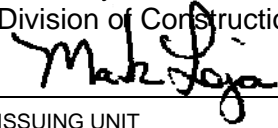


<b>MANUAL CHANGE TRANSMITTAL</b>		NO. <b>12-9</b>
TITLE: Department of Transportation <i>Construction Manual</i>	APPROVED BY: Mark Leja, Chief Division of Construction 	DATE ISSUED: November 30, 2012
SUBJECT AREA Table of Contents and various sections of the <i>Construction Manual</i>	ISSUING UNIT Division of Construction	
SUPERSEDES	DISTRIBUTION All Requested Manual Holders	

This manual change transmittal delivers the revisions of Chapter 4, Section 4-86 of the *Construction Manual*. Updated sections may contain updated language, information, corrections, and references resulting from updates to the 2010 *Standard Specifications*, and from policy, and procedural changes. Change bars in the margins of the revised sections indicate text that was changed or added.

Please update your manual according to the table below.

Section	Incorporates	Remove Old Page(s)	Insert New/Revised Page(s)
Goldenrod, Chapter 4, Section 86, "Electrical Systems"	None	4-86.i	4-86.i
Chapter 4, Section 86, "Electrical Systems"	None	4-86.1 thru 4-86.12	4-86.1 thru 4-86.13

### Section 86, "Electrical Systems"

- Updates references to align with 2010 *Standard Specifications*.
- Changes title of section from "Signal, Lighting, and Electrical Systems."
- Deletes reference to specific state-furnished materials (such as signs, lamps, light emitting diodes, signal controllers, and cabinets).
- In 4-8602A, reference to Section 6-1.05 of *Standard Specifications* is changed to 6-3.02, "Specific Brand or Trade Name and Substitution."
- 4-8603A, "Foundations," is modified for cross references to *Traffic Manual* and *Standard Plans*.
- Inserts new Section 4-8604, "Contract Administration," which describes what the resident engineer must do to execute the project.
- Changes Section 4-8604, "Measurement and Payment," to Section 4-8605.

### **Section 86 Electrical Systems**

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Example 4-86 Electrical Systems Sample Checklist

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 86 Electrical Systems

### Section 86 Electrical Systems

#### 4-8601 General

#### 4-8601 General

Electrical work involving traffic signals, street lighting, illuminated signs, changeable message signs, electrical devices, and communication systems requires a specialized knowledge. The district should retain staff or train sufficient personnel to inspect this type of work.

Highway transportation signal and illumination systems are in a state of evolution, and changes in materials and specifications on successive projects are continually arising. Both the contractor and the resident engineer should be continually alert to this situation because even experienced electrical contractors may not be familiar with all of the work included in current specifications.

In most districts, transportation electrical engineers are resident engineers on projects where electrical work is predominant. On projects where electrical work is not predominant, personnel with electrical expertise can be made available for assistance to inspect electrical work.

In the smaller districts, transportation electrical engineers in the district traffic unit and highway electricians in the electrical maintenance unit are available for consultation. In recent years, Caltrans has been using many more electrical systems in addition to just the traditional traffic signals and street lighting used in the past. These new systems include the following:

- Closed circuit television
- Changeable message signs
- Roadway weather information systems
- Microwave vehicle detection systems
- Other types of current technology devices

For the most part, the major changes are in the equipment being used. The basic construction features are the same. For design intent and operational requirements, the resident engineer should pay particular attention to the special provisions and have close contact with the project designer and the operational end user.

#### 4-8602 Before Work Begins

#### 4-8602 Before Work Begins

Before work begins, do the following:

- Study the project plans, special provisions, and standard plan details thoroughly. Record on the plans any unusual items covered in the specifications but not shown on the plans. Additionally, in the margin of the plan sheet containing the pole schedule, it can be useful to indicate foundation sizes, bolt sizes, and bolt circles.

- Signal and lighting construction often involves many agreements and requires the coordination of activities with outside agencies and utilities. Contact the project engineer to obtain the resident engineer's pending file and to discuss the status of utility agreements and relocations. At the start of the project, review the resident engineer's pending file to become familiar with such agreements.
- If signal modification work requires the detectors to be disconnected or the signal turned off, give the signal maintenance superintendent prior notice. When necessary, a Caltrans electrician will place the signal temporarily on recall. If the signal must be shut down completely for a time, give the appropriate law enforcement agency 24 hours' notice to provide police protection and traffic control.
- To determine whether changes or revisions are needed, you may also need to review the project with the traffic signal maintenance electricians, the electrical design unit, and the district traffic unit.
- Although the district utilities coordinator coordinates with utility companies during project development, the resident engineer will be responsible for coordinating with outside agencies once the project has entered the construction phase. Provide advance notice and information to the utilities and others so they can plan their work in an orderly manner. When necessary, notices should include a request for electrical energy and telephone interconnection lines. Either the resident engineer or the district utility coordinator should submit an application to the utility company.
- Advise utility company representatives of clearances necessary to accomplish the work. Insufficient overhead clearance requiring utility relocation is the most common obstruction overlooked on contracts that cover improvements to existing highways. To avoid delays, determine any necessary relocations or adjustments as early as possible. Review the project with the contractor to determine the locations where cranes and pile-driving or other equipment will be used. If utility facilities must be relocated because of the proposed work, refer this situation to the district right-of-way unit. Also, if overhead wires for temporary lighting or signals encroach on private property, refer this situation to the district right-of-way unit.
- Before any excavation, under California government code 4216, the contractor must notify the regional Underground Service Alert (USA) notification center by calling 811 or submitting an electronic ticket request at least 2 days before excavating. To ensure that the contractor has notified the regional USA notification center, request the contractor provide the ticket number issued by the USA center. Caltrans is not affiliated with USA so Caltrans is not notified to mark out Caltrans underground facilities. To ensure that existing Caltrans underground facilities are identified before allowing the contractor to excavate, contact the local electrical maintenance regional manager for help in locating Caltrans facilities. To help identify any Caltrans facilities within the right-of-way, such as irrigation systems, signal and lighting systems, ramp metering systems, traffic monitoring stations and communication conduits, obtain the latest utility "as-built" from the electrical maintenance unit.
- Promptly order the Department-furnished materials and equipment listed in the special provisions. To control the pickup and delivery of these materials to the contractor, contact all the necessary parties.

#### 4-8602A Materials

For materials, do the following:

- As stated in Section 6-3.02 [6-1.05], “Specific Brand or Trade Name and Substitution,” of the *Standard Specifications*, the contractor may request permission in writing to make a substitution for a product specified if the substitution is of equal or better quality and suitability. The Office of Materials Engineering and Testing Services, the Office of Structure Design, and the electrical design unit have personnel with technical knowledge to evaluate the suitability of properties, including the electrical characteristics of the items involved. Consult these personnel to obtain recommendations as to the acceptability of a proposed product substitute.
- For any electrical materials that the plans indicate will be salvaged, check their condition before the contractor arrives on the job site. To document the material’s condition, take photographs. For more information on salvage materials, see Section 3-403B (4), “Surplus and Salvaged Material,” of this manual.

#### **4-8603 During the Course of Work**

During the work, do the following:

- During construction, ensure the use of adequate warnings and safeguards in the form of signs, lights, and barricades. Jacking pits or foundation holes where pedestrians may walk must be covered with adequately braced plywood or an equivalent.
- Inspect underground work while it is actually underway, because when the work is complete, an inspection cannot be done. Include in your inspection the placing of conduit and the excavation for and the placing of concrete for signal standards, electrolier bases, and similar items.
- If communication cables or utility pipe lines are encountered, contact a representative of the utility owner.
- Continuously record all changes into the as-built plans.

#### 4-8603A Foundations

For foundations, do the following:

- The location of electroliers near exit ramps is related directly to the gore on exit ramps and to the lane width of entrance ramps. Keep this fact in mind, and if necessary, revise the locations of the electroliers. For the location of freeway luminaires, see Figures 9-25 and 9-26, “Freeway Lighting,” of the *Traffic Manual*. Also, pay particular attention to the foundation locations shown on Sheet ES-11, “Electrical Systems (Foundation Installations),” of the *Standard Plans*.
- Concrete for electrolier and signal foundations is often placed against the excavation without forms. The resulting rough block of concrete is functionally satisfactory. However, ensure the contractor forms and finishes the exposed part of the footing as specified. To ensure the proper operation of breakaway or slip bases, the top of the foundation must not be higher than the height shown on the plans. Also, the conduit must be below the slip plane. For various standards and foundations as they relate to monolithic foundation pours and grout pads, pay particular attention to the details in the *Standard Plans*.

#### **4-8603**

#### **During the Course of Work**

- During concrete placement operations, ensure that anchor bolts are securely held in the proper position and that the proper size anchor bolts and the correct bolt circle are used. When bar reinforcing steel is required, ensure that it is securely fastened and has the required clearances. Verify that the foundation excavation is the proper size and depth, and ensure the specified concrete is used.

#### 4-8603B Standards

For standards, do the following:

- Where areas behind asphalt concrete dikes are filled with dirt to the level of the top of the dikes, ensure the contractor also sets standards and pull boxes to the top of the dikes.
- When standards are laid out, ensure no obstructions will prevent vehicular or pedestrian traffic from seeing signal faces. Standards with push buttons must be no more than 5 feet from crosswalks and the push buttons must be on the side of the standard nearest the crosswalk.

When the standards are set, ensure that washers are used between the bottom and top, and on both sides of slip-base plates. Before standards are erected, ensure that all leveling and top nuts are properly torqued. When using slip-base inserts, ensure that the contractor assembles the top and bottom plates and torques the bolts before placing the standard on the top plate of the slip-base assembly. For the location of standards with slip bases or slip-base inserts, refer to Section 9-11.4, "Slip Bases," of the *Traffic Manual*. If the exception areas as listed in Section 9-11.4 apply to a planned slip-base standard, contact the designer about a change order.

- Ensure electroliers on structures are located with regard to bridge rail plans so that anchor bolts may be placed where the bridge rail gap will be. Ideally, keep electrolier bases at least 5 feet from expansion joints. This practice prevents extra stresses from the electrolier at these critical structural locations.
- A slight rake of the standard about 3 degrees from the roadway prevents the impression that the standard is leaning toward the highway. If the rake is not correct, ensure that the contractor rakes the standard by plumbing the side of the tapered standard from the road.
- Before accepting a project, ensure that the grounding of standards complies with specified methods.

#### 4-8603C Conduit

For conduit, do the following:

- For permitted or required methods for placing conduit, check the special provisions. Ensure that the trench backfill is compacted 90 to 95 percent relative compaction, depending upon the location. Also, ensure that the backfill is properly placed around pull boxes and conduit.
- Any conduit projecting from solid concrete is likely to be broken or bent when forms are removed or backfilling equipment operates close to the structure. Therefore, even if the conduit will be used in the near future, ensure that when it is embedded in concrete structures, it is plugged flush as shown on the plans. To assist in finding the location of the conduit in the future, mark the concrete and indicate the conduit's location on the as-built plans.

- Ensure that expansion joints are placed in the conduit where it passes through expansion joints in concrete structures. To ensure the joints operate correctly, check their proper type and placement.
- Ensure conduit terminating in a pull box extends into the box in a manner that will keep the box as clear as possible for making connections and placing ballasts. Check all conduit for proper bonding and proper connections.
- When conduit is being placed across existing roadways, ensure one of several common methods is used. These methods include directional boring, air drill, fishtail bit, water, hydraulic jack, compressed air, two diameters of conduit (one within the other), and trenching across the pavement. For some of these methods, take the following conditions into account:
  1. Directional boring uses a locator and electronics that are in the boring head. The operator can control the direction and depth of the boring head. Using this method of boring allows the conduits to be placed in precise locations. It is possible to bore across a roadway and come out within a fraction of an inch of the planned location.
  2. The air drill and fishtail bit should be used with the minimum amount of water possible. Too much water tends to saturate the grade and wash out large voids that can cause the road surface to collapse and the pipe to drop excessively.
  3. If the air drill and fishtail bit are used in sandy soil, the water and sand will tend to bind the conduit. Common soap powder or detergent may overcome this condition. If not, the use of rotary mud and water will seal off the sand and lubricate the conduit. However, if rotary mud is used, ensure that before the backfilling of the drill pit, the contractor flushes the mud from the pipe and then removes all the mud from the drill pit. Failure to thoroughly remove mud results in a spongy backfill.
  4. When a hydraulic jack and compressed air are used to push conduit under pavement through sand, the smaller diameter pipe carries a jet of air. To prevent removing too much sand from under the road and so leaving large voids, ensure the contractor restricts the amount of air used to jet out sandy material.
- In bridges, ensure the conduit riser is out of the way of utilities or manholes in the sidewalk.
- Ensure that conduit placed from a light fixture to a pull box above it terminates in the pull box with sufficient clearance from the walls to permit the placing of the specified sealing fitting without interference from the box cover or transformer.

#### *4-8603C (1) Metal Conduit*

When a conduit is properly connected, all threads are covered by the coupling and the ends of the conduit are butted tightly together. If threads are exposed, generally either the connection is not tight or the threads are crossed in the coupling. Conduit threads are not tapered. Either observe the joining of conduit during placement or test with a wrench to ensure the joints are tight, but not over tight. Over-tightening will cause bellowing of the end of the conduit inside the coupling and can cause damage to the conductors during installation. If the conduit is not in a straight line when being assembled, frequently the joints do not butt together even when tightened with a



wrench. Ensure that conduit ends are square and field cuts are made with a pipe cutter as specified.

Ensure that field bends are not made too close to a coupling. Stress at a coupling frequently causes the conduit to fracture at the threads. This fracture may be covered by the coupling and not be discernible at the time, but the fracture may cause trouble at a later date.

Ensure the contractor uses only approved tools to make field bends. The bends should never be made on the back of a truck, under a railroad track, or around a tree. A hydraulic bender is best, while ensuring that the bend is not too sharp. To make a smooth, 90-degree bend without kinks or flat places, three to four settings of the hydraulic shoe are necessary.

Check the ends of factory-reamed conduit for burrs, and ensure field cuts are always reamed. Prohibit threadless connectors for conduit, because they do not have sufficient mechanical strength.

#### *4-8603C (2) Plastic Conduit*

During installation, plastic conduit, like polyvinyl chloride water pipes and fittings, requires special handling. After installation, ensure the contractor takes special precautions to prevent damage to the conduit when installing pull box markers, sign posts, and guardrail.

To pull conductor wire through plastic conduit, ensure the contractor uses a soft nylon pull rope.

To obtain good, non-threaded joints for plastic conduit, ensure the contractor takes special care to clean the ends of the pipe and uses the right amount of the proper solvent cement.

#### 4-8603D Pull Boxes

For pull boxes, do the following:

- As required under the contract, ensure that pull boxes are installed in conduit runs and adjacent to operating units; however, prohibit pull boxes from being installed within the boundaries of a curb ramp.
- Ensure pull boxes are placed away from any expansion joint. If pull boxes are improperly shown on the plan, provide an alternate location.
- Ensure that in surfaced areas, behind portland cement concrete curbs, or in sidewalks the top of the box is even with the surrounding surface—never depressed. On unpaved slopes, ensure the pull boxes are kept out of depressions so as not to collect water. Pull boxes must be set over a layer of gravel that will provide a means of draining water away from the electrical components within.
- In unpaved, relatively flat areas, ensure the contractor places pull boxes at 1¼ inches higher than the average surrounding elevation.
- When final grades of surrounding features under construction are not accurately established, it is sometimes necessary to set the pull boxes temporarily low and raise them to final grade as curbs and sidewalks are built.
- Before a bridge deck is poured, if the formed type of pull box is to be used, ensure the contractor first places properly dimensioned wooden pull box templates at pull box locations.



- To provide a drain hole within structures, ensure the contractor places a 3/4-inch pipe or plastic hose through a hole in the form at the lowest point of the pull box location.
- To determine that the covers are properly inscribed, perform a final check of the pull boxes.
- In illumination and signal work, the voltages employed range from millivolts for pedestrian push-button and detector loops to 5,000 volts for highway lighting circuits. Ensure these voltages are isolated from one another.
- Prohibit the splicing of a pedestrian push-button common into a signal or street-light common, and never permit a signal conductor to enter a pull box containing a high-voltage, street-lighting circuit. The possibility of a crossover, although remote, is nevertheless present.

#### 4-8603E Conductors

For conductors, do the following:

Each separate signal section needs one conductor, plus one neutral and three spares in a pole. If one R, Y, G head is to be installed on the pole, then 3+1+3, or 7, conductors are needed. An additional R, Y, G facing at a right angle to the other head on the same pole requires three more conductors, a total of 10. Each arrow lens generally needs an additional conductor. Ensure that the number of conductors is correct and, if questions arise about conductor color coding, size, or installation method, consult the district traffic unit or the electrical maintenance unit.

- Although more than one field conductor may go on the same terminal at the controller cabinet, do not allow these conductors to be spliced at a pull box and a single conductor to be run to the controller cabinet. Individual leads are needed so that testing can be done at the controller cabinet. Only the neutrals, pedestrian pushbutton, and lighting conductors can be spliced.
- On 30-foot poles, it is often best to install the luminaire conductors inside the pole before erection and splicing to leads in the pull box after erection. Luminaires and mast arm signals can also be attached to the poles before raising. To reach from the pull box to the terminal block on the standard without additional splices, ensure the contractor leaves sufficient slack conductor in the pull box. Splices are only permitted at the locations stated in the specifications. Checking for tight connections and splices in all wiring is extremely important.
- When pulling conductors, a wire trailer is desirable. Ensure the contractor pulls conductors from the reels in such a manner that traffic will not run over the conductors and that pedestrians will not walk on them. Both events can cause damage to the conductors. To prevent damage to small conductors by over-pulling, the *Standard Specifications* require that the conductor be pulled by hand. Do not permit the use of winches, trucks, or other mechanical aids. The special provisions may permit power pulling of large conductors. If so, ensure tension measuring devices are used in accordance with the manufacturer's recommendations.
- Before pulling conductors into conduits, ensure proper planning and careful measuring to avoid the slipping of one conductor past another in the conduit. To prevent any damage to insulation that slipping causes, ensure the contractor feeds the various conductors into the conduit in a sequence determined by the length of the individual runs and the use of lubricant as specified. If additional conductors

are being installed in an existing conduit, the *Standard Specifications* require that all of the conductors be removed, the conduit cleaned and mandrelled, and the conductors pulled into the conduit as a unit. Prohibit the slipping of added conductors past existing ones.

- To prevent cutting the conduit, ensure the contractor takes extra care when pulling conductor in plastic conduit. Bushings or pulling bells are required on the ends of conduits.
- Ensure conductors are tagged or labeled according to the specifications. Prohibit the painting of conductors or the use of colored tape on the ends of conductors to obtain the specified insulation colors. The *Standard Specifications* permit the use of phase taping on conductors size 2 and larger.
- Ensure conductor splices are made as shown on the standard detail sheets and as specified. All splices must be tight and waterproof. Conductors size 8 and smaller must be soldered.
- Ensure leads to transformers are spliced as shown on the detail sheet and as specified. A ground clamp fastened to one of the secondary terminals makes an ideal connection for the grounding bond. Ensure transformers are never picked up by the leads.

#### 4-8603F Vehicle Detectors

Along with the controller unit, check the portion of vehicle detectors installed in the controller cabinet. When testing the completed system, include the entire detector system. Perform the following duties during installation:

- Verify the loops are laid out in the proper locations.
- Before installing inductive loop detectors, ensure the contractor washes, blows out, and dries all slots cut in pavement. Ensure residue from saw-cutting operations is vacuumed from the roadway and disposed of off of the project.
- Ensure that detector loops contain the required conductor type and number of turns and are wound in the specified direction.
- Ensure the contractor splices conductors only at locations permitted under the contract. All splices must be soldered.
- Ensure the contractor places loop wire in the slot with a tool that will not damage the wire's insulation.
- Ensure that loop wires between the loop and adjacent pull box are twisted together as required.
- Observe the placement of loop sealant to ensure the contractor uses the specified material and method of placement.
- When final splicing between loops and lead-in cable is approved, advise the contractor.
- In pull boxes and at the controller cabinet, ensure the contractor identifies and bands the conductors as specified.

#### 4-8603G Soffit and Wall Luminaires

Ensure soffit lights are installed with the hinge side toward the curb or as shown on the plans. Before concrete is poured around soffits, ensure they are securely fastened. The

danger of floating always exists during the pour, and workers frequently will rotate them to place steel or forms. To prevent damaging conduit joints, ensure that conduit between soffit lights is secured and supported with concrete blocks. Prohibit standing on conduits or piling material on them.

#### 4-8603H Falsework Lighting

Require the contractor to submit a falsework lighting plan for review and approval by the resident engineer. Ensure the plan conforms to the specifications. Prohibit the contractor from proceeding with work requiring falsework lighting until the plan's approval. The contractor must provide temporary electricity through arrangements with the utility company.

#### 4-8603I Testing

Before completing the work, the contractor must test all traffic signal and lighting circuits in the presence of the resident engineer. The tests are outlined in Section 86-2.14, "Testing," of the *Standard Specifications*. The following tests are to be performed:

- Continuity
- Grounding
- Insulation resistance
- Operational tests
- High voltage tests

The maintenance highway electrician, traffic operations engineers, or construction electrical engineers will aid the resident engineer in observing the test results.

The continuity and test for grounds may be made with an ohmmeter, buzzer and battery combination, or other similar device.

The insulation resistance test is usually made with a megohmmeter, a small hand-operated or battery-operated generator, which usually generates about 500 volts. However, prohibit megohmmeter tests on magnetometer-sensing elements.

Ensure the contractor tests each circuit of a signal system by applying voltage to it and verifying the lights are operating.

The operational tests consist of a 5-day continuous satisfactory operation test for traffic signals and two consecutive nights for lighting systems. If the operation test fails, repairs will be made and the test will be restarted. If Department-furnished material fails, do not restart the test. Once the Department-furnished material has been repaired, the test can continue to completion.

#### 4-8603J Completing the Project

Do the following to complete the project:

- Before new work is opened to traffic, ensure all traffic control devices are in place and working properly.
- Until signals are placed in operation, ensure the signal heads are turned away from traffic and completely covered with cardboard boxes or other suitable material.

- Never put into operation a completed traffic signal on a Friday or any day preceding a legal holiday. Also, before the signal is turned on, the traffic operations engineer must be present to adjust the timing in the controller.
- For correct light distribution and minimum glare from luminaires, ensure the contractor positions the luminaires as parallel to the roadway as possible.
- Ensure the contractor has properly installed all signing and striping items.
- To ensure that items that might possibly be overlooked when accepting the work are completed in all their details, prepare for reference a printed checklist similar to the one shown at the end of this section. This checklist should include reminders about the proper positioning of louvers and heads, the placing of the cap on top of lighting standards, final painting and cleanup, and similar details.
- Give 2 weeks' notice of the proposed turn-on of the signal system to district traffic operations, public information, signal maintenance, the local fire department, the police department, and schools.

#### **4-8604 Contract Administration**

##### **4-8604 Contract Administration**

The resident engineer must do the following:

- Determine the contractor's operations schedule so you can make arrangements to maintain existing signals and street lighting.
- Section 86-1.03, "Schedule of Values," and Section 9-1.16, "Progress Payments," of the *Standard Specifications* provide for a cost breakdown of each lump-sum unit of electrical work. Check the contractor's breakdown for completeness and accuracy. Before approving the submittal, call the contractor's attention to unbalanced unit costs, and require their correction. You can use this breakdown for progress payments and as a cost basis for change orders. Approve the cost breakdown before making partial payments on lump-sum electrical items.
- Obtain a list of the equipment and materials the contractor proposes to install, as required by Section 86-1.04 [86-6.065], "Equipment List and Drawings," of the *Standard Specifications*. To prevent omissions or irregularities, you must check the required list of materials, and the electrical design unit must recheck the list. For compliance with the contract, ensure that manufacturers' names, catalog numbers, and other appropriate listings properly identify the materials.

##### 4-8604A Materials Approval

Do the following regarding materials approval:

- Verify the receipt and proper distribution of Form CEM-3101, "Notice of Materials to Be Used," which lists electrical materials. Refer to Section 6-202, "Responsibilities and Procedures for Acceptance of Materials," of this manual for additional information.
- To determine materials assigned for release at the job site, review Form TL-0028, "Notice of Material to Be Inspected." Also, ensure that the contractor delivers test results and the necessary certificates of compliance (including compliance with Buy America requirements) to the site. Release or reject the materials in accordance with Chapter 6, "Sampling and Testing," of this manual.

- Recommend approval or denial of a substitute. Under no circumstances may the supplier or contractor bypass the resident engineer by negotiating with others for proposed substitutes on projects under contract.
- Substitute for a specified product by change order since it is a change in specifications.
- Refer to Section 86-8.01, "Payment" of the *Standard Specifications*, and deduct money for electrical poles inspection cost whenever applicable. The sum of \$5,000 is deducted per inspection site when located at more than 300 and less than 3000 airline miles from Sacramento and Los Angeles. The sum of \$8,000 is deducted for airline miles greater than 3000.

#### 4-8604B Forms

The resident engineer must ensure that all necessary forms are completed or placed in the file, including, but not necessarily limited to, the following:

- Notification to the appropriate district units of dates when electrical facilities were placed in or removed from service.
- Notification to the district electrical billing coordinator by submittal of the completed utility service request form. This request provides the necessary information for the billing, inventory items, and turn-on, and turn-off data.
- As-built plan copies to the electrical maintenance unit and to the district traffic unit, the original as-built plans to the district construction office, and one set of field as-built plans and a copy of the special provisions in the controller cabinet.

#### 4-8604C Guarantees

Take the following actions on contracts that include a guarantee for work performed:

- Ensure a notice is installed in each controller cabinet with the following information:
  1. Name, address, and phone number of the contractor, including the phone number of the individual to be notified of any action regarding the guarantee. The contractor referred to here is the one who signed the original guarantee.
  2. Name, address, and phone number of the signal equipment vendor.
  3. Date of the contract acceptance.
  4. Date the guarantee expires.
- Before contract completion, ensure the district maintenance unit is provided with two sets of contract special provisions and project plans.
- Advise the district maintenance unit as soon as possible of the date of contract acceptance.

#### **4-8605 Measurement and Payment**

During the course of the project, ensure progress payments are made to the contractor for work completed during the estimate period. The estimate period is from the 21st of one month through the 20th of the next month. For progress payment purposes, keep records of the work completed in each period.

On many projects, traffic signal and lighting standards, traffic signal equipment, and electrical hardware items are listed as eligible for payment as material on hand (MOH).

#### **4-8605 Measurement and Payment**

On a monthly basis, check the contractor's submittals for MOH, and verify that materials incorporated into the work have been removed from the MOH submittal.

| Verify all the bid items and review the special provisions as to the method of payment and the condition of the item payments.

**Example 4-86**  
**Electrical Systems Sample Checklist**

Check if satisfactory.

1.	Pull boxes to grade	
2.	Crosswalks correct	
3.	WALK–DON'T WALK heads	
4.	Signal heads louvered properly	
5.	Vehicle detector in proper lane	
6.	Pull boxes correctly labeled	
7.	Pedestrian signs correct at push buttons	
8.	Heads correctly positioned	
9.	Heads checked for brilliance	
10.	Pole base bolts checked for tightness	
11.	Poles checked for proper painting	
12.	Ground bushings and connections tight	
13.	Shield of telephone interconnect proper in controller box	
14.	Lugs in controller cabinet checked for tightness	
15.	Guarantees	
	Inspected by _____	
Comments:		