

TRAFFIC SIGNAL SPECIFICATIONS AND INSTALLATION GUIDELINES

1.0 SPECIAL PROVISIONS, INSTALLATION, AND EQUIPMENT REQUIREMENTS

The following sections provide special traffic signal equipment and installation requirements as required by the City of Lake Elsinore. The City adheres to the latest editions of the Caltrans Standard Plans and Standard Specifications in addition to the following provisions below:

1.1 POLES AND MAST ARMS

1.1.1 POLES

- 1) Standards shall be placed on opposite sides of the pedestrian ramp (see ES-4C of the State of California Standard Plans for the typical location of signal standard placement). All traffic signal plans shall indicate required traffic signal pole locations as referenced from BCR, ECR, and curb face.
- 2) All Poles must meet the standard wind load specified in the latest revision of the State of California Standard Plans.
- 3) No poles or pull boxes are allowed within the limits of pedestrian ramps including the ramp slopes.
- 4) Pole anchor bolts shall be cut and finished one-half inch (1/2") above the nut. Base plate bolt covers shall be installed for all standards.
- 5) Where modifications will leave holes in existing poles, the holes shall be repaired pursuant to State of California Standard Specifications, Section 86-1.02B(1).
- 6) Poles shall not be installed within center medians unless approved by the City Engineer.

1.1.2 MAST ARMS

- 1) Mast arms shall be provided for all approaches unless otherwise approved by the City Engineer.
- 2) All traffic signal mast arms shall present a uniform and level appearance when complete.
- 3) If fully protected left turn phasing is provided, the mast arm shall be long enough to align the left-turn signal head as close as possible to the center of the left-turn lane where there is one left-turn lane, or to the lane line between the left-turn lanes if there are two left-turn lanes.
- 4) Avoid signal standards in center medians (use only on very wide streets where signal mast arms are not long enough to reach to left-turn lanes).
- 5) Street light mast arms shall be 15 feet long or as determined by the Engineer.
- 6) Empty tenons shall be provided on mast arms where lane geometrics are expected to change in the future.

1.2 PULL BOXES

- 1) All pull boxes (box, lid, extension) shall be concrete and size No. 6 unless otherwise indicated. Pull box covers shall be stamped "Traffic Signal" or "Signal Communication" as needed.
- 2) The approved manufacturer is Christy and the approved models are in Table 1 below. Use of other non-Christy pull boxes shall be approved by City Engineer.

Table 1: Pull Box Product Numbers

Pull box	Manufacturer and Model
#5 Box	N30 Box
#5 Lid	N30R Lid
#6 Box	N36 Box

#6 Lid	N36R Lid
#6 Box Fiberlyte Lid	N36 Box with FL36T Lid

- 3) Pull box lids shall be composite with UV inhibitor. Concrete lids shall not be used.
- 4) Pull boxes shall not be placed: In raised or painted medians, in paved shoulder, in traveled way, in driveways, within one foot of a sidewalk access ramp or flares unless approved by the City Engineer.
- 5) When retrofitting pedestrian ramps and relocating existing boxes is cost prohibitive, existing pull boxes must be replaced with traffic rated models and non-skid steel lids.
- 6) Pull boxes placed in dirt shall have utilize white paddle markers for easy location of pull box.
- 7) Pull boxes shall be spaced at intervals of 300 feet or less.
- 8) A No. 5 pull box may be used for advance loops.
- 9) Electrical power pull box shall be No. 5 with extension and shall be placed no more than 20 feet from the service cabinet.
- 10) Where the sump of an existing pull box is disturbed by the CONTRACTOR's operations, the sump shall be reconstructed and, if the sump was grouted, the old grout shall be removed and replaced with new grout.
- 11) Pull boxes shall be tamper resistant and utilize a special key tool for opening.
- 12) See City of Lake Elsinore Standard Plan #504 for additional information.

1.3 CONDUIT

- 1) All traffic signal conduit street crossings or any conduit located within the roadway travelled way (including driveways) shall be schedule 80 rigid PVC. Exceptions to this requirement shall be determined by the City Engineer.
- 2) All conduits shall be three inches (3") minimum. All conduits crossing streets shall be 4" minimum. All legs of the intersection shall have a conduit crossing installed (one spare with mule tape). All conduits shall contain "detectable mule tape" mule tape per State of California Standard Specification 86-1.02B and a No. 8 XHHW-2 stranded insulated green trace wire.
- 3) As much as practical, conduit shall be laid out perpendicular to the curb line of the street crossing under the center of the crosswalk.
- 4) Conduit fill shall not exceed the 26% for new construction and allow exception up to 40% for conduits with three or more conductors. For traffic signal modifications, max percent conduit fill shall be approved by the City Engineer.
- 5) Install two, four-inch (2-4") and one, three-inch (1-3") conduits from controller cabinet base to the adjacent home run pull box with signal cable in one conduit and the balance of conductors in the other. Install signal cable in the first conduit, and interconnect conductors in the second and the balance of conductors in the third.
- 6) All conduits entering pull boxes, vaults and cabinets shall be protected with duct seal. No open holes are allowed. The ends of all conduits shall have Carlon or approved equal bell fittings.
- 7) Install conduit to a depth of not less than 30 inches below finished grade, except in sidewalk and curbed paved median areas, where it must be at least 18 inches below grade. See City of Lake Elsinore Standard Plan #508 for additional information.

1.4 CONDUCTORS AND WIRING

- 1) #14 gauge/3 conductor and #14 gauge/12 conductor per Caltrans-Standard Specification 86-1.02F(2) shall be continuous from the signal cabinet to the terminal block on the signal standard it services. No splicing of signal cable shall be permitted unless otherwise directed by the City Engineer.
- 2) The signal cables shall be labeled (permanently affixed printed labels) in each pull box per State

of California Standard Specifications Section 86-1.02(F)(a) and at the signal cabinet, indicating the cable/wire type and signal standard to which it is connected. Labels are required for loops, signal conductors, SIC, fiber, and any other conductors within cabinet and pull box.

- 3) All traffic signal field conductors shall have a 6-foot coil of extra wire in each pull box to allow for servicing. The signal conductors shall be organized in a bundle to allow for easy identification of wires and cables.
- 4) Multi conductor video cable shall be 6 conductor 2 elements: 18 AWG 5 conductors 7/26 bare copper, 20 AWG 1 conductor, solid bare copper (McCain part number KG-995P or approved equivalent).
- 5) Loop detector lead-in cable shall be Type B Caltrans Standard 16 AWG.
- 6) Loop detector wire shall be Type 2. All lead-in DLCs shall be labeled in the cabinet with lane number and phase assignment.
- 7) Cable or video radar, or communications purposes shall be Cat6 outdoor rated Ethernet unless otherwise specified by the equipment manufacturer.
- 8) Conductors for Safety Lighting (SL) shall be No. 10 XHHW-2. The conductors shall be black and white.
- 9) The Street Light conductors may be spliced to branch the Street Light circuit as it progresses around the intersection.
- 10) Fused splice connectors shall be installed in the pole hand hole for each luminaire.
- 11) All field installed wiring shall be Megger-Ohm tested. The CONTRACTOR shall provide documentation showing results that the wiring has passed the test.

1.5. DETECTION

- 1) For new construction or intersection upgrade, video detection shall be installed. The use of radar detection is allowed where applicable.
- 2) Loop detection is not required on streets and approaches unless special conditions exist that preclude the installation of video detection or at the discretion of the City Engineer.
- 3) Loop detection shall be installed on all limit line, advance detection, left turn lanes, and bike lanes. Loops shall be circular Type E (6' diameter). Limit line detectors shall be Modified Type E loops (for bike detection). Loops shall be installed flush with the limit line.
- 4) All bicycle lane detector loops shall be Type Q.
- 5) Advance detection is required on all approaches with an 85th percentile speed or posted speed limit greater than 25 mph (if not available, use design speed). Install a single loop per lane with one DLC for all loops. Setbacks from the limit line shall be per CAMUTCD Table 4D-101.
- 6) If a minor street approach has advance detection, install two loops per lane spaced 10 feet apart starting at the crosswalk or limit line.
- 7) Install four loops spaced 10 feet apart in advance of the crosswalk or limit line in left-turn lanes and for approach lanes without advance detection.
- 8) Minor street right-turn only lanes will have 2 loops spaced 10 feet apart. Provide separate DLC to controller cabinet.
- 9) On a minor street, if there is no right-turn only lane, install one loop at the limit line, adjacent to the curb for sneak-by traffic.
- 10) All detection cables and cards shall be labeled in the cabinet with lane number and phase assignment.

1.5.1 BICYCLE DETECTION

- 1) If the approach has a bike lane, install a six-foot-long Type Q loop, 44 feet in advance of and one at the crosswalk or limit line in the bike lane (or where the bike lane drop transition occurs if further back).

- 2) On streets classified as local, residential or other minor streets with bike lanes, install a six-foot long Type Q loop at the limit line and at 44 feet in advance of the crosswalk/limit line.
- 3) Width of Type Q loop varies: 6" to 12" inside bike lane line and 6" to 12" outside gutter or other channelization line, providing a 3-foot wide to 4-foot wide loop.

1.5.2 LOOP DETECTION INSTALLATION

- 1) Prior to installation, the City Engineer or designated representative shall verify all loop detector locations. All necessary striping shall be in place prior to position of detectors.
- 2) Loop detectors in asphalt shall use rubberized hot melt type sealant (Brewer/Flex or approved equal).
- 3) Loop detector splices shall be soldered and sealed with heat-shrink containing waterproof sealant.
- 4) The number of sensor units and lead-in cables required to achieve the specified detection shall be installed.
- 5) Four (4)-channel sensor units shall not be used.
- 6) Sensor unit for Vehicles shall be Reno Model C-1100 SS Vehicle Detector or approved equal. Sensor unit for Bicycles shall be Reno Model C-1100 SS-B Bicycle Detector or approved equal.

1.5.3 VIDEO DETECTION INSTALLATION

When special conditions exist that preclude the installation of in-pavement detection, video detection shall be used. The video detection system shall be Iteris Vantage Vector camera system (or City approved equivalent). All installation shall include necessary components to run the system including but not limited to: Iteris Vantage Apex video processor(s), flat panel monitor (17" TFT LCD video monitor or City approved equal), Ethernet modules, and camera(s). Detection units shall be installed on signal mast arm per manufacturer specifications. Detection units without radar functionality or other advance detection shall be mounted on a 6' pole extension above the mast arm.

1.6 CABINET AND EQUIPMENT

The model 2070 ATC controller and 322L cabinet shall be manufactured and furnished by the same manufacturer.

1.6.1 CONFLICT MONITOR

The conflict monitor shall meet all the requirements of the latest edition of the Caltrans Standard Specifications and shall also meet the following specifications:

- 1) The conflict monitor shall be a model 2010ECLip by EDI (or City-approved equivalent).
- 2) The base design shall be tested by an independent lab for transient and environmental requirements.
- 3) The conflict monitor shall have 16 channel capability with a 10/100 Ethernet port.
- 4) A portable laptop computer shall not be required to program or verify monitor setting (only used for log events).
- 5) The conflict monitor shall be capable of monitoring 5 section heads.
- 6) The conflict monitor shall display active colors independently during operation.
- 7) The conflict monitor shall display active colors independently at time of fault.
- 8) Shall be compatible with McCain Omni eX intersection control software.

1.6.2 CONTROLLER

- 1) The Controller shall conform to Caltrans "Transportation Electrical Equipment Specifications

- (TEES)" (latest edition) and be on the latest Caltrans qualified products list.
- 2) The controller unit shall be a 2070 LX running McCain Omni eX firmware.
 - 3) The 2070 LX controller shall be delivered pre-loaded with the latest version of McCain Omni eX controller firmware. The controllers shall be delivered at least two weeks prior to scheduled signal turn on.
 - 4) The CONTRACTOR shall schedule the controller manufacturer to be present at the time of signal turn on in the field.
 - 5) The CONTRACTOR shall furnish a Transparency intersection user license with each controller furnished.
 - 6) The controller manufacturer shall submit a notarized Certificate of Compliance with the State testing specifications prior to or at the time the controller is delivered to the jobsite. The controller shall not be installed until the Certificate is received and approved by the Traffic Engineer /Inspector/City Electrician or their assigned representative. Testing of control equipment and cabinet wiring shall be accomplished by the controller manufacturer in accordance with the State Standard Specifications (all references to State testing facilities or laboratories shall be interpreted as the controller manufacturer's testing facility; however, State testing procedures referred to shall remain in effect). All testing costs for the complete control system shall be borne by the CONTRACTOR.
 - 7) The CONTRACTOR shall furnish one (1) maintenance and operation manual for all new controller units, auxiliary equipment, vehicle detector sensor units, ITS and communication equipment, and interactive plug-ins to the City's Maintenance Division. The operation and maintenance manuals shall be submitted upon equipment delivery. The O&M manual(s) shall include, but need not be limited to, the following items:
 - a) Specifications.
 - b) Design characteristics.
 - c) General operation theory.
 - d) Function of all controls.
 - e) Troubleshooting procedure (diagnostic routine).
 - f) Block circuit diagram.
 - g) Geographical layout of components.
 - h) Schematic diagrams.
 - i) List of replaceable component parts with stock numbers.
 - j) As-built drawings.
 - k) Detector assignment table.

1.6.3 Controller Cabinet

The controller cabinet shall be model 332L with an anodized aluminum finish and include front and back door switches per Section 86-1.02Q(2) of the latest edition of the Caltrans Standard Specifications and Caltrans "Transportation Electrical equipment Specifications (TEES)" (latest edition).

- 1) The preferred location for cabinets shall be on the approach-side corner of the minor arterial. Where sufficient right of way exists, a minimum of 48-inches of concrete sidewalk and clearance shall be provided at the front and rear of the cabinet(s) and a minimum of 36- inches of sidewalk and clearance on the sides of the cabinet(s). Clearances shall be unobstructed by any above ground facilities. The City Traffic Engineer must approve any variance from the preferred location.
- 2) The front side of traffic signal controller cabinet shall be oriented such that the technician faces

the intersection when viewing the controller front panel and the front door handle should be on the right and the door shall open toward the street.

- 3) The controller cabinet shall be equipped with an interior light (Dialight Part # CL2-CF-TC4 or approved equal).
- 4) The controller cabinet shall be caulked at the bottom.
- 5) The controller cabinet shall be wired for red monitoring.
- 6) The controller cabinet shall be wired for door alarm monitoring.
- 7) The controller cabinet shall include emergency vehicle preemption equipment as required.
- 8) The controller cabinet shall be wired for full 8 phase capability.
- 9) The controller cabinet shall have vehicle loop detector cards on the Qualified Product List, Model C-1100 SS preferred.
- 10) The controller cabinet shall include an integral rack mounted document drawer assembly for the purpose of document storage and writing surface. The document drawer shall have an interior depth of approximately 1.5 inches, have drawer guides made of anodized aluminum, have drawer mounting brackets made of stainless steel, and have a hinged lift top writing area with a textured powder coat surface.
- 11) The controller cabinet output files shall be equipped with UL rated multi-conductor terminal lug.
- 12) The controller cabinet shall include an "AS-BUILT" blueprint of the signal and timing plan inside the cabinet.

If the controller cabinet design deviates in any way from the details in this manual, such deviation shall be submitted to the Traffic Engineer or their assigned representative for review before fabrication of the contract cabinets. If deemed necessary by the Traffic Engineer or their assigned representative, one complete prototype cabinet shall be delivered to him for review at least 30 days before fabrication of the contract fixtures. The prototype cabinet will be returned to the CONTRACTOR and if permitted by the Traffic Engineer or their assigned representative, the cabinet may be installed.

1.7 SERVICE AND ELECTRIC SERVICE CABINET

Except for false work lighting, the CONTRACTOR shall be responsible for applying for and arranging with the serving utility to complete service connections for both temporary and permanent installations and the CONTRACTOR shall pay all costs and fees required by the utility.

The City will provide the SCE service address for the meters.

The electrical service cabinet shall:

- 1) Be fabricated with an anodized aluminum finish.
- 2) Provide Type III-C dual meter electrical service for all new signal installation. Deviations shall be approved by City Engineer. See City of Lake Elsinore Std. Plan #501 for additional information.
- 3) Meet the SCE Service Guide service requirements and the Caltrans Standard Plan Drawing ES-2F cabinet specifications.
- 4) Have separate main disconnect circuit breakers for metered and unmetered sections.
- 5) Have plug-in type circuit breakers. Cable bussing is not allowed.
- 6) Have 2 time delay control contactors.
- 7) Be caulked at the bottom.
- 8) Be a model, part, class or type number as approved by City.

1.8 BATTERY BACK-UP SYSTEM

The battery back-up system (BBS) cabinet shall conform to the following items:

- 1) Be housed in a cabinet attached to the side of the controller cabinet. Stand-alone cabinet may be requested by City for special circumstances.
- 2) The BBS cabinet shall contain a thermostatically controlled cooling fan and 12x16 air filter.
- 3) The battery back-up system shall be an Alpha FXM 1100 or other as approved by the City Engineer.
- 4) The BBS must be Ethernet/IP compatible and wired for communication to the TMC and for an alarm output to the controller unit. The wiring shall consist of a CAT5 cable and 2 pair #20 cable. The alarm output shall provide Railroad 1 flashing operation upon 40% battery power remaining.
- 5) Install a 2 pair communication cable between the BBS and 332 cabinet and wire up to provide an alarm when batteries are in service.
- 6) The BBS shall have a manual bypass switch with automatic transfer.
- 7) The BBS cabinet shall have an auxiliary generator plug installed and include any necessary generator kits.
- 8) The BBS cabinet shall be outfitted with a minimum of four (4) battery backup batteries.

1.9 SIGNAL INDICATION HARDWARE FINISH SPECIFICATIONS

Except for anodized components, all exposed metal signal housings, doors, visors, backplates and framework parts shall have a powder coated finish and be a City approved process. The minimum requirements are as follows:

- 1) A 3-5 stage pretreatment consisting of: Degrease, Rinse, Iron Phosphate, Rinse, and Seal. Note: Degrease and Iron Phosphate can be combined, thereby eliminating Rinse, making this a 3-stage process.
- 2) A dry off cycle for at least 10 minutes at 300° to 400° F.
- 3) Electrostatically applied powder at 75-90KV.
- 4) Thermal setting cycle for 20 minutes at 400° F.
- 5) All parts shall be coated with an ultraviolet resistant polyester powder. The only exception is for items of flat black, which can be coated with a self-cleaning flat black epoxy.
- 6) All threaded fitting hardware to be assembled with anti-seize compound.
- 7) All terminal boxes are to be made of bronze.

The CONTRACTOR shall furnish the manufacturer's certificate of compliance with City approved powder coating process prior to installation of equipment.

1.10 FOUNDATIONS

- 1) Portland cement concrete shall conform to Section 90-20, *Minor Concrete*, of the State Standard Specifications and shall contain not less than 590 pounds of cement per cubic yard. Foundation shall be installed per Standard Plan ES-3C.

1.11 GROUNDING AND BONDING

- 1) The grounding jumper shall be attached by a 3/16 inch or larger brass bolt in the signal standard or controller pedestal and shall be run to the conduit, ground rod, or bonding wire in the adjacent pull box.
- 2) The grounding jumper shall be visible after the cap has been poured on the foundation.

- 3) Equipment grounding conductor #8 AWG is required in all conduits.

1.12 REFLECTORIZED STREET NAME SIGNS (RSNS)

- 1) The street name sign panel shall include the City of Lake Elsinore logo and shall have blue background per City of Lake Elsinore specifications and Standard Plan #404A.
- 2) Street names signs shall be manufactured with Diamond Grade DG3 material reflective sheeting.
- 3) Street names signs shall include street and road name suffixes (Ave, St, etc.), no block numbers.
- 4) Font and lettering size shall be per City Standard Plan #404A.
- 5) Street name signs shall be 6', 8' or 10' in length (City Engineer determines based on street name) and 1.5' in height.
- 6) Street name sign mounting bracket shall be Tapco Mast Arm Swing Bracket or approved equal.
- 7) RSNS shall be mounted on separate arm per City of Lake Elsinore Standard #404B.

1.13 EMERGENCY VEHICLE PREEMPTION

- 1) Provide emergency vehicle preemption (EVPE) for all approaches (except minor driveways).
- 2) The emergency vehicle preemption (EVPE) system shall include infrared detectors (Opticom Model no. 721 or approved equal) and Opticom GPS system. GPS antenna shall be mounted on nearest 30' arm to the controller cabinet unless otherwise specified by the City Engineer or manufacturer.
- 3) The EVPE discriminator module shall be an Opticom Model no. 764 (or approved equal).
- 4) The detector shall be mounted on the mast arm using an astro bracket with threaded nipples and lock washers.
- 5) EVPE detectors shall not be mounted on the signal head, unless exception made by the City Engineer.

1.14 SIGNAL HEADS

- 1) All traffic signal modules shall be LED. Approved manufacturers are GE and Dialight.
- 2) All LED traffic signal modules shall be fully compliant with the latest Institute of Transportation Engineers (ITE) specifications and circular supplements.
- 3) Each LED product bid must be certified in the Intertek LED Traffic Signal Module Certification Program. Proof of certification must be documented and approved by the Engineering Division Inspector prior to installation.

1.14.1 VEHICULAR SIGNAL HEADS

- 1) Signal heads should be located as follows:
 - a) Provide a minimum of two vehicular signal heads for all phases.
 - b) Provide a minimum of 50 feet from the limit line to the far side indications
 - c) Provide a maximum of 150 feet from the limit line to the far side indications, unless a near side indication is installed.
 - d) There should be two signal heads for the through movement visible within a 40 degree cone measured at the center of the approach at a point 10 ft behind the limit line (20 degrees to the right and 20 degrees to the left of the center of the approach extended, see CAMUTCD, Figure 4D-4)
- 2) Signal section housing shall be aluminum per 86-1.02R(4)(b)(iii) "Signal Housings" of the latest edition of the Caltrans Standard Specifications.
- 3) All (red, yellow, and green) LED (light-emitting diode) signal modules shall be Type 1 and meet

the following specifications:

- a) LED signal modules for all balls and arrows shall be twelve-inch diameter (12").
- b) LED signal modules shall be complete, and factory installed in aluminum signal sections
- c) LED signal modules shall be mounted and soldered onto a printed circuitboard.
- 4) The normal failure of one LED signal module shall not deactivate any other LED signal module
- 5) LED signal module shall have a minimum 5-year warranty beginning after traffic signal system has been accepted by the City.
- 6) All signal faces shall have one-piece backplates and tunnelvisors.
- 7) Left turn signal modules shall be all arrows.
- 8) Plastic signal heads, plastic visors, or plastic backplates are not acceptable.
- 9) Terminal blocks shall be mounted in red section on the MAS/MAT signal heads. There shall be a drip loop for the field installed signal wires.
- 10) Red and yellow ball and arrow indicator lenses shall be tinted. Green ball and arrow indicator lenses shall be clear.
- 11) Backplates shall be outfitted with 2" retroreflective yellow borders. Yellow borders shall be installed at the factory. Installation of yellow borders outside of the factory or retrofit backplates shall not be accepted.

1.14.2 PEDESTRIAN SIGNAL HEADS

- 1) All pedestrian indications shall be of the LED type.
- 2) All new traffic signals and traffic signal modifications with pedestrian phasing shall use pedestrian indications of the "Countdown" type. For traffic signal modifications, new pedestrian housings may be necessary to accommodate the "Countdown" type pedestrian indications.
- 3) Plastic pedestrian heads are not acceptable.
- 4) All pedestrian heads shall be side mounted with appropriate housing and bracketry.
- 5) Provide curb ramps and truncated domes at every corner that has a pedestrian crossing. Curb ramps and truncated domes shall meet the latest ADA/PROWAG requirements.

1.15 PEDESTRIAN PUSH BUTTON ASSEMBLY

- 1) Pedestrian push button locations shall meet latest edition of CA MUTCD and ADA standards.
- 2) If the signal standard is more than 10 feet from the landing area of the curb ramp, then install the push button(s) on a push-button pole adjacent to the curb ramp.
- 3) Pedestrian push buttons shall be 2-inch minimum in diameter complying with all Federal ADA requirements. Push buttons shall be vibratory.
- 4) The pedestrian push button assembly shall be Accessible Pedestrian Signal (APS) with a nine inch (9") by fifteen inch (15") international symbol push button plate per the latest edition of the Caltrans Standard Specifications.
- 5) The push button frame shall include adjustable mounting brackets to accommodate most standard Caltrans traffic signal poles.
- 6) The pedestrian push button housing shall be:
 - a. Made of die cast aluminum.
 - b. A telescoping, vandal-proof design.
 - c. Painted a Federal Standard color (yellow) as specified by the Traffic Engineer.
- 7) Plastic push buttons housings are not acceptable.
- 8) Accessible Pedestrian Signal (APS) push buttons shall be Polara INS3-3-T-N-O-Y or approved equal APS.
- 9) Accessible Pedestrian Signal (APS) push buttons are to be installed at all locations possible.

1.16 LED BLANKOUT SIGNS

- 1) LED Blank-out signs may be used at specific locations (upon approval by City Engineer) to minimize undesirable vehicular movements.
- 2) The signs shall be compliant with the latest CA MUTCD requirement.
- 3) The window dimensions shall be 30"x30" for near side sign, and 36"x36" for far side sign.

1.17 LIGHTING STANDARDS

- 1) Safety lighting luminaires above the traffic signals shall conform to the City of Lake Elsinore Street Light Manual – Design criteria and Standards. Current safety lights used by the City are GE model ERL-1-0-13-D5-40-A-GRAY-L.
- 2) Safety Lighting shall be:
 - a. Completely assembled.
 - b. 120 volt.
 - c. Have photoelectric control unit and switches (Type IV). The photoelectric control unit shall have a shorting cap and capable of being controlled from the meter pedestal.
 - d. Full cutoff type.
 - e. Have fifteen feet (15') mast arms (maximum) unless otherwise directed by the City Engineer.
- 3) Optical Requirements for street lighting luminaires are as follows:

Certified luminaire performance data shall be furnished with "Equipment List and Drawings," conforming to State Standard Specifications. This data shall include complete photometric test data in the form of isolux charts at a scale of one-inch equals twenty feet (1" = 20') for the luminaire and lamp sizes indicated on the plans. Alternate data may be in the form of horizontal foot-candle values recorded on a fifteen foot x fifteen foot (15' x 15') grid, extending one hundred fifty feet (150') longitudinally from the light source and fifteen feet (15') behind and one hundred twenty feet (120') in front of the light source for the luminaire and lamp sizes indicated on the plan. The horizontal foot-candle levels in the data submitted shall provide a minimum horizontal foot-candle level of at least 0.9 fc average maintained in the intersection with minimum of 0.60 at centerline and 0.5 at the furthest crosswalk. Failure to satisfactorily meet the referenced values will be justification for refusal of equipment by the City of Lake Elsinore.

The test shall be performed by an independent and recognized testing laboratory or by the manufacturer's laboratory. When the tests are performed by the manufacturer's laboratory, the test data shall be certified. Subsequent to the CONTRACTOR's installation of any street light luminaires, field checks may be performed at random by the Traffic Engineer or City Electrician or their assigned representative and calculated according to the "I.E.S. Guide for Photometric Measurement of Roadway Lighting Installations (LM-50)," approved in July 1974. Failure to satisfactorily meet or exceed the referenced values during field check will be justification for replacement by the CONTRACTOR at the sole option of the City.

1.18 SALVAGED EQUIPMENT

- 1) The CONTRACTOR shall deliver all salvaged equipment to a location as determined by City Inspector.
- 2) Obtain a receipt for all salvaged equipment.

2.0 TRAFFIC SIGNAL INTERCONNECT

- 1) Traffic signal interconnect shall be provided on all new traffic signals and existing traffic signal modifications to all adjacent traffic signals determined by the City Engineer.
- 2) All traffic signal interconnect designs shall be fiber optic unless otherwise approved by the City Engineer and shall be designed and installed per the latest edition of the Caltrans "Fiber Optic Design Guidelines."
- 3) Under special conditions wireless or other methods of interconnect may be used when approved by the City Engineer.
- 4) The existing SIC system shall be maintained at all times during construction. In the event of damage, the CONTRACTOR or responsible party, as determined by the project inspector, shall commence repairs immediately. Repairs shall be completed within 10 working days or the City shall have the option to complete necessary repairs and charge the responsible CONTRACTOR(s) for any associated repair costs.

2.1 INTERCONNECT CONDUIT

- 1) All interconnect conduits shall be three inches (3") minimum. All conduits shall have mule tape.
- 2) All new intersections shall include separate conduits for SIC and signal wiring (including DLC). Sharing of the DLC and CCTV wiring in the same conduits with SIC will be allowed on intersection modifications, as long as conduit fill is less than 40% and as approved by the City Engineer.
- 3) All interconnect conduits shall contain a No. 8 green insulated stranded copper trace wire.
- 4) All conduits entering pull boxes, vaults and cabinets shall be protected with duct seal. No open holes are allowed.
- 5) Install conduit to a depth of not less than 30 inches below finished grade, except in sidewalk and curbed paved median areas, where it must be at least 18 inches below grade. See City of Lake Elsinore Standard Plan #421 for additional information.
- 6) See Section 1.3 of this Specification for additional conduit information.

2.2 INTERCONNECT PULL BOXES AND VAULTS

- 1) All interconnect pull boxes shall be #6 concrete with extension and installed per Caltrans Standard Plans ES-8A except as approved by the City Engineer for existing facilities.
- 2) Interconnect pull box lids shall be stamped "SIGNAL COMMUNICATION".
- 3) Boxes shall be installed between 300 feet (minimum) and 600 feet (maximum) apart unless geographical or site conditions necessitate a shorter run.
- 4) SIC conduit shall be installed in pull boxes using 45-degree, UL approved elbows. These elbows shall be placed as far apart in the pull box as possible, oriented in the direction of the cable, and offset to one side to facilitate cable pulling and coiling.
- 5) Approximately 100-feet of SIC slack shall be coiled inside of each splice box (12 and 72 SMFOC). Approximately 100-feet of SIC slack shall be coiled on either side of the splice enclosure where present.
- 6) Approximately 20-feet of SIC slack shall be coiled inside of each pull box.
- 7) Approximately 20-feet of SIC slack shall be coiled inside each controller cabinet.
- 8) See Section 1.2 of this Specification for additional pull box information.

2.3 TRACER WIRE

- 1) All interconnect conduits shall contain a No. 8 green insulated stranded copper trace wire.
- 2) No splices are permitted between pull boxes.
- 3) Proper operation of the tracer wire shall be demonstrated prior to acceptance.

2.4 INTERCONNECT CABLE

- 1) All fiber optic cable shall be single mode. Approved cable is Altos Loose Tube All Dielectric Gel Free Cables with FastAccess Technology or approved equal. Trunk fiber optic cable shall be minimum 72 fiber count. Product code is 072-E-U4-T47-01-D20, or approved equal.
- 2) Cable installed in runs between splice enclosures and cabinet termination equipment shall be minimum 12 fiber count. Product code is 012-E-U4-T47-01-D20, or approved equal.
- 3) Splices are to be made in splice enclosures in fiber optic vault only. SIC shall be continuous and unspliced between cabinets. Exceptions must be approved by City Engineer.
- 4) The design engineer shall perform a site survey to determine slack availability on existing SIC runs, or require cable replacement when sufficient slack is not available.
- 5) A patch panel shall be installed to terminate the 12 SMFOC. In instances where there is insufficient rack capacity, a spider fan out kit shall be installed upon approval of City Engineer.
- 6) New SIC shall be connected to the City network and a revised assignment table shall be submitted as part of the final design.
- 7) Where existing copper SIC (CuSIC) is to be retained, CuSIC shall be a minimum of six (6) twisted pair 20 AWG conductor communication cable with standard color code and water resistant as required by Caltrans specifications. CuSIC (Must be approved by the City).

2.5 FIBER OPTIC INTERCONNECT EQUIPMENT

Termination components for vaults and signal cabinets are listed in Table 3 below. The fiber optic cables shall be terminated and/or spliced with these components per the fiber assignment provided by Traffic Engineering during project design or before signal turn-on. A minimum of 5 working days-notice will be required for Traffic Engineering to produce this documentation.

Table 3: Cabinet and Vault Fiber Termination Components

Description	Manufacturer	Model
Splice Closures	Corning	SCF-4C18-01
Splice Closure Splice Tray	Corning	SCF-ST-099
Splice Housing	Corning	
Splice Trays	Corning	M67-048
Cabinet Termination	Corning	CCH-01U
72 Port Patch Panel with MTP Adapter	Corning	CCHE-CP72-89
12 Port Panel	Corning	CCH-CP12-A9
Fiber Distribution Unit	Corning	CCH-01U
Splice Cassette	Corning	CCH-CS12-A9-P00RE
Jumpers	Generic	
Connectors	Generic	LC

2.6 COMMUNICATION DATA NETWORK

The communication protocol shall be Ethernet. New or modified signals shall receive the communication standard components in Table 4.

Table 4: Data Communication Standards

Description	Manufacturer	Model
Ethernet Switch	Cisco- Fiber	IE-4000-4GS8GP4G-E
	Actelis- Copper	ML688
Power Supply	Cisco	
Cat 6 Patch Cable RJ45	Generic	
Power Connection	Generic	
Gigabit Fiber SFP Transceivers	Cisco	

2.7 ETHERNET SWITCHES

Ethernet switches shall provide the following functionality:

- 1) All switches shall be managed and support advanced features including:
 - a. Port based VLAN segregation.
 - b. DHCP snooping and/or IGMP snooping
 - c. MAC address filtering
 - d. Quality of Service
 - e. SNMP
 - f. Remote Management
- 2) Fiber uplinks shall be single mode and support 10/100/1000 Duplex Ethernet ports and provide long haul capacity.
- 3) In addition to the above requirements, local switches (located at intersections) shall meet the following requirements:
 - a. Shall be environmentally hardened (-40 to 160 degrees F) and NEMA TS-2 rated.
 - b. Provide a minimum eight ports with a minimum of six 10/100 Base TX copper ports and two duplex fiber uplink ports.
 - c. The fiber uplink ports shall be SC, LX, or LC type connectors. Connectors shall be compatible with Gigabit speed.
 - d. Power supply shall support 120 VAC and/or 24 VDC.
 - e. The switch shall support standard 332 rack mount, DIN rail or 19" rack mountable.
- 4) All switches shall provide a minimum 2 year warranty on parts and 1 year "live" technical support (either in person or over the phone) during business hours (either in person or over the phone) during business hours (Pacific time) 9AM to 5PM Monday through Friday, from the date of installation Warranty parts replacement shall be within three business days. A warranty certificate meeting these requirements shall be provided on the date of installation.
- 5) Fiber SFP Transceivers shall be Corning brand.

The CONTRACTOR shall provide, install and configure all Ethernet switches at the local intersections and test the communication between the field switch and the TMC. The switches shall be configured with IP address provided by Traffic Engineering during project design or before operational tests. A minimum of 5 working days notice will be required for Traffic Engineering to produce this documentation. The testing of the Ethernet switches shall provide for the necessary operation of all devices connected to the Ethernet System.

Approved manufacturers of Ethernet communications shall include Cisco. Non-listed manufacturers shall be approved by the City Engineer.

2.8 BROADBAND WIRELESS ETHERNET COMMUNICATION

The Broadband Wireless Ethernet Communication System shall provide traffic signal and CCTV video and control communication. The CONTRACTOR shall furnish and install such other items or details not mentioned below, that are required to construct a complete and operational system including: antennas, radios, mounting equipment, hardware, cabling, and incidental materials shall be performed, placed, constructed or installed.

The CONTRACTOR shall follow the manufacturer recommendations and instructions for installation.

Wireless communication shall provide the following functionality:

- 1) Support Ethernet communications.
- 2) Support mesh network topology and point-to-point and point-to-multipoint configuration.
- 3) 802.11 Compliant and operate on a license free band.
- 4) Provide a minimum of 300 Mbps data rate.
- 5) Provide a minimum of 10 miles range.
- 6) Provide security encryption (WPA, WPA2, MAC, and Radius)
- 7) Be compatible with Ethernet switching and routing protocols including:
 - a. VLAN
 - b. VPN
 - c. DHCP snooping
 - d. Quality of Service
 - e. SNMP
 - f. Remote Management
- 8) Be a NEMA rated enclosure.
- 9) Power supply support 120 VAC and/or 24 VDC.
- 10) All wireless equipment shall provide a minimum 2-year warranty on parts and 1 year "live" technical support (either in person or over the phone) during business hours (either in person or over the phone) during business hours (Pacific time) 9AM to 5PM Monday through Friday, from the date of installation. Warranty parts replacement shall be within three business days. A warranty certificate meeting these requirements shall be provided on the date of installation.
- 11) Radio shall come with management software with no licensing fees.

The CONTRACTOR shall perform a wireless site survey to determine the exact radio path and signal strength values to each wireless site. The results of the survey (path quality, data integrity, and spectrum analysis) shall be provided to the Engineer to determine optimized system configuration and performance.

The CONTRACTOR shall test the completed system and ensure the proper functioning of all wireless components and connected devices to the satisfaction of the Engineer.

Approved manufacturers of Wireless Ethernet communication solutions include Proxim Wireless or Approved Equal. Non-listed manufacturers shall be approved by the Engineer.

2.9 CCTV VIDEO NETWORK

All new traffic signal installations shall include, as part of the standard safety systems, the installation of CCTV camera equipment and transmission equipment and any additional wiring or hardware required to support an operational CCTV system. This requirement shall apply unless otherwise specified by the City Traffic Engineer. Table 5 provides the camera equipment.

- 1) The CCTV communication protocol shall be Ethernet. Ethernet requirements are provided in Section 2.7.
- 2) A License Key shall be provided for each CCTV camera.
- 3) The approved location for new CCTV camera installations shall be specified by the City Traffic Engineer.
- 4) Installation: The CCTV system shall be installed per manufacturer's installation recommendations.
- 5) Power for CCTV systems at new intersections shall consist of a power cord plugged into a power strip mounted on the rail of the 332 cabinet plugged into Equipment Receptacle 2. The next alternative locations in order of preference are the ECB and least used signal breaker (auxiliary). The power cord shall be routed through the pole and terminated in the CCTV housing per the manufacturer's instructions.
- 6) The CCTV transmission equipment shall be installed and tested for operation by the CONTRACTOR to the satisfaction of the City Engineer before acceptance of the system.

CCTV Camera and Transmission components required to accommodate a typical CCTV installation are shown in Table 5 below.

Table 5: CCTV Camera and Transmission Equipment

Description	Manufacturer	Model
Dome Camera	Bosch	MIC IP dynamic 7000 HD
Coaxial cable	Generic	RG6A/U
Data cable	Generic	
Pole Mount Bracket	Bosch	MIC-PMB
Wall Mount Bracket	Bosch	MIC-WMB-WD
Shallow Conduit Adaptor	Bosch	MIC-SCA-WD
POE+ Power Supply	Bosch	NPD-6001A

2.10 TESTING

- 1) The CONTRACTOR will be responsible for ensuring the operability and quality of SIC delivered from the manufacturer before installation. SIC shall not be removed from the reel or installed until it has been successfully tested by the CONTRACTOR. The pre-installation test results shall be documented and provided to the Engineering Division Inspector for approval. SIC found to be defective or damaged shall be returned to the source for replacement by the CONTRACTOR.
- 2) Fiber optic SIC shall be installed, spliced, terminated, and tested in accordance with NECA/FOA 301-2009 standards. This includes pre-installation and post installation testing of the cable.
- 3) Pre-installation testing shall be performed on all fibers using an Optical Time-Domain Reflectometer (OTDR) to preclude manufacturing and shipping damage. The CONTRACTOR shall perform such testing either on-site or at a holding facility prior to installing the cable into conduit.
- 4) Post-installation testing of all terminated fibers shall be performed using launch cables at both ends as specified in NECA/FOA 301-2009 Annex B.3. The CONTRACTOR shall perform such testing on-site after all termination and splicing work is completed.

- 5) Test results, in the form of pre-installation test data and post installation OTDR traces, shall be provided to the Engineering Division Inspector in a bound hard copy format along with the electronic file and appropriate viewing software, for review and approval after installation and splicing/termination work are completed.
- 6) The pre-installation test results shall be in the form of a spreadsheet detailing the length and loss/km for each fiber as well as the parameters used for testing. The post-installation OTDR traces shall clearly show each continuous fiber, the connectors on each end, and the loss for each event.
- 7) The Engineering Division Inspector shall approve the test results before final acceptance.

2.11 GPS UTB MODULES

A Global Positioning System Universal Time Base (GPS UTB) module shall be furnished and installed within the cabinet for all new traffic signals and modified traffic signals that do not have a GPS UTB module. The module shall incorporate a microprocessor unit and utilize an external antenna to retrieve time signals from the atomic clocks of the United States National Institute of Standards broadcast on the GPS satellite network. Modules for 2070 controllers shall be in rack mount form factor. All other controller types shall utilize a stand-alone module. Modules shall be McCain model 2070-7G unless otherwise directed by the City Engineer or required by the controller manufacturer.

3.0 TRAFFIC CALMING DEVICES

3.1 SPEED RADAR SIGNS

- 1) Speed radar signs shall be Traffic Logix SafePace evolution 15 or as approved by the City Engineer.
- 2) Speed radar shall be solar powered unless otherwise approved by City Engineer.
- 3) Speed radar shall have Bluetooth and ethernet communications capabilities.
- 4) Speed radar device shall have remote monitor and management capabilities.
- 5) Speed radar signs shall be mounted on Type 15-FBS pole (16' high), or existing street light.

3.2 SCHOOL FLASHER SIGNS

- 1) School flasher signs shall be determined by City Engineer.
- 2) School flasher shall be solar powered unless otherwise approved by City Engineer.
- 3) School flasher shall have Bluetooth and ethernet communications capabilities.
- 4) School flasher device shall have remote monitor and management capabilities.
- 5) School flasher signs shall be mounted on Type 15-FBS pole (16' high), or existing street light.

3.3 RECTANGULAR RAPID FLASHING BEACON (RRFB) SIGNS

- 1) RRFB signs shall be W11-2 (30" x 30") and W16-7P (24" x 12") at a minimum.
- 2) RRFB shall be solar powered unless otherwise approved by City Engineer.
- 3) RRFB signs shall be mounted on 2" solid quick punch telespar pole, Type 15-FBS pole (16' high), or existing street light.

- 4) APS buttons shall be installed on every RRFB sign..

4.0 TRAFFIC SIGNAL GENERAL NOTES

For City of Lake Elsinore Traffic Signal General Notes, see Improvement General Notes section of the City website.

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