

TRAFFIC SIGNALS AND LIGHTING

DEFINITIONS

4001.1 Wherever in the Special Provisions and other contract documents the following terms, or pronouns in place of them are used, the intent and meaning shall be interpreted as provided in this Section.

Electrical Superintendent: Electrical Supervisor or his representative.

Engineer: City Engineer or his representative.

GENERAL

4002.1 Installation of traffic signals and highway safety lighting and payment therefore shall conform to the provisions in Section 86, "**Signals, Lighting, and Electrical Systems**," of the Standard Specifications, the Standard Plans, these Special Provisions and the Plans.

4002.2 Traffic Signal installation is to be performed at the following location:

(Insert Location here).

4002.3 Work or equipment not specified or shown on the plans, which is necessary for the proper operation of the work in this section, shall be provided and installed at no additional cost to the City.

4002.4 The locations of services pull boxes and other appurtenances shown on the plans are approximate. The Engineer in the field will establish exact locations and grades as necessary.

MATERIALS

4003.1 Attention is directed to Section 6, "**Control of Materials**," of the Standard Specifications and these Special Provisions.

4003.2 All materials required to complete the work under this contract shall be furnished by the Contractor and shall be sampled and tested to insure conformance with plans and specifications. However, at the discretion of the Engineer, a Certificate of Compliance, as described in Section 6-1.07, "**Certificates of Compliance**," of the Standard Specifications may be provided in lieu of such sampling and testing.

4003.3 The materials furnished and used shall be new, except such used materials as may be specifically provided for on the plans.

4003.4 All work and materials shall be in full accordance with the latest rules and regulations of the National board of Fire Underwriters, and local ordinance or State laws, the State of California Industrial Accident Commission's Safety Orders, and Regulations of the Southern California Edison Company pertaining to service equipment and installations thereof.

All work shall comply with Tulare City Electrical Ordinances and National Electrical Manufacturer's Association Standards and all regulations and codes as stated in Section 86-1.02, "**Regulations and Code**," of the Standard Specifications. Nothing in these plans and specifications shall be construed to permit work not complying with these codes.

EQUIPMENT LIST

- 4004.1 Equipment list and drawings shall conform to the provisions in Section 86-1.04, "**Equipment list and Drawings**," of the Standard Specifications and these Special Provisions.
- 4004.2 All equipment and materials that the Contractor proposes to install shall conform to these specifications and the contract plans. A list of substitute equipment and/or materials, along with a written descriptive summary, describing the functions of the components, which the Contractor proposes to install, shall be submitted along with his bid proposal. The list shall be complete as to the name of the manufacturer, size and identifying control number of each item. The list shall be supplemented by such other data as may be required. In all cases, the judgment of the Engineer shall be final as to whether substitute equipment and/or material recommended by the Contractor conforms to the intent of these specifications and is acceptable for use.

WARRANTIES, GUARANTEES AND INSTRUCTION SHEETS

- 4005.1 Warranties, guarantees and instruction sheets shall conform to the provisions in Section 86-1.05, "**Warranties, Guarantees and Instruction Sheets**," of the Standard Specifications and these Special Provisions.
- 4005.2 The controller cabinet schematic wiring diagram and intersection sketch shall be combined into one drawing, so that, when the cabinet door is fully open, the drawing is oriented with the intersection.
- 4005.3 The Contractor shall furnish a maintenance manual for the controller unit, auxiliary equipment, and vehicle detector sensor units, control units and amplifiers. The maintenance manual and operation manual may be combined into one manual. The maintenance manual or combined maintenance and operation manual shall be submitted at the time the controller is delivered to the job site. The Maintenance manual shall include, but not be limited to, the following items:
- A. Specifications
 - B. Design Characteristics
 - C. General operation theory
 - D. Function of all controls
 - E. Trouble shooting procedure (diagnostic routine)
 - F. Block circuit diagram
 - G. Geographical layout of components
 - H. Schematic diagram
 - I. List of replaceable component parts with stock numbers.

- 4005.4 Three (3) copies of the individual manuals or the combined “**Maintenance and Operation Manual,**” shall be delivered to the City for each intersection.
- 4005.5 The manufacturers shall guarantee all equipment furnished to the City for a period of not less than one (1) year, unless otherwise indicated, following the date of acceptance of the signal installation of such equipment. If any parts are found to be defective in materials or workmanship within the one-year period, and it is determined by the Engineer, or by an authorized manufacturer’s representative that said parts cannot be repaired on the site, the manufacturer shall provide replacement parts of equal kind and/or type during the repair period and shall be responsible for the removal, handling, repair, or replacement and reinstallation of the parts until such time as the traffic signal or street lighting equipment is functioning as specified and as intended herein; the repair period shall in no event exceed seventy-two (72) hours, including acquisition of parts.
- 4005.6 The one-year guarantee on the repaired or replaced parts shall again commence with the date of reassembly of the system.

MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

- 4006.1 Existing electrical systems, or approved temporary replacements thereof, shall be kept in effective operation during the progress of the work, except when shutdown is permitted.

SCHEDULING OF WORK

- 4007.1 Scheduling of work shall conform to the provisions in Section 86-1.07, “**Scheduling of Work,**” of the Standard Specifications and these Special Provisions.
- 4007.2 The Contractor shall notify the Engineer at least two (2) working days in advance of any electrical work and also at least two (2) working days in advance of any work done intermittently to facilitate inspection.

FOUNDATIONS

- 4008.1 Foundations shall conform to the provisions in Section 86-2.03, “**Foundations,**” of the Standard Specifications and these Special Provisions.
- 4008.2 Portland cement concrete shall conform to Section 90-10, “**Minor Concrete,**” of the Standard Specifications and shall contain not less than 470 pounds of cement per cubic yard, except concrete for reinforced pile foundations shall contain not less than 564 pounds of cement per cubic yard.
- 4008.3 Foundation concrete shall be placed in a single pour except that pouring of the top six inches may be postponed when prior approval of the Engineer has been obtained.

- 4008.4 The Engineer shall designate exact location for service equipment enclosure. Forty-eight (48) hour notice is required.
- 4008.5 No utilities shall run through any foundations.
- 4008.6 Foundations shall be poured against undisturbed earth where practicable. The exposed portion shall be formed and finished to present a neat appearance. Where obstruction or other conditions prevent construction of planned foundations, the Contractor shall construct an effective foundation satisfactory to the Engineer.
- 4008.7 The bottom of concrete foundations shall rest on firm ground. When placing the foundations, the Contractor shall place all conduit ends in their proper position, at the correct heights and shall securely bond them together with conduit ground wire attached to the grounding bushings and standard ground lugs.
- 4008.8 Poles and standards shall be bonded to the conduit system. Conduit shall be capped before any concrete is poured.
- 4008.9 Both forms and earth to be in contact with foundations shall be thoroughly moistened before placing concrete.
- 4008.10 Anchor bolts shall be galvanized and shall extend above the finished base as shown on the standard plans. If bolt treads extend beyond specifications shown on Standard Plan ES-7M, bolts shall be cut to three threads above the nut and painted with zinc rich paint. Pole leveling shall be accomplished by means of leveling nuts. All nuts, washers, screws, and other post hardware shall be galvanized. Anchor bolts and conduits shall be held in place by means of a template until concrete sets.
- 4008.11 An additional 8 ½ inches of P.C.C. shall be added to the 3 ½ inch foundation height shown on the Foundation Details for Model 332 cabinets on Standard Plan ES-3C, to position the controller cabinet base 12 inches higher than the adjacent sidewalk or raised P.C.C. pad in unpaved areas.
- 4008.12 An additional 10 inches of P.C.C. shall be added to the 2 inch foundation height shown on the foundation details for Type III-B service equipment enclosures on Standard Plan ES-2E, to position the service equipment enclosure 12 inches higher than the adjacent sidewalk or raised P.C.C. pad in unpaved areas.

STANDARDS, STEEL PEDESTALS AND POSTS

- 4009.1 Standards, steel pedestals and posts shall conform to the provisions in Section 86-2.04, "***Standards, Steel Pedestals and Posts,***" of the Standard Specifications and these Special Provisions.
- 4009.2 The Contractor may install all underground electrical components, including foundations for signal standards and controller cabinet at the site of the project; however no traffic

signal standards shall be erected until all equipment is available to the Contractor for installation.

- 4009.3 Poles, standards, and pedestals shall not be erected until the foundation concrete has set at least seven (7) days, and shall be plumbed or raked as directed by the Engineer. Top of concrete foundations shall be finished relative to curb or sidewalk grade as shown on the plans or as directed by the Engineer.
- 4009.4 Locations shown on the plans are schematic. Contractor shall notify Engineer's office forty-eight (48) hours prior to commencing work to establish locations for all traffic signal facilities.
- 4009.5 Where the plans refer to the side tenon detail at the end of the signal mast arm, the applicable tip tenon detail may be substituted.
- 4009.6 Type I standards shall be assembled and set with the handhole on the downstream side of the pole in relation to traffic.
- 4009.7 The sign mounting hardware, as shown on Detail U of Standard Plan ES-7N shall be installed at each location where a sign is to be mounted on a traffic signal mast arm.
- 4009.8 Tenons for future use shall be capped with a galvanized metal cap attached with 3 (three) cadmium plated steel setscrews similar to mast arm mounting - type "MAT" and "MAS" shown on Standard Plan ES-4D.

CONDUIT

- 4010.1 Conduit shall conform to the provisions in Section 86-2.05, "**Conduit**," of the Standard Specifications and these Special Provisions.
- 4010.2 All conduits shall be the rigid steel type, except for the conduit on the supply side of the service equipment enclosure and that placed via the "**Trenching in Pavement Method**."
- 4010.3 When a standard coupling cannot be used for joining Type I conduit, a UL listed threaded union coupling conforming to the provisions in Section 86-2.05C, "**Installation**," of the Standard Specifications, a concrete-tight split coupling or concrete-tight set screw coupling shall be used.
- 4010.4 After conductors have been installed, the ends of conduits terminating in pull boxes, service equipment enclosures, and controller cabinets shall be sealed with an approved type of sealing compound.
- 4010.5 Conduit runs shown on the plans to be located behind curbs may be installed in the street, by the "**Trenching in Pavement Method**," as provided in Section 86-2.05C, "**Installation**," of the Standard Specifications and these Special Provisions, if approved by the Engineer. If permitted to be installed in the street, such conduits shall be placed

adjacent and parallel to the lip of the gutter whenever practicable. However, in no case shall the distance between conduit and the curb exceed 4 feet.

- 4010.6 At locations where conduit is to be installed under pavement and, in the opinion of the Engineer, existing underground facilities require special precautions, conduit shall be placed by the **“Trenching in Pavement Method,”** as provided in Section 86-2.05C, **“Installation,”** of the Standard Specifications.
- 4010.7 Paragraph 22 of Section 86-2.05C, **“Installation,”** of the Standard Specifications is revised as follows:
- A. The conduit shall be placed on the bottom of the trench and the trench shall be backfilled with commercial quality concrete, containing not less than 564 pounds of cement per cubic yard. Concrete backfill shall be placed to the pavement surface except; when the trench is in asphalt concrete pavement and additional pavement is not being placed, the top 0.20 foot of the trench shall be backfilled with asphalt concrete produced from commercial quality paving asphalt and aggregates.
- 4010.8 At the option of the Engineer, the mineral aggregate for asphalt a concrete used for trench and pavement restoration shall conform to the grading specified for three-eighths (3/8”) inch maximum aggregate in Section 39, **“Asphalt Concrete,”** of the Standard Specifications.

PULL BOXES

- 4011.1 Concrete pull boxes shall conform to the provisions in Section 86-2.06, **“Pull Boxes,”** of the Standard Specifications and these Special Provisions.
- 4011.2 All pull boxes shall be No. 5 with extension unless otherwise noted on the plans.
- 4011.3 Grout shall be placed in bottom of pull boxes and in between pull box and extension.
- 4011.4 All pull boxes installed in dirt areas shall be wrapped with building paper. Install a one-foot ring of concrete, four inches (4”) deep; around the wrapped pull boxes, sloped to drain away from pull box.
- 4011.5 All pull boxes shall be located behind curb or at the locations shown on the plans.

CONDUCTORS AND WIRING

- 4012.1 Conductors and wiring shall conform to the provisions in Section 86-2.08, **“Conductors,”** and Section 86-2.09, **“Wiring,”** of the Standard Specifications and these Special Provisions.
- 4012.2 When cables are pulled into the conduit, all ends of the cables shall be taped to exclude moisture, and shall be so kept until connected to terminals.

- 4012.3 A minimum of three feet of slack in each single conductor and cable run shall be at each signal or lighting standard and in each pull box.
- 4012.4 Conductors of No. 14 AWG size and larger shall be spliced by means of a compression-type sleeve and its mating, indenting, or staking tool. In-line, tap, tee, And pigtail splices, in multiple circuits shall be insulated by application of an approved, vinyl backed, insulating and adhesive padding material, rated for 600 volts, molded closely about the splice and the adjacent conductor insulation. Care shall be taken to eliminate skips and voids. The splice shall then be wrapped with one layer of **"All Weather"** type, plastic backed, pressure sensitive, electrical tape, leaving no adhesive material exposed, and then covered with a type of sealing compound approved by the Engineer.
- 4012.5 Signal Cable: All signal cable shall conform to the provisions of Section 86-2.08D, **"Signal Cable,"** of the Standard Specification and these Special Provisions.
- 4012.6 Where shown on the plans, signal cable shall be installed in lieu of individual conductors.
- 4012.7 Each signal cable shall run from the Model No. 332 cabinet to the appropriate terminal compartment without splicing.
- 4012.8 Each signal cable shall be marked, in each pull box, showing the signal standard to which it is connected.
- 4012.9 Signal Cable shall be ordered at the same time or prior to the signal standards to ensure ample time for delivery.
- 4012.10 All splices between loops and the lead-in cable shall be soldered as specified in Section 86-2.09C, **"Connectors and Terminals,"** of the Standard Specifications. Open flame soldering will **NOT** be permitted. In addition, splices between loops and lead-in cable shall be covered with a layer of sealing compound, as approved by the Engineer, and allowed to dry thoroughly before any tape is applied.
- 4012.11 Wiring and wiring methods shall conform to the provisions of the applicable codes. All conductors No. 8 or larger shall be stranded.
- 4012.12 The insulation for No. 14 or larger conductors in multiple circuits shall be one of the types listed in Section 86-2.08B, **"Multiple Circuit Conductors,"** of the Standard Specifications.
- 4012.13 At any point, the minimum thickness of any Type THWN insulation shall be 13 mils for conductor sizes No. 14 and No. 12, 18 mils for conductor size No. 10, 27 mils for conductor sizes No. 8 and No. 6, and 36 mils for conductor sizes No. 4 and No. 2. At any point the minimum thickness of the nylon jacket shall be 4 mils for conductor sizes No. 14 to No. 10, inclusive, 5 mils for conductor sizes No. 8 and No. 6, and 6 mils for conductor sizes No. 4 and No. 2.

4012.14 Paragraph No. 5 in Section 86-2.09D, "**Splicing**," which permits splicing of ungrounded conductors is hereby deleted.

4012.15 Conductors in cables shall not be spliced to other single conductors or conductors in other cables. Signal conductors shall not be spliced and shall run from terminal strip to terminal strip of signal terminal compartments. Pedestrian head conductors shall not be spliced and shall run from terminal strip to terminal strip of pedestrian compartments.

SIGNAL INTERCONNECT CABLE

4013.1 Not Applicable.

BONDING AND GROUNDING

4014.1 Bonding and grounding shall conform to provisions in Section 86-2.10, "**Bonding and Grounding**," of the Standard Specifications and these Special Provisions.

4014.2 A No. 8 AWG stranded copper conductor with green insulation shall be used for bonding and grounding.

4014.3 Bonding jumpers in standards with handholes and traffic pull box lid covers shall be attached by a UL listed lug using 3/16" diameter or larger brass or bronze bolts and shall run to the conduit or bonding wire in the adjacent pull box. The grounding jumper shall be visible after the standard has been installed and the motor pad and cap have been placed on the foundation.

TESTING

4015.1 Testing shall conform to the provisions in Section 86-2.14B, "**Field Testing**," and Section 86-2.14C, "**Functional Testing**," of the Standard Specifications and these Special Provisions.

4015.2 The functional test for each lighting system shall consist of not less than fourteen (14) days. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until fourteen (14) days of continuous satisfactory operation is obtained.

PAINTING

4016.1 Painting shall conform to the provisions in Section 86-2.16, "**Painting**," of the Standard Specifications and these Special Provisions.

4016.2 The Contractor shall furnish all paint. Minor touch-up painting on all material whose surface is damaged or not protected from rusting shall be painted as directed by the Engineer. Cold galvanized zinc-rich paint; Military Specifications DOD-P-21035A shall be used on all damaged galvanized surfaces.

SERVICE

- 4017.1 Service shall conform to the provisions in Section 86-2.11, "**Service**," of the Standard Specifications and these Special Provisions.
- 4017.2 Service pedestal is to be a Type IIIBF, with a PEC window for a Type V photoelectric control, approved by the Engineer.

MODEL 170E CONTROLLER ASSEMBLIES

- 4018.1 The Model 170E controller assembly furnished by the Contractor shall conform to the provisions of Section 86-3.03, "**Model 170 and Model 2070 Controller Assemblies**," of the Standard Specifications, and these Special Provisions.
- 4018.2 Software shall be compatible with those presently in use by the City, shall have time base coordination, and be capable of operating all phasing up to eight phase "quad left" operations.
- 4018.3 The software being used by the City is the BI Tran System, 200CA that uses a Type 412C prom module.
- 4018.4 In addition to the provisions in Section 86-3.03, "**Model 170 and Model 2070 Controller Assemblies**," of the Standard Specifications, the complete control system, including the Model 332A cabinet, shall conform to the California Business, Transportation and Housing Agency, Department of Transportation, "**Traffic Signal Control Equipment Specifications**," dated January 1989, and any subsequent addenda.
- 4018.5 **QUALIFIED PRODUCTS LIST (QPL)** - The State of California Department of Transportation maintains a trade name list of Model 170 Traffic Controller Assemblies that have been tested by the California Transportation Laboratory and found to be compliant to the "**Traffic Signal Control Equipment Specifications**," (TSCES), dated 1989, and applicable addendum(s).

When these assemblies are to be purchased, only those listed below will be considered.

- 4018.6 A manufacturer's listing on the QPL does not waive any of the requirements of the specifications or relieve the manufacturer/vendor of any obligation hereunder. Defective work, materials and equipment will be rejected. All equipment must comply with current specifications.
- 4018.7 When listing of approved prequalified and tested Model 170 Traffic Controller Assembly materials and products cover the following:
 - A. Model 170E Controller Units
 - B. Model 200 Switch Packs
 - C. Model 240 Flashers

- D. Model 206 Power Supply Module
- E. Model 208 Monitor Unit
- F. Model 210 Monitor Unit
- G. Model 222 Two-Channel Loop Detectors
- H. Model 224 Four-Channel Loop Detectors
- I. Model 231 Magnetic Detector Element
- J. Model 232 Dual Magnetic Detector Sensor Unit
- K. Model 242 Two-Channel DC Isolators
- L. Model 252 Two-Channel AC Isolators
- M. Model 332A Cabinets
- N. Model 334C Cabinets
- O. Model 400 Modems
- P. Model 412 Program Modules
- Q. PDA2 (Power Distribution Assembly)
- R. PDA3 (Power Distribution Assembly)

4018.8 None of the above listed Model 170 Controller Assembly materials and products shall be used in the work unless such material or product is listed on the State of California Department of Transportation's Qualified Products List. A Certificate of Compliance shall be furnished as specified in Section 6-1.07, "***Certificate of Compliance***," of the Standard Specifications for Model 170 Controller Assembly materials and products. Said certificate shall also certify that the Model 170 Controller Assembly material or product conforms to the prequalified testing and approval of the State of California Department of Transportation, Division of Transportation Laboratory and was manufactured in accordance with the approved quality control program.

4018.9 A copy of the most recent listing of the Model 170 Controller Assembly Qualified Products Lists (QPL) may be downloaded from the following Internet site:

http://www.dot.ca.gov/hq/esc/approved_products_list/

4018.10 All Model 170E controller assemblies shall be warranted for a period of one year from the date of "turn-on."

4018.11 The controller assemblies shall include a pullout shelf with internal document storage compartment mounted immediately below the 170 controller position.

4018.12 The Contractor shall arrange to have a signal technician, qualified to work on the controller unit and employed by the controller unit manufacturer, or the manufacturer's representative, present at the time the equipment is turned on.

VEHICLE SIGNAL FACES AND SIGNAL HEADS

4019.1 Signal faces, signal heads and auxiliary equipment as shown on the plans and the installation thereof, shall conform to the provisions in Section 86-4.01, "***Vehicle Signal Fac-***

es,” Section 86-4.04, “Backplates,” and Section 86-4.08, “Signal Mounting Assemblies,” of the Standard Specifications and these Special Provisions.

4019.2 All signal heads, visors and backplates shall be metallic.

4019.3 All lenses shall be glass.

4019.4 Backplates shall be provided for all signal heads.

LIGHT EMITTING DIODE SIGNAL MODULE

4020.1 Traffic signal faces with 12-inch sections, or arrow sections, shall use light emitting diode (LED) signal modules as the light source in conformance with these Special Provisions. Incandescent lamps in existing traffic signal faces shall be replaced with LED signal modules as shown on the plans and in conformance with these Special Provisions.

4020.2 GENERAL

- A. Type 1 LED signal modules shall be installed in the doorframes of standard traffic signal housings. Lamp sockets, reflectors, reflector holders and lenses used with incandescent lamps shall not be used when Type 1 LED signal modules are installed.
- B. LED signal modules, including green, yellow, red, circular balls and arrow indications shall be from the same manufacturer, and each size shall be the same model.
- C. Type 1 LED signal modules shall be sealed units with two color-coded conductors for power connection, a printed circuit board, a power supply, a lens and a gasket. LED signal modules shall be weatherproof after installation and connection. Circuit boards and power supplies shall be contained inside Type 1 LED signal modules. Circuit boards shall conform to the requirements in Chapter 1, Section 6 of the “*Transportation Electrical Equipment Specifications*,” (TEES) published by the Department.
- D. Conductors for Type 1 LED signal modules shall be one meter in length with quick disconnect terminals attached, and shall conform to the provisions in Section 86-4.01C, “*Electrical Components*,” of the Standard Specifications.
- E. Lenses of Type 1 LED signal modules shall be integral to the units, shall be convex with a smooth outer surface and shall be made of ultraviolet (UV) stabilized plastic or glass. The lenses shall be capable of withstanding ultraviolet exposure from direct sunlight for a minimum period of 36 months without exhibiting evidence of deterioration.

- F. Type 1 LED signal modules shall be sealed on doorframes with one-piece ethylene propylene rubber (EPDM) gaskets.
- G. LEDs used in signal modules shall be of Aluminum Indium Gallium Phosphide (AlInGaP) technology for red and yellow indications and of Gallium Nitrate (GaN) technology for green indications. LEDs shall be the ultra bright type rated for 100,000 hours of continuous operation from -40°C to +74°C.
- H. Individual LEDs shall be wired so that a total failure of one LED will result in the loss of not more than 5 percent of the signal module light output. Failure of an individual LED in a string shall not result in the loss of the entire string or any other indication.
- I. Maximum power consumption requirements for LED signal modules shall be as follows:

LED Signal Module	Power Consumption in Watts					
	RED		YELLOW		GREEN	
	12°C	74°C	25°C	74°C	25°C	74°C
300 mm (12") circular	11	17	22	16	12	12
200 mm (8") circular	8	13	13	16	10	10
300 mm (12") arrow	9	12	10	12	13	13

4020.3 PHYSICAL AND MECHANICAL REQUIREMENTS:

- A. Installation of LED signal modules shall only require the removal of the optical unit components such as the lens, lamp module, gaskets and reflector. LED signal modules shall be weather tight, fit securely to the housing and connect directly to electrical wiring.
- B. Arrow modules shall conform to the requirements in Section 9.01 of the Institute of Transportation Engineers (ITE) Publication: Equipment and Materials Standards, "Vehicle Traffic Control Signal Heads" for arrow indications. LEDs shall be spread evenly across the illuminated portion of the arrow area.
- C. LED Signal Module Lens
 - 1. The LED signal module shall be capable of replacing the optical unit. The lens may be tinted or may use transparent film or materials with similar characteristics to enhance "ON/OFF" contrasts. The use of tinting or other materials to enhance "ON/OFF" contrast shall not affect chromaticity and shall be uniform across the face of the lens.
 - 2. If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance.
- D. Environmental Requirements
 - 1. LED signal modules shall be rated for use in the operating temperature range of -40°C to +74°C.
 - 2. LED signal modules shall be protected against dust and moisture intrusion in conformance with the requirements in NEMA Standard 250-1991 for Type 4 enclosures to protect internal components.
- E. Construction
 - 1. LED signal modules shall be single, self-contained devices, not requiring on-site assembly for installation into existing traffic signal housings. The power supply for LED signal modules shall be integral to the module.
 - 2. Assembly and manufacturing processes for LED signal modules shall be designed to assure all internal components will be adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- F. Materials

1. Materials for lenses and LED signal modules shall conform to the requirements in ASTM Specifications for the materials.
2. Enclosures containing the power supply or electronic components of LED signal modules shall be made of UL94V0 flame-retardant materials. Lenses of LED signal modules are excluded from this requirement.

G. Module Identification

1. LED signal modules shall have the manufacturer’s name, trademark, model number, serial number, lot number, month and year of manufacture, and required operating characteristics permanently marked on the back of the module. Required operating characteristics shall include rated voltage, power consumption and volt-ampere (VA).
2. Type 1 LED signal modules shall have prominent and permanent vertical markings for correct indexing and orientation within the signal housings. Markings shall consist of an up arrow or the work “UP” or “TOP”.

4020.4 PHOTOMETRIC REQUIREMENTS:

- A. Initial luminous intensity values for LED signal modules, operating at 25°C, shall meet or exceed the following minimum values:

Circular Indications (in cd)

Angle (v,h)	200 mm (8-inch)			300 mm (12-inch)		
	RED	Yellow	Green	Red	Yellow	Green
2.5, ±2.5	157	314	314	399	798	798
2.5, ±7.5	114	228	228	295	589	589
2.5, ±12.5	67	133	133	166	333	333
2.5, ±17.5	29	57	57	90	181	181
7.5, ±2.5	119	238	238	266	532	532
7.5, ±7.5	105	209	209	238	475	475
7.5, ±12.5	76	152	152	171	342	342
7.5, ±17.5	48	95	95	105	209	209
7.5, ±22.5	21	43	43	45	90	90
7.5, ±27.5	12	24	24	19	38	38
12.5, ±2.5	43	86	86	59	119	119
12.5, ±7.5	38	76	76	57	114	114
12.5, ±12.5	33	67	67	52	105	105
12.5, ±17.5	24	48	48	40	81	81
12.5, ±22.5	14	29	29	26	52	52
12.5, ±27.5	10	19	19	19	38	38
17.5, ±2.5	19	38	38	26	52	52

17.5, ±7.5	17	33	33	26	52	52
17.5, ±12.5	12	24	24	26	52	52
17.5, ±17.5	10	19	19	26	52	52
17.5, ±22.5	7	14	14	24	48	48
17.5, ±27.5	5	10	10	19	38	38

Arrow Indications in cd/m² (foot-lamberts)

	Red	Yellow	Green
Arrow Indication	5 500 (1,600)	11 000 (3,200)	11 000 (3,200)

- B. LED signal modules shall meet or exceed the following minimum illumination values for a minimum period of 36 months, based on normal use in traffic signal operation over an operating temperature range of -40°C to +74°C. In addition, yellow LED signal modules shall meet or exceed the following minimum illumination values for a minimum period of 36 months, based on normal use in traffic signal operation at 25°C.

Circular Indications (in cd)

Angle (v, h)	200 mm (8-inch)			300 mm (12-inch)		
	Red	Yellow	Green	Red	Yellow	Green
2.5, ±2.5	133	267	267	339	678	678
2.5, ±7.5	97	194	194	251	501	501
2.5, ±12.5	57	113	113	141	283	283
2.5, ±17.5	25	48	48	77	154	154
7.5, ±2.5	101	202	202	226	452	452
7.5, ±7.5	89	178	178	202	404	404
7.5, ±12.5	65	129	129	145	291	291
7.5, ±17.5	41	81	81	89	178	178
7.5, ±22.5	18	37	37	38	77	77
7.5, ±27.5	10	20	20	16	32	32
12.5, ±2.5	37	73	73	50	101	101
12.5, ±7.5	32	65	65	48	97	97
12.5, ±12.5	28	57	57	44	89	89
12.5, ±17.5	20	41	41	34	69	69
12.5, ±22.5	12	25	25	22	44	44
12.5, ±27.5	9	16	16	16	32	32
17.5, ±2.5	16	32	32	22	44	44
17.5, ±7.5	14	28	28	22	44	44
17.5, ±12.5	10	20	20	22	44	44
17.5, ±17.5	9	16	16	22	44	44
17.5, ±22.5	6	12	12	20	41	41
17.5, ±27.5	4	9	9	16	32	32

Arrow Indications in cd/m² (foot-lamberts)

	Red	Yellow	Green
Arrow Indication	5 500 (1,600)	11 000 (3,200)	11 000 (3,200)

- C. Measured chromaticity coordinates of LED signal modules shall conform to the chromaticity requirements of the following table, for a minimum period of 36 months, over an operating range of -40°C to +74°C.

Red	Y: not greater than 0.308, or less than $0.998 - x$
Yellow	Y: not less than 0.411, nor less than $0.995 - x$, Nor less than 0.452
Green	Y: not less than $0.506 - 0.519x$, nor less than $0.150 + 1.068x$, nor more than $0.730 - x$

- D. LED signal modules tested or submitted for testing shall be representative of typical production units. Circular LED modules shall be tested in conformance with California Test 604. Optical testing shall be performed with LED signal modules mounted in standard traffic signal sections without visors or hoods attached to the signal sections.
- E. LEDs for arrow indications shall be spread evenly across the illuminated portion of the arrow area. Arrow LED signal modules shall be tested in conformance with California Test 3001. Optical testing shall be performed with LED signal modules mounted in standard traffic signal sections without visors or hoods attached to the signal sections. LED arrow signal section indication shall provide minimum initial luminous intensity as listed herein. Measurements shall be performed at the rated operating voltage of 120 V (ac).

4020.5 ELECTRICAL:

- A. Maximum power consumption requirements for LED signal modules shall not exceed those listed in "General." LED signal modules shall operate at a frequency of 60 Hz \pm 3 Hz over a voltage range from 95 V (ac) to 135 V (ac) without perceptible flicker. Fluctuations of line voltage shall have no visible effect on luminous intensity of the indications. Rated voltage for all measurements shall be 120 V (ac).
- B. Wiring and terminal blocks shall conform to the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards, (Vehicle Traffic Control Signal Heads). Two secured, color coded, 1 meter long, 600 V, 20AWG minimum, jacketed wires, conforming to the National Electronic Code, rated for service at +105°C, shall be provided for electrical connection for each Type 1 LED signal module.

- C. LED signal module on-board circuitry shall include voltage surge protection to withstand high repetition noise transients in conformance with the requirements in Section 2.1.6 of NEMA Standard TS2-1992.
- D. LED signal modules shall be operationally compatible with currently used controller assemblies including solid-state load switches, flashers and conflict monitors. When a current of 20 milliamperes (ac) or less is applied to the unit, the voltage read across the two leads shall be 15 V (ac) or less.
- E. LED signal modules and associated on-board circuitry shall conform to the requirements in Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.
- F. LED signal modules shall provide a power factor of 0.90 or greater.
- G. Total harmonic distortion from current and voltage induced into an alternating current line by LED signal modules shall not exceed 22% percent at an operating temperature of 25°C.

4020.6 QUALITY CONTROL PROGRAM:

- A. Design Qualification Testing
 - 1. The manufacturer or an independent testing lab hired by the manufacturer shall perform all necessary design qualification testing on all LED signal module designs, and on existing designs when a major design change has been implemented. Failure to conform to the requirements of any design qualification test shall be cause for rejection.
 - 2. A major design change is defined as a design change, electrical or physical, which changes any of the performance characteristics of the LED signal module, results in a different circuit configuration for the power supply, or changes the layout of the individual LEDs in the signal module.
 - 3. Two LED modules for each design shall be used for DQT. The two LED signal modules shall be selected at random. These signal modules shall be submitted to the Transportation Laboratory after the DQT is complete. Testing shall be submitted with the modules to the Transportation Laboratory for verification of DQT data.
 - 4. LED signal modules shall be energized for a minimum of 24 hours, at 100% percent on-time duty cycle, at a temperature of 74°C before performing and DQT.
 - 5. After burn-in LED signal modules shall be tested for rated initial luminous intensity in conformance with the provisions in **“Photometric Requirements.”** Before measurement, LED signal modules shall be energized at

rated voltage, with 100% percent on-time duty cycle, for a time period of 30 minutes. Photometrics, luminous intensity and color measurements for yellow LED signal modules shall be taken immediately after the modules are energized. The ambient temperature for these measurements shall be 25°C. Test results for this testing shall record the current, voltage, total harmonic distortion (THD) and power factor (PF) associated with each measurement.

6. LED signal modules shall be tested by measuring for chromaticity (color) in conformance with the provisions in **“Photometric Requirements.”** A spectra radiometer shall be used for this measurement. The ambient temperature for this measurement shall be 25°C.
7. LED signal modules shall be tested by measuring the current flow in amperes. The measured current values shall be used for quality comparison of production quality assurance on production modules.
8. LED signal modules shall be tested by measuring the power factor. A commercially available power factor meter may be used to perform this measurement.
9. LED signal modules shall be tested by measuring the total harmonic distortion. A commercially available total harmonic distortion meter may be used to perform this measurement.
10. LED signal modules shall be tested in conformance with the provisions in **“Electrical,”** with reference to Class A emission limits referenced in Federal Communications Commission (FCC) Title 47, SubPart B, Section 15.
11. LED signal modules shall be tested for compatibility with the controller unit, conflict monitor and load switch. Each signal module shall be connected to the output of a standard load switch connected to an alternating current voltage supply between the values of 95 and 135 V (ac) with the load switch in the “OFF” position. The alternating current voltage developed across each LED signal module so connected shall not exceed 15 V rms as the input alternating current voltage is varied from 95 V (ac) rms to 135 V (ac) rms.
12. LED signal modules shall be tested for transient immunity in conformance with the provisions in **“Electrical,”** and conforming to the procedure described in NEMA Standard TS2-1992.
13. Mechanical vibration testing shall be performed on LED signal modules in conformance with the requirements in MIL-STD-883, Test Method 2007, using three 4-minute cycles along each x, y, and z-axis, at a force of 2.5 Gs, with a frequency sweep from 2 Hz to 120 Hz. The loosening of the lens, internal components, or other physical damage shall be cause for rejection.

14. Temperature cycling shall be performed on LED signal modules in conformance with the requirements of MIL-STD-883, Test Method 1010. The temperature range shall conform to the provisions in **“Environmental Requirements.”** A minimum of 20 cycles shall be performed with a 30-minute transfer time between temperature extremes and a 30-minute dwell time at each temperature. LED signal modules under test shall be non-operating. Failure of LED signal modules to function properly or evidence of cracking of LED signal module lenses or housings after temperature cycling shall be cause for rejection.
15. Moisture resistance testing shall be performed on LED signal modules in conformance with the requirements in NEMA Standard 250-1991 for Type 4 enclosures. Evidence of internal moisture after testing shall be cause for rejection.

B. Production Quality Testing

1. Production quality testing shall be performed on each LED signal module prior to shipment. Failure to conform to the requirements of any production quality test shall be cause for rejection. The manufacturer shall retain test results for seven years for warranty purposes.
2. LED signal modules shall be tested for rated initial intensity after burn-in. The burn-in period shall consist of signal modules being energized at rated voltage for a 30-minute stabilization period before the measurements are made. A single point measurement with a correlation to the minimum initial luminous intensity requirements of **“Photometric Requirements,”** for circular modules may be used. The ambient temperature for this measurement shall be +25°C.
3. LED signal modules shall be tested for luminous intensity requirements in **“Photometric Requirements.”**
4. LED signal modules shall be tested for required power factor after burn-in.
5. LED signal modules shall be tested by measuring current flow in amperes after burn-in. The measured current values shall be compared against values resulting from design qualification measurements under **“Design Qualification Testing.”** The current flow shall not exceed the rated value. The measured ampere values with rated voltage shall be recorded as volt-ampere (VA) on the product labels.
6. LED signal modules shall be visually inspected for any exterior physical damage or assembly anomalies. The surface of the lens shall be free of scratches, abrasions, cracks, chips, discoloration, or other defects. Any such defects shall be cause for rejection.

4020.7 CERTIFICATE OF COMPLIANCE:

- A. The Contractor shall provide the Engineer a Certificate of Compliance from the manufacturer, in conformance with the provisions of Section 6-1.07, "**Certificates of Compliance**," of the Standard Specifications. The certificate shall certify that the LED signal modules comply with the requirements of these specifications. The certificate shall also include a copy of all applicable test reports on the LED signal modules.

4020.8 WARRANTY:

- A. The manufacturer shall provide a written warranty against defects in materials and workmanship for LED signal modules for a period of 36 months after installation of LED signal modules. Replacement LED signal modules shall be provided within 5 days after receipt of failed LED signal modules at no cost to the City of Tulare, except the cost of shipping the failed modules. All warranty documentation shall be given to the Engineer prior to installation. Replacement LED signal modules shall be delivered to the City of Tulare Corporation Yard, 3989 South "K" Street, Tulare, California, 93274.

PEDESTRIAN SIGNALS

- 4021.1 Pedestrian signals shall conform to the provisions in Section 86-4.06, "**Pedestrian Signal Faces**," of the Standard Specifications and these Special Provisions.
- 4021.2 Pedestrian signals shall be Type A. International type symbols shall be used.
- 4021.3 All pedestrian signal housing shall be metallic.

LIGHT EMITTING DIODE PEDESTRIAN SIGNAL FACE MODULES

- 4022.1 Light emitting diode (LED) pedestrian signal face (PSF) modules shall be installed in standard Type A pedestrian signal housing. "**UPRAISED HAND**" and "**WALKING PERSON**" shall use light emitting diodes as the light source as shown on the plans and in conformance with these special provisions.
- 4022.2 **GENERAL:**
 - A. PSF modules shall be designed to mount in Standard Type A housings. PSF modules shall be designed to mount behind or replace face plates of Standard Type A housings in conformance with the requirements of the Institute of Transportation Engineers (ITE) Standards: "**Pedestrian Traffic Control Signal**

Indications,” and the “*Manual on Uniform Traffic Control Devices,*” (MUTCD). Where existing Type A pedestrian signal faces contain both incandescent and LED light sources, both sources shall be removed and replaced by a new LED pedestrian signal face module in conformance with these special provisions.

- B. PSF modules used on this project shall be from a single manufacturer.
- C. Circuit boards and power supplies shall be contained inside the LED modules. Circuit boards shall conform to the requirements in Chapter 1, Section 6 of the “*Transportation Electrical Equipment Specifications,*” (TEES) published by the Department.
- D. PSF modules shall fit into existing Type A housings and shall not require a specific mounting orientation and shall not vary in light output, pattern, or visibility for any mounting orientations.
- E. LEDs for “*UPRAISED HAND,*” symbols shall utilize Aluminum Indium Gallium Phosphide (AlInGaP) technology and shall be the ultra bright type rated for 100,000 hours of continuous operation from -40° C to +74° C.
- F. Individual LEDs shall be wired so that a total failure of one LED will result in the loss of not more than 5 percent of the PSF module light output. Failure of an individual LED in a string shall not result in the loss of the entire string or any other indication.
- G. PSF modules tested and those submitted for testing shall be representative of typical production units. PSF modules shall be tested in conformance with California Test 610 and as specified herein.

7. Luminance Requirements

8. Luminance of the “*UPRAISED HAND,*” symbol shall be 3750 cd/m² {1,100 foot-lamberts} minimum. Color of “*UPRAISED HAND,*” shall be Portland Orange conforming to the requirements of the ITE Standards: “*Pedestrian Traffic Control Signal Indicators,*” and the MUTCD.

9. Luminance of the “*WALKING PERSON,*” symbol shall be 5300 cd/m² {1,550 foot-lamberts} minimum. Color of “*WALKING PERSON,*” shall be white (Luminous Tubing) conforming to the requirements of the ITE Standards: “*Pedestrian Traffic Control Signal Indications,*” and the MUTCD.

10. Height and width of each symbol shall not be less than 250 mm {10 inches} and 165 mm {6½ inches} respectively. Uniformity ratio of illuminated symbols shall not exceed 4 to 1 between the highest luminance area and the lowest luminance area.

11. PSF modules shall be rated for a minimum useful life of 36 months and shall maintain at least 85% percent of 5300 cd/m² {1,550 foot-lamberts} for **“WALKING PERSON,”** symbols after 36 months of continuous use in traffic signal operation over a temperature range of -40°C to +74°C.

H. Physical and Mechanical Requirements

1. PSF modules shall be designed as retrofit replacement for existing optical units of signal lamps, or existing pedestrian signal faces with both LED and incandescent light sources, and shall both require special tools for installation. PSF modules shall fit into pedestrian signal section housings built in conformance with the ITE Publication: Equipment and Materials Standards, Chapter 2 **“Vehicle Traffic Control Signal Heads,** (VTCSH) without modification to the housing.

I. Environmental Requirements

1. PSF modules shall be rated for use in the operating temperature range of -40°C to +74°C.

J. Construction

1. PSF modules shall be single, self-contained devices, not requiring on-site assembly for installation into standard Type A housing. Power supplies for PSF modules shall be integral to the modules.
2. Assembly and manufacturing processes for PSF modules shall be designed to assure all internal components will be adequately supported to withstand mechanical shock and vibration from high winds and other sources.

K. Materials

16. Material used for PSF modules shall conform to the requirements in ASTM specifications for the materials.
17. Enclosures containing either the power supply or electronic components of the PSF module shall be made of UL94VO flame-retardant materials.

L. Module Identification

1. PSF modules shall have the manufacturer’s name, trademark, model number, serial number, lot number, month and year of manufacture, and required operating characteristics permanently marked on the back

of the module. Required operating characteristics shall include rated voltage, power consumption, and volt-ampere (VA).

2. Type A pedestrian signal face, combination **“UPRAISED HAND”/“WALKING PERSON,”** section, housings without the reflectors shall be used for PSF modules.

4022.3 PHOTOMETRIC REQUIREMENTS:

- A. PSF modules shall maintain at least 85% percent of the following luminous intensity values over 36 months of continuous use in signal operation over the temperature range of -40°C to +74°C. In addition, PSF modules shall meet or exceed the following luminous intensity values upon initial testing at 25°C.

PSF module	Luminous Intensity
UPRAISED HAND	3750 cd/m ² {1,100 foot-lamberts}
WALKING PERSON	5300 cd/m ² {1,550 foot-lamberts}

- B. The measured chromaticity coordinates of PSF modules shall conform to the requirements for chromaticity in Section 5.3.2.1 and Figure C of the VTCSH Standards.

4022.4 ELECTRICAL:

- A. PSF module power consumption shall not exceed the following maximum values:

PSF module	Power Consumption @ 25°C	Power Consumption @ 74°C
UPRAISED HAND	10.0 W	12.0 W
WALKING PERSON	12.0 W	15.0 W

- B. PSF modules shall operate at a frequency of 60 HZ ±3 Hz over a voltage range from 95 V (ac) to 135 V (ac) without perceptible flicker. Fluctuations of line voltage shall have no visible effect on the luminous intensity of the indications. Rated voltage for all measurements shall be 120 V (ac).
- C. PSF module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients in conformance with the requirements in Section 2.1.6 of NEMA Standard TS2-1992.
- D. Wiring and terminal blocks shall conform to the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards, **“Vehicle Traffic Control Signal Heads.”**

- E. PSF modules shall be operationally compatible with currently used controller assemblies including solid-state load switches, flashers and conflict monitors. When a current of 20 milliamperes (ac) or less is applied to the unit, the voltage read across the two leads shall be 15 V (ac) or less.
- F. PSF modules and associated on-board circuitry shall conform to the requirements in Federal Communications Commission (FCC) Title 47, Sub-Part B, Section 15 regulations concerning the emission of electronic noise.
- G. PSF modules shall provide a power factor of 0.90 or greater.
- H. Total harmonic distortion from current and voltage induced into an alternating current line by PSF modules shall not exceed 20% (percent) at an operation temperature of 25°C.

4022.5 QUALITY CONTROL PROGRAM:

- A. PSF modules shall be manufactured in conformance with a vendor quality control (QC) program. The QC program shall include two types of testing: (1) design qualification and (2) production quality. Production quality testing shall include statistically controlled routine tests to ensure minimum performance levels of PSF modules built to meet these specifications.
- B. Documentation of the QC process and test results shall be kept on file for a minimum period of seven years.
- C. PSF module designs not satisfying design qualification testing and the production quality testing performance requirements specified herein shall not be labeled, advertised, or sold as conforming to these Specifications.
- D. Identification of components and subassemblies of PSF modules, which may affect reliability and performance, shall be traceable to the original manufacturers.
- E. Design Qualification Testing
 - 1. The manufacturer or an independent testing lab hired by the manufacturer shall perform all necessary design qualification testing (DQT) on all PSF module designs, and on existing designs when a major design change has been implemented. Failure to conform to the requirements of any design qualification test shall be cause for rejection.
 - 2. A major design change is defined as a design change, electrical or physical, which changes any of the performance characteristics of the PSF module, results in a different circuit configuration for the power supply, or changes the layout of the individual LEDs in the PSF Module.

3. Two PSF modules for each design shall be used for DQT. The two PSF modules shall be selected at random. These PSF modules shall be submitted to the Transportation Laboratory after DQT is complete. The testing data shall be submitted with the PSF modules to the Transportation Laboratory for verification of DQT data.
4. The PSF modules shall be energized for a minimum of 24 hours, at 100% percent on-time duty cycle, at a temperature of 74°C before performing any DQT.
5. After burn-in, the PSF modules shall be tested for rated initial luminous intensity in conformance with the provisions in “Photometric Requirements.” Before measurement, PSF modules shall be energized at rated voltage, with 100% percent on-time duty cycle, for a time period of 30 minutes. The ambient temperature for these measurements shall be 25°C. The test results shall include the recorded current, voltage; total harmonic distortion (THD) and power factor (PF) associated with each measurement.
6. PSF modules shall be tested by measuring for chromaticity (color) in conformance with the provisions in “*Photometric Requirements.*” A spectra radiometer shall be used for these measurements. The ambient temperature for these measurements shall be 25°C.
7. PSF modules shall be tested by measuring for current flow in amperes. The measured current values shall be used for comparison of production quality assurance on production modules.
8. PSF modules shall be tested by measuring for power factor. A commercially available power factor meter may be used to perform this measurement.
9. PSF modules shall be tested by measuring for total harmonic distortion. A commercially available total harmonic distortion mater may be used to perform this measurement.
10. PSF modules shall be tested in conformance with the provisions in “*Electrical*”, with reference to Class A emission limits referenced in Federal Communications Commission (FCC) Title 47, Sub-Part B, Section 15.
11. PSF modules shall be tested for compatibility with the controller, conflict monitor and load switch. Each PSF module shall be connected to the output of a standard load switch connected to an alternating current voltage supply between the values of 95 and 135 V (ac) with the input to the load switch in the “OFF” position. The alternating current voltage developed across each PSF module shall not exceed 10 V rms as

the input alternating current voltage is varied from 95 V (ac) rms to 135 V (ac) rms.

12. PSF modules shall be tested for transient immunity in conformance with the provisions in “*Electrical*” and conforming to the procedure described in NEMA Standard TS2-1992.
13. Mechanical vibration testing shall be performed on PSF modules in conformance with the requirements in MIL-STD-883, Test Method 2007, using three 4-minute cycles along each a, y, and z axis\,s, at a force of 2.5 Gs, with a frequency sweep from 2 Hz to 120 Hz. The loosening of the lens, of any internal components or other physical damage shall be cause for rejection.
14. Temperature cycling shall be performed on PSF modules in conformance with the requirements of MIL-STD-883, Test Method 1010. The temperature range shall conform to the provisions in “*Environmental Requirements.*” A minimum of 20 cycles shall be performed with a 30-minute transfer time between temperature extremes and a 30-minute dwell time at each temperature. Signal under test shall be non-operating. Failure of PSF Modules to function properly or evidence of cracking of PSF module lenses or housings after temperature cycling shall be cause for rejection.
15. Moisture resistance testing shall be performed on PSF modules in conformance with the requirements in NEMA Standard 250-1991 for Type 4 enclosures. Evidence of internal moisture after testing shall be cause for rejection.

F. Production Quality Testing

1. Production quality tests shall be performed on each PSF module prior to shipment. Failure to conform to the requirements of any production quality tests shall be cause for rejection. The manufacturer shall retain test results for seven years for warranty purposes.
2. PSF modules shall be tested for rated initial intensity after burn-in. The burn-in period shall consist of signal modules being energized at rated voltage for a 30-minute stabilization period before the measurements are made.
3. PSF modules shall be tested for luminous intensity requirements in “*Photometric Requirements.*”
4. PSF modules shall be tested for required power factor after burn-in.

5. PSF modules shall be tested by measuring current flow in amperes after burn-in. The measured current values shall be compared against current values resulting from design qualification measurements under *“Design Qualification Testing.”* The current flow shall not exceed the rated value. The measured ampere values with rated voltage shall be recorded as volt-ampere (VA) on the product labels.
6. PSF modules shall be visually inspected for any exterior physical damage or assembly anomalies. The surface of the lens shall be free of scratches, abrasions, cracks, chips, discoloration, or other defects. Any such defects shall be cause for rejection.

G. CERTIFICATE OF COMPLIANCE

The Contractor shall provide the Engineer a Certificate of Compliance from the manufacturer, in conformance with the provisions of Section 6-1.07, *“Certificate of Compliance”*, of the Standard Specifications. The certificate shall certify that the PSF modules comply with the requirements of these specifications. The certificate shall also include a copy of all applicable test reports on the PSF modules.

H. WARRANTY

The manufacturer shall provide a written warranty against defects in materials and workmanship for the PSF modules for a period of 36 months after installation of the PSF modules. Replacement PSF modules shall be provided within 5 days after receipt of failed PSF modules at no cost to the City of Tulare, except the cost of shipping the failed modules. All warranty documentation shall be given to the Engineer prior to installation. Replacement PSF modules shall be delivered to the City of Tulare Corporation Yard, 3989 South “K” Street, Tulare, CA 93274.

4023 DETECTORS

- A. Detectors shall conform to the provisions in Section 86-5, *“Detectors,”* of the Standard Specifications and these Special Provisions.
- B. Circular “Type E” loops as shown on Standard Plan ES-5B, are preferred for installations within roadways. However, square “Type A” loops, provided and installed in conformance with the State Standard Plans and Specifications will be acceptable.
- C. For Type E detector loops, sides of the slot shall be vertical and the minimum radius of the slot entering and leaving the circular part of the loop shall be 1½”. Slot width shall be a maximum of ¾”. Slots of circular loops shall be filled with Elastometric sealant or hot melt rubberized asphalt sealant.

- D. Detector loop wire shall be Type 2 and loop detector lead-in cable shall be Type "B".
- E. Detector lead-in cable shall not be spliced between the termination pull box and the controller terminals.
- F. In lieu of the requirements in the fourth paragraph of Section 86-5.01A(5), "***Installation Details,***" of the Standard Specifications, slots in asphalt concrete pavement shall be filled as follows:
 1. After conductors are installed in the slots cut in the pavement, paint binder shall be applied to all vertical surfaces of slots in accordance with the provisions in Section 94, "***Asphaltic Emulsions,***" of the Standard Specifications. The slots shall then be filled with asphaltic emulsion sealant.
 2. Temperature of sealant material during installation shall be above 70° degrees F. Air temperature during installation shall be above 50° degrees F. Sealant placed in the slots shall be compacted by use of an 8-inch diameter by 1/8-inch thick steel hand roller or other tool approved by the Engineer. Compacted sealant shall be flush with the pavement surface. Minimum conductor coverage shall be 5/8 inch. Excess sealant remaining after rolling shall not be reused. Traffic may be released immediately over compacted materials.

4024 **MAGNETIC DETECTORS**

- A. Not Applicable.

4025 **PEDESTRIAN PUSH BUTTON ASSEMBLIES**

- A. Pedestrian push buttons shall conform to the provisions in Section 86-5.02, "***Pedestrian Push Button Assemblies,***" of the Standard Specifications and these Special Provisions.
- B. Pedestrian push buttons shall be Type "B" with sign and housing.
- C. All pedestrian push button housings shall be metallic.
- D. Signs shall be of the international symbol type shown on Standard Plan ES-5C.

4026 **SIGNAL MOUNTING ASSEMBLIES**

- A. Signal mounting assemblies shall conform to the provisions in Section 86-4.08, "***Signal Mounting Assemblies,***" of the Standard Specifications and these Special Provisions. Mounting assemblies shall be bronze.

- B. Clamshell mountings shall not be used.
- C. Mountings shall be as shown on Standard Plan ES-4A and ES-4B. After installation of signal mountings, if bolt threads extend beyond specifications shown on Standard Plan ES-7M of the Standard Plans, bolts shall be cut to three (3) threads above nut and painted with unthinned zinc rich paint conforming to the requirements of Military Specifications DOD-P.21034A.
- D. All setscrews exposed to weather shall be zinc or cadmium-plated and have square heads. Mounting bolt length shall meet the same specifications as stated for the standard anchor bolts.

4027 LUMINAIRES

- A. Luminaries shall conform to the provisions in Section 86-6, "**Lighting**," of the Standard Specifications and these Special Provisions.
- B. Luminaries shall have a built-in regulator type ballast. All luminaries shall be furnished with 200-watt high-pressure sodium (HPS) lamps.
- C. Sockets shall be positioned for Type III light distribution.
- D. Luminaries shall utilize Type V photoelectric control with the photoelectric control located within the service equipment enclosure.
- E. After installation and plumbing of standard, the luminaries shall be leveled on both the long and transverse axis by use of a spirit level.
- F. Each luminaire shall be furnished without photoelectric unit receptacle.
- G. The ballasts for each horizontally mounted luminaire shall consist of components mounted on a metal plate secured to the housing or components mounted on a down opening door.

4028 INTERNALLY ILLUMINATED STREET NAME SIGNS

- A. Internally illuminated street name signs (ISIS) shall conform to the provisions in Section 86-6.065, "**Internally Illuminated Street Name Signs**," of the Standard Specifications and these Special Provisions.
- B. ISIS shall be Type "A", 6 feet long designed for 120 V (ac) operation. Letters shall be 8-inch upper case and 6 inch lower case, Series "E" where possible. For long or multiple street names, a design shall be submitted by the Contractor and approved by the Engineer.
- C. Photoelectric control for ISIS shall be Type V.

4029 **EMERGENCY VEHICLE DETECTORS**

- A. Emergency vehicle detectors shall conform to the following:
 - 1. The emergency vehicle detector systems provided by the Contractor shall be compatible with those presently in use by the City and shall be capable of providing the same and/or greater number of features.
 - 2. The emergency vehicle detector systems being used by the City are 3M *OPTICOM*™ Priority Control Systems.
 - 3. Detectors shall be 3M Model 511 (optical signal from a signal direction and output a signal electrical signal), Phase Selectors shall be 3M Model 562 and Detector Cable shall be 3M Model 138.
 - 4. A Model 562W Auxiliary Function Harness (interface cable) shall be installed within each Model 332A Traffic Signal Controller Cabinet by the controller manufacturer pursuant to 3M Company instructions to provide the green light monitoring and auxiliary detector input connections shown below prior to the testing and delivery of the cabinet.

<u>PIN</u>	<u>FUNCTION</u>
1	Phase 1 green input
2	Phase 2 green input
3	Phase 3 green input
4	Phase 4 green input
5	Phase 5 green input
6	Phase 6 green input
7	Phase 7 green input
8	Phase 8 green input
9	Channel A auxiliary detector input
10	Channel A auxiliary detector input
11	Channel B auxiliary detector input
12	Channel B auxiliary detector input
13	No connection
14	No connection
15	Common for green sense, neutral (AC-)

- B. The Contractor shall arrange to have a 3M Company certified technician, qualified to work on the *OPTICOM* system, present at, or prior to, the signal turn-on to test that the system is correctly installed and functioning properly.
- C. The Contractor shall notify the Engineer at least 48 hours in advance of the performance of such test.

4030 **SIGNAL TURN-ON REQUIREMENTS**

- A. The following items are the responsibility of the Contractor and **MUST** be completed to the satisfaction of the City prior to signal turn-on of new, modified or relocated equipment:
1. The Engineer must be notified in writing, seven (7) working days in advance of proposed turn-on.
 2. All wiring shall have passed the test for shorts and continuity. Detector loops shall have been “Meggered” and meet Specifications.
 3. All “Field” connections shall be made.
 4. All signal heads shall be properly aimed as directed by the Engineer.
 5. All signal poles and heads shall have been in place a minimum of seven (7) days.
 6. All auxiliary functions (e.g., safety lights, internally illuminated street signs, etc.) shall be operational.
 7. The “**Service**” shall be complete, including the utility company meter.

4031 **TRAFFIC CONTROL**

- A. Traffic control shall be provided in accordance with State of California, “**Manual of Traffic Controls for Construction and Maintenance Work Zones,**” latest edition.
- B. Payment for traffic control shall be included in various items of work and no separate payment will be made therefore.

4032 **SOUTHERN CALIFORNIA EDISON COMPANY (SCE)**

- A. The City of Tulare has applied for electrical service for the subject project and will pay SCE costs, which include riser and cabling installation.
- B. It is the Contractor’s obligation to contact SCE and to meet any requirements they may have regarding the installation and connection of service.

4033 **PAYMENT**

- A. Payment for modifications shall conform to the provisions in Section 86-8, “**Payment,**” of the Standard Specifications and these Special Provisions.

- B. The contract price paid for signal and highway safety lighting work shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals necessary to make the signal and lighting system operational, including but not limited to all trenching, excavation, and backfill, foundations, vehicle signal heads, pedestrian signal heads, pedestrian push buttons, electroliers, controller equipment for 8-phase traffic signal system including emergency vehicle preemption, service equipment, inductive loop detectors, magnetic detectors, relocating signs, adjusting vaults to grade, and internally illuminated street name signs, and no additional compensation will be allowed therefore.

4034 APPLICABLE STANDARD PLANS

4034.1 The following Standard Plans shall apply to this contract:

- A. A10A Abbreviations
- B. A10B Symbols
- C. A20A Pavement Markers and Traffic Lines - Typical Details
- D. A20B Pavement Markers and Traffic Lines - Typical Details
- E. A20D Pavement Markers and Traffic Lines - Typical Details
- F. A24A Pavement Markings - Arrows
- G. A24D Pavement Markings - Words
- H. A24E Pavement Markings - Words and Crosswalks
- I. RS-1 Roadside Signs - Typical Installation Details No. 1
- J. RS-4 Roadside Signs - Typical Installation Details No. 4
- K. T11 Traffic Control System for Lane Closure on Multi-lane Conventional Highways (included)
- L. T12 Traffic Control System for Lane Closure on Multi-lane Conventional Highways (included)
- M. T13 Traffic Control System for Lane Closure on Two-lane Conventional Highways (included)
- N. ES-1A Signal, Lighting and Electrical Systems - Symbols and Abbreviations
- O. ES-1B Signal, Lighting and Electrical Systems - Symbols and Abbreviations
- P. ES-2A Signal, Lighting and Electrical Systems - Service Equipment
- Q. ES-2C Signal, Lighting and Electrical Systems - Service Equipment Notes Type III Series
- R. ES-2E Signal, Lighting and Electrical Systems - Service Equipment and Typical Wiring Diagram - Type III-B Series
- S. ES-3B Controller Cabinet Details
- T. ES-3C Controller Cabinet Details
- U. ES-4A Signal, Lighting and Electrical Systems - Signal Heads and Mountings
- V. ES-4B Signal, Lighting and Electrical Systems - Signal Heads and Mountings
- W. ES-4C Signal, Lighting and Electrical Systems - Signal Heads and Mountings
- X. ES-4D Signal, Lighting and Electrical Systems - Signal Heads and

		Mountings
Y.	ES-4E	Signal, Lighting and Electrical Systems - Signal Heads and Mountings
Z.	ES-5A	Signal, Lighting and Electrical Systems - Detectors
AA.	ES-5B	Signal, Lighting and Electrical Systems - Detectors
BB.	ES-5C	Signal, Lighting and Electrical Systems - Detectors
CC.	ES-5E	Signal, Lighting and Electrical Systems - Detectors
DD.	ES-7B	Signal and Lighting Standards - Type I Standards and Equipment Numbering
EE.	ES-7D	Signal and Lighting Standards - Case 2 Arm Loading Wind Velocity = 80MPH - Arm Lengths 15' to 30'
FF.	ES-7F	Signal and Lighting Standards - Case 4 Arm Loading - Wind Velocity = 80MPH - Arm Lengths 25' to 45'
GG.	ES-7N	Signal and Lighting Standards - Details No. 1
HH.	ES-7M	Signal and Lighting Standards - Details No. 2
II	ES-7O	Sign Illumination - Internally Illuminated Street Name Sign
JJ	ES-8	Signal, Lighting and Electrical Systems - Pull Box Details
KK	ES-10	Signal, Lighting and Electrical Systems - Isolux Diagrams
LL	ES-11	Signal, Lighting and Electrical Systems - Foundation Installations
MM	ES-13A	Signal, Lighting and Electrical Systems - Splicing Details
NN	ES-13B	Signal, Lighting and Electrical Systems - Wiring Details and Fuse Ratings

4034.2 The following City of Tulare Standard Plans shall apply to this contract:

- A. Standard - Street Sign Locations
- B. Standard - Curb and Gutter, Traffic Bars, and A.C. Dike
- C. Standard - Fire Hydrant, Type "A"
- D. Standard - Driveway Approach and Sidewalk Pattern
- E. Standard - Storm Water Drop Inlet (Sheet 1 of 2 Sheets)
- F. Standard - Storm Water Drop Inlet (Sheet 2 of 2 Sheets)
- G. Standard - Installation of Valve Box

4034.3 In case of a conflict between the City Standard Plans and the State Standard Plans, the City standards shall prevail.

4035 TESTING

4035.1 Required compaction tests will be at City expense, when the Contractor notifies the Engineer that the area is ready for testing. If the initial test for an area does not indicate adequate compaction, all subsequent testing for the same area shall be at the Contractor's expense. All tests will be taken at locations selected by the Engineer.

4035.2 All materials required to complete the work under this contract shall be sampled and tested to insure conformance with plans and specifications. However, at the discretion

of the Engineer, a Certificate of Compliance, as described in Section 6-1.07, “*Certificates of Compliance*,” of the Standard Specifications may be provided in lieu of such sampling and testing.