

**SECTION 80****FENCES**

Fences shall conform to Section 80 of the Caltrans Standard Specifications and these City Standard Specifications.

**80-1 GENERAL**

**80-1.05 Temporary Fencing.** - Temporary fencing, for the control, safety or convenience of traffic or the preservation of property required during the course of construction, shall conform to Section 80-4 of these specifications or as otherwise specified in the special provisions.

**80-4 CHAIN LINK FENCE**

**80-4.01 Materials.** - Chain link fence and gate materials shall conform to the specification provisions of AASHTO M181 and ASTM A392 and as modified herein.

The Contractor, through the manufacturer or fabricator, shall establish the necessary quality control and inspection practice to assure compliance with these specifications. The Contractor shall furnish a certificate of compliance, as specified in Section 6-1.07, "Certificates of Compliance," that all of the required tests have been made and the results comply with the requirements of these specifications.

**80-4.01A Posts and Braces.** - The base metal for the manufacture of posts and braces shall conform to the requirements of AASHTO M 181, except that steel made by the oxygen furnace process will be acceptable.

Gate posts shall be fabricated from pipe conforming to the requirements of ASTM A120 (Schedule 40).

Posts and braces shall be galvanized in accordance with the provisions in Section 75-1.05 "Galvanizing," except that galvanizing and sampling of pipe posts for performing galvanizing tests shall conform to the requirements of ASTM A120.

Posts and rails for vinyl coated chain link fence shall be hot dipped galvanized and covered with 2 coats of black metal paint applied over a metal primer.

**80-4.01B Fabric.** - The wire used in the manufacture of the fabric shall be 9-gage, or 0.148-inch nominal diameter coated wire, for all fences. The base metal of the fence fabric shall be steel of a quality and purity that, when drawn to the gage size of the wire specified and coated with zinc, the finished fence shall be of uniform quality and have the properties and characteristics as prescribed herein.

The diameter of the coated wire shall be determined as the average of 2 readings taken at right angles to each other on the straight portion of parallel sides of the mesh and measured to the nearest 0.001 inch. The permissible variation in diameter of the coated wire shall be plus or minus 0.005 inch. The tolerances shall apply to uniform areas of the galvanized wire only.

The size of mesh shall be 2 inches except for tennis court fabric, which shall be 1-3/4 inches. The permissible variation in size of mesh shall be plus or minus 1/8-inch. The size of mesh shall be determined by measuring the minimum clear distances between the wires forming the parallel sides of the mesh.

Chain link mesh to have slats inserted shall be 3 inch by 5 inch mesh.

Steel chain-link fabric is classified according to the weight of zinc coating on the fabric. The weight of zinc coating on Class 1 fabric shall be 1.2 ounces per square foot of uncoated wire surface. The average weight of zinc coating for Class 2 fabric shall not be less than 2.0 ounces per square foot of uncoated wire surface as determined from the average results of 2 or more specimens and not less than 1.8 ounces per square foot of uncoated wire surface for any individual specimen.

Unless otherwise shown on the plans or specified in the special provisions, Class 1 chain link fence fabric shall be used.

Vinyl coated chain link fence shall be black polyvinyl chloride coated steel link fabric and fittings. Polyvinyl chloride shall be applied by the thermal extrusion process.

**80-4.01C Miscellaneous.** - Wire fasteners, if required, shall consist of a 12-gage (0.108 inch diameter) galvanized, hard, bright, basic iron wire "S" clip with 1/2-inch inside diameter loops and 1/4-inch end openings.

**80-4.01D Gates.** - Drive gates are classified as either single or double. Welding shall conform to the requirements of AWS D2.0. Gate frames shall be galvanized after fabrication.

**80-4.01E Slats.** - Chain link with slats shall be Viewguard Fabric with PDS slats or approved equal. Chain link fabric shall be pre-woven with 2-3/8 inches wide brown virgin polyethylene slats with ultra violet inhibitors with a wall thickness of .030 inch plus .003 inch. The length of the slats shall be 3-1/2 to 3-3/4 inches shorter than the height of the chain link fence to allow for the installation of the bottom retaining channel.

**80-4.02 Construction.** - At locations where breaks in a run of fencing are required for gates or at intersections with existing fences, adjustments in post spacing shall be made to conform to the requirements for the type of closure indicated.

Unless directed by the Engineer, temporary guys or other braces as required shall be installed to hold posts in proper position until the concrete has set.

## SECTION 81

## MONUMENTS

Monuments shall conform to Section 81 of the Caltrans Standard Specifications and these City Standard Specifications.

**81-1.01 Description.** - This work shall include furnishing and installing monuments.

**81-1.02 Materials.** - Survey monuments shall be portland cement concrete structures with brass discs. Concrete shall be "Class B" conforming to Section 90, "Portland Cement Concrete." The maximum aggregate size used shall be 3/4-inch.

Unless otherwise specified in the special provisions, survey marker discs shall be supplied by Contractor and shall be leaded red or semi-red brass conforming to ASTM Designation: B 584-88, Copper Alloy UNS No. C84400. The disc shall be 2-1/2 inches in diameter and not less than 2-1/2 inches long.

Mortar shall be "Class 1" as specified in Section 51-1.135, "Mortar."

Delete references to "Type D" from Section 81-1.02 of the Caltrans Standard Specifications.

The materials used in the construction of survey monuments shall conform to, and be tested for, the physical and composition requirements in accordance with the referenced ASTM Designation, or referenced specification sections.

**81-1.03 Construction.** - The brass disc shall be imbedded in the fresh concrete and centered within the cross ties of the survey point. The finished survey monument shall be cured and protected for such time as the Engineer may direct.

**81-1.04 Monument Cases.** - Where called for, monument cases shall be installed over new or existing monuments in accordance with the details as shown on the plans. The finished monument case shall be flush with the surrounding area and shall be secured by a concrete or mortar collar.

**81-1.06 Payment.** - The contract unit prices paid for survey monuments shall include brass discs unless otherwise specified in the specified provisions. The method of payment for monument cases is same as that provided for survey monuments.

**SECTION 82**

**MARKERS AND DELINEATORS**

Markers and delineators shall conform to Section 82 of the Caltrans Standard Specifications.

## SECTION 83

## RAILINGS AND BARRIERS

Railings and barriers shall conform to Section 83 of the Caltrans Standard Specifications and these City Standard Specifications.

**83-2 BARRIERS**

**83-2.01 Description.** - This work shall also consist of furnishing, placing, and maintaining, Type I, II, and III portable construction barriers, with or without warning lights, and Type IV permanent barriers at the locations as directed by the Engineer, in accordance with specifications in Section 12-3.02B, "Materials."

**83-2.01F Construction Barriers.** - Construction barriers of the type specified in the special provisions shall be furnished and set at locations as the Engineer may direct. The barriers shall be maintained for as long as necessary and shall be checked for their position location at the close of each day's activity and more often as necessary.

The batteries of warning lights shall be maintained at a high rate of charge at all times.

## SECTION 84

## TRAFFIC STRIPES AND PAVEMENT MARKINGS

Traffic stripes and pavement markings shall conform to Section 84 of the Caltrans Standard Specifications and these City Standard Specifications.

## 84-1 GENERAL

**84-1.01 Description.** - The traffic striping and pavement message markings shall conform to the standards, dimensions, and details as specified in the "Manual on Uniform Traffic Control Devices for Streets and Highways," U.S. Department of Transportation, Federal Highway Administration and the Caltrans "Traffic Manual."

**84-1.05 Striping Pattern.** - Traffic striping is classified by pattern of the center line or lane line and the marking line as follows:

Single Traffic Stripe	-	4 inch wide broken yellow line for center line or white for lane line.
Two-way Barrier Stripe	-	Double 4 inch wide solid yellow lines with 3 inch space between lines.
One-way Barrier Stripe	-	Double 4 inch wide yellow lines, one line broken and the other line solid, with 3 inch space between lines.
Edge Stripe	-	3 inch wide solid white line.
Stop Bar	-	Solid 12 inch wide white line.
Crosswalk Lines	-	Solid 12 inch wide white line each side of crosswalk boundary.

The pattern and color of traffic striping shall be as shown on the plans or as directed by the Engineer.

**84-1.06 Message Unit.** - Pavement message markings are classified by unit for the message conveyed as shown in the manuals referenced in Section 84-1.01.

The message marking shall be as shown on the plans or as directed by the Engineer.

**84-2 THERMOPLASTIC TRAFFIC STRIPES AND PAVEMENT MARKINGS**

**84-2.02 Materials.** - Thermoplastic traffic stripe material is classified by color only as either white or traffic yellow.

**84-2.04(A) Removal.** - Thermoplastic stripes and markings on existing surfacing shall be removed by grinding before placement of asphaltic concrete overlay.

**84-3 PAINTED TRAFFIC STRIPES AND PAVEMENT MARKINGS**

**84-3.02 Materials.** - Delete Rapid Dry Solvent Borne and Rapid Dry Water Borne paints from Section 84-3.02 "Materials" of the Caltrans Standard Specifications.

**84-3.05 Application.** - The finished paint shall have an opaque, well painted appearance, with no black or other discolorations showing through.

In restriping broken lines, the newly painted line shall exactly coincide with the original painting.

Traffic paint shall be applied at the following rates:

**BROKEN STRIPE**

**First Painting**

New surface, first coat . . . . .	4 to 5 gallons per mile
Second coat . . . . .	7 to 7.4 gallons per mile
Glass beads with second coat . . .	42 pounds per mile
Restriping . . . . .	7 to 7.4 gallons per mile
Glass beads . . . . .	42 pounds per mile

**SOLID STRIPE**

**First Painting**

New surface, first coat . . . . .	12 to 14 gallons per mile
Second coat . . . . .	16 to 18 gallons per mile
Glass beads with second coat . . .	110 pounds per mile
Restriping . . . . .	16 to 18 gallons per mile
Glass beads . . . . .	110 pounds per mile
Black traffic paint . . . . .	8 gallons per mile

**PAVEMENT MARKINGS**

**First Painting - Light Application to Seal Pavement**

Second coat . . . . .	1 gallon per 100 square feet
Glass beads . . . . .	6 pounds per gallon of paint
Repainting . . . . .	1 gallon per 100 square feet
Glass beads . . . . .	6 pounds per gallon of paint

When specified in the special provisions for single application of traffic paint, the rates shown for "second coat" shall apply.

**84-3.05A Temporary Striping.** - Self-sticking traffic marking tape, vinyl or otherwise, developed for such use, shall be used for temporary striping as required, unless shown otherwise on the plans or specified in the special provisions.



SECTION 85

PAVEMENT MARKERS

Pavement markers shall conform to Section 85 of the Caltrans Standard Specifications and these City Standard Specifications.

**85-1.01 Description.** - The manufacturer shall furnish a certificate of compliance, as specified in Section 6-1.07, "Certificates of Compliance."

## SECTION 86

## SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS

Signals, Lighting and Electrical Systems shall conform to Section 86 of the Caltrans Standard Specifications and these City Standard Specifications.

## 86-1 GENERAL

**86-1.01 Description.** - Delete paragraph 1 of Section 86-1.01 of the Caltrans Standard Specifications.

Electrical work shall consist of furnishing and installing, modifying, extending or removing one or more of the following systems: electrical distribution, controller assemblies, traffic signal, detectors, lighting, communications, flashing beacons, interconnection facilities, traffic count, sprinkler control, falsework lighting, pumping stations and sewer lift stations, temporary installations, and provisions for future systems or combinations thereof as shown

Where required, Traffic Controller Assemblies will be furnished by the City and shall be installed by the Contractor as part of the work unless otherwise noted on the Plans or in the Special Provisions.

Existing facilities which are to remain in place shall be protected as required by Section 7-1.11, "Preservation of Property."

The Engineer shall establish locations for standards, service cabinets and controller cabinets using stakes or marks on existing pavements or curbs. Such location stakes or marks shall be protected and preserved for however long as is necessary.

**86-1.015 Definitions.** -

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

**Signal Cycle** - A complete sequence of signal indications.

**Signal Standard** - Any pole which supports signal head(s).

**Traffic Signal Communications** - A method by which traffic signals are connected electrically through a multi-point analog communications system for central control, monitoring and data collection at individual intersections.

**86-1.02 Regulations and Code.** - Electrical equipment shall also conform to the following additional standards wherever applicable: The International Municipal Signal Association (IMSA); The Insulated Power Cable Engineers Association (IPCEA); The National Electrical Code as amended by the City of San Jose Municipal Code.

**86-1.03 Equipment List and Drawings.** - Delete paragraphs 2 and 3 of Section 86-1.03 of the Caltrans Standard Specifications.

## SECTION 86 SIGNALS, LIGHTING AND ELECTRICAL SYSTEMS

Following the review of the equipment and material lists, any correction or modifications shall be made, and not less than five complete sets shall be resubmitted to the Engineer. The City will not be liable for any material purchased, labor performed, or delay to the work prior to such review.

If ordered by the Engineer, the Contractor shall submit for review, sample articles of the material proposed for use. After review, said sample articles will be returned.

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

Where electrical equipment is provided by City for installation by the Contractor, the submission of detailed drawings and diagrams will not be required providing the Contractor makes no changes or modifications to the equipment.

Upon completion of the work, the Contractor shall prepare and submit one complete set of record drawings showing in detail construction changes of all traffic signal and streetlight wiring, conduits, standards, and associated equipment. In particular, record drawings shall accurately depict the location and depth of conduits, location of standards, pull boxes and wiring changes.

Record drawings shall be submitted prior to the time of acceptance of the work and shall meet the requirements of Section 5-1.04A "Record Drawings."

**86-1.05 Maintaining Existing and Temporary Electrical Systems. -** Delete paragraphs 1 and 2 of Section 86-1.05 of the Caltrans Standard Specifications.

Existing electrical systems, including traffic signals, traffic signal vehicle and pedestrian detection facilities, traffic signal communication and monitoring facilities, streetlighting facilities, flashing beacons and sign illumination facilities, or approved temporary replacements thereof, shall 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 shall notify the Engineer at least 24 hours prior to performing any work on existing systems, including any work which may take vehicle detectors or pedestrian push-buttons out of service, or may reroute traffic off of existing vehicle detectors.

The Contractor shall notify the Engineer at least 24 hours prior to any operational shutdown of traffic signals, streetlighting or other electrical systems or facilities.

Traffic signal activations shall follow the Public Works procedures for "Signal Activation," or shall be as specified in the Special Provisions.

Police officers shall be provided, at the Contractor's expense, to direct traffic during the shutdown of a traffic signal system. The Contractor shall arrange for police officer traffic control at least 24 hours prior to the shutdown of a traffic signal system. Traffic signal shutdowns shall be limited to Monday through Thursday excluding holidays, from 9:00 AM to 4:00 PM, or as specified in the special provisions.

Where a facility requires continuous lighting, the shutdown time shall be limited to one-half hour as scheduled by the Engineer, unless otherwise permitted by the Engineer. The shutdown of lighting systems shall not interfere with the regular lighting schedule, unless otherwise permitted by the Engineer.

Vehicle detectors and pedestrian push-buttons shall remain in effective operation at all times during the progress of the work on an existing actuated traffic signal system, except as indicated in the special provisions, or as provided herein.

Vehicle detectors or pedestrian push-buttons taken out of service shall be repaired or replaced within 72 hours. New vehicle detectors for rerouted traffic shall be installed within 72 hours. Where worksite conditions do not permit the installation of permanent vehicle detectors within 72 hours, temporary vehicle detectors shall be installed, at the Contractor's expense, as directed by the Engineer. Permanent vehicle detectors shall be installed as soon as worksite conditions permit.

**86-1.06 Scheduling of Work.** - "Hot cutovers" will not be allowed for electrical circuits, wiring, or equipment involving any traffic signals, streetlights and other electrical systems. The traffic signals and streetlights shall be shutdown for "cutovers" and the Contractor shall provide police officers for traffic control at the Contractor's expense. All work requiring shutdowns shall be performed in accordance with Section 86-1.05, "Maintaining Existing and Temporary Electrical Systems."

24 hour notice shall be given to the Telephone Company and/or Pacific Gas and Electric Company before the beginning of any operation involving their facilities or systems.

Traffic signal activations shall follow the Public Works procedures for "Signal Activation," or shall be as specified in the Special Provisions. The Signal Activation procedure is available from the City upon request.

**86-1.08 Inspection.** - Prior to backfilling of conduit trenches or the pouring of concrete foundations, the Contractor shall notify the Department of Public Works Inspector and request inspection of all conduits and foundation forms.

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

The contractor shall not backfill, enclose or otherwise cover up any electrical work prior to inspection and/or testing. Should any of the work be backfilled, enclosed or covered up, the Contractor shall, at his expense, expose such work for such inspection and/or testing.

## **86-2 MATERIALS AND INSTALLATION**

**86-2.01 Excavating and Backfilling.** - The trenches shall be straight and true to line and grade, and the bottom shall be smooth and even.

**86-2.02 Removing and Replacing Improvements.** - Add the following to paragraph 1 of Section 86-2.02 of the Caltrans Standard Specifications: Improvements such as sprinkler and irrigation systems.

Delete paragraphs 2 and 3 of Section 86-2.02 of the Caltrans Standard Specifications.

Whenever a part of a square or slab of existing concrete sidewalk, curb, gutter, driveway or driveway approach is broken or damaged, the entire square, section or slab from score line to score line shall be removed and the concrete reconstructed as specified in Section 73, "Concrete Curbs and Sidewalks."

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All areas of Portland cement concrete sidewalks, driveways and driveway approaches and asphalt and/or concrete pavements to be removed shall be cut to a minimum depth of 0.17-foot with an abrasive type saw prior to removal. Cuts shall be neat and true along score lines.

**86-2.03 Foundations.** - Delete paragraphs 16, 19, 20, 21 and 22 of Section 86-2.03 of the Caltrans Standard Specifications.

Foundations shall be the type and constructed to the lines, dimensions and configurations as shown on the Plans and Standard Plan Details.

Foundations shall be installed at the locations shown on the Plans or as designated by the Engineer.

Unless otherwise specified or shown on the plans, foundations not to be reused shall be removed or abandoned.

When a foundation is abandoned, the top of foundation, anchor bolts, and conduits shall be removed to a depth of not less than one foot below surface of sidewalk or unimproved ground and one foot below the pavement structure in street areas. The resulting hole shall be backfilled with material equivalent to the surrounding material and the surface areas restored in kind, or as directed by the Engineer.

Where obstructions prevent the construction of a planned foundation, the Contractor shall consult with the Engineer to determine an effective resolution.

Unless otherwise specified by the Engineer, posts and standards shall be erected within 10 calendar days after commencement of excavation of the foundation, but not until the foundation has set at least 7 calendar days. They shall be plumbed or raked as directed by the Engineer. Plumbing of posts and standards shall be accomplished before the foundation is finished to final grade and/or before placing the mortar between the base plate and the foundation cap or structure.

Conduit shall enter the foundation at the locations as shown on the plans or as directed by the Engineer. Conduit elbows shall be integrally cast with the foundation.

Forms for foundation caps shall be rigid, at least 0.30 foot in width, and shall be accurately placed and secured. The elevation or grade of the foundation cap shall conform to existing surrounding grades or as directed by the Engineer.

The top portion of the foundation or cap shall not be constructed until after the post, standard or pedestal is set in proper position, and other improvement constructed, unless otherwise directed.

Mortar shall be placed between the base plate and foundation cap or structure. The thickness of mortar for signal standards shall be at least 0.10 foot and not more than 0.30 foot. The thickness of mortar for streetlighting standards shall be a maximum of 0.10 foot. The mortar shall be struck off and brushed smooth to present a neat appearance.

In paved areas, the top of foundation shall be at least 1-1/4 inches but not more than 4 inches below finished grade. Mortar, topping slab, or pavers shall be placed after the post or standard is in proper position. Mortar shall conform to provisions of Caltrans Section 51-1.135, "Mortar."

In unpaved areas posts and standards without adjacent pull boxes shall have a foundation cap formed a minimum of 2 feet square. When posts or standards are within 1.5 feet of other finished concrete work, finish foundation cap shall extend to existing adjacent surfaces.

In unpaved areas posts and standards with adjacent pull boxes shall have a foundation cap constructed to include the pull box.

In unpaved areas, cabinets shall be provided with a raised pad of portland cement concrete in front of the doors: a minimum 3-1/2 inches thick, 3 feet long and 4 feet wide, or as indicated.

Anchor bolts shall be of the sizes and lengths as shown on the Standard Plan Details.

Anchor bolts 5/8 inch through 1-1/4 inch shall have cut threads; rolled threads are not permitted.

Bending of anchor bolts will not be permitted. For traffic signal standards, anchor bolts shall extend a minimum of three full threads, but no more than 2 inches above the top nut. For streetlight standards, anchor bolts shall extend a minimum of three full threads above the top nut, but shall not extend so as to interfere with the installation of the ornamental leaf design nut cover.

All anchor bolts, nuts, and washers shall be galvanized. Anchor bolts with reinforcing bars or plates shall be set in a bolt circle using a template and securely attached to the foundation forms. The anchor bolts shall be set so that the exposed threads will accommodate the thickness of the foundation cap, mortar, base plate, locking nuts and washers.

If anchor bolts require extension, contractor shall provide structural details to City for approval prior to start of work.

Ground rods when installed in foundations of standards shall be located to either side of the handhole opening with top of ground rod even with bottom of handhole opening.

**86-2.04 Standards, Steel Pedestal and Posts.** - Delete paragraph 33 of Section 86-2.04 of the Caltrans Standard Specifications.

Standards, steel pedestals, and posts shall be of the type indicated on the Plans.

The mast arm(s), signal equipment, luminaire and other devices may be assembled and attached to a standard prior to its being erected and set.

After erection, standards and posts shall be plumbed or raked as directed by the engineer. Plumbing or raking of standards and posts shall be accomplished by adjusting the leveling nuts before the foundation cap is placed. The use of shims or other similar devices for plumbing or raking of standards and posts is not acceptable.

Signal equipment shall be plumbed and aimed and luminaires shall be leveled after the standard has been erected and set.

Guard posts shall be installed when the axis of a standard is located within three feet of a driveway approach to protect the standard from damage by moving vehicles or as directed by the Engineer. Guard posts shall be galvanized standard pipe conforming to the specifications of ASTM Designation: A53 or A120.

Existing standards to be relocated or reused in place shall be repaired as directed by the Engineer. Holes shall be welded closed, large dents shall be removed, shafts shall be straightened, and portions which are in poor condition due to rust, corrosion or damage shall be replaced. Repaired areas shall be ground smooth and primed for application of finish.

Existing standards having a painted finish which are modified, relocated, repaired or upon which equipment is altered by the Contractor shall be repainted.

The Contractor shall apply pressure-sensitive identification number labels to all lighting standards and all signal standards with luminaires, as directed by the Engineer. Labels shall conform to the specifications indicated in the Standard Plan Details.

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**86-2.04(A) Octafluted Lighting Standards.** - Octafluted lighting standards shall conform to the dimensions, design and gage indicated in the Standard Plan Details. Octafluted standards shall be certified by the fabricator to be of such manufacture as to retain a minimum yield strength safety factor of 1.8 when subjected to a 23 pounds per square foot basic wind pressure.

Lighting standards to be installed shall be type 10B (octafluted) with type C-8 mast arm per the Standard Plan Details, unless indicated otherwise on the Plans.

Octafluted lighting standards shall have a uniform 0.14 inch per foot taper over the length of the 30 foot shaft. The shaft shall be straight with a permissive variation not to exceed one inch as measured at the midpoint of the shaft.

The shaft of octafluted lighting standards shall be fabricated from a single sheet of 7 gauge or 11 gauge hot rolled basic open hearth steel conforming to the Standard Plan Details and to ASTM Designation: A 570, Grade C. Base plates shall be one piece cast steel, conforming to ASTM Designation: A27, Grade 65-35. Mast arms shall be fabricated from standard two inch pipe conforming to the specifications of ASTM Designation: A53 or A120.

The shaft of octafluted lighting standards shall have a single, continuous longitudinal welded seam from the base to the top of the standard. Longitudinal welds shall be formed by the submerged process. After fabrication of the shaft, the longitudinal weld shall be rolled smooth. The base plate shall be secured to the shaft by two continuous welds, one inside the standard and one outside.

The shaft of octafluted lighting standards shall be tapered and shall consist of eight equally spaced doric flutes which shall be formed by the cold rolling process. Flutes shall have sharp crests and be uniform in size, taper and radius over the entire length of the shaft. The radius of the crest shall be less than the thickness of the metal in the shaft.

The standard pipe for mast arms shall be reamed, free from burrs, and without intermediate splices or couplings.

Mast arms for octafluted lighting standards shall be attached to the shaft by means of a steel fitting welded to the mast arm and a matching steel fitting welded to the shaft. When assembled, the fittings on the mast arm and the shaft shall interlock and be secured by means of a hexagon head cadmium plated cap screw. The connection between the mast arm and the standard shall be weather resistant and shall form a smooth wireway.

Type C mast arms for octafluted lighting standards shall be provided with an ornamental scroll bracket as depicted in the Standard Plan Details. The scroll bracket shall be fabricated from cold-rolled steel "U"- channel stock, 1/8-inch by 1-1/2 inches wide by 1/2 inch deep. The bracket shall be drilled at the ends and secured to the standard by means of hexagon head cadmium plated cap screws and 1/2-inch nuts welded to the shaft and the mast arm.

Type E mast arms for octafluted lighting standards shall be as shown in the Standard Plan details.

Transformer base pedestals for type 10A octafluted standards shall conform to the dimensions and design as indicated in the Standard Plan Details. The top and bottom plates of the transformer base pedestals shall be fabricated from 3/4-inch steel plate and the sides from 7 gauge hot-rolled steel. After fabrication, exposed welds shall be ground smooth. Transformer base pedestals shall have a trapezoidal access door a minimum of 8-1/2 inches wide at the top, 9 7/8 inches wide at the bottom and 13-1/4 inches high. The door shall be provided with tamper resistant locking hardware. To facilitate plumbing, leveling and positioning of the

transformer base pedestal, two 1/2-inch steel anchor clip plates of the design depicted in the Standard Details shall be provided for each anchor bolt.

Each of the four anchor bolt nuts on octafluted lighting standards shall be concealed by an ornamental cast steel or cast aluminum leaf-design cover held in place by a hexagon head cadmium plated cap screw.

Octafluted standards shall be provided with an ornamental cast steel or cast aluminum spear point finial held in place by four cadmium plated set screws.

Octafluted standards shall be provided with a handhole as indicated in the Standard Plan Details. The handhole cover shall be secured with a cadmium plated allen-head screw and steel locking bar or other tamper resistant device as approved by the Engineer. A 1/2-inch diameter N.C. by 1 inch long ground lug shall be welded to the inside of the shaft directly opposite the handhole. A hex nut and two flat washers shall be provided on the ground lug.

Octafluted standards and all ferrous accessories shall have a hot-dipped galvanized finish, unless specified otherwise on the Plans.

Lighting standards which are fed overhead shall be provided with pole band(s), clevis(es), spool(s) and a mastarm with a 1-1/2 inch diameter conduit entrance nipple and insulated bushing welded to the underside of the mast arm as indicated in the Standard Plan Details. The connection between the entrance nipple and the mast arm shall form a smooth wireway.

**86-2.04(B) Signal Standards.** - Signal equipment and other devices shall be secured to signal standards using cadmium plated threaded bolts and/or screws. Signal standards shall be drilled and tapped as required to accept such bolts and/or screws. The use of "through-bolts" with nuts to secure equipment to standards is not acceptable.

Signal mast arms shall have the end signal head mounting tenon located on the side of the mast arm, rather than at the tip.

Drilling, tapping and machining of signal standards shall be performed on the job site. Holes in standards shall be cut using drills or hole saws. The use of a cutting torch for the purpose of producing holes in standards will not be permitted unless authorized by the Engineer prior to performing the work.

When modifying signal or lighting equipment on existing signal standards, the Contractor shall de-energize and remove circuit conductors prior to drilling, cutting, welding and/or tapping the pole. When performing this work, the Contractor shall schedule a system shutdown in accordance with Section 86-1.05, "Maintaining Existing and Temporary Electrical Systems."

**86-2.05 Conduit.** - Conduit shall be of the sizes and types as shown on the Plans or as specified in the specifications or the special provisions.

**86-2.05A Material.** - Replace the entire Section 86-2.05A of the Caltrans Standard Specifications with the following:

Conduit and conduit fittings shall be UL or ETL listed and shall be of one of the following types:

- (1) Galvanized Rigid Steel (GRS). GRS conduit shall conform to the requirements of UL Publication UL6 for Rigid Metallic Conduit. The zinc coating shall be



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- applied by the hot-dip process and shall conform to the requirements of ASTM Designation: A239.
- (2) Plastic Coated Galvanized Rigid Steel (PCGRS). PCGRS conduit shall conform to (1) above and shall have an external coating of polyvinyl chloride. The thermoplastic coating shall have a minimum thickness of 40 mils.
  - (3) Rigid Non-Metallic Polyvinyl Chloride (PVC). PVC conduit shall conform to the requirements of the UL Standard for Rigid Non-Metallic Conduit (UL Publication 651).

GRS and PCGRS conduit shall be terminated with insulated bonding type ground bushings. PVC conduit shall be terminated with end bell fittings.

All fittings used for installing, supporting, joining and connecting conduit shall be specifically designed and manufactured for electrical use.

All metal conduit couplings shall have straight non-tapered threads and shall be marked by the manufacturer with an "E" to identify them as being of electrical grade. Tapered plumbing type couplings and couplings with slip joints, set screws or running threads will not be permitted for joining conduits.

**86-2.05B Use.** - Replace the entire Section 86-2.05B of the Caltrans Standard Specifications with the following:

Conduit that is installed underground or in concrete foundations shall be Schedule 40 PVC or PCGRS. Conduit that is installed as a service riser shall be Schedule 80 PVC and shall conform to the requirements of the Pacific Gas and Electric Company. Conduit that is installed in exposed locations or in structures shall be GRS.

Exposed conduit installed on a painted structure shall be painted the same color as the structure as specified in Section 86-2.16, "Painting."

Conduit runs shall be continuous and uniform in kind and diameter. Where existing conduit runs are to be modified or extended, new conduit shall match existing in kind. Reducing couplings shall not be permitted.

Conduit diameter shall be as indicated on the Plans or, if not specified, shall be a minimum of the following:

- (1) 1-1/2 inches between an electrolier and pull box.
- (2) One inch between a pedestrian push button post and pull box.
- (3) 2 inches between a signal standard and pull box.
- (4) 2 inches for detector lead-in cable runs.
- (5) 3 inches between a type "M" controller cabinet and pull box.
- (6) 3 inches (two conduits) between a type "P" controller cabinet and pull box.
- (7) One inch between the detector loop termination at the lip-of-gutter and pull box.
- (8) 3 inches for traffic signal conduits between pull boxes where the conduit crosses a roadway.
- (9) 1-1/2 inches for streetlighting systems.

- (10) 2 inches for traffic signal systems.

**86-2.05C Installation.** - Delete paragraphs 2, 8, 10, 11, 13, 18, 19, and 20 of Section 86-2.05C of the Caltrans Standard Specifications. Conduit installed underground shall be installed in open trenches, unless approved otherwise by the Engineer. Trenches for conduit shall be straight and uniform in depth, free of ridges and depressions. Conduit shall not be covered until the installation has been approved by the Engineer.

Trench-laid conduit shall have a minimum of 18 inches of cover in non-roadway areas and 24 inches of cover (below finished grade) in roadway areas, including driveways, unless otherwise indicated or approved by the Engineer. Conduit depth requirements shall not apply at locations where conduit slopes upward to a pull box or standard.

The minimum cover requirements for trench-laid conduit may be reduced if the conduit is protected in a portland cement concrete encasement. Revisions to the minimum conduit depth requirements will be at the Contractor's expense and will require written approval from the Engineer, prior to conduit placement.

Conduit less than 18 inches below the surface and not encased in concrete or less than 10 feet above the finished surface shall be PCGRS or GRS conduit unless specifically indicated otherwise on the Plans or allowed by the Engineer.

Parallel conduit runs installed in a common trench without concrete encasement shall have a minimum of 6 inches of separation between conduits. Where parallel conduit runs installed in a common trench are encased in concrete, a minimum of 2 inches of separation shall be maintained between the conduits and the trench walls and floor and between individual conduits. Conduit spacers and anchors shall be installed as required to insure a complete and uniform flow of concrete around the conduits. Distances between conduit spacers and between anchors shall not exceed 5 feet.

Where an underground obstruction is encountered which prevents the installation of a conduit run as shown on the plans the alignment of the conduit run may be revised and/or additional pull box(es) may be installed as required to avoid the obstruction. Such revisions to the conduit alignment and pull box layout will be at Contractor's expense and will require the prior written approval of the Engineer.

Contractor shall, at the request of the Engineer, open inspection holes as required to determine compliance with the requirements for trench-laid conduit depth and alignment. Inspection holes shall not be backfilled until the conduit installation has been approved by the Engineer. Upon completion of inspection, inspection holes shall be filled to the satisfaction of the Engineer. The opening and filling of inspection holes shall be at the expense of the Contractor.

Backfilling, compaction and restoration of the surface of trenches shall be in accordance with the provisions of the applicable section of these Specifications.

In traffic signal installations GRS or PCGRS conduit runs may be laid on top of existing pavement within curbed median islands that are to have Portland cement concrete surfacing.

Conduit runs for streetlighting shall be installed either parallel to or perpendicular to the curb, unless otherwise approved by the Engineer prior to placement. Conduit at an oblique angle to the curb will not be permitted. Conduit runs parallel to the curb shall be located not more than 27 inches nor less than 6 inches behind the face of curb, unless otherwise indicated on the Plans or approved by the Engineer.

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Conduit shall not be installed by the "impact driving" method.

With the approval of the Engineer, conduit may be installed by either the jacking or drilling method. When a conduit jacking or drilling pit is to be left open overnight, it shall be covered in accordance with the requirements set forth by the Engineer, and/or the American Railway Engineering Association (AREA) Standard Specifications, for railroad crossings.

Conduit installed under a roadway by jacking or drilling shall not be less than 24 inches nor more than 48 inches below the flow line of the gutter or edge-of-pavement grade where no gutter exists.

Where conduit is installed under a roadway by the drilling method, any excessive voids shall be filled to the satisfaction of the Engineer.

Conduit bends shall be avoided wherever possible and where required shall be of the largest possible radius. Where underground conduit changes direction, long radius sweeps shall be used instead of short radius bends.

The radius of conduit bends and elbows entering foundations shall not be less than 12 times the internal conduit diameter. Unless specified otherwise, other conduit bends and elbows shall not have a radius less than 30 inches.

PVC conduit elbows shall be factory manufactured. Field bending of PVC conduit is not permitted.

Conduit bends and elbows shall be free of flattening, kinks and indentations.

No single conduit bend or elbow shall exceed an angle of 90 degrees.

Unless otherwise approved by the Engineer, there shall be no more than the equivalent of:

- (1) 135 degrees of bends in a conduit run from a pull box to a foundation.
- (2) 90 degrees of bends in a conduit run from a pull box to a pull box where the conduit is installed parallel to and on the sidewalk side of curb.
- (3) 270 degrees of bends in a conduit run from a pull box to a pull box where the conduit is installed parallel to and on the streetside of the curb.
- (4) 180 degrees of bends in a conduit run from a pull box to a pull box where the conduit is installed perpendicular to the curb.

PVC conduit, elbows, couplings and fittings shall be joined by solvent welding. Solvent weld cement shall conform to the requirements of ASTM D2564. In solvent welding of PVC conduit and components, the Contractor shall thoroughly coat the mating surfaces of the joint with cement and, after insertion, shall twist the joint 180 degrees to insure a complete bond.

Conduit in the foundation of a standard or an enclosure shall terminate not more than 2 inches and not less than 1 inch above the top surface of the foundation.

The uppermost 8 inches of conduit terminating in a standard or an enclosure shall be straight and shall be so positioned in the foundation that its prolongation would pass through the handhole opening.

Any conduit elbow stub leaving a foundation shall extend a minimum of 6 inches from the face of the foundation and shall have at least 18 inches of cover. The elbow stub shall exit the foundation in the direction indicated on the Plans and shall be capped until conduit is attached or a bushing is installed.

Conduit between a foundation and an adjacent pull box shall be continuous, without couplings, from the elbow stub at the foundation to the elbow into the pull box. The conduits entering foundations shall be PVC schedule 40 or PCGRS.

Conduit shall enter a concrete pull box through the short side and shall be so positioned that the prolongation of the conduit would pass through the top opening of the pull box. Conduit shall not enter from the bottom or from the long side of a pull box unless otherwise approved by the Engineer. Conduit shall enter a pull box in the direction of the conduit run. Conduit shall terminate not more than 2 inches and not less than one inch from the inside wall or bottom of the pull box.

Where a new pull box is installed in an existing metallic conduit run, the conduit shall be cut, threaded, fitted with grounding bushings and bonded.

The exterior surface of conduit which will be partially or completely imbedded in concrete structures shall be cleaned before the concrete is placed.

Conduit to be placed beneath a railroad track shall be installed in conformance with the American Railway Engineering Association Standard Specifications, any local railroad regulations and the requirements set forth by the Public Utilities Commission. Conduit beneath a railroad track shall be installed by jacking or drilling methods. The neat side of each conduit jacking pit shall be constructed not less than 12 feet from the centerline of track. Conduit shall be PCGRS, a minimum of 2 inches in diameter and shall be installed with a minimum of 36 inches of cover below the bottom of ties. The Contractor shall contact the railroad company involved 20 working days prior to the start of work for approval of construction methods.

The installation of conduit into a manhole, vault, and/or pull box of the Pacific Gas and Electric Company, Pacific Bell Telephone Company or other agency shall conform to the requirements of the respective agency. The Contractor shall contact representatives of those organizations for instructions regarding the preferred location of entry and termination method of such conduit. The conduit shall project into the manhole, vault and/or pull box only far enough for a bushing to be placed on the conduit end. The opening around the conduit shall be carefully and completely filled with mortar and neatly finished.

A pull rope shall be installed in all conduits which are designated for future use. The pull rope shall be nylon or polypropylene with a minimum tensile strength of 500 pounds. At least two feet of pull rope shall be doubled back into the conduit at each termination.

Prior to the installation of conductors or cables in either existing or newly installed conduit, the Contractor shall prove and clean the conduit by pulling a mandrel or wire brush through the conduit or by rodding, then blowing out the conduit with compressed air.

Rodding shall be performed by simultaneously pushing and turning a straight steel or wooden rod through the conduit, taking care not to damage the conduit walls.

The cost of proving conduit shall be considered as included in the price paid for electrical installations and no extra payment shall be made therefor.

**86-2.06 Pull Boxes.** - Delete paragraph 1 of Section 86-2.06 of the Caltrans Standard Specifications.

Except as noted below, pull boxes shall be installed at the locations shown on the Plans and shall be of the sizes specified. To facilitate his work, the

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Contractor may, at his option and expense, install additional pull boxes or pull boxes of a larger standard size than those shown or specified. The locations of additional pull boxes shall be established by the Engineer.

**86-2.06A Materials.** - Replace the entire Section 86-2.06A of the Caltrans Standard Specifications with the following:

Pull boxes, extensions and covers for installation in the ground or in sidewalk areas shall be constructed of pre-cast reinforced concrete. Pull boxes shall be of the sizes shown on the Plans and, unless indicated otherwise, shall conform to the dimensions indicated in the Standard Plan Details. Pull boxes shall have gray plastic coated rims. Each pull box cover shall be secured with two 3/8-inch brass hold down bolts with brass washers and nuts. Nuts shall be recessed below the surface of the cover.

Pull boxes and extension for installation in areas subject to traffic loads shall be constructed of pre-cast reinforced concrete. Traffic pull boxes shall be of the sizes shown on the Plans and, unless indicated otherwise, shall conform to the dimensions indicated in the Standard Plan Details. Each traffic pull box shall be provided with a checkered steel plate cover, a minimum of 1/4-inch thick, conforming to the design indicated in the Standard Plan Details. The steel cover shall be electrically grounded by means of a 3 foot length of copper braid equivalent to a Number 8 AWG or larger copper conductor. The copper braid shall be attached to a suitable grounding lug welded to the underside of the traffic cover and shall be bonded to either a metallic conduit or a grounding conductor which shall be bonded to the service grounding electrode.

Pull boxes and covers for installation in structures shall be of the sizes and details shown on the Plans. In lieu of the structure pull box shown on the Plans, the Contractor may use a telescoping steel pull box, with interior dimensions, conduit entrances and cast iron cover conforming to the details shown in the Standard Plan Details. The design of the steel pull box shall be submitted to the Engineer for approval prior to fabrication.

**86-2.06B Cover Markings.** - Replace the entire Section 86-2.06B of the Caltrans Standard Specifications with the following:

The covers for pull boxes except ceiling pull boxes shall be clearly marked with a legend that identifies the electrical system served by the pull box. Pull box cover legends shall be as follows:

- |                        |  |
|------------------------|--|
| CSJ TRAFFIC SIGNAL:    | for traffic signal systems with or without streetlighting systems. |
| CSJ STREETLIGHTING:    | for streetlighting systems only.                                   |
| CSJ COMMUNICATIONS:    | for traffic signal communications only.                            |
| CSJ TREE LIGHTING:     | for tree lighting systems only.                                    |
| CSJ SPRINKLER CONTROL: | for sprinkler control systems only.                                |

CSJ COUNT STATION:	for traffic count stations only.
CSJ SERVICE:	for service laterals to utility facilities termination point only.
CSJ ELECTRICAL:	for combined electrical systems or miscellaneous systems not mentioned above.

The pull box cover legend shall be formed of capital block letters between one and 3 inches in height. The legend may be parallel to either the long or short side of the cover.

Concrete pull box covers shall have the legend cast into the cover at the time of manufacture. The lettering of the legend shall be sharply defined, uniform in depth, evenly spaced and neatly aligned.

Steel pull box covers shall have the legend applied to the cover prior to galvanizing using one of the following methods:

- (1) Cast iron strips, at least 1/4-inch thick with the letters raised a minimum 1/16-inch. Strips shall be fastened to covers with 1/4-inch flathead stainless steel bolts and nuts. Bolts shall be peened after tightening.
- (2) Sheet steel strips at least 22 gage with the letters raised a minimum of 1/16-inch above the surrounding surface of the strips. Strips shall be fastened to the covers by spot welding, tack welding, brazing, with 1/4-inch stainless steel rivets or 1/4-inch roundhead stainless steel machine bolts and nuts. Bolts shall be peened after tightening.
- (3) Bead welding the letters on the covers. The letters shall be raised at least 3/32-inch.

**86-2.06C Installation and Use.** - Replace the entire Section 86-2.06C of the Caltrans Standard Specifications with the following:

Pull boxes shall be installed at the locations shown on the Plans. Pull boxes shall not be spaced at intervals over 200 feet whether indicated on the Plans or not, unless otherwise directed by the Engineer. Pull boxes shall not be installed in roadways, driveways, driveway approaches, gutters, or wheelchair ramps.

The bottoms of pull boxes installed in the ground or in sidewalk areas, shall be bedded in washed river drain rock as shown in the Standard Plan Details and shall be grouted prior to the installation of conductors. The grout shall be between one and 2 inches thick and shall be sloped toward the drain hole. One layer of roofing paper shall be placed between the grout and the rock sump. A one inch diameter drain hole shall be provided in the center of the pull box through the grout and the roofing paper.

Existing pull boxes disturbed by the Contractor's operations shall, at Contractor's expense, have drain rock sumps and grouted bottoms installed and shall be reconstructed in conformance with these Specifications, or as directed by the Engineer. Pull boxes shall be CSJ Number 3-1/2 minimum for lighting systems and Number 5 minimum for traffic signal systems or other systems, unless specified otherwise.

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Pull boxes shall be installed with the long dimension parallel to the main conduit run. In the vicinity of curbs, pull boxes shall be placed adjacent to the back of curb. In the vicinity of standards, pull boxes shall be placed alongside the foundation as indicated in the Standard Plan Details. The top of the pull box shall be flush with the surrounding grade or top of adjacent curb unless otherwise indicated.

Where pull boxes are placed in areas subject to traffic loads, (when permitted by the Engineer), they shall be installed on suitable concrete footings as shown in the Standard Plan Details.

**86-2.08 Conductors.** - Replace the entire Section 86-2.08 of the Caltrans Standard Specifications with the following:

Conductors shall be copper of the gage shown on the plans, unless specified otherwise.

The minimum wire gages for streetlighting systems shall be as follows: Number 8 AWG for service and feeder conductors from the service point to the main disconnect and branch circuits, Number 12 AWG for branch circuits from feeder to lamp ballasts, and Number 14 AWG for control circuits from photo-electric-unit (PEU) to contactor.

Copper wire shall conform to the specifications of ASTM Designations: B3 and B8.

Wire sizes, other than conductors used in loop detector lead-in cable, shall be based on American Wire Gage (AWG). Conductor diameter shall be not less than 98 percent of the specified AWG diameter. Conductors used in loop detector lead-in cable shall conform to the specifications of ASTM Designation: B 286.

Conductors shall be UL or ETL listed and rated for 600-volt operation. The insulation for traffic signal conductors installed between a traffic signal controller and related traffic signal appurtenances shall conform to one of the following:

- (1) Type UF, with a minimum insulation thickness of 60 mils at any point, for conductor sizes Number 14 AWG through Number 10 AWG.
- (2) Type THW or UF, with a minimum insulation thickness of 60 mils at any point, for conductor sizes Number 8 AWG and larger.

The insulation for all conductors other than traffic signal conductors as specified above shall conform to one of the following:

- (1) Type THW, with a minimum insulation thickness of 45 mils at any point, for conductor sizes Number 14 AWG through Number 10 AWG.
- (2) Type THW or UF, with a minimum insulation thickness of 60 mils at any point, for conductor sizes Number 8 AWG and larger.

Type THW polyvinyl chloride conductor insulation shall conform to the requirements of ASTM Designation: D 2220.

Conductors for wiring wall luminaries shall be stranded copper, Type AVL, with insulation rated for use at temperatures up to 125°C.

Overhead feeder conductors shall be of the multiconductor aerial power cable with self-supporting messenger cable type. The cable shall consist of one or more weather-resisting cross-linked polyethylene insulated aluminum conductors, as required, bound to an aluminum-clad steel messenger cable by means of a flat metallic strip applied with open-lay "figure eight" spiraling helical wrap, not to exceed one rotation per 4 feet of cable length. Conductors shall be No. 6 AWG minimum size, seven strand insulated aluminum with a No. 6 steel reinforced bare aluminum neutral when required, suitable for maximum operating temperature of 90 degrees Celsius and rated 600-volt AC, 1170 pound ultimate strength. The minimum conductor insulation shall be 45 mils, conforming to IPCEA standard #566-524 and IPCEA standard #561-402.

Aerial power cable shall be installed at the locations shown on the plans or as specified.

Aerial power cable shall be installed on existing poles or on new poles as required. The pole mounting brackets shall be installed at a height as shown in the Standard Plan Details or as directed by the Engineer.

Aerial power cable shall be supported by its integral messenger securely attached at each end with approved devices as shown in the Standard Plan Details or as directed by the Engineer.

Aerial power cable mounting supports, hangers, clamps, and all other ferrous hardware shall be hot dipped galvanized in conformance with Section 75-1.05, "Galvanizing." Size and strength requirements shall conform to the Standard Plan Details and the manufacturers recommendations for the size of cable and length of span supported.

Aerial power cable shall be installed with stringing pulleys or other acceptable means to carry the cable at each pole during the pulling operation. The dragging of cable across the top of steel or "unroofed" cross arms in aerial installations will not be permitted.

The cable shall be so tensioned to maintain legal clearance over roadway and non-roadway areas. The sag in no case shall be more than eight percent (8%) nor less than two percent (2%) of the span length.

Aerial cables shall be bonded in accordance with Section 86-2.10, "Bonding and Grounding." Aerial cables shall be installed in accordance with Caltrans Section 86-2.09, "Wiring" and shall be marked in accordance with the provisions of Section 86-2.08A, "Conductor Identification."

All aerial cable splices shall be readily accessible.

**86-2.08A Conductor Identification.** - Replace the entire "Conductor Table" of the Caltrans Standard Specifications with the following "Conductor Table."



CONDUCTOR TABLE

CONDUCTOR USE	SIGNAL PHASE or FUNCTION	INSULATION COLOR			IDENTIFICATION		CONDUCTOR SIZE
		BASE	STRIPE	DESIGNATION	LABEL DESIGNATION		
Vehicle Signals	2,6	Re, Ye, Bm	Black	2,6		14	
	4,8	"	Orange	4,7		14	
	1,5	"	None	1,5		14	
	3,7	"	Purple	3,7		14	
	Overlaps	"	Note 1	OL#		14	
Pedestrian Signals	2p, 6p	Red, Brown	Black	2p, 6p		14	
	4p, 8p	"	Orange	4p, 8p		14	
	1p, 5p	"	None	1p, 5p		14	
	3p, 7p	"	Purple	3p, 7p		14	
Pedestrian Push Buttons	2p, 6p	Blue	Black	pb2, pb6		14	
	4p, 8p	"	Orange	pb4, pb8		14	
	1p, 5p	"	None	pb1, pb5		14	
	3p, 7p	"	Purple	pb3, pb7		14	
Traffic Signal Controller Cabinet	Ungrounded-Line 1	Black	None	CN1		As	
	Grounded-Neutral	White	None	CNN		Req'd	

CONDUCTOR TABLE (CONT.)

CONDUCTOR USE	SIGNAL PHASE or FUNCTION	INSULATION COLOR		IDENTIFICATION		CONDUCTOR SIZE
		BASE	STRIPE	LABEL DESIGNATION	CONDUCTOR SIZE	
Streetlighting	Ungrounded-Line 1	Black	None	SL1	As	Req'd
	Ungrounded-Line 2	Red	None	SL2		
	Grounded-Neutral	White	None	SLN		
Lighting Control	Ungrounded to Photo- electric unit (PEU)	Black	None	C1	14	14
	Switched leg from PEU unit	Red	None	C2	14	
	Grounded-Neutral	White	None	C3	14	
Irrigation Control	Undergrounded-Line 1	Black	None	IR1	As	Req'd
	Grounded-Neutral	White	None	IRN		
Service	Undergrounded-Line 1	Black	None	SR1	As	Req'd
	Undergrounded-Line 2	Red	None	SR2		
	Grounded-Neutral	White	None	SRN		
Sign Lighting	Undergrounded-Line 1	Black	None	SN1	12	12
	Undergrounded-Line 2	Red	None	SN2	12	

CONDUCTOR TABLE (CONT.)

CONDUCTOR USE	SIGNAL PHASE or FUNCTION	INSULATION COLOR			IDENTIFICATION	
		BASE	STRIPE	LABEL DESIGNATION	CONDUCTOR SIZE	
Flashing Beacons	Undergrounded between flasher & beacons Grounded-Neutral	Red or Yellow	None	Flasher- location FLN	14	
		White	None		14	
Logic Common	Pedestrian Push Buttons . . . . .	White	Black	None	14	
Grounded Neutral	Traffic Signals	White	None	TSN	As Req'd	
Traffic Signal Communications	As required . .	As Req'd	As Req'd	Per Sect. 86-2.09G	As Req'd	
Railroad Pre-emption	As Required . .	Black	None	RR	14	
Emergency Vehicle Pre-emption	As Required . .	Black or as req'd	None	EV#1,2,3 as Req'd	14 or as Req'd	
Spares	Traffic Signal Spares	Black	None	None	14	

CONDUCTOR TABLE (CONT.)

CONDUCTOR USE	SIGNAL PHASE or FUNCTION	INSULATION COLOR		IDENTIFICATION		CONDUCTOR SIZE
		BASE	STRIPE	LABEL DESIGNATION		
Inductive Loop Detector Circuits	Vehicle Detection	As Req'd	None	Per Sect. 86-5.01A(5)	As Req'd	

## Notes:

1. Conductors for overlap traffic signal phases shall have their insulation striped for the first signal phase in the designation. For example, a phase (2+3) overlap conductor shall have its insulation striped as phase 2.
2. Conductors for overlap traffic signal phases, special traffic signal phases and other special functions shall be labeled accordingly.
3. Conductors shall be labeled in each pull box and at termination points. Ungrounded traffic signal conductors shall be labeled by banding groups of conductors comprising a signal phase or function.

**86-2.08B Multiple Circuit Conductors.** - Delete the entire Section 86-2.08B of the Caltrans Standard Specifications.

**86-2.08C Series Circuit Conductors.** - Delete the entire Section 86-2.08C of the Caltrans Standard Specifications.

**86-2.09A Circuitry.** - Delete paragraphs 2 and 5 of Section 86-2.09A of the Caltrans Standard Specifications.

The "common" for pedestrian push button circuits shall be a separate conductor and shall not be used for any other purpose.

**86-2.09B Installation.** - Delete paragraphs 4, 6, 7, and 10 through 14 of Section 86-2.09B of the Caltrans Standard Specifications.

Conductors shall not be pulled into conduits until after pull boxes are set to grade, drain rock sumps installed, conduit grouted in place, bottoms of concrete boxes grouted, and the conduits bonded.

The conduit system shall be complete and approved by the Engineer before any conductors are installed in conduits. All conductors shall be run in conduit except overhead installations or where conductors are installed inside poles, pull boxes or cabinets. Conductors shall be installed by means which will not in any way damage the conductor or its insulation.

Conductors entering conduits shall be carefully fed and "positioned" to avoid "tangles" and "crossovers." All conductors shall be installed simultaneously.

Conductors and cables in all pull boxes shall be grouped and arranged in a workmanlike manner. Conductors and cables in manholes shall be supported by strapping to the side wall.

A UL or ETL listed inert lubricant such as powdered soapstone or talc shall be used in placing conductors in conduit.

Conductors shall be pulled into conduit by hand; use of winches or other power actuated pulling equipment will not be permitted.

When conductors are to be added to existing conductors in a conduit, all conductors shall be removed; the conduit shall be cleaned as provided in Section 86-2.05C, "Installation" and all conductors shall be pulled into the conduit as a unit. Traffic signal and streetlighting conductors receiving power from different service points shall not be installed in the same standard, conduit, pull boxes or other enclosures. Service conductors shall not be installed in traffic signal or streetlighting conduits.

Temporary conductors less than 10 feet above grade shall be enclosed in flexible or rigid metal conduit.

At least 2 feet of slack shall be left in traffic signal conductors at each signal or combined lighting/signal standard, where a pull box is not adjacent to the standard and/or there is more than one conduit in the base of the standard. Slack shall be measured by removing the handhole cover on the standard and extending the wire horizontally beyond the handhole opening.

At least 2 feet of slack shall be left in lighting conductors at each standard to facilitate the removal of fused spliced connectors. Slack shall be measured by removing the handhole cover on the standard and extending the conductors horizontally beyond the handhole opening.

At least 3 feet of conductor slack shall be left in all conductors, at each pull box. Slack shall be measured by removing the pull box lid and extending the conductors vertically above the pull box grade.

Conductors shall be permanently identified as to function (vehicle signal phase, pedestrian signal phase, streetlight circuit, streetlight controls, irrigation circuit, etc.) as detailed in the "Conductor Table" of Section 86-2.08A, "Conductor Identification." Identification shall be means of encircling individual conductors/cables or functional groups of conductors with a permanent identification label in each pull box and at the termination of the conductors/cables. Labels shall be fastened in such a manner that they will not move along the conductors/cables.

**86-2.09C Connectors and Terminals.** - Replace the entire Section 86-2.09C of the Caltrans Standard Specifications with the following:

Conductors shall be joined by means of approved spring-type pressure connectors, crimp style terminal lugs, or by other methods approved by the Engineer. Crimp style terminals shall have continuous barrels or seams shall be brazed so they shall not separate during crimping.

Finished connections and terminals shall comply with all UL requirements.

All stranded conductors smaller than number 14 AWG shall be terminated in crimp style terminal lugs.

Crimp tools shall be of the type that necessitates a crimp pressure of manufacturer's required value before tool will unlock. Where splices are required to be soldered they shall be soldered using the Hot Iron method with rosin core solder. Soldering with an open flame shall not be allowed.

All joints shall be covered with insulation equivalent to the voltage and temperature rating of the insulation on the conductors and as indicated in the Standard Plan Details.

Split bolt connectors shall not be used except where specifically authorized by the Engineer.

Connectors and terminals for use with aluminum conductors shall be approved for aluminum-to-aluminum or aluminum-to-copper as required, and shall comply with all UL requirements, unless otherwise approved by the Engineer.

**86-2.09D Splicing.** - Replace the entire Section 86-2.09D of the Caltrans Standard Specifications with the following:

Unless specified otherwise or permitted by the Engineer, splices shall conform to the Standard Plan Details. Conductor splices will not be permitted in controller cabinets. Use of terminal compartments or terminal blocks on standards shall not be permitted.

Splices will be permitted only in the following types of circuits at the following locations:

- (1) Grounded conductors and branch signal light neutrals in pull boxes.
- (2) Pedestrian push button conductors in pull boxes.
- (3) Multiple lighting and power conductors shall be spliced in a pull box adjacent to the standard.
- (4) Traffic signal conductors shall be spliced in pull boxes only at locations shown on the plans.

- (5) Ungrounded traffic signal conductors to a signal head on a standard shall be spliced to through conductors of the same phase in the pull box adjacent to the standard.

**86-2.09E Splice Insulation.** - Replace the entire Section 86-2.09E of the Caltrans Standard Specifications with the following:

Splice insulation shall conform to the Standard Plan Details.

Low-voltage tape shall be UL or ETL listed and shall be the following types:

- (1) Self-fusing, oil and flame-resistant, synthetic rubber.
- (2) Pressure-sensitive, adhesive, polyvinyl chloride, 0.007 inch minimum thickness.

Where polyvinyl chloride tape is used for a final layer, an electrical insulating coating, compatible with the tape, shall be used. It shall be fast drying, resistant to oil, acid, alkalis and corrosive atmospheric conditions.

The Contractor may elect to use, with approval of the engineer, one of the following splice insulation methods:

- (1) A minimum of 2 thicknesses of electrical insulating pad, composed of a laminate of 0.085 inch thickness of electrical grade polyvinyl chloride and a 0.125 inch thickness of butyl splicing compound with removable liner. Pads shall be applied to the splice in accordance with the manufacturer's recommendations. The applied pad shall be wrapped with polyvinyl chloride tape half lapped over the conductor insulation.
- (2) Heat shrinkable insulating tubing shall be applied after completing the splicing procedure shown on the Standard Plan Details. Insulation over the connector shall consist of a heat shrinkable, mastic lined, heavy wall polyolefin cable sleeve, or cover, to which heat shall be applied at a temperature greater than 120°C until the sleeve or cover, shrinks and covers the connector and the mastic material has flowed completely around the cable to form a waterproof insulation.

Where splices are below grade or exposed overhead, the insulation and taping shall be applied between the conductors in such a manner as to provide a watertight joint. The splice shall be capable of satisfactory operation under continuous submersion in water.

Multi-conductor cables shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the cable.

**86-2.09F Fused Splice Connector.** - Replace the entire Section 86-2.09F of the Caltrans Standard Specifications with the following:

Fused disconnect splice connectors with fuses shall be installed as shown in the Standard Plan Details and as specified as follows:

- (1) In the service conductors of unmetered underground streetlight and irrigation controller services or other services as specified and shall be placed in the "service" pullbox.
- (2) In the drip loop of unmetered overhead streetlight service conductors.
- (3) In branch circuit conductors of each streetlight.

A fused disconnect splice connector shall be installed in each ungrounded service conductor and shall be located as required, in the designated service pullbox or the drip loop.

Circuits with two un-grounded conductors shall use a fused disconnect splice connector that will disconnect both conductors simultaneously.

A fused disconnect splice connector shall be installed in each ungrounded conductor between the line and the ballast of the luminaire.

A fused disconnect splice connector shall be located in the base of the streetlight standard directly behind the hand hole and readily accessible, for streetlights fed from underground wiring systems. A fused disconnect splice connector for overhead fed streetlight standards shall be located in the drip loop.

The fused disconnect splice connector shall completely enclose the fuse and shall protect the fuse against damage from water and weather. The contact between the fuse and fuse holder shall be by spring pressure. Springs shall not carry current. When the fuse holder is disassembled, the fuse shall remain in the load end of the fuse holder. The terminals of the fused disconnect splice connector shall be rigidly crimped, onto the conductors using a tool of the type recommended by the manufacturer of the fused splice connector, and shall be insulated and made waterproof in accordance with the splice connector manufacturer's recommendations, the Standard Plan Details and Section 2.09E, "Splice Insulation."

The connector shall have no exposed metal parts, except the head of a stainless steel assembly screw may be exposed. The head of the metal assembly screw shall be recessed a minimum of 1/32-inch below the top of a plastic boss which surrounds the head.

Fused disconnect splice connectors shall be rated 30A, 250V AC minimum and shall accept 13/32" X 1-1/2" standard midget ferrule type fuses of the ampacity and types specified. Fused disconnect splice connectors shall be TRON type "HEX" for 240V or TRON type "HEB" for 120V applications, as manufactured by Bussman Div., McGraw-Edison Co., or approved equal.

Fuses for individual streetlight fusing applications shall be rated 10A, 250V AC, general purpose non-time delay types "BAF" or "BAN."

Fuses for streetlight services feeding more than one streetlight shall be rated 30A, 500V AC, TRON time-delay type "FNQ."

Fuses for streetlight services feeding only one streetlight shall be rated 10A, 500V AC TRON time-delay type "FNQ."

Fuses for irrigation controllers shall be rated 15A, 500V AC TRON time-delay type "FNQ."

Fuses shall be as manufactured by Bussman Div., McGraw-Edison Co. or approved equal.

**86-2.09G Traffic Signal Communications Cable.** - Cable intended for use in Traffic Signal Communications shall conform to the provisions of the National Electrical Code "Communication Systems," the requirements of the Rural



Electrification Administration, (REA) Specification: PE-89, REA Designation BFCAE, and to the requirements as herein specified:

- o Conductor Size: Number 22 AWG, solid
- o Conductor Type: Commercially pure annealed copper
- o Conductor Insulation, Inner: Expanded Polyethylene
- o Conductor Insulation, Outer: Solid Polyethylene
- o Core: Gel-Filled, with Petrolatum-Polyethylene Compound
- o Shield: Coated Aluminum

The number of conductors per cable shall be as indicated on the plans. The conductor insulation shall be color coded per REA specifications. Cables containing more than 25 pairs shall be assembled in binder-groups. The binder-groups shall be identified by spirally applied color coded non-hygroscopic binding tapes. Binder-group assemblies and binding color code shall be per REA specifications.

The outer jacket of the cable shall be black, low-density polyethylene with an ultraviolet ray blocking material to prevent damage to the polyethylene.

The cable shall be factory tested on reels for each pair's mutual capacitance, crosstalk loss, insulation resistance, and conductor resistance as per REA specifications. The Contractor shall furnish a certificate report from the cable manufacturer for each cable reel showing compliance with the REA specifications, the factory test results, and the date that the cable was manufactured. Cable manufactured more than one year prior to installation shall not be used.

**86-2.09G1 Traffic Signal Communications Cable Installation.** - The Traffic Signal Communications cable shall be installed in conduit as specified. Precautions shall be taken to ensure that the cable is not damaged during storage or installation. The cable shall not be stepped on by workmen nor run over by any vehicle or equipment. The cable shall not be pulled along the ground, over or around obstructions.

Cable ends shall be kept sealed at all times during installation, using an approved cable end cap. Tape shall not be used to seal the cable ends. The cable ends shall remain sealed until termination takes place. Cables that are not immediately terminated shall have a minimum of five feet of slack. Slack is defined as the length of cable extending out of the traffic signal or termination cabinet opening when the cable is held straight outward.

The cable shall enter controller and termination cabinets, as specified, through existing conduit or through new conduit installed in existing or new foundations.

Approved duct seals shall be placed around the communications cable(s) in the end of each conduit or riser assembly entering a controller cabinet or termination cabinet.

Communications cables shall be labeled in conformance with Section 86-2.09B, "Installation" and as follows:

- (1) In all pull boxes cables shall be labeled "TS-COM."

- (2) In controller cabinets and termination cabinets, cables shall be suitably labeled with location of origin and destination respectively.

Where communications cable is installed, the cable installer shall not damage the existing cables, and shall exercise care during installation of equipment to provide safety to the public and to prevent damage to existing facilities. Should any damage be caused to existing cables and/or equipment, the City shall be immediately notified and repairs shall be made by the Contractor at no cost to the City.

Any existing cables shall be removed as specified in Section 86-2.09B, "Installation." All cables and other conductors to be installed in a given conduit shall be pulled into the conduit as a unit. Before installation of new cable(s), a mandrel shall be pulled through all existing conduit and ducts to be used as specified. If the mandrel does not satisfactorily pass through the conduit, the Contractor shall rod and clean the conduit by pulling a stiff bristled wire brush through the conduit. In the event a section of existing conduit or duct is blocked or impassable, the City shall be notified immediately.

Before any communications cable installation is performed, four copies of the cable manufacturer's recommended and maximum pulling tensions for each cable size and type shall be provided to the City. These pulling tensions shall be specified for pulling from the cable's outer jacket. A list of the cable manufacturer's approved pulling lubricants and application guidelines shall also be provided to the City. Only these lubricants shall be permitted. These lubricants shall be harmless to conduit, duct, jackets, and insulation.

The allowable pulling tension shall be the smaller of the cable manufacturer's recommended pulling tension for that cable for pulling by the outer jacket, or 80 percent of the manufacturer's maximum pulling tension for pulling by the outer jacket. The contractor shall ensure that the allowable pulling tension is not exceeded at anytime during cable installation by using one of the following methods, as approved by the engineer:

- (1) Pulling the cable by hand.
- (2) Using a winch with an adjustable clutch for taking up the pulling line. The clutch shall be set such that the clutch slips, and the winch immediately ceases taking up the pulling line, whenever the allowable pulling tension of the cable is exceeded. The proper operation of the winch/clutch assembly shall be demonstrated to the City for approval prior to any cable installation, and at any time during cable installation as may be directed by the City.

Cables shall be attached to the pulling line with one of the following methods:

- (1) For cable sizes 25 pairs or less - a cable grip designed to provide a firm hold on the exterior covering of the cable, and with heat shrinkable end caps placed on the cable ends.
- (2) For cable sizes greater than 25 pairs - cable shall be ordered in the proper cut lengths (i.e., termination to

termination distances plus additional length for terminations) with factory equipped pulling eyes.

The pulling eye/cable grip shall be attached to the pulling line by means of a "B" swivel of 0.75-inch links minimum.

To prevent damage to the cable, voice communications shall be established and maintained between the cable feeding location and the cable pulling equipment location prior to, and during all pulling operations. A qualified person shall be stationed at the "feed" end at all times during the cable pulling operation. The cable reels shall be set up on the same side of the junction box as the conduit section in which the cable is to be placed. The reel axle shall be made level and brought into proper alignment with the conduit section such that the cable shall pass from the top of the reel in a long smooth bend into the duct without twisting. The cable shall not be pulled from the bottom of the reel. The cable shall be fed by manually rotating the reel.

The cable shall not be pulled through any intermediate junction box, pull box, handhole, or any other opening in the conduit not shown on the plans unless specifically approved by the Engineer. Once the installation of a necessary length of cable to be pulled from a cabinet to the immediate next downstream cabinet begins, the cable installation shall be completed that same work day. Cable that has to be temporarily stored during the work day shall be carefully stored in a manner that is not hazardous to pedestrian or vehicular traffic, and which ensures that no damage to the cable shall occur. When cable is stored temporarily it shall be stored in a manner that allows that length of cable to be safely pulled into the next conduit directly from the cable reel or storage rack. Cable shall not be stored on the jobsite overnight unless approved by the Engineer.

The Contractor shall determine the length of cable necessary to reach from termination point to termination point. Splicing of cable at any location other than controller cabinets and termination cabinets shown on the plans is not permitted. Splicing of cable in conduit, pull boxes, junction boxes, or handholes is not permitted.

A cable feeder guide designed for the purpose shall be used between the cable reel or storage stack and the face of the duct to protect the cable, and to guide the cable into the conduit as it is paid off the reel or from the storage stack. The dimensions and set-up of the feeder guide shall be such that the cable does not bend at any location to a radius less than 10 times the diameter of the cable's outside dimensions. This minimum bending radius of the cable shall not be exceeded at any time during cable installation. The cable shall not be pulled over edges or corners, over or around obstructions, or through unnecessary curves or bends. Cables shall be looped in and out of pull boxes to provide adequate slack and the least amount of stress on conductors.

A lubricant approved for the installation, in the amount recommended by the cable manufacturer, shall be used to facilitate pulling the cable. The cable shall be lubricated as it is rolled off the cable reel or storage stack into the cable feeder. An approved cable lubricator (funnel) shall be placed around the cable just ahead of the cable feeder to facilitate proper lubrication of the cable. After the cable has been installed, the exposed cable in a pull box or cabinet must be wiped clean of cable lubricant with a cloth before leaving the pull box or cabinet.

At the start of the pull, tension shall be kept on both the cable reel or storage stack, and the pulling line. As far as possible, the cable shall be pulled

without stopping until the required amount of cable is at the downstream pull box or cabinet. If for any reason the pulling operation is halted between pull boxes and/or cabinets, the tension shall not be released. In restarting the pulling operation, the inertia of the cable shall be overcome by gradually increasing the tension, in small steps a few seconds apart, until the cable is once again in motion.

**86-2.09G2 Traffic Signal Communications Cable Terminations.** - All communications cable entering controller cabinets and termination cabinets shall be terminated by the City.

**86-2.09G3 Traffic Signal Communications Cable Testing.** - The ultimate acceptance of new cable(s) shall be determined by testing performed by the City. The City will perform a DC characteristics test and a signal level test. The DC characteristics test will be performed within 30 days, after the installation of the cables. The signal level test will be performed after the cables are terminated and operationally complete back to the central computer. The City will use the following testing specifications for performing the prescribed acceptance tests.

- (1) DC Characteristics Test
  - a. Insulation resistance of the cable shield and all conductors shall exceed 500 megohm miles. Insulation resistance testing will be performed with the shield bonded to ground. Test will be between shield or ground and to each conductor and each conductor to every other conductor.
  - b. Continuity shall be less than 18 ohms per 1,000 ft per one cable pair.
- (2) Signal Level Test - test frequencies 1200, 1700, 2200, Hz
  - a. The total attenuation at each frequency shall not be greater than 3 Db per cable mile.
  - b. The communications channel shall have a differential signal level less than 6 Db between 1200 and 2200 Hz.

Prior to cables being accepted by the City they shall meet or exceed these test values. If the cable is determined to be defective or damaged, the Contractor shall replace the cable with new cable at no cost to the City. And testing shall be repeated accordingly.

**86-2.10 Bonding and Grounding.** - Replace the entire Section 86-2.10 of the Caltrans Standard Specifications with the following:

Metallic cable sheaths, metal pull box covers, metal conduit, equipment grounding conductors, ballast and transformer cases, service equipment, sign switches, anchor bolts, metal poles and pedestals shall be made mechanically and electrically secure to form a continuous system, and shall be effectively grounded.

Bonding and grounding jumpers shall be Number 8 AWG or larger copper wire or copper braid, except where bonding and grounding wire is provided as an integral part of manufacturer's splice kit and is in conformance with the Code. Equipment grounding conductors shall be color coded to Code requirements or may be bare.

Bonding of standards and pedestals with handholes shall be by means of a 3/8-inch or larger noncorrosive grounding lug installed in the lower portion of the pole shaft as indicated in the Standard Plan Details. Standards without handholes shall be bonded by a Number 8 AWG minimum jumper, attached to all anchor bolts, and run to the conduit or bonding wire in the adjacent pull box. The grounding jumper shall be visible after the foundation cap has been placed on the foundation.

Where a pull box is located adjacent to the standard the grounding electrode shall be driven in the pull box. Grounding electrodes in foundations shall be set obliquely through the foundation and shall extend above the finished foundation sufficiently to attach a ground clamp and bare copper wire ground conductor. Ground rod identifying marks shall be visible. Both the bolt and ground rod clamp shall be visible from the door or handhole.

Grounding of metal conduit, service equipment and the grounded conductor at service point shall be accomplished as required by the Code and the serving utility, except that the grounding electrode conductor shall be Number 6 AWG minimum for Type III service cabinets and Number 8 AWG minimum for all other service types.

Bonding to grounding electrodes shall be by use of UL approved ground clamps or as approved by the Engineer.

A Number 8 AWG or larger stranded copper equipment grounding conductor shall be provided in all conduits carrying traffic signal and/or streetlight conductors. The equipment grounding conductor shall not be required under the following conditions:

- (1) Where a conduit is to be left empty for future use, provided that the conduit is terminated in pull box(es) that do not have metallic covers or components.
- (2) Where a conduit contains only detector lead-in cable(s) and/or signal communication cable(s), provided that the conduit is terminated in pull box(es) that do not have metallic covers or components.

The equipment grounding conductor shall be bonded in accordance with the Standard Plan Details.

At each multiple service point and at each pole, or within 10 feet of each pole a grounding electrode shall be furnished and installed.

Grounding electrodes shall be 5/8-inch x 10 foot copper clad rods or 3/4-inch x 10 foot galvanized steel rod; resistance to ground shall not exceed 25 ohms. Grounding electrodes shall be installed in accordance with the provisions of the Code.

On wood poles, all metallic equipment mounted less than 8 feet above ground surface shall be grounded.

Bonding of metallic conduit shall be by means of galvanized or bronze grounding bushings and bonding jumpers.

Bonding of metallic conduit in steel pull boxes shall be by means of locknuts, one inside and one outside of the box.

**86-2.11 Service.** - Replace the entire Section 86-2.11 of the Caltrans Standard Specifications with the following:

Service points shall be at the locations shown on the plans or as established by the Engineer. Electrical service installations and materials shall conform to the requirements of the serving utility company, the Standard Plan Details, these specifications and the Special Provisions.

Services shall be underground to a service cabinet or pull box, or overhead to electroliers or as established by the Engineer. Service equipment shall be installed as soon as possible to enable the utility to schedule its work well in advance of the completion of the project.

At all service locations, the Contractor shall furnish and install all material and equipment necessary to complete the installation of the service including but not limited to, the service entrance conductors, service drops, service risers, conduits or laterals, conductors, pull boxes, cabinets and related equipment such as: disconnecting means, circuit protection, lighting contactor(s) and grounding system. The position of the riser shall be determined by the utility. Service conduit shall conform to the requirements of the serving utility and these specifications and shall not be less than 1-1/2 inches in size.

The conductors between the service equipment and the utility company service connection point shall be continuous and shall not be spliced. When these conductors pass through pull boxes, they shall be looped one complete loop in the pull box following the perimeter of the pull box tightly before exiting.

The Contractor shall install pull boxes, conduit, and conductors between the utility company service point and the service equipment. Where the service point is a utility-owned pole, the Contractor shall install a 2 inch service conduit riser up the pole one foot above grade in the quadrant assigned by the serving utility company and shall also install a pull box at the base of the utility pole in accordance with the utility company and City requirements.

Service cabinets and related equipment shall be UL listed as suitable for use as service equipment.

Service equipment enclosures shall be CSJ "Type III" (unmetered) or "Type III M" (metered), suitable for outdoor installation, NEMA 3R construction and shall conform to the provisions of Section 86-1.02, "Regulations and Code." Equipment enclosures shall be fabricated from cold rolled sheet steel, 12 gauge exterior, 14 gauge interior, welded by the wire fed inert gas process. All welds shall be ground smooth. Doors shall be padlockable and vandal resistant. Door hinges shall be continuous stainless steel piano type. No screws, rivets, or bolts shall be visible outside the enclosure. Measurements of the enclosure shall conform to those shown on the plans. Inside dead-front door and back panel shall be white. Enclosures shall be painted in accordance with the provisions in Section 86-2.16, "Painting."

For metered service cabinets, a meter socket equipped with manual closing devices or space for a test block and sealing ring shall be provided, as approved by the serving utility.

Each service equipment enclosure shall be factory pre-wired conforming to the plans and specifications and delivered to the job site ready to bolt to the foundation and connect to service and load wires. The Contractor shall furnish 3

sets of wiring diagrams showing location and describing components and wiring connections. One set shall be sealed in plastic and attached to the inside of the cabinet door.

All circuit breakers for service cabinets shall be quick-break on either automatic or manual operation and shall be identified with a permanently affixed laminated phenolic nameplate designating the connected circuit. The circuit breaker operating mechanism shall be enclosed and shall be trip-free from the operating handle on overload, shall be trip-indicating and shall have trip and frame size plainly marked. Overload tripping of circuit breakers shall not be influenced by an ambient temperature range from minus 18 to plus 50°C. Multiple-pole breakers shall have a common trip. All circuit breakers shall be listed by UL or ETL. Current rating of breakers shall be as shown on the plans. Circuit breakers shall have a minimum short circuit current interrupting capacity rating of 10,000 amperes, root-mean-square symmetrical, at applied voltage. Circuit breakers shall be installed in dead-front panels. For service cabinets which have both unmetered and metered sections, provide a separate main disconnect means for the metered and the unmetered service sections of the cabinet. Service disconnecting means shall be designed to disconnect all ungrounded conductors simultaneously.

Service equipment enclosure wiring shall conform to NEMA class II C. Wiring troughs shall be provided in the enclosure as necessary. Control wiring shall be 7 strand copper, Number 14 AWG with type TW insulation except for hinge wiring, which shall be 19 strand copper, Number 14 AWG with type THWN insulation. Wiring shall be arranged so that any piece of apparatus may be removed without disconnecting any wiring except the leads to that piece of apparatus. All wiring shall be marked with permanent clip sleeve wire markers. Felt, pencil, or stick back markers will not be acceptable.

Nameplates shall be provided for each control component and circuit breaker of the service equipment enclosure. The nameplates shall be phenolic, black background with white lettering except main breaker(s) which shall be red with white lettering. All nameplates shall be fastened to the inside dead-front door with two screws each minimum. If an alternate design is proposed for the service equipment enclosure, plans of such design shall be submitted to the Engineer for review and approval.

Overhead services to electroliers shall have circuit protection installed in the drip loop in accordance with the Standard Plan Details.

Unmetered underground services to streetlights shall have circuit protection installed in the "service" pull box in accordance with the Standard Plan Details.

Only when a temporary service is required can service equipment be installed on a wood pole if permitted by the utility company, or at the direction of the Engineer.

Temporary power for the Contractor's operations shall be arranged by the Contractor with the serving utility. Requests shall not be submitted less than 15 days before service connections are required. Expenses of the service and cost of energy shall be born by the Contractor except when service or energy is used for public benefit or when ordered by the Engineer which will be at the expense of the City.

Full compensation for furnishing and installing City-owned or permanent service poles, service equipment, conduit, conductors and pull boxes (including equipment, conduit, and conductors placed on utility-owned poles) shall be

considered as included in the contract item of electrical work involved and no additional compensation will be allowed therefor.

Where the service point is indeterminate and is shown on the plans as an "approximate location" or "service point not yet established," the labor and materials required for making the connection between the service point, when established, and the nearest pull box shown on the plans will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

**86-2.12 Wood Poles.** - The bottom of the hole shall be free of loose dirt and shall be compacted equal to or greater than the density of the surrounding soil. Compaction shall exceed 90 percent. Sufficient additional soil shall be heaped around the pole to provide drainage away from the base of the pole.

Mast arms for wood lighting standards shall conform to the requirements of mast arms for octafluted standards contained in Section 86-2.04, "Standards, Steel Pedestals and Posts," except that the steel fitting welded to the end of the mast arm shall be specifically designed for wood pole mounting. Unless shown otherwise on the Plans, mast arms for wood lighting standards shall be 6 feet in length.

**86-2.14A Material Testing.** - Delete the last paragraph of Section 86-2.14A of the Caltrans Standard Specifications.

The Contractor shall allow 30 days for testing or re-testing of material or equipment. The Contractor shall be responsible for delivery of equipment to the City for testing. The Contractor will be notified by the City when testing of the equipment has been completed and it shall be his responsibility to deliver said equipment to the site of work.

**86-2.14B Field Testing.** - Any fault in any material or in any part of the installation revealed by these tests shall be replaced or repaired by the Contractor at his expense in a manner approved by the Engineer, and the same test shall be repeated until no fault appears.

**86-2.14B(3) Insulation Resistance.** - All traffic signal phases and their conductors, hardware, and associated wiring shall be considered a circuit. The complete traffic signal system with all associated wiring shall have an insulation resistance of not less than 10 megohms.

**86-2.14B(4) Inductive Loop Detector Testing.** - Inductive loop detector circuit(s) shall be tested in accordance with Section 86-5.01A(5), "Installation Details."

**86-2.14C Functional Testing.** - Delete paragraphs 2 and 5 of Section 86-2.14C of the Caltrans Standard Specifications.

The functional test for each new or modified traffic signal, traffic signal system, flashing beacon, traffic count station, lighting system, and such other electrical installation work as the Engineer may direct shall consist of not less than 5 days of continuous, satisfactory operation. If unsatisfactory performance of the system develops, the condition shall be corrected by the Contractor at his expense and the test shall be repeated until the 5 days of continuous, satisfactory operation is obtained.



**86-2.16 Painting.** - Delete paragraphs 13, 24, and 27 of Section 86-2.16 of the Caltrans Standard Specifications.

Unless specified otherwise in the Special Provisions or Plans, two applications of Traffic Signal Dark Olive Green enamel paint, Section 91-4.02, shall be applied to the following non-galvanized equipment: reused and/or City furnished lighting and signal standards, signal heads and hardware.

Reused and City furnished equipment previously finished as specified in this Section 86-2.16, except for galvanized standards shall be given a spot finishing application on newly primed areas, followed by one finishing application over the entire surface.

Equipment numbers shall be applied to standards through the use of adhesive labels in accordance with the Standard Plan Details after all finish painting or galvanizing has been performed. The number designation will be determined by the Engineer.

### 86-3 CONTROLLER ASSEMBLIES

**86-3.01 Controller Assemblies.** - The Contractor shall install the controller cabinet on a prepared foundation. Seams, where the controller cabinet rests on the foundation, shall be sealed with approved joint sealing compound.

The cabinet door shall be installed on the side of the foundation as directed by the Engineer.

**86-3.06 Type 90 Controller Assembly.** - Type 90 controller assemblies shall conform to the requirements specified in Caltrans specifications, the NEMA Standards Publication No. TS 1-1989, Sections 1, 2, 13 and 14 and the latest CSJ "Cabinet and Controller Specifications" and these specifications.

**86-3.07A Cabinet Construction.** - Cabinets shall be constructed of aluminum as specified. Cold rolled steel and stainless steel shall not be used.

**86-3.07B Cabinet Ventilation.** - Each controller cabinet shall be provided with a louvered vent and a replaceable filter held firmly in place, which will permit the fan to pass the volume of air specified. The filter shall be as specified in the CSJ "Cabinet and Controller Specifications."

**86-3.07C Cabinet Wiring.** - The use of optional flat cable in lieu of individual conductors shall not be permitted.

**86-3.07D Cabinet Accessories.** - A convenience receptacle shall be mounted in a readily accessible location inside the cabinet on the right wall. It shall not be mounted in any other location.

**86-3.08A Interconnect Isolation Relay Unit.** - Delete the entire Section 86-3.08A of the Caltrans Standard Specifications.

**86-3.08B Pre-emption Equipment.** - Delete paragraphs 1 and 2 of Section 86-3.08B of the Caltrans Standard Specifications.

The pre-emptor shall be an integral part of the controller unit. Separate solid-state units shall not be used. The controller unit shall be provided with timing

controls for the intervals as shown in the City Cabinet and Controller Specifications. Indicator lights shall not be provided.

**86-3.08C Monitoring Device.** - Delete the last paragraph of Section 86-3.08C of the Caltrans Standard Specifications.

**86-3.08D Solid-State Switching Devices.** - Each circuit shall have a minimum rating of 1,800 watts. The referenced NEMA Standards Publication shall be TS1-1989.

**86-3.08G Calling Detector Disconnect.** - Calling detector disconnect function shall be internal to the controller unit. External units shall not be used.

**86-3.08K Convenience Receptacle.** - Convenience receptacle shall be GFCI type.

**86-3.08L Flasher.** - The referenced NEMA Standard Publication shall be TS1-1989. The flasher capacity per circuit shall be 20 amperes.

**86-3.09G Circuit Breakers.** - Circuit breaker minimum short circuit current interrupting capacity shall be 10,000 amperes, root-mean-squared symmetrical, at applied voltage.

**86-3.09H Printed Circuit Boards.** - Identification shall be made by both part identification markings and by providing a pictorial diagram in the maintenance manual for the unit showing the physical location and identification of each component.

**86-3.09K Lighting Fixture.** - The "On-Off" switch for the lighting fixture shall be a door-activated switch (type B) that turns the light on when the door is opened and off when the door is closed. Type (A) shall not be used.

#### **86-4 TRAFFIC SIGNAL FACES AND FITTINGS**

**86-4.00 Traffic Signal Equipment.** - Traffic signal equipment shall include the traffic signal head (vehicular and pedestrian) consisting of an assembly containing one or more signal faces together with optical units, the assembly housing, mountings, and other appurtenant devices.

Signal assemblies shall meet the requirements of the latest edition of ITE Publication "Adjustable Face Vehicular Traffic Control Signal Heads," in addition to the requirements contained herein.

**86-4.01 Vehicle Signal Faces.** - The various mounting types for vehicle and pedestrian traffic signals are shown in the Standard Plan Details. The type of mountings to be used shall be as indicated on the Plans.

Signal sections shall be metal. Plastic signal sections shall not be allowed. Vehicle signal heads mounted on mastarms shall have 12 inch sections. Vehicle signal heads for left turn indications shall have all 12 inch arrows.

Signal faces shall be the adjustable, colored light, vertical type with the number and type of lights (faces) shown on the plans. Each signal face shall provide an indication in one direction only.

**86-4.01A Optical Units.** - Each reflector, lens, and hood shall be designed in such a manner as to reduce sun-phantom to a minimum. The lens design shall produce high illumination transmission, and outward and downward light distribution, with minimum of light distributed above the horizontal. Lamp receptacle openings in reflectors shall be designed so that there will be no dark spots cast on the lens.

Lamps for signal assemblies shall be incandescent, suitable for horizontal operation with medium base, 130-volt, 8,000 hour rated life, clear traffic signal lamps.

Lamps for 8-inch vehicle traffic signal sections shall be, ANSI Designation A21, with an initial rated output of 685 lumens.

Lamps for 12 inch vehicle traffic signal sections shall be, ANSI Designation P25, with an initial rated output of 1950 lumens.

**86-4.01B Signal Sections.** - Each signal section housing shall be either die-cast or permanent mold-cast aluminum conforming to ANSI Standard: D-10.1. Plastic signal sections shall not be used.

Each signal section shall be constructed in such a manner that structural failure of the housing will not occur with a wind load pressure of 25 pounds per square foot on the projected area of the complete signal face housing, including back plate and visors.

A sample, consisting of a complete signal section assembly, with the optical unit, shall be submitted to the City for testing prior to acceptance of any design or fabrication method not previously tested and accepted by the City.

The signal face housing, or case shall consist of an assembly of separate interchangeable sections, expandable type for vertical mounting without tie rods, substantially secured together in a water tight manner to form a unit. Each section shall house an individual optical unit.

Each section shall be complete with a one-piece, hinged door mounting for the lens and other parts of the optical system, watertight gaskets, and simple door-locking device. The optical system shall be so mounted that the various parts may be swung open for ready access or removal. The sections shall be interchangeable and so constructed that sections can be removed or added.

**86-4.01B(1) Metal Signal Sections.** - All metal signal faces shall be provided with metal backplates.

**86-4.01B(2) Plastic Signal Sections.** - Delete the entire Section 86-4.01B(2) of Caltrans Standard Specifications.

**86-4.01C Electrical Components.** - Lamp receptacles shall have a heat-resistant molded phenolic housing and shall be designed to accommodate standard traffic signal lamps, ANSI Designation A21 or P25. The lamp receptacle shall be capable of positioning the lamp at the exact focal point of the reflector. The lamp receptacle shall provide proper lamp filament orientation without affecting lamp focus.

The lamp receptacle conductors shall be connected to the shell of the lamp receptacle by an approved mechanical method. Solder shall not be used for the only means of conductor attachment to the lamp receptacle shell.

**86-4.01D Visors.** - Each signal section shall be provided with a removable metal visor conforming to ANSI Standard D-10.1. Plastic visors shall not be used.

**86-4.03 Backplates.** - Metal backplates shall be furnished and installed on all vehicle signal faces. Plastic backplates shall not be used.

Backplates shall be constructed of 5052-H32 aluminum alloy sheet 0.051-inch minimum thickness, and of the dimensions shown on the plans.

**86-4.05A Pedestrian Signal Faces.** - Pedestrian signal faces shall be Type A. Types B and C shall not be used.

**86-4.05A(1) Type A.** - Each message plate shall be one piece and shall be made of 3/16 inch tempered glass. Polycarbonate plastic shall not be used.

Lamps for pedestrian signal assemblies shall be incandescent, ANSI Designation A21, suitable for horizontal operation with medium base, 130-volt, 8,000 hour rated life, clear traffic signal lamps with an initial rated output of 685 lumens.

**86-4.05A(2) Type B.** - Delete the entire Section 86-4.05A(2) of the Caltrans Standard Specifications.

**86-4.05A(3) Type C.** - Delete the entire Section 86-4.05(3) of the Caltrans Standard Specifications.

**86-4.05B Front Screen.** - A front screen shall be provided on each Type A signal face. The front screen shall be of the 1-1/2 inch deep eggcrate or Z-crate type. Aluminum honeycomb screens shall not be used.

The screen and frame shall be fabricated from aluminum anodized flat black, or finished with flat black enamel. Flat black plastic shall not be used.

**86-4.05D Visors.** - Delete the entire Section 86-4.05D of the Caltrans Standard Specifications.

**86-4.06 Signal Mounting Assemblies.** - Signal mounting assemblies shall consist of 1-1/2 inch standard steel pipe, necessary fittings of either brass or malleable iron and cast bronze slip fitters. The following shall not be used in signal mounting assemblies: galvanized conduit; galvanized steel, copper or bronze conduit fittings; terminal compartments; and clamshell mounting assemblies. All mounting assemblies shall be painted as specified in Section 86-2.16, "Painting."

Traffic signals, conforming to the provisions of Section 86-4 "Traffic Signal Faces and Fittings" shall be assembled and mounted to signal standards in accordance to the provisions of Section 86-2.04 "Standards, Steel Pedestals and Posts."

The dimensions of mounting bracket assemblies, as well as fittings and slip-fitters shall be as shown in the Standard Plan Details. Each slip-fitter shall be provided with 2 rows of steel set screws, with 3 screws in each row to secure the assembly in plumb position. Set screws shall be cadmium plated.

Signal heads shall be equipped with positive brass lock rings and fittings designed to prevent heads from turning due to external forces. Lock ring and

connecting fittings shall have serrated contacts as shown in the Standard Plan Details.

Signal head assemblies for suspension from mast arms shall be equipped with slip-fitters as shown in the Standard Plan Details.

Quadrants for mounting of signal fixtures shall be verified with the City prior to drilling or cutting holes in signal standards.

Traffic signal vehicle and pedestrian heads that are mounted and erected, and are not in operation, shall be immediately directed away from traffic and covered with an approved weather resistant cover. Standards that are erected with the signal heads already mounted and not placed in operation, shall have the signal heads directed away from the proposed direction of traffic and covered before the standard is erected.

On the day of the traffic signal system activation, the signal faces shall be uncovered and properly oriented to traffic as directed by the Engineer.

### 86-5 DETECTORS

**86-5.01 Vehicle Detectors.** - Circuitry shall be solid state including the output circuit. Relays shall not be used. The detector delay/extension enable circuit, when activated with a "low" state voltage, shall inhibit the delay detector operation.

Splices shall be insulated by method C handcrafted insulation only. Methods A and B shall not be used.

Detector lead-in cables shall be continuous, without splices, from the controller cabinet detector panel terminal block to the loop termination pull box.

**86-5.01A(3) Sensor Unit Construction.** - Sensor units shall conform to the requirements in Section 15 of the NEMA Standards Publication No. TS 1-1989, "Traffic Control Systems."

**86-5.01A(4) Construction Materials.** - Conductors for inductive detector loops shall be continuous and unspliced and shall be Type 1 loop wire. Type 2 loop wire shall not be used. Loop detector lead in-cable shall be type B, unless specified otherwise.

**86-5.01A(5) Installation Details.** - Replace the entire Section 86-5.01A(5) of the Caltrans Standard Specifications with the following:

Installation and testing shall conform to the details and notes shown in the Standard Plan Details, Caltrans 1 Section 86-2.14 "Testing," and these specifications.

Unless specified otherwise, each loop shall consist of the number of turns of conductor as shown in the Standard Plan Details and shall be constructed of the material as specified in Section 86-5.01A(4), "Construction Materials."

Sawcut slots shall be cut into the pavement to the depth and width shown on the Standard Plan Details and at the location laid out by the Engineer. Sawcuts shall be overlapped at all corners so that slots are full depth at the corners. The bottom of the sawcut slots shall be smooth and even.

After conductors are installed in the slots cut in the pavement, one inch strips of 3/8-inch diameter foam backer rod shall be inserted in the slot over the loop wires, spaced as necessary, but not more than 5 feet apart to prevent the loop wires from rising up in the slot when the slots are being filled with sealant. The

slots shall be filled with sealant to within 1/8-inch of the pavement surface. The sealant shall be a minimum of 1-1/4 inch thick above the top conductor in the slot. Conductors in asphalt concrete pavement and within 4 feet of the lip of gutter shall have a minimum cover of 3 inches. Before setting, surplus sealant shall be removed from the adjacent road surfaces without the use of solvents.

The sealant for filling slots shall conform to the following:

**Elastomeric Sealant.** - Elastomeric Sealant shall conform to the requirements of Section 86-5.01A(5), "Installation Details," of the Caltrans Standard Specifications for the performance characteristics on "Elastomeric Sealant." Elastomeric sealant shall be used only in Portland Cement concrete.

**Asphaltic Emulsion Sealant.** - Asphaltic Emulsion Sealant shall conform to the requirements of Section 86-5.01A(5), "Installation Details," of the Caltrans Standard Specifications on "Asphaltic Emulsion Sealant."

Loop conductors shall be installed without splices and shall terminate in the pull box indicated on the Plans. The loop conductors shall be spliced to the lead-in cables in the termination pull box adjacent to the loops. Each loop shall be provided with its own detector lead-in cable. Detector lead-in cables shall be continuous, without splices between the loop termination pull box and the detector panel terminal block in the controller cabinet. The shield and drain wire of the detector lead-in cable shall be grounded in the traffic signal controller cabinet only.

The start (S) and finish (F) conductors of each loop shall be permanently labeled with a (S) on the start conductor and a (F) on the finish conductor and then grouped together as a pair. The start (S) loop conductor shall be spliced to the black conductor in the lead-in cable and the finish (F) loop conductor to the white conductor in the lead-in cable. Each loop pair and lead-in cable shall be identified as to direction, lane, and signal phase in all pull boxes and in controller cabinets. Labeling shall conform to the provisions in Section 86-2.09B, "Installation."

The end of the lead-in cable shall be taped and waterproofed prior to installing in conduit to prevent moisture from entering the cable. Where loop conductors are not immediately to be spliced to a lead-in cable, the ends of both the loop conductors and lead-in cable shall be taped and waterproofed with an electrical insulating coating. If the ends of the loop and lead-in cable are left not taped and waterproofed for more than 24 hours the loop and the lead-in cable shall both be replaced at the contractors expense.

All adjacent loops shall be wound in the same direction. No more than 4 loop conductors (2 twisted pairs) shall be installed in one home-run slot. Loop conductors for more than one signal phase shall not be combined in a common home-run slot.

Loops shall be set back 2 feet from stop bar and shall be centered in lanes except for curb lanes greater than 12 feet where they shall be installed 3 feet from the lane line, unless specified otherwise. The distance between the side of the loop and the home-run saw cut from the adjacent loops shall be 2 feet minimum. The distance between home-run saw cuts shall be 6 inches minimum. Loop conductors shall be installed a minimum of 3 feet from any metal obstacles in the street such as metal manhole covers unless otherwise approved by the Engineer prior to installation.

If loops are to be installed in asphalt concrete pavement, the loop conductors may, at the Contractor's discretion, be installed either in the finished surface layer of asphalt concrete or in the compacted layer of asphalt concrete immediately below the uppermost layer.

Before installing loop conductors in the sawed slots, the slots shall be thoroughly washed with water and then blown out with compressed air and allowed to dry thoroughly.

The loop conductor shall be installed into the slot using a 3/16-inch to 1/4-inch thick wood paddle or roller designed and approved for the purpose. The loop conductors shall be carefully installed in the sawcut slots to prevent insulation damage. The loop conductors shall be loosely installed around the sawcut slot corners to prevent tension from being placed on the conductors at the corners.

The loop shall be wound in accordance with the standard plan details unless otherwise specified.

Four feet of loop conductor slack for each loop, shall be left in the loop termination pull box.

The loop conductor home-run for each loop shall have its start (S) and finish (F) conductors twisted together into a pair (at least 3 turns per foot) before being placed in the home-run slot, conduit, and termination pull box.

Each loop shall be tested at the termination pull box before the slots are filled with sealant. Each loop shall not exceed 0.5 ohms circuit resistance and shall not measure less than 200 meg-ohms insulation resistance. As measured with a 500 VDC megger.

The loop conductors shall be spliced to the detector lead-in cables using non-insulated crimp style butt splice connectors and soldered in accordance with Section 86-2.09C, "Connectors and Terminals."

In the loop termination pull box the outer jacket of detector lead-in cable shall be removed a maximum of 4 inches. The loop conductor to lead-in cable splices and the lead-in cable conductors back to and over to the lead-in cable outer jacket ending point shall be taped and water-proofed in accordance with Section 86-5.01, "Vehicle Detectors," method C. The tape and waterproofing shall overlap the ending point of the outer jacket of the lead-in cable a minimum of 2 inches.

In the controller cabinet the outer jacket of the detector lead-in cable shall be removed between the cable termination point on the detector panel to the bottom of the controller cabinet.

Care shall be taken not to nick or otherwise damage the detector lead-in cable conductor insulation while removing the outer jacket.

The detector lead-in cable drain wire shall be terminated on the detector panel ground bus using spade lug terminals. Only one drain wire shall be connected to each spade lug terminal.

All detector loop circuits shall be tested for circuit resistance, insulation resistance, and inductance at the controller cabinet with the drain wires terminated before final termination of the detector lead-in cable to detector panel terminal blocks.

The detector loop circuit resistance shall not exceed 0.5 ohms plus 0.35 ohms per 100 feet of lead-in cable. The complete detector loop circuit insulation resistance shall not be lower than 100 meg-ohms between any conductor and earth ground. The complete detector loop circuit inductance shall be between 250 and 450 micro-henries for type "C" loops and between 150 and 300 micro-henries for type "Q" loops.

The detector lead-in cables shall be terminated in the controller cabinet using non-insulated crimp style spade lugs and then soldered in accordance with Section 86-2.09C, "Connectors and Terminals." The detector lead-in cable conductors shall be twisted together into a pair (at least 3 turns per foot) before termination on the detector panel terminal blocks.

**86-5.01C Magnetic Detectors.** - Delete the entire Section 86-5.01C of the Caltrans Standard Specifications.

**86-5.02 Pedestrian Push Buttons.** - Pedestrian push buttons shall be Type B. Types A and C shall not be used.

Pedestrian push buttons signs shall be porcelain enameled metal. Structural plastic signs shall not be used.

Pedestrian push button housings shall be either die-cast or permanent mold cast aluminum. They shall be mounted at the height shown in the Standard Plan Details.

## 86-6 LIGHTING

**86-6.00 Luminaire Class and Types.** - Luminaires are classified by class according to the method by which illumination is provided, and by type as differentiated by power absorption (watts), initial lumens, light dispersion characteristics, and photocell requirements. The luminaire class and types are as shown in the Standard Plan Details and the class and type to be used in the work will be shown on the Plans or specified in the Special Provisions.

**86-6.01 High Pressure Sodium Luminaires.** - Replace the entire Section 86-6.01 of the Caltrans Standard Specifications with the following:

All luminaires shall conform to ANSI performance standards and the provisions as specified herein.

High pressure sodium luminaires shall be of the semi-cutoff type as designated by the Illuminating Engineering Society (IES). Luminaires shall match existing City Standards.

The refractor shall be capable of producing the light pattern and optical characteristics specified. The optical system shall produce the maximum usable light with minimum glare. Light distributions obtainable shall conform to IES standards.

The refractor shall be securely hinged to the housing in such a manner that the lower assembly cannot accidentally become detached and fall when the luminaire is opened.

Conductor insulations shall be a high temperature formulation suitable for use in street lighting luminaires.

All wiring connections shall be at terminals or made with quick-disconnect plugs that are polarized or keyed to prevent incorrect connections.

All luminaires shall have wiring diagrams, voltage ratings, lamp wattage and all other pertinent electrical data prominently and permanently displayed on a durable label in each luminaire. The label shall be conspicuous when the luminaire is open for servicing.

No luminaire supplied under this specification shall have appearance incompatible with those already in use by the City nor shall it have any feature making it impractical, unsafe or expensive to use and maintain.



All parts shall be smooth and free of sharp edges. Mating parts shall fit together easily, and without strain. Wiring shall be neatly arranged.

Luminaires requiring photocells shall have a NEMA 15 amp twistlock receptacle. A shorting cap shall be installed in the receptacle when a photocell is not required.

A durable label shall be provided in a conspicuous place within the luminaire housing displaying wiring diagrams, voltage ratings, lamp wattage and other pertinent electrical data.

The housing shall be die-cast aluminum with natural or aluminum colored epoxy coating. Latches shall have a protruding handle so that the ring and refractor assembly can be easily opened for lamp replacement and closed by hand wearing lineman's gloves.

Mounting shall be secured to withstand an impact on the pole which does not knock the pole to the ground.

Sealing shall be provided by a high-temperature felt or elastomer gasket to produce a dust-proof seal without strain on the mating parts.

**86-6.01A - High Pressure Sodium Lamp Ballast.** - Delete paragraph 10 of Section 86-6.01A of the Caltrans Standard Specifications.

Ballast coils shall be heavily encapsulated in epoxy, electrical varnish or other suitable compounds to prevent ballast noise. Ballasts shall be the regulator type.

Ballast shall be the multi-tap type for different voltage ranges. Ballast shall be an integral part of the luminaire and held securely in place with devices that allow easy and safe removal and replacement in the field without the necessity of removing the luminaire from the bracket arm.

The lamp current wave-shape crest factor shall not exceed 2 at rated line voltage.

Ballast shall maintain wattage output within 14% to 18% of rated value with 10% fluctuation of supply voltage.

After a warm-up period of 15 minutes, input current and output watts shall not vary more than 5% from the ballast rating when operated at the rated voltage with a lamp of the correct type and wattage.

Ballast starting current shall be lower than operating current.

**86-6.01B High Pressure Sodium Lamps.** - Lamps shall be either:

- 150 watts with minimum initial output of 16,000 lumens, or
- 200 watts with minimum initial output of 22,000 lumens, or
- 250 watts with minimum initial output of 27,500 lumens, or
- 310 watts with minimum initial output of 37,000 lumens, or
- 400 watts with minimum initial output of 50,000 lumens

with an average rated life of 24,000 hours operating a minimum of 10 hours per start. Lamps shall operate in any position.

**86-6.02 Low Pressure Sodium Luminaires.** - All luminaires shall conform to ANSI performance standards and the provisions as specified herein.

Low pressure sodium luminaires shall be completely assembled and shall consist of a housing, reflector, refractor or lens, lamp socket, lamp support, integral ballast and removable ballast tray, terminal block, slip fitter and lamp.

Luminaires shall be of the enclosed type with a horizontal burning lamp.

Luminaries shall be the semi cut-off type as classified by the IES, with a minimum total downward Coefficient of Utilization of 67 percent for 55W luminaires and 59 percent for 90W luminaires.

Luminaires shall be manufactured by a manufacturer who is now regularly engaged in the manufacture of street lighting luminaires.

Housing shall be of corrosion resistant die cast aluminum - 0.0625 inch minimum thickness, corrosion resistant aluminum sheet and plate with concealed continuous welds, or acrylonitrile butadiene styrene sheet material - 3/32 inch minimum wall thickness, in a cast aluminum frame that provides mounting for all electrical components and slipfitter. The housing shall be divided into optical and power compartments that are individually accessible for service and maintenance. Positioning and clamping of the luminaire to the pipe tenon shall be accomplished by tightening mounting bolts.

Housings shall be painted with a fused coating of electrostatically applied polyester powder paint or other ultraviolet inhibiting film. Color shall be aluminum grey.

A high temperature neoprene, or equal, sealing ring shall be installed in the pipe tenon opening to prevent entry of water and insects into the power and optical compartments.

Access to the power unit assembly shall be through a weathertight hinged cover secured with spring type latches or captive screws to the luminaire housing.

Hardware shall be stainless steel or cadmium plated. Machine screws or bolts shall be used to secure removable components. Sheet metal screws shall not be used.

Reflectors shall have a minimum Reflection Factor of 88 percent.

Refractors or lenses shall be one piece polycarbonate of 3/32-inch minimum thickness, constructed to rigidly maintain its shape, and hinged and secured to the luminaire housing with captive latches.

The refractor shall be capable of producing the light pattern and optical characteristics specified. The optical system shall produce the maximum usable light with minimum glare. Light distributions obtainable shall conform to IES standards.

Conductor insulations shall be a high temperature formulation suitable for use in street lighting luminaires.

All wiring connections shall be at terminals or made with quick-disconnect plugs that are polarized or keyed to prevent incorrect connections.

All luminaires shall have wiring diagrams, voltage ratings, lamp wattage and all other pertinent electrical data prominently and permanently displayed on a durable label in each luminaire. The label shall be conspicuous when the luminaire is open for servicing.

All parts shall be smooth and free of sharp edges. All mating parts shall fit together easily and without strain and wiring shall be neatly arranged.

No luminaire supplied under this specification shall have appearance incompatible with those already in use in San Jose nor shall it have any feature making it impractical, unsafe or expensive to use and maintain.

Lamp socket of high temperature flame retardant material with self-wiping, silver plated copper alloy contacts, shall be rated for 660 watts and 1,000 volts.

Lamp support shall maintain positive lamp retention and position.

Terminal block shall be mounted to the inner support frame within the ballast compartment, pre-wired to the ballast and other integral controls if required, and provide for quick disconnect for removal of the integral ballast tray.

Integral ballast tray shall be removable and replaceable without the use of tools, and provide a single multi-circuit connector for quick and easy disconnection of the ballast tray.

Slipfitter shall mount onto standard 1-1/4 inch to 2 inch diameter by 6-3/4 inch long tenons and provide plus or minus 5 degree leveling with positive mounting clamps.

**86-6.02A Low Pressure Sodium Lamp Ballasts.** - Each ballast shall be designed for the type, characteristics and wattage of the lamp it is to operate and shall provide the proper starting and operating waveforms, voltage and current.

Ballasts shall be the autotransformer or high reactance type. Ballast shall be the multi-tap type for different voltage ranges. Ballast shall be an integral part of the luminaire and held securely in place with devices that allow easy and safe removal and replacement in the field without the necessity of removing the luminaire from the bracket arm.

The power factor shall not be less than 90 percent when the ballast is operated at nominal line voltage.

Lamp wattage regulation shall not vary by more than plus or minus 6 percent for plus or minus 10 percent input voltage variation.

Lamp current crest factor shall not exceed 1.8 at line voltage.

**86-6.02B Low Pressure Sodium Lamps.** - Low pressure sodium lamps shall conform to the applicable ANSI Standard for Lamp Designation L74-RF-135. Lamps shall be:

- 55 watts with minimum initial output of 8,000 lumens, or
- 90 watts with minimum initial output of 13,500 lumens, or
- 135 watts with minimum initial output of 22,500 lumens

Lamps shall have an average rated life of 18,000 hours operating a minimum of 10 hours per start. Lamp depreciation over life shall not exceed 2 percent.

Operating position shall be horizontal plus or minus 20 degrees.

**86-6.04 Pedestrian Crossing Fixtures.** - Replace the entire Section 86-6.04 of the Caltrans Standard Specifications with the following:

Pedestrian crossing fixtures shall consist of lighting fixtures for pedestrian undercrossings and for pedestrian overcrossings as shown on the plans.

**86-6.055 Sign Lighting Fixtures - Mercury.** - Delete the entire Section 86-6.055 of the Caltrans Standard Specifications.

**86-6.07 Photoelectric Controls.** - Streetlighting systems shall be switched as indicated on the Plans. The control circuit wiring between the photoelectric unit and the contactor shall be installed as indicated on the Plans. The photoelectric unit shall be normally oriented north or as directed by the Engineer.

**86-6.07A Types.** - Replace the entire Section 86-6.07A of the Caltrans Standard Specifications with the following:

The types of photoelectric controls shall be as follows:

Type II photoelectric control shall consist of a remote photoelectric unit in a weatherproof housing, a separate contactor and a test switch located in the service equipment enclosure unless shown otherwise. The photoelectric control unit shall be pole-top mounted unless otherwise specified.

Type IV photoelectric control shall consist of a photoelectric unit in a weatherproof housing which plugs into an EEI-NEMA twist lock receptacle integral with the luminaire.

A switch to permit manual operations of the lighting circuit shall be provided for each Type II photoelectric control. Switches shall be of the single-hole mounting toggle type, single-pole, single-throw, rated at 12 amperes, 125 volts. Switches shall be furnished with an indicating nameplate reading "Auto-Test" and shall be connected in parallel with the load contacts of the photoelectric unit. The test switch shall not have an "off" position.

**86-6.07B(1) Photoelectric Unit.** - Delete paragraphs 7, 10, and 11 of Section 86-6.07B(1) of the Caltrans Standard Specifications.

The supply voltage rating shall be 60 Hz, 105-130, 210-240, 105-240 volts as specified or as required.

The load rating shall be 1800 watts minimum, high pressure sodium or low pressure sodium.

**86-6.07B(2) Contactor.** - Replace the entire Section 86-6.07B(2) of the Caltrans Standard Specifications with the following:

The contactor shall have 4 normally open poles rated to switch the specified lighting load, rated 600 volts, 60 hertz industrial duty, or as indicated. The contacts shall be rated to switch the actual connected load, and not less than 30 amperes per contact. Contactors shall be capable of making and breaking any load within its rating without the assistance of auxiliary arcing contacts; arcing contacts are not permitted. All contacts must be removable without disturbing line or load wiring.

Contactor shall be electrically held with coil operating on 120 volts and rated for continuous load. The contactor coil shall be fully encapsulated.

**86-6.07B(3) Contactor and Test Switch Housing.** - Delete the entire Section 86-6.07B(3) of the Caltrans Standard Specifications.

**86-6.09 Transformers.** - Delete the entire Section 86-6.09 of the Caltrans Standard Specifications.

**86-6.09A Electrical Requirements.** - Delete the entire Section 86-6.09A of the Caltrans Standard Specifications.

**86-6.09B Physical Requirements.** - Delete the entire Section 86-6.09B of the Caltrans Standard Specifications.

**86-6.09C Submersible Type Transformers.** - Delete the entire Section 86-6.09C of the Caltrans Standard Specifications.

### 86-7 REMOVING, REINSTALLING OR SALVAGING ELECTRICAL EQUIPMENT

**86-7.01 Removing Electrical Equipment.** - Delete the last sentence of paragraph one of Section 86-7.01 of the Caltrans Standard Specifications.

This work shall consist of removing and/or salvaging existing lighting and traffic signal electrical equipment where shown on the Plans, or as specified in the Special Provisions, or directed by the Engineer.

Items scheduled for salvage or items to become the property of the Contractor shall not be reused in the work.

The contractor shall replace, at his expense, any electrical equipment scheduled for salvage as well as any facilities to remain, which, as determined by the Engineer, has been damaged or destroyed by reason of his operations.

Electrical equipment to be salvaged shall be as indicated on the Plans and includes but shall not be restricted to such items as: controller units, cabinets, signal heads, luminaires, standards, mast arms, ballasts, service equipment, conduit, conductors, cables, and detector contact units.

The items to be salvaged shall be disassembled, dismantled or otherwise removed to the extent necessary for transporting to the salvage stockpile.

The Contractor shall transport the salvaged items to the stockpile location, as specified in the Special Provisions, and will off-load the items as directed. The Contractor shall give the City 24 hours. notice before delivering salvaged materials. An itemized receipt, in duplicate, shall be prepared by the Contractor prior to delivery of salvaged equipment to the City and shall be signed by the City custodian at the stockpile site. One copy of the receipt shall be given to the City custodian and one copy shall be delivered to the Engineer by the Contractor.

### 86-8 MEASUREMENT AND PAYMENT

**86-8.01 Measurement.** - Replace the entire Section 86-8.01 of the Caltrans Standard Specifications with the following:

Where shown on the bid estimate, the quantities for items specified to be paid for will be measured in units as specified in Section 9-1.01 "Measurement of Quantities".

Conduit, by size and type, except in traffic signal systems, shall be measured by the linear foot installed, completed, and accepted. Measurement will be from center of facility structure to center of facility structure. Horizontal bends will be measured by arc length. No allowance or payment will be made for vertical sweeps and bends into pull boxes or bases. Separate measurements will be made for each conduit run.

Pull boxes, by size number, except in traffic signal systems, shall be measured by the individual unit, installed in place, completed and accepted as satisfactory.

Conductors, by size and type, except in traffic signal systems, will be measured by the linear foot from center of pole or structure to center of pole or structure with no allowance for slack. Each conductor will be measured separately.

Cables for traffic signal communications, by size and number of paired conductors, except when installed as a part of a traffic signal system, will be measured by the linear foot from the center of facility structure to the center of

facility structure. No allowance or payment will be made for slack in pull boxes. Separate measurement will be made for each cable run.

Service installation by type will be measured per each installed complete, except when installed as a part of a traffic signal system.

Guard posts will be measured by the individual unit, installed in place, completed and accepted as satisfactory.

Electroliers, for streetlight installations will be measured per each unit by class and type of luminaire, and type of standard, installed complete in place. If the lighting system is contiguous and part of a traffic signal system, the standard with luminaire will be considered as incidental to the electrical work of the traffic signal system and no separate measurement or payment will be made.

Traffic signal system, installations or modifications will be determined as a completed item and paid for on a lump sum basis.

Salvage electrical equipment, will be determined as a completed item and paid for on a lump sum basis unless specified otherwise in the special provisions.

#### 86-8.02 Payment. -

Conduit will be paid for at the contract unit price per linear foot, for each size and type completed and accepted. Such price shall be full compensation for furnishing all materials and for all preparation, trenching, jacking or drilling assembly, installation of pull wires, and backfill of trench, restoration of pavement, curb, gutters, and sidewalks.

Pull boxes for each size, will be paid for at the contract unit price per each complete and in place. Such price will be full compensation for furnishing all materials and for all preparation, excavation, drain rock, grout, extensions, hangers, grounding electrodes, covers with hold down lugs, and such other items as may be necessary to complete the item.

Conductors will be paid for at the contract price per linear foot for each size and type completed and accepted. Such price shall be full compensation for furnishing all materials, tools, labor, and equipment necessary to install the conductor or conductors.

Cables, for traffic signal communications systems, by size and number of paired conductors, will be paid for at the contract unit price per linear foot completed and accepted. Such price will be full compensation for furnishing all materials, tools, labor, and equipment necessary to install cable.

Service installation by type, will be paid for at the contract unit price per each complete and in place. Such price will include full compensation for furnishing and installing the type of service specified and foundation where required.

Guard posts will be paid for at the contract unit price per each complete and in place. Such price will be full compensation for furnishing all materials and for all preparation and installation materials.

Electroliers by class and type, will be paid for at the contract unit price per each complete and in place. Such unit price will include full compensation for furnishing and installing the light standard, mast arm where required, luminaire, ballast and photocell where required, lamp, conductors (internal to the light standard), foundation, foundation cap, bonding and grounding including the ground rod, and all required painting and numbering.

Traffic Signal System - The contract lump sum price paid for traffic signal systems or for modifying traffic signals shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for performing the work involved in furnishing and installing or modifying the systems, combinations or units thereof, including luminaires, as shown on the plans, as specified in these specifications and the special provisions and as directed by the Engineer, including any necessary pull boxes, excavation and backfill; concrete foundations; restoring sidewalks, pavements, and other such facilities, and making all required tests.

Salvage Electrical Equipment - The contract lump sum price paid for Salvage Electrical Equipment shall include full compensation for furnishing all labor, materials, equipment and incidentals, and for performing all work involved in removing, dismantling items to be salvaged and the removal and disposal of all other facilities so designated.

Transportation costs incurred for delivering salvaged item to the stockpile location shall be considered as incidental to the work and no additional compensation will be allowed therefor.

Full compensation for all additional materials and labor, not shown on the plans or specified, which are necessary to complete the installation of the various systems, shall be considered as included in the prices paid for the systems, or units thereof, and no additional compensation will be allowed.

Payment will be made under:

Conduit, (Size), (Type) - per linear foot  
 Pull Box, (Size) - per each  
 Conductors, (Size), (Type) - per linear foot  
 Cable, (Size), (Pairs) - per linear foot  
 Service, (Type) - per each  
 Guard Posts - per each  
 Electroliers, (Class), (Type) - per each  
 Traffic Signal System - per lump sum  
 Modify Traffic Signals - per lump sum  
 Salvage Electrical Equipment - per lump sum