtures and lamps for electrical and noise standards, verify that all connections are electrically and mechanically sufficient, and other purposes as directed by the Agency or stated in the Special Provisions. The Contractor must furnish all material and equipment for the testing at the Contractor's expense.

49-2.13 Painting

Unless otherwise specified or shown in the Contract Documents, painting must conform to the State Specifications and these Specifications. Painting of existing steel street light poles, decorative street light poles, signal appurtenances, and bridges must conform to the Special Provisions.

Painting of newly installed decorative street lights consisting of a steel pole and cast iron decorative base cover must conform to the following specifications.

A. Painting must conform to Section 59, “Painting”, of the State Specifications, with the following additions and modifications:

1. Paint materials, unless otherwise specified, must conform to Section 91, “Paint”, of the State Specifications.

2. A Certificate of Compliance must be furnished in conformance with the provisions in Section 6-3.05E, “Certificates of Compliance”, of the State Specifications, certifying that the coating system furnished complies in all respects with the Contract. Coatings may be applied

before Certificates of Compliance have been received. The Certificates of Compliance must accompany the order when shipped and be supplied to the Agency.

3. The steel street light pole, cast iron base, and light fixture must be painted and fully cured at the time of manufacture and shipped to the job site ready for installation.

4. Light fixtures must be powder coated. Surface preparation and coating application must be in conformance with both light fixture manufacturer's specifications and coating manufacturer's recommendations. Color will be a Federal Standard 595B color number as specified in the Contract.

B. Surface Preparation (steel pole & cast iron base)

1. All surfaces to be painted must be cleaned in conformance with the requirements in Surface Preparation Specification No. 6, "Commercial Blast Cleaning", of the Steel Structures Painting Council (SSPC-SP6).

2. Cleaning must leave all surfaces with a blast profile consisting of a dense, uniform, angular anchor pattern of 1.5 to 2.5 mils as measured in conformance with the requirements in ASTM D4417.

3. All burrs and weld splatter must be completely removed.

4. All surfaces must be clean, dry, and free of any dirt, chalk, dust, oil, grease, salts, curing compounds, release agents, preservatives and other detrimental foreign matter before coating application is performed.

C. Coating Application (steel pole & cast iron base)

1. All paint must be applied in accordance with the manufacturer's recommendations and these Specifications. Manufacturer's recoat windows must be adhered to.

2. Apply one prime coat of an epoxy coating. Coating manufacturer and product identification will be indicated in the Contract, and approved by the Sacramento County Department of Transportation Street Light Operations Section. Dry film thickness must be between 4 and 8 mils.

3. Apply one intermediate color coat of polyurethane. Coating manufacturer and product identification will be indicated in the Contract, and approved by the Sacramento County Department of Transportation Street Light Operations Section. Dry film thickness must be between 2 and 3 mils.

4. Apply one finish clear coat of polyurethane. Coating manufacturer and product identification will be indicated in the Contract, and approved by the Sacramento County Department of Transportation Street Light Operations Section. Dry film thickness must be between 2 and 3 mils.

5. Total system dry film thickness must be a minimum of 9 mils.

6. The bottom of the base plate and the interior of the steel street light pole up to the handhole must be coated with one coat of the epoxy primer (6 to 8 mils dry film thickness). The top and edges of the base plate and the exterior of the pole must be multi-coated as detailed above.

7. The interior of the cast iron base, including the access doors, must be coated with one coat of the epoxy primer (between 6 and 8 mils dry film thickness). The exterior and edges of the cast iron base, including the access doors, must be multi-coated as detailed above.

8. The access doors on the cast iron base must be removed during the painting process.

9. The color coat polyurethane will be a Federal Standard 595B color number as indicated in the Contract, or as directed by Agency.

D. All coatings must comply with Proposition 65 regarding cancer-causing agents.

E. All street light components must be packaged for shipping to prevent damage to the coatings during loading, transport, and unloading.

F. An appropriate quantity of touch-up paint (epoxy primer, color polyurethane, and clear polyurethane) must be supplied with each shipment.

G. After installation of the street light (pole, decorative base cover, and fixture), any damaged coatings must be repaired with the supplied touch-up paint. Clean and prepare the damaged area by abrading with 100 grit sandpaper.

49-3 CONTROLLER ASSEMBLIES

All controller assemblies will be furnished by the Agency unless otherwise shown or specified in the Contract.

The controller assemblies must be installed complete by the Contractor. The Contractor must construct the foundation and install the controller cabinet on the constructed foundation as shown on the Plans and as designated by the Agency. Seams where the controller cabinet rests on the foundation must be sealed with an approved joint sealing compound. The Contractor must make all wire connections to the appropriate terminals in the cabinet. All detector equipment external to the wired cabinet must be furnished and installed by the Contractor. The Contractor must provide anchor bolts for each controller cabinet.

Upon the receipt of a written request to the Agency at least 2 Working Days in advance, equipment and materials will be made available to the Contractor for pick up. The Contractor is responsible for the safe pickup and delivery of the Traffic Controller Assemblies to the work site. Traffic Controller Assemblies must be delivered directly to the work site and installed the same day they are acquired by the Contractor. See Section 49-7, “Agency-Supplied Equipment”, of these Specifications for time, place, and person to contact for pick up arrangements.

49-4 TRAFFIC SIGNAL FACES AND FITTINGS

Traffic signal faces and fittings must conform to the State Specifications, and these Specifications.

49-4.01 Vehicle Signal Faces

All vehicle signal sections, housings, and visors must be metal. The Contractor must remove all manufacturing labels from the traffic signal head lenses prior to installation.

All vehicle signal heads supplied by the Contractor must have 12-inch (300mm) signal faces. All vehicle signal heads must be illuminated by light emitting diode (LED) units that are Caltrans-approved. The LED modules must be Gelcore or Dialight or County approved equal.

49-4.02 Programmable Directional Louvers

Plastic programmable directional louvers are only permitted where shown or specified in the Contract. Plastic programmable directional louvers must be Pelco Brand GPL (Geometrically Programmed Louver) or approved equal.

49-4.03 Backplates

Backplates must be furnished and installed on all vehicle signal faces. All backplates must be metal.

49-4.04 Pedestrian Signal Faces

Pedestrian signal heads must be of the “countdown” variety and must conform to the following specifications:

1. The design of pedestrian signal heads must conform to Sections 4E.04, “Size, Design, and Illumination of Pedestrian Signal Head Indications” and 4E.07, “Countdown Pedestrian Signals”, of the current edition of the Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD), including approved errata, revisions, and California supplements, the State Specifications, and these Specifications.
2. The housing, finish, control, and terminal blocks of pedestrian signal heads must conform to the State Specifications, except that the housing must be metal.

3. The display of pedestrian signal heads must consist of integrated WALKING PERSON and UPRAISED HAND symbols on the left side and a countdown timer display on the right side. The integrated WALKING PERSON and UPRAISED HAND symbols portion of the display must conform to the documents listed in item 1 above. In addition, the WALKING PERSON and UPRAISED HAND symbols must be Caltrans-approved LED type and must be solid. Outline style symbols must not be used. The countdown timer portion of the display must conform to the documents listed in item 1 above and the specifications in item 4 below.
4. The countdown timer portion of the display must consist of Portland orange numbers that are 9 inches in height on a black opaque background. The display must be capable of indicating the numbers 0 through 99 inclusive. The numbers 0 through 9 inclusive must be displayed as a single digit (i.e. without a leading zero, the left digit dark). The display must be high-intensity LED type in conformance with Caltrans specifications for LED modules. The display must be legible, day or night, from a minimum distance of 120 feet from the signal. The timer must calculate and display the appropriate Flashing Don't Walk time, as programmed on the signal controller, after one cycle of Flashing Don't Walk operation. The timer must continuously recalculate Flashing Don't Walk time each cycle so that the unit will display the proper Flashing Don't Walk time after any change in the settings for that phase on the traffic signal controller. If the Flashing Don't Walk timing is interrupted or shortened (e.g. transition into a preemption sequence or transition to flashing mode), then the countdown timer portion of the display must be discontinued and go dark immediately.
5. Each pedestrian signal head must have an egg crate or Z-crate type screen as specified under number 2 of Section 86-4.03B, "Front Screen", of the State Specifications, modified as follows:
 - a. The screen must be fabricated from aluminum anodized flat black or finished with lusterless black exterior grade latex paint formulated for application to properly prepared metal surfaces, or must be fabricated from flat black plastic.
 - b. The frame for the screen must be aluminum alloy; polycarbonate will not be allowed.
 - c. The only alternate method of screening allowed is to eliminate the screen completely and design the pedestrian signal head display so the results are at least equal to those obtained with the use of the egg crate or Z-crate type screen as determined by the Agency.
 - d. Visors are not required for pedestrian signal faces.

The Contractor must mount the framework for all pedestrian signals so the terminal section is positioned on the back side of the associated traffic signal poles, i.e., the side furthest from the public roadway.

The following meet the standards for Pedestrian Signal Heads and are approved for use on Sacramento County signals:

- Countdown module model LEDP-HMC-001 manufactured by US Traffic;
- Gelcore countdown module PS7-CFF1-01; and
- Signal housing model 4302OG, painted olive green, manufactured by US Traffic.

49-4.05 Audible Pedestrian Signals

In addition to each standard pedestrian signal shown on the Plans, the Contractor must supply and install audible pedestrian signals. One audible pedestrian signal unit must be supplied and installed for each standard pedestrian signal head installed under the Contract. Audible pedestrian signal units must be model APS-10 by Indicator Controls Corporation, or approved equal. Unit output volume must be field adjustable and must be capable of output of not less than 90db at 1 watt/1 meter. Units must be capable of automatic self-adjustment of

output volume depending on ambient noise conditions. The type of signal output must be field-selectable, with each unit capable of emitting both a “cuckoo” signal and a “peep-peep” signal.

Audible pedestrian signal units must be mounted on top of the standard pedestrian signal heads with the face of the units tipped downward such that they are directed toward a point 5 feet above the roadway surface in the center of the crosswalk at the edge of pavement on the opposite side of the associated crosswalk. Mounting of audible pedestrian signal units must conform to manufacturer’s recommendations and as directed by the Agency in the field.

49-5 DETECTORS

Detectors must conform to the State Specifications, and these Specifications.

Traffic signal loop detectors must be installed as shown on the plans and as detailed on Standard Drawings 5-24 and 5-44.

At locations where existing loop detectors are damaged, the Contractor must replace the damaged loop detectors with new loop detectors meeting the Agency’s current standards. At advanced detector locations, loop detectors that are more than 100 feet from the associated stop bar at the signalized intersection, the Contractor must replace any damaged loop detector with a new Type A loop detector (one per lane). If there is no existing detector handhole in the vicinity of the new loop detector, a new detector handhole and conduit connecting to the associated pull box must be supplied and installed. At presence detection locations, loop detectors that are less than 100 feet from the associated stop bar at the signalized intersection, the Contractor must replace any damaged loop detector with one or more Type A loop detectors as needed so that there are 4 working loop detectors per lane, spaced as shown on Standard Drawing 5-24 and 5-44. If there is no existing detector handhole in the same lane as the new loop detector(s), a new detector handhole and conduit connecting to the associated pull box must be supplied and installed. Unless otherwise indicated on the plans, all costs associated with the replacement of damaged loop detectors, including the supply and installation of detector handholes and connecting conduits, will be borne by the Contractor.

49-5.01 Vehicle Detectors

Unless otherwise specified in the Contract, all vehicle detector sensor units in the controller cabinet will be provided by the Agency.

Splices must be insulated as specified in these Specifications.

Detector lead-in cables must be continuous, without splices, from the controller cabinet detector panel terminal block to the loop termination pull box unless otherwise shown on the Plans.

49-5.01.A Construction Materials

Each inductive detector loop conductor must be continuous, unspliced, Type RHW-USE neoprene-jacketed or Type USE crosslinked polyethylene insulated No. 12 stranded copper wire. Conductor insulation thickness must be a minimum of 40 mils.

Loop detector lead-in cable must consist of 4 No. 18 AWG stranded copper conductors insulated with 9 mils minimum of polypropylene, color coded, parallel laid, twisted together with 4 to 6 turns per foot. An amorphous interior moisture penetration barrier must be provided to prevent hosing, siphoning, or capillary absorption of water along cable interstices. Aluminum-polyester shielding must be applied around the conductors. The outer jacket must be 32 mils minimum thickness, high density polyethylene conforming to ASTM D1248, 65T for Dielectric Material, Type I, Class C, Grade 5, J3. The diameter of the lead-in cable must be approximately 1/4 inch.

49-5.01.B Installation Details

Installation and testing must conform to the details and notes shown in the Standard Drawings and these Specifications.

Unless otherwise indicated in the Contract, loop detectors must be installed after the construction of all lower lifts of paving and after construction of pavement leveling courses but prior to the placement of the final lift of asphalt concrete for the affected portion of the roadway. Inductive loop detectors must be installed as shown on Standard Drawing 5-24, 5-44 and as specified in these Specifications. The Contractor must place all loop detectors in left turn lanes that adjoin a through traffic lane so that the loop detectors are 3.5 feet from the channelizing stripe that separates the left turn lane from the through traffic lane. Detector handholes must be centered in the associated vehicle lane and must be located approximately 4 feet clear of the nearest traffic signal loop detector. Loop detectors that are installed in the vehicle lane closes to the edge of pavement, either with or without curbs and gutters, must be constructed such that the wires connecting the loops to the associated detector handhole run on the side of the loops further from the edge of pavement.

Unless otherwise shown or specified in the Contract or directed by the Agency in the field, each new detector loop must be 5 feet by 5 feet and must be centered in the traveled lane. All detector loops must be field marked by the Contractor and their location approved by the Agency prior to pavement cutting. For installations that will serve lanes that are not parallel or concentric to lane markings existing at the time of loop installation, the Contractor must accurately mark the future lane lines prior to pavement cutting.

Sawcut slots must be cut into the pavement to the depth and width shown on the Standard Drawings. Slots cut in the pavement must be blown out with compressed air, then dried and inspected for any sharp objects or corners, which must be removed prior to installation of loop conductors. All conductors and conductor loops installed in the traveled way must be installed so that the top of the conductor is a minimum of 5/8 inch below the surface grade of the street.

Unless specified otherwise, each loop must consist of the 3 turns of conductors for each detector loop. All detector loops located two hundred 250 feet or farther from the stop line must consist of 4 turns of conductors for each detector loop.

The loop conductors must be installed in the slots using a 5/16 to 1/4 inch wooden paddle. As it is installed, the wire must be kept under slight tension and must be kept in the slots with suitable cardboard wedges. The cardboard wedges must not be removed until the loop sealant operation requires removal.

Loop conductors must be installed without splices and must terminate in the nearest pull box. Detector loops must be joined, in series, in the nearest pull box. See the Standard Drawings for typical loop connection details.

Each detector loop must be identified and tagged by loop number, start (S), and finish (F). Loop lead-ins must be individually identified as shown on the Plans. Identification must be by means of bands placed on the lead-in cable.

Each detector loop circuit must be tested for continuity, circuit resistance, and insulation resistance at the controller location. The loop circuit resistance must not exceed 0.50 ohms plus 0.35 ohms per 100 feet of lead-in cable. The insulation resistance must be performed between each circuit conductor and ground. The megged insulation resistance must not be less than 200 megohms. The Contractor must replace any detector loop that fails this test at the Contractor's expense. All test results and corrections of failures must be documented. Test documentation must be provided to the Agency to become a permanent record for future reference. All testing must be completed to the satisfaction of the Agency prior to traffic signal turn-on.

All loop conductors must be spliced to a lead-in cable, which must be run from the pull box adjacent to the loop detector to a sensor unit mounted in the controller cabinet. All splices between loops and the lead-in cable must be soldered.

If the conduit is not dry, the ends of all lead-in cable must be taped and waterproofed prior to installation. If splicing is not done immediately after installation, the ends of both the loop conductors and lead-in cable must be taped and waterproofed with an electrical insulating

coating. The insulating coating must be fast drying, resistant to oils, acids, alkalis and corrosive atmospheric conditions and must be compatible with the insulations used in the conductors and cables.

Sealant for inductive loop detectors must be supplied and installed by the Contractor in accordance with the State Specifications, and these Specifications.

Sealant for loop detectors must be as specified for Elastomeric Sealant. Epoxy sealant will not be permitted. The Agency might allow the use of Asphaltic Emulsion Sealant in areas scheduled for asphalt concrete overlay.

Detector handholes must be type "B." Detector handholes must be installed at the locations shown on the Plans, in the center of the lanes and in conformance with the Standard Drawings. The cement used to join the ABS sweep "Y" to the PVC conduit must be capable of providing a solvent type weld between the two materials.

49-5.01.C Splicing Details

All splicing must be made in a dry environment. The splice between the lead-in cable and the loop conductors in the adjacent pull box must be a soldered waterproof type. This must be accomplished by stripping and cleaning ends of wires, twisting ends together, dipping twisted ends in flux, then soldering. Open flame soldering will not be permitted. Wire insulation must not be damaged while soldering. The soldered splice must be protected with an electrical spring connector of 3-part construction.

The 3-part construction spring connector must consist of a zinc-coated, free-expanding steel spring enclosed in a steel shell with a jacket of polyvinyl chloride. The outer jacket must have a flared skirt, be flexible, and be able to withstand 105 degrees C temperature continuously. Each splice must have the spring connector sized in accordance with the manufacturer's recommendations for the number of conductors and gauges being spliced. Wire strip lengths must also be in accordance with the manufacturer's recommendations.

After the spring connector has been applied to the splice, the Contractor must apply tape sealant to the splice. The tape sealant must be applied over the entire area of the splice and overlap the spring connector and detector lead-in cable at least 1-1/2 inches. The tape sealant must be Thomas and Betts Catalog No. HSTS25 or approved equal.

The Contractor must then apply heat-shrink tubing over the splice. Heat shrink tubing must be medium or heavy wall thickness irradiated polyolefin tubing containing an adhesive mastic inner wall. Minimum wall thickness prior to contraction must be 0.04 inch. When heated, the inner wall must melt and fill all crevices and interstices of the object being covered while the outer wall shrinks to form a waterproof insulation. Each end of the heat-shrink tube or the open end of the end cap of heat-shrink tubing must, after contraction, overlap the conductor insulation at least 1-1/2. Heat shrink tubing must conform to the requirements of UL Standard 468D and ANSI C119.1, for extended insulated tubing at 600 volts. The Contractor must use the appropriate size heat-shrink tubing from the following Thomas and Betts Catalog Numbers HS6-1, HS6-1L, HS4-30, HS40-400 or equal product if approved by the Agency.

All heat shrink tubing must meet the following requirements:

Shrinkage Ratio:	33 percent, maximum, of supplied diameter when heated to 125°C and allowed to cool to 25°C
Dielectric Strength:	350 kilovolts per inch, minimum
Resistivity:	10 ¹⁴ ohms - centimeter, minimum
Tensile Strength:	2,000 lbs. per square inch, minimum
Operating Temperature:	-40°C to 90°C (135°C Emergency)
Water Absorption:	0.5 percent, maximum

When 3 or more conductors are to be enclosed within a single splice using heat-shrink tubing, mastic must be placed around each conductor, prior to being placed inside the heat-shrink tubing. The mastic must be the type recommended by the manufacturer of the heat-shrink tubing.

Heat-shrink tubing must not be heated with an open flame. A heating device designed for the purpose is required. Immediately after heating the splice and while the internally-applied sealant is still liquid, the open end of the splice must be clamped together until the sealant dries.

If any detector lead-in splice fails within 1 year due to poor workmanship, the Contractor must replace all detector lead-in splices made by the Contractor within the intersection.

Where shown on the Plans, detector loops must be sawcut into detector handholes. Detector handholes must be installed in accordance with these Specifications and as shown on the Standard Drawings unless otherwise specified or directed by the Agency. Splicing in the detector handholes is not permitted.

Conduit from the detector handhole to the adjacent pull box must be sized as shown below:

Conduit Size	Loop Conductors
1-1/2" minimum	1-4 pairs
2" minimum	5 or more pairs

49-5.01.D Video Detector System

A video detection system must be supplied and installed for those locations indicated in the Contract. Unless there is a bid item for video detection system, the video detection system, including but not limited to specified hardware, software, warranty, maintenance, and support, is included in the lump sum price paid for the traffic signal installation, and no additional payment will be made.

This video detection specification is the minimum requirements for a system that detects vehicles on the roadway using monochrome or color video images of the vehicle traffic and provides detector outputs to a traffic signal controller. The system must consist of one or two video cameras, a video detection processor (VDP), extension module/s (EM) appropriate for the installation, and a pointing device. The VDP and EM/s must be designed to function in a standard Detector Input File. The VDP and EM must meet the Type 170, 170E, 2070, NEMA TS1 and TS2, and ATC environmental specifications. The system must be Iteris' Vantage Edge II™, Traficon VIP3D.2™, or approved equivalent.

49-5.01.D.(1) Functional Capability:

The system must use NTSC or PAL composite video from a camera(s) to detect vehicles on the roadway. The video signal must be digitized and analyzed in real time. The dual camera VDP must process the video from two cameras simultaneously. The VDP must support a minimum of 24 detection zones within a camera field-of-view (FOV). Each zone must be individually capable of detecting a licensed motor vehicle, bicycles, or pedestrians. Supported detection types must include pulse, presence count extend and delay. Logical operations of 'AND' and 'OR' must be supported. The VDP must also support delay inhibit inputs. The VDP must provide a 'failsafe' output in the event of loss of video or internal failure. System programming must be accomplished via a standard pointing device using a menu overlaid on the monitor screen. System setup or operation must not require a computer.

49-5.01.D.(2) VDP and EM Hardware:

The system must employ plug-in based units compatible with a standard Type 170/332, 2070, NEMA TS1 and TS2, and ATC systems. The VDP must be 2 units wide. The EM must be available in both single unit wide (2 Channel) and two unit wide (4 Channel) forms. EM must be automatically recognized and addressed by the VDP when connected. The VDP must

support sufficient EM's to provide a minimum of 24 outputs per camera input. Both the VDP and EM will provide front panel LED indicators for each output channel and a miniature 3-position switch to provide temporary detection activation. Video input and output must be by means of standard BNC type connectors. Provision for input video impedance matching must be provided by means of a simple jumper arrangement. The units must be addressable and capable of multi-drop communications.

49-5.01.D.(3) Video Detection Camera:

The camera must be housed in a sealed environmental enclosure with integral thermostatically controlled heater. The enclosure must be provided with an adjustable sunshield. The camera bracket must be included and provide for full 360-degree pan adjustment using simple hand tools. The enclosure must provide for separate connectors for the power and video signal. Video surge suppression should be provided for each video input.

49-5.01.D.(4) Video Camera Cabling:

Video camera cable must be per the Manufacturer's Specifications and must be provided by the Contractor for each camera between the camera mounting location and the controller cabinet.

49-5.01.D.(5) Firmware:

The detection algorithms must be stored in FLASH memory and be upgradeable by using a manufacturer supplied floppy disc or CD ROM. Upgrading must be by means of a laptop computer connected directly to the front panel RS-232 connector. Upgrades must be provided on a periodic basis at no cost to the user.

49-5.01.D.(6) Remote Access Software:

Included at no additional cost must be full-function remote access system software, which will support both local and remote configuration.

49-5.01.D.(7) Installation:

The product supplier of the video detection system must supervise the installation and the testing of the video equipment. A factory certified representative from the manufacturer must be on-site during installation, and is responsible for determining the final locations of the video detection cameras. The factory representative must install, make fully operational, and test the system per the manufacturer's recommendations, the Contract, and these Specifications.

49-5.01.D.(8) Warranty:

The supplier must provide a limited 2-year warranty of the video detection system. During this period technical support must be available from factory-certified supplier personnel via telephone within 4 hours of receipt of your request.

49-5.02 Emergency Vehicle Detector Cable, Detectors, and Phase Selectors

The Contractor must supply and install 3M Opticom cable model 138, or approved equal, where emergency vehicle detector (EVD) conductors are shown on the Plans. Opticom cable must be installed to the EVD installed on the traffic signal mast arms, as shown on the Plans.

The Contractor must supply and install EVD's for each mast arm signal installation and at locations shown on the Plans. Unless otherwise shown on the Plans, EVD's must be 3M Opticom model 721, or approved equal. EVD's must be installed on the top of the signal mast arm at the locations indicated on the Plans or at the location on the mast arm as directed by the Agency in the field. For each EVD installation, the associated cable must be continuous and unspliced from the detector to the controller cabinet. The Contractor must provide for 5 feet of conductor slack in the pull box at the base of each pole with an EVD installation.

Unless otherwise shown or specified in the Contract, the Contractor must supply two (2) EVD phase selectors for each new traffic signal controller cabinet installed under the Contract.

EVD phase selector(s) must be 3M Opticom model 752 or approved equal. The Contractor must supply the phase selector(s) to the Agency a minimum of 2 weeks prior to the date of traffic signal controller cabinet installation.

49-5.03 Pedestrian Push Buttons

The Contractor must supply and install push buttons that provide accessible pedestrian signals to users. The push buttons must have the following features integrated into the devices:

1. an audible push button locator tone,
2. an audible walk signal and
3. a tactile arrow.

Operation of the push button must activate both the “walk” interval and the accessible pedestrian signals. During the “walk” phase of signal operation the associated pedestrian push button must have both audible and vibrotactile indications. The vibrotactile indication must be provided by a tactile arrow on the push button that has high visual contrast (light on dark or dark on light), must be aligned parallel to the direction of travel on the associated crosswalk, and must vibrate during the “walk” interval.

The audible “walk” indication must be a tone that repeats at 8 to 10 ticks per second during the entire “walk” phase. The audible tone used as a “walk” indication must consist of multiple frequencies with a dominant component at 880 Hz.

The unit must be able to produce a speech message that can be used instead of the above described audible “walk” indication. The speech message must be customizable for the location where the device is installed. For example, a unit installed at a crosswalk that crosses Main Street must be able to produce a speech message that says, “Main Street. Walk sign is on to cross Main Street.”

The volume of the “walk” indication, the speech message, and of the locator tone, must be set to a maximum of 5dBA louder than ambient sound. The device must provide for automatic volume adjustment in response to changes in ambient traffic sound levels up to a maximum volume of 100dBA.

Following the audible walk indication, the accessible pedestrian signal must revert to the push button locator tone during the pedestrian change interval. The push button locator tone must have a duration of 0.15 seconds or less and must repeat at 1 second intervals. The locator tone must be deactivated when the traffic signal is operating in a flashing mode. The locator tone must be intensity responsive to ambient sound, and must be audible six to twelve feet from the installed location of the push button.

The housing for the accessible pedestrian signal device must incorporate mounting space for the pedestrian push buttons signs described below.

The County has preapproved the use of the following accessible pedestrian push button signal devices:

- Navigator Accessible Pedestrian Signal by Polara Engineering, Inc. (four wire system)
- Advisor Accessible Pedestrian Signal by the Campbell Company

Use of other devices that meet the requirements above might be allowed upon review and approval by County of Sacramento’s Department of Transportation. The Contractor may propose use of a device other than one of the ones listed above by supplying manufacture’s information about the proposed device a minimum of 3 weeks prior to the date planned for ordering the equipment. The Agency may request submittal of a sample device for testing.

In addition to the pedestrian push buttons shown on the Plans, the Contractor must provide the Agency with one additional push button unit including control module. The push button unit must match the ones installed on the project and must meet all of the above requirements.

Pedestrian push button signs must be 5 inch by 7-3/4 inch metal as manufactured by Pelco

Products Inc., model SF-1017-05 (left arrow) and model SF-1018-05 (right arrow), or approved equal.

Each pedestrian push button unit must be mounted on traffic signal poles so the center of the portion of the unit that is intended to be pushed is located no lower than 42 inches above the surface of the sidewalk or walkway adjacent to the pole. At locations where installation of the pedestrian push button is not practical at 42 inches, the unit must be placed so the portion of the unit that is intended to be pushed is located between 42 and 48 inches above the surface of the sidewalk or walkway adjacent to the pole.

49-6 LIGHTING

Lighting must conform to the State Specifications, and these Specifications.

49-6.01 NOT USED

49-6.02 Photoelectric Controls

The control circuit wiring between the photoelectric unit and the contactor must be installed as shown on the Standard Drawings.

Unless otherwise shown or specified in the Contract, the photoelectric controls must be Type II as modified herein. Type II photoelectric control must consist of a luminaire mounted EEI-NEMA twist-lock type photoelectric unit in a weatherproof housing, a separate contactor and a test switch located in the service enclosure.

Switches must be furnished with an nameplate reading "Hand-Off-Auto" and must be connected as specified in Section 49-2.11, "Service", of these Specifications and as shown on the Standard Drawings. Test switch must have an "OFF" position.

49-6.02.A Photoelectric Unit

The photoelectric unit will be supplied by the Contractor. The photoelectric unit must be compatible with Light Emitting Diode (LED) street light luminaires. Photoelectric units must be Dark to Light DLL Elite long life LED photocell – DLL127 F 1.5, or approved equal.

The photoelectric unit receptacle must be an EEI-NEMA twist-lock type and must be provided on the luminaire(s) as shown on the Plans. If approved by the Agency, mounting brackets must be used where luminaire mounting is not possible.

49-6.02.B Contactors

Contactors must be as specified in Section 49-2.11, "Service", of these Specifications and as shown on the Standard Drawings.

49-6.02.C Contactor and Test Switch Housing

Contactor and test switch housing must be as specified in Section 49-2.11, "Service", of these Specifications and as shown on the Standard Drawings.

49-6.02.D Wiring

Wiring must be as specified in Section 49-2.11, "Service", of these Specifications and as shown on the Standard Drawings.

49-6.03 Light Emitting Diode (LED) Luminaires

LED luminaires must be of the wattage and ANSI light distribution pattern shown on the plans and specified in the Special Provisions. Safety light luminaires for use at signalized intersections must be on the list prepared by the State of California Department of Transportation titled "Pre-Qualified Product List LED Luminaires", latest version

The luminaire must consist of a housing, LED array, and electronic driver (Power supply). Each luminaire must be rated for a minimum operational life of 70,000 hours, and must be designed to operate at an average nighttime operating temperature of 70 degrees F. The

individual LEDs must be connected so that a catastrophic loss or failure of one LED will not result in the loss of the entire luminaire. The luminaires must be listed with Underwriters Laboratory, Inc., under UL1598 for luminaires, or an equivalent standard from a recognized testing laboratory.

The luminaires must operate at 60 Hz AC line over a voltage range of 95 to 250 Volts AC, and must have a power factor of 0.90 or greater. The on-board circuitry must include surge protection, and must prevent perceptible flicker to the unaided eye. The luminaire must be compatible with currently utilized lighting control systems and photocell controls as detailed these Specifications

The luminaire must have a correlated color temperature of 4,000K \pm 300, and a color rendition index of 65 or greater. The luminaire must have a BUG (Backlight, Uplight and Glare) rating of B2 U0 G2.

The heat sink material must be aluminum, and thermal management must be passive by design. The luminaire must contain circuitry that will automatically reduce the power to the LEDs to 50% of normal operating power, or to a level that will insure that the maximum junction temperature is not exceeded, when the ambient, outside air temperature is 100°F or greater.

The maximum weight of the LED luminaire must be 35 pounds, and the maximum effective projected area must be 1.4 square feet. The housing must be light grey in color. The housing must be constructed of materials that are designed to withstand a 1,000-hour salt spray test as defined in ASTM Designation B117. Each housing must be provided with a slip fitter, clamping bracket, and two or four bolts capable of mounting on mast arms from 1-5/8 to 2-3/8 inch outside diameter.

The optical assembly of the luminaire must be protected from dust and moisture intrusion per the requirements of IP-66. The electronics/power supply enclosure must be protected per the requirements of IP-43 (Minimum).

Each luminaire must be supplied with a photoelectric unit receptacle and rain tight shorting cap.

Field wires connected to the luminaire must terminate on a barrier type terminal block secured to the housing. When components are mounted on a down-opening door, the door must be hinged and secured to the housing. A safety cable must mechanically connect the door to the housing.

Luminaires must be vibration tested in conformance with California Test 611, or other internationally recognized vibration test standard.

Each luminaire must have the manufacturer's name, trademark, model number, serial number, and date of manufacture (Month-Year) permanently marked inside each luminaire and outside of each box. Each luminaire must be marked on the underside with a suitable decal visible from the ground that includes the fixture's system wattage and identifies the luminaire as an LED type.

The manufacturer must provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 84 months after acceptance of the luminaires. The warranty must include language indicating that replacement luminaires must be provided promptly after receipt of luminaires that have failed, at no cost to the County.

49-7 AGENCY-SUPPLIED EQUIPMENT

All equipment and materials supplied by the Agency will be available to the Contractor at the County Corporation Yard at 4135 Traffic Way near the intersection of Bradshaw Road and Kiefer Boulevard. The Contractor must inform the Agency and the Traffic Signal and Street Light Manager (875-5327) at least 2 Working Days in advance of date equipment pickup is required. The hours for pickup are 9:00 a.m. to 3:00 p.m. Monday through Thursday. Full

compensation for pick-up and transport to the job site is considered as included in the lump sum price for the traffic signal work.

49-8 REMOVING AND SALVAGING ELECTRICAL EQUIPMENT

All traffic signal and street lighting equipment shown on the Plans as "Salvaged to the County", including but not limited to such items as controller units, cabinets, signal heads, luminaires, standards, mast arms, ballasts, service equipment, conduit, conductors, cables, and detector contact items, must be delivered, in the same condition as before removal, by the Contractor to the County Corporation Yard located at 4135 Traffic Way.

All poles, signal arms, luminaire arms, tie rods, and appurtenances must be tagged with a suitable waterproof tab and marking pen before removal from the work site. The tag must give the date, the intersection name, corner, and location from which the equipment was removed as shown on the Plans.

The Contractor must inform the County Traffic Signal Shop (875-5327) at least 2 Working Days in advance of the date equipment drop-off is required. The hours for drop-off are 9:00 a.m. to 3:00 p.m., Monday through Thursday. The Contractor must be responsible for unloading the equipment at the County Corporation Yard, including providing any necessary cranes or other lifting devices. Full compensation for transport to and drop-off at the County yard is considered included in the lump sum price paid for the traffic signal work. All other traffic signal and street lighting equipment shown on the Plans as salvaged become the property of the Contractor and must be removed from the right-of-way by the Contractor.

49-9 PAYMENT

The lump sum price or prices paid for signal, lighting, electrical system, or combinations thereof; for modifying or removing such systems; for temporary systems; or the lump sum or unit prices paid for various units of said systems include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing, modifying, or removing the systems, combinations or units thereof, as shown or specified in the Contract, these Specifications, and directed by the Agency. The price also includes pull boxes; excavation and backfill; concrete foundations (except when shown as a separate contract item); pedestrian barricades; furnishing and installing illuminated street name signs; installing Agency-furnished sign panels and equipment; salvaging existing materials; and performing required tests.

Full compensation for all additional materials and labor, not shown or specified in the Contract or these Specifications, which are necessary to complete the installation of the various systems, is included in the prices paid for the systems, or units thereof, and no additional compensation will be paid. Full compensation for pick up and safe and direct transport of controller assemblies and other Agency-furnished materials and equipment to the Work is included in the price paid for the various items of work and no additional compensation will be paid.

Full compensation for loading and transporting the salvaged equipment to the stockpile location is included in the price paid for the various items of work and no additional compensation will be paid.