SECTION 02453 - TRAFFIC SIGNALS

CONTENTS:

TABLE OF CONTENTS continued:

SECTION 02453 - TRAFFIC SIGNALS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The repair, modification, or installation and testing of new fully actuated and functioning traffic signal system, including signal cabinet, controller, electric service equipment, and related signal hardware at the specified intersections.

B. The repair and restoration of damaged signal loops, conduits and equipment.

1.02 RELATED REQUIREMENTS

A. Section 03300, *"Minor Concrete"*

B. Section 16550, *"Street Lighting System"*

1.03 REFERENCE STANDARDS

A. State Specifications

1.04 QUALITY ASSURANCE

Not used

1.05 MEASUREMENT AND PAYMENT

A. The Lump Sum or unit bid prices for traffic signals as set forth on the bid Proposal, shall include total compensation for furnishing and installing fully functioning traffic signals, intersection lighting, internally illuminated street name signs, vehicle/pedestrian detectors, signal controllers and electric services, complete with all required labor, materials, tools and equipment for performing all work to provide complete installations, all as applicably required and shown on the plans and as specified herein; and as directed by the Engineer, including all required, associated traffic signal conduits, conductors, and pullboxes.

1.06 SUBMITTALS

A. Equipment list and drawings shall conform to Section 86-1.03, *"Equipment List and Drawings,"* of the *State Specifications* and these specifications.

B. The Contractor shall submit to the Engineer, within ten (10) working days after the contract award, a minimum of eight (8) copies of a list of equipment and materials proposed for installation.

C. The Contractor, upon completion of the project, shall furnish "As-Built" drawings, including the controller cabinet wiring on a reproducible photo Mylar in accordance with Section 01730, *"Operating and Maintenance Data*," and other submittals.

1.07 WARRANTIES, GUARANTEES, AND INSTRUCTION SHEETS

A. Warranties, guarantees and instruction sheets shall conform to Section 86-1.04, *"Warranties, Guarantees and Instruction Sheets,"* of the *State Specifications* and Section 01740, *"Warranties and Bonds," of* these specifications.

B. If traffic signal and street lighting systems installed under these specifications, including all equipment, and appurtenances furnished or performed in connection therewith, are found to be defective in materials or workmanship within the guarantee period and it is representative that said part (or parts) cannot be repaired satisfactorily on the site, the Contractor shall immediately provide a replacement part (or parts) of equal kind and/or type during the repair period. The Contractor shall be responsible for the removal, handling, repair or replacement, and reinstallation of the part (or parts) until such time as the traffic signal system is functioning as specified and as intended herein; the repair period shall in no event exceed seventy-two (72) hours, including acquisition of parts. The guarantee on the repaired or replaced parts shall again commence with the date of reassembly of the system.

C. The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of the City's acceptance. The Video Detection Supplier shall provide all documentation necessary to maintain and operate the system.

1.08 SCHEDULE OF WORK

A. Scheduling of work shall conform to the provisions in Section 86-1.06, *"Scheduling of Work,"* of the *State Specifications* and these specifications.

B. The Schedule of Work shall be submitted to the Engineer for his approval prior to commencing work. Work shall include, in addition to other requirements, all dates, activities, and other pertinent data necessary to describe the Contractor's proposed activities on the project concerning the installation of a traffic signal and highway lighting system. The Schedule shall include, but shall not necessarily be limited to, the following items pertaining to the installation of a traffic signal and highway lighting system:

1. Conduit and Conductor Installation

2. Erection of Signal Standards

3. Detector Systems Installation and Test

4. System Test/Controller Test

5. Job Ready for Acceptance and Scheduling

6. The Schedule shall also include all other major items of work.

7. Signal Turn-On

No on-site above ground signal equipment shall be installed until the Contractor has received all signal equipment, installed all conduit runs, and pull boxes set to grade and the signal controller has been tested and approved by the Engineer.

PART 2 - PRODUCTS

2.01 CONTROLLER ASSEMBLY AND AUXILIARY EQUIPMENT

A. Shall conform to Section 86-3, *"Controller Assemblies"* of the *State Specifications* and these specifications. Unless otherwise specified, the controller shall be a Type 170 Controller and shall include all required software. Both controller and software shall be of a type and manufacture specified by the City, installed in a Type 332, or at the City's option, specify a Type 333 cabinet pre-wired as specified in the Special Provisions and Project Plans.

2.02 STANDARDS, STEEL PEDESTALS AND POSTS

A. Standards, steel pedestals, and posts shall conform to the provisions in Section 86-2.04, *"Standards, Steel Pedestals and Posts"* of the *State Specifications* and these specifications.

B. Anchor bolts shall be hot dipped galvanized over entire length.

C. All standards, steel pedestals, and posts shall be galvanized, and shall not be painted.

D. 1B poles shall have two (2) notched steel locknuts for 4" rigid conduit installed before the base flange.

Locknuts are to be tightened against the base flange to prevent pole rotation.

E. Flange is to be cast iron.

2.03 VEHICLE SIGNAL FACES AND SIGNAL HEADS

A. Signal faces, signal heads and auxiliary signal hardware, shall be polycarbonate (plastic) as manufactured by Econolite, or approved equivalent, as shown on the plans, and the installation thereof, shall conform to the provisions in Sections 86-4.01, *"Vehicle Signal Faces,"* 86-4.02, *"Directional Louvres,"* 86-4.03, *"Backplates,"* and 86-4.06 *"Signal Mounting Assemblies,"* of the *State Specifications* and these specifications, except that plastic reflectors, plastic signal

section housings, plastic signal sections, plastic signal lenses, and plastic visors, shall not be used unless authorized by the Engineer. Backplates shall be metal. It shall be painted the color Blue, as manufactured by BEHR paints under product type "DEEP BASE (8300)".

New vehicle signal head installations shall be fitted with ASTRO-BRAC clamp kit with mark 1 terminal compartment (cable mount) or approved equivalent.

B. All mounted signal faces and all arrow indications signal faces shall be provided with twelve inch (12") sections and louvered metal backplates as manufactured by Econolite, Inc.

C. All indications to include Red, Amber, and Green shall be the Light Emitting Diode (LED) type.

D. LED indicators shall be the latest version of LUMILEDS by the Dialight Corporation, or equal.

E. Painting of electrical equipment shall conform to the provisions of Section 86-2.16, "Painting" of the State's Standard Specifications.

2.04 VEHICLE DETECTORS

A. Video Vehicle Detection System: These technical specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all licensed vehicles on the roadway, providing video detection for areas outlined in the construction drawings. The entire video detection system shall consist of the following:

- Video Image Processing unit(s).
- Video camera(s) with IR filter, enclosure and sunshield.
- Camera lens.
- Surge suppressor.
- All other necessary equipment for operation.

All vehicle detection shall be video based unless otherwise shown on plans. The latest version of Traficon Video Detection System, or approved equivalent, shall be used and shall conform to the provisions in Section 86-5.01, *"Vehicle Detectors"* of the *State Specifications* and these specifications.

The entire video vehicle detection system shall consist of the following:

- Video Detection Module(s)
- Video Camera(s) with IR filter, lens, enclosure, and sun shield
- Luminaire Arm or Signal Mast Arm Sensor Bracket(s)
- Surge Suppressor
- Programming Devices and/or software
- Coaxial/Power Cable

- All other necessary equipment for operation
- Training for installation, operation, & maintenance

1. Video Detection System

   a. The **V**ideo **I**mage **P**rocessor (VIP) shall be modular by design and housed in either a self-contained stand-alone unit or fit directly into NEMA TS1 & TS2 type racks as well as Type 170/179 input files. The VIP shall be interchangeable between a shelf or rack mount installation without replacing or modifying existing the VIP units.

   b. The system shall control from 1 to 4 VIP boards allowing for 1 to 8 image sensors.

   c. The system shall be designed to operate reliably in the adverse environment of roadside cabinets and shall meet or exceed all NEMA TS1 and TS2, as well as Type 170/179 environmental specifications.

   d. Ambient operating temperature shall be from –35 to +75 degrees Centigrade at 0 to 95% relative humidity non-condensing.

   e. The system shall be powered by 12-40 VDC and draw less than 2 amperes.

   f. The system shall utilize cabinet 24 VDC for rack mount installations or external 24 VDC for stand-alone shelf installations.

   g. Surge ratings shall be set forth in the NEMA TS1 and TS2 specifications.

   h. Serial communications shall be through an RS232 serial port. This port can be used for communications to a modem or laptop to upload/download detector configurations, count data and software upgrades. RS485 on the rear edge connector shall facilitate communications to other VIP boards.

   i. Each VIP board shall have 4 opto-isolated open collector outputs. Twenty (20) additional outputs shall be available via the expansion port. The outputs shall be programmed for signaling the presence, the arrival or the departure of vehicles in a minimum of 48 detection zones.

   j. Each VIP board shall allow for 20 digital inputs via the I/O Expansion port.

   k. Each VIP board shall have error detection. An output contact will open if the video signal is bad or the VIP board is not functioning properly. A user defined quality level will automatically put the VIP into a recall state in cases of severe degraded visibility (i.e., fog, blizzard, etc.). Normal detection resumes when visibility improves above the user defined quality level.

   l. Operator selectable recall shall be available via the VIP front panel.

m. A video select button on the VIP front panel will switch between camera images of the VIP.

n. The VIP board shall have 2 video inputs (RS-170 NTSC or CCIR composite video) and one video out.

o. The VIP board shall have a reset button on the front panel to reset video detectors to "learn" the roadway image. Learning time of video detectors shall be less than 10 seconds.

p. External surge suppression, independent of the VIP board shall separate the VIP from the image sensor.

q. The VIP board shall have separate light emitting diodes (LEDs) that indicate:

POWER	Red to verify power supply.
I/O COMM	Red to indicate communications to expansion boards.
VIDEO 1 & 2	Red to verify the presence of video input 75 Ohm.
TX & RX	Red to indicate communications via the serial port.
OUT1- OUT4	Green if the corresponding detection group is active.

The VIP board shall also have 2 separate buttons for:

VIDEO SELECT	
RECALL	Manually places call on detectors.
RESET	Manually reset detectors to "learn" new background.

The VIP board shall also have a video out female RCA style connector, DB9 female Service port and DB9 I/O Expansion port.

r. The VIP Expansion board shall also have separate LEDs that indicate:

POWER	Red to verify power supply.
COMM	Red to indicate communications to VIP board.
I/O1- I/O4	Green if the corresponding detection group is active.

The VIP Expansion board shall have 8 dip switches that define inputs and outputs used (range: 1-12 or 13-24).

2. FUNCTIONAL CAPABILITIES

a. Each VIP board shall be capable of processing the video signal of one camera. The video signal shall be analyzed in real time (30 times per second).

b. The system shall be expandable up to 8 cameras that may be connected to different VIP units and programmed independently.

c. The system shall be capable of displaying detectors on the video image with associated outputs. Outputs/Inputs status will be indicated on the screen. Parameters will also include the ability to view raw video without any verbiage and/or detectors for surveillance purposes.

d. Each VIP board will detect within the view of the connected camera the presence of vehicles in user defined zones. Detectors available shall be presence, count, delay, extension, or pulse mode of either arrival or departure of vehicles. Delay and extension shall be defined between .1 - 99 seconds and pulse mode between 20ms-100ms in 20ms increments.

e. The VIP board shall be programmed without the use of a supervisor computer. A standard CCTV monitor and keypad plugged into the VIP serial port will facilitate detector programming.

f. The VIP board shall store up to 4 detector configurations. It shall be possible to switch between detector configurations manually or automatically by time of day or input from the traffic controller.

g. Via the serial port, detector configurations can be uploaded to a laptop and stored on disk.

h. Detectors may be linked to 24 outputs and 20 inputs using Boolean Logic features: AND, OR, NOT. It will be possible to generate conditional outputs based upon inputs from a controller.

i. It shall be possible to make a detector directional sensitive. Options will include an omni-directional detector or a detector that only senses movement: from right to left, left to right, up to down or down to up as you look at the monitor.

j. To facilitate “fine tuning” of detection zones a maximum of 10 lines and a minimum of 4 lines may be adjusted within the confines of the detector.

k. All detectors and parameters can be changed without interrupting detection. For example: when one detector is modified all existing

detectors continue to operate, including the one that is being modified. When the new position is confirmed, the new detector will enter a learning phase. Once the new detector is in function it will take over the job of the old one. In this way, the detector is always fully operational with no interruption on any detector, even during modification. Learning phases for new detectors shall not exceed 10 seconds.

l. Six detectors per input may be used as count detectors. Count detectors will detect and store count data at user-defined intervals of .5, 1, 5, 10, 15, 30 & 60 minutes. It shall be possible for each VIP board to store up to 4000 intervals of count data in non-volatile memory.

m. Associated software may be used with a PC to download count data and export to a spreadsheet. Software will also be used to upload/download detector configurations and update software versions of the VIP board.

3. IMAGE SENSOR- CAMERA

a. The unit shall be a high resolution, 1/3" or larger image format CCD camera, designed for professional video surveillance systems. Incorporating the latest in CCD technology, the video camera shall provide detailed video without lag, image retention, or geometric distortion.

• Temperature range	-20 to + 55 degrees C	
• Humidity	0% to 95% relative, non-condensing	
• Dimensions	47mm X 47mm X 83mm	
• Weight	200g	
• Camera mounting slots	1/4-20, top and bottom	
• Connectors	BNC for video out	
• Lens mount	CS Power-in / pressure screw Lens / 4-square connector	
• Finish	Off-white semi-gloss polyurethane	
• Construction	All metal housing	
• Rated input voltage	12VDC or 24VAC +/-10% @60Hz	
• Nominal power	6 Watts	
• Imager	Interline transfer CCD 1/3" format	
• Imager spectral response	100% @ 550nm: 30% @ 400nm and 800nm	
• Sync system	EIA RS-170	
• Active picture elements	768 H X 494 V	
• Horizontal resolution	580 TVL	
• Sensitivity (2856 K)	Usable Picture	Full Video

Scene Illumination	fc	0.012	0.08
	lx	0.12	0.8
Imager Illumination	fc	0.0015	0.01
	Lx	0.015	0.1

** F1.2 lens @ 75% highlight*

- Signal to noise ratio — 54 dB minimum, 58 dB typical
- AGC — 18 dB
- Light range (AGC on) — 1,000,000:1 min. with f/1.4 to 360 auto-iris lens
- Video out — 1.0 volts peak-to-peak +/- 0.1 volt @ 75 Ohms
- Gray scale — At least 10 steps

B. If inductive loop detectors are indicated on the construction drawings, they shall include the following:

1. Type A Hand Holes

2. Lead-in cable shall be Type B as shown in the *State Specifications*.

2.05 CONDUIT

A. Conduit shall conform to Section 86-2.05A, *"Material,"* of the *State Specifications* and these specifications and shall be made of rigid steel.

B. All conduits shall be new.

C. Insulated bonding bushings shall be required. Bushings shall be installed on conduit ends before pulling in conductors and cables.

D. Conduit size shall be as indicated on the plans.

E. Bonding and grounding jumpers shall be bare #8 stranded copper wire.

F. Conduits entering pull boxes shall terminate at a height from box bottom not to exceed 1/3 interior box height.

2.06 PULL BOXES

A. Pull boxes shall conform to the provisions in Section 86-2.06, *"Pull Boxes,"* of the *State Specifications* and these specifications.

B. All pull boxes shall be of precast reinforced concrete of the size indicated on the construction drawings.

C. Spacing between pull boxes shall not exceed one hundred feet (100').

D. All pull boxes and covers shall be precast reinforced concrete.

E. Covers and lids shall be of the lightweight "Fiberlite" type or approved equivalent and shall be inscribed "TRAFFIC SIGNAL" or "ELECTRIC" for the use intended. If exposed to traffic, covers and pullboxes shall be traffic rated.

F. 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 new grout placed.

2.07 PEDESTRIAN SIGNALS

A. Pedestrian signals shall conform to the provisions in Section 86-4.05, *"Pedestrian Signal Faces,"* of the *State Specifications* and these specifications.

B. Pedestrian signals shall be International Symbol Face Message (Type A).

C. Front screens shall conform to Paragraph 2 of Section 86-4.05(B), *"Front Screen,"* of the *State Specifications*.

D. All indications shall be the Light Emitting Diode (LED) type.

2.08 PEDESTRIAN PUSH BUTTON

A. Shall conform to the provisions in Section 86-5.02, *"Pedestrian Push Button,"* of the *State Specifications* and these specifications. Push buttons shall be Type B and shall be of polyethylene material "Bumblebee" brand, or approved equivalent.

B. Shall be post top mounted in median or pedestrian push button post installations.

C. Pedestrian Push Button Signs shall contain the text, colors and symbols shown on applicable City Standard Drawings.

2.09 AUDIBLE PEDESTRIAN SIGNALS

A. Audible pedestrian signals shall be Model APS-10 manufactured by Indicator Controls Corporation, or approved equal.

2.10 FOUNDATIONS AND FOOTINGS

A. Portland cement concrete shall conform to Section 03300, *"Minor Concrete,"* of these Specifications.

B. Foundations shall conform to the provisions in Section 86-2.03, *"Foundations,"* of the *State Specifications* and these specifications.

2.11 CONDUCTORS AND WIRING

A. Conductors and wiring shall conform to the provisions of Section 86-2.08, *"Conductors,"* and Section 86-2.09, *"Wiring,"* of the *State Specifications* and these specifications.

B. Aluminum conductors shall not be substituted for copper conductors.

C. Splice connectors and splicing shall be of an approved UL listed compression type, utilizing “Method B” or high voltage circuit insulation methods as shown on State Plan ES-13.

D. Conductors No. 8 AWG and larger shall be stranded.

E. All signals, including mast arm signal equipment shall be wired and spliced to the nearest pull box. Splicing at signal conductors to other phase conductors on pole is not allowed. All signal heads shall be spliced to the appropriate phase conductor only in the sidewalk pull box indicated on the construction drawings.

2.12 PULL ROPE

A. Pull rope shall be nylon or polypropylene with a minimum tensile strength of five hundred pounds (500#).

2.13 INTERNALLY ILLUMINATED STREET NAME SIGNS

A. General

1. See applicable Special Provisions, Project Plans and/or City Standard Drawings.

2. Internally illuminated street name sign shall conform to the provisions in Section 86-6.065 *"Internally Illuminated Street Name Signs"* of the *State Specifications* and these Specifications.

3. Street name signs shall have a maximum length of six (6) feet, and be four (4) feet wherever feasible.

4. 1/8” diameter steel safety cables with a minimum breaking strength of 1760 lbs. shall be attached to each end of the sign assembly to connect sign to the signal mast arm.

5. ½” strain relief connectors with PVC grummets and knock-out sealing ring cord grips fitting a 0.500"-0.600" electrical cord shall be used to connect electrical cord to sign assembly.

6. PECO Tuf-Flex, 12/3 SEOW-A electrical cord E-25411, or approved equal, with a temperature range of 105 degrees C to minus 50 degrees C shall be used.

B. Sign Construction

1. The sign shall consist of extruded aluminum, top, bottom, and door, cast aluminum ends, sign face or faces and illumination.

2. The door shall open from the top. It shall be held closed by three (3) 1/4-turn airlock fasteners. The door shall have a watertight (PVC) gasket. The door shall have a continuous hinge 1-1/16" (open), Stainless Steel mounting at the bottom of the door. The doors shall have one side removable to gain access to the sign face. The doorframe shall be 0.125-inch thick, extruded aluminum, minimum.

3. The top shall be extruded from 6063-T5 aluminum alloy, or other approved aluminum alloy, with a minimum thickness of 0.140". There shall be drip rails overhanging the sign face to prevent water intrusion.

4. The ends shall be cast from 356 aluminum, or other approved aluminum type, and shall have a minimum thickness of 0.188".

5. Seams connecting the top and bottom to the ends and seams of doorframe shall be Heli-Arc welded to provide weather proof seal.

6. All pop rivets, and hex head indented sheet metal screws shall be stainless steel.

7. Photocontrol shall be the "Dark to Light", Catalog #D124-1.0-SM, locking type with rubber gasket and shall be mounted on a weather proof single gang electrical box attached to the side of the sign.

8. Sockets shall be Kulka #582 and 583, or approved equal, with rubber gasket on the lamp-mating surface to prevent possible water damage. Socket tracks shall be constructed from 0.063" aluminum, minimum thickness and shall be painted white.

9. Reflectors shall be made from 0.20-inch thick aluminum, minimum, and painted white.

10. Back plate shall be made from 0.63-inch thick aluminum, minimum, and painted white.

11. Fluorescent lamps shall be T12-CW-HO Type 800MA.

12. Ballast shall be high output, Valmont 6G3934WF, or equivalent. Ballast shall be placed inside the sign assembly by mounting ballast a minimum of 1/4" from the bottom extrusion.

13. All wiring shall be 600 volt, 90 degree C, soft annealed copper wire.

14. All wire connections shall be made with insulated compression wire nuts.

15. All electrical boxes shall be watertight.

16. Sign shall be equipped with four (4) 3/16" diameter drain holes located in the bottom of the housing (two at each end). Refer to the applicable Daly City Standard Drawing for typical sign assembly.

C. Sign Panel

1. All messages shall be clearly legible, attracting attention under any lighting conditions.

2. Face legend shall consist of a continuous piece of translucent vinyl applied over the polycarbonate sign face.

3. Formed letters shall conform to State Standard Lettering, Series E, for highway signs and shall be a maximum of 8" upper case and 6" lower case letters. Refer to the applicable Daly City Standard Drawing for text sizing and placement.

4. Face Colors --- letters and border shall be white with a blue background.

D. Brackets

1. See applicable Special Provisions, Project Plans and/or City Standard Drawings.

2. All bracket material shall be 6061-T6 Aluminum or better.

3. All hardware shall be Stainless Steel.

4. Top nut of a double-nutted installation shall be Nylock type.

5. Centerline of pole shall be congruous with the centerline of the sign assembly.

6. Unit shall allow swivel up to 75 degrees in both directions.

7. Self-lubricating bushings shall be provided in the hinge.

8. Anti-rotation provisions for pivot bolts shall be provided.

9. Bracket mount shall consist of two (2) 3/16" thick, 3" x5" silicon sealant; 6061-T6 Aluminum, or better, plates, one (1) 1/2" diameter, 4" Stainless Steel bolts; and one (1) Nylock nut.

10. Base bracket shall be held by three (3) bolts and two (2) washers as shown in applicable Daly City Standard Drawing.

11. Center of bracket mounts shall be placed on top of sign assembly 6" from either end of sign assembly as shown in applicable Daly City Standard Drawing.

2.14 SERVICE

A. Service shall conform to the provisions in Section 86-2.11, *"Service,"* of the *State Specifications* and these specifications.

B. Service connection shall be made to the traffic signal system from the approximate location shown on the plans. Service to the traffic signal system shall be Type III AF as shown on *State Plan ES-2B.*

C. A type 2 Corbin Lock shall be used in place of the standard hasp and lock latch.

PART 3 - EXECUTION

3.01 CONTROLLER ASSEMBLY AND AUXILIARY EQUIPMENT

A. Controller assembly shall conform to the provisions in Section 86-3, *"Controller Assemblies,"* of the *State Specifications* and these specifications.

B. The Contractor shall be held responsible for the successful operation of the traffic signal equipment. The Contractor shall assign qualified representatives from the supplier of the controller assemblies to field test installed equipment and to demonstrate, to the satisfaction of the Engineer, that the traffic signal equipment is completely operational in accordance with these specifications, the *State Specifications* and the manufacturer's specifications.

3.02 STANDARDS, STEEL PEDESTALS AND POSTS

A. Standards, steel pedestals, and posts shall conform to the provisions in Section 86-2.04, *"Standards, Steel Pedestals and Posts,"* of the *State Specifications* and these specifications.

B. The sign mounting hardware for mast arm, as shown on Detail U of the *State Standard Plan ES-6T,* shall be installed at the locations shown on the plans.

C. Where the plans refer to mast arm signals, the tip tenon detail shall be used.

D. When a standard or mast arm is relocated, or when a used standard or mast arm is City-furnished, new nuts, bolts, cap screws, and washers shall be provided and, if the standard has a slip base, a new keeper plate shall be provided. New hardware shall conform to the requirements for hardware used with new standards and shall be provided by the Contractor.

3.03 VEHICLE SIGNAL FACES AND SIGNAL HEADS

A. Vehicle signals shall be installed at all locations in accordance with the construction drawings. Location of signal faces and orientation of mounting brackets shall be approved by the Engineer prior to drilling of standard. Adjustment of signal faces shall be as directed and approved by the Engineer prior to Section 86-2.14C, *"Functional Testing,"* of the *State Specifications*.

3.04 PAINTING

A. Painting of electrical equipment and materials shall conform to the provisions of Section 86-2.16, "Painting" of the State's Standard Specifications.

3.05 VIDEO DETECTION SYSTEM - INSTALLATION & TRAINING

A. The product supplier of the video detection system shall supervise the installation and the testing of the video equipment. A factory certified representative from the manufacturer shall be on-site during installation. The factory representative shall install, make fully operational, and test the system as indicated on the intersection drawings and this specification.

B. Two days training shall be provided to personnel of the contracting agency in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be produced for a maximum of 10 persons and shall be conducted at a location selected by the contracting agency. The contracting agency shall be responsible for travel, room and board expenses for its own personnel.

3.06 VEHICLE DETECTORS – INDUCTIVE LOOPS

A. Vehicle detectors shall conform to the provisions in Section 86-5.01, *"Vehicle Detectors,"* of the *State Specifications* and these specifications.

B. Detector loop installation shall commence after all roadway repair work has been completed. Detector loop saw cutting, installation and testing shall occur prior to the roadway resurfacing.

C. In addition to the installation notes, details, and tests indicated on the *State Plans ES-5A and ES-5B*, the following shall apply:

1. Each detector loop shall be coiled clockwise; and

2. Loop lead-in cable from the first pull box to the controller cabinet shall be tagged with the identity of all conductor loops connected to the circuit.

3. Loops within eight feet (8') of existing or proposed curbs shall have a minimum of two inches (2") cover.

D. The Contractor shall install Type 2 conductor loop wires as specified by the State Specifications, and place the approved sealant on the same day that saw cuts are made.

E. The Contractor shall insure compatibility of each inductive loop sensor and its associated loop lead-ins and loops, and shall insure and prove to the satisfaction of the Engineer that the combined system will provide consistent and stable operation and be unaffected by input voltage variations of plus or minus ten percent (10%), common electric and magnetic disturbances, flooding of cable with water, and normal range of temperature, humidity, and other weather and climatic conditions. Any deviation from insuring such compatibility shall be approved by the Engineer prior to installation.

F. In lieu of the requirement in the fourth paragraph of Section 86-5.01A(5), *"Installation Details,"* of the *State Specifications*, slots in asphalt concrete pavement shall be filled as follows:

"After conductors are installed in the slots cut in the pavement, the slots shall then be filled with sealant as approved by the Engineer."

G. Conductor loops shall be installed, soldered connections made and circuits completed through amplifier to controller, and system energized.

H. The test vehicle shall be detected continuously across eight feet (8') of lane width at all conductor loop locations immediately adjacent to a crosswalk or limit line, as shown on the construction drawings, for at least three (3) minutes. For all other conductor loops, except extension type, the test vehicle shall be detected continuously across eight feet (8') of lane width at each loop shown in the construction drawings, for at least ninety (90) seconds. Detection loops shall be tested using an insulation tester (megger) and shall read a minimum of 100 mega ohms.

I. Inductive loop detector sensors controlling extension type detection, as designated on the construction drawings, shall signal continually the presence of any vehicle within the required eight-foot (8') lane width until the vehicle leaves the area of detection, whereupon the vehicle call shall drop after an extension which shall be adjustable from one half (0.5) second to seven and one half (7.5) seconds, minimum. Should a vehicle enter the detection area during the timed extension period, the extension timer shall reset to zero (0) and begin timing the extension period when this vehicle leaves the detection area.

J. If the Engineer approves, the Contractor may place the conductor loops and sealant prior to testing and prior to field installation of the controller cabinet.

K. Provide one detector loop per lane to be used as a dedicated counting loop where required on the plans.

L. Header loops shall be Type “D”.

3.07 CONDUIT

A. Conduit shall be installed in accordance with Section 86-2.05C, "*Installation*" of the *State Specifications*.

B. Bonding and Grounding

1. Bonding and grounding shall conform to Section 86-2.10, "Bonding and Grounding," of the State Specifications and these specifications. Grounding to existing water system pipes shall not be permitted.

   In addition to the requirements of Section 86-2.05, "Conduit," of the State Specifications, conduit shall be installed in accordance with State of California Electrical Safety Orders (ESO). Conduit joints and connections shall be made watertight and rustproof by an application of an approved non-insulating thread compound (Crouse Hinds ST2-2 Screw Threading Lubricant and Sealer or approved equal).

2. Trenching by suitable wheel cutter will be allowed provided that trenching is accomplished in accordance with applicable City Standard Drawings for rock wheel trench construction. Calcium chloride shall not be used in concrete or slurry that is in contact with metal conduit.

3. With the Engineer's approval, conduit runs shown in sidewalk areas on the plans may be placed in the street adjacent to the front edge of the curb with boxes located behind the curb in the paved sidewalk area.

3.08 PULL BOXES

A. Pull boxes shall be installed as indicated in Section 86-2.06, "Pull Boxes,” of the State Specifications, and as shown on the plans and as directed by the Engineer.

3.09 PEDESTRIAN SIGNALS

A. Pedestrian signals shall be installed on all standards, as shown on the plan. In addition, audible pedestrian signals shall be installed per manufacturer’s recommendations.

3.10 PEDESTRIAN PUSH BUTTONS

A. Pedestrian push buttons shall conform to the provisions in Section 86-5.02, *"Pedestrian Push Buttons,"* of the *State Specifications* and these specifications.

3.11 FOUNDATIONS AND FOOTINGS

A. Foundations and footings shall be installed for all poles and standards and for the controller at the location shown on the plans. If type “P” cabinet is specified, it shall be installed on an eighteen-inch (18") raised concrete foundation, 50" x 30" in dimension, with 1” drain and driven ground rod.

B. The Contractor shall install fifteen feet (15') of bare #4 stranded copper wire below each combined traffic signal and street lighting pole base prior to pouring the concrete. This additional grounding conductor is to be bolted to the bonding terminal in each pole. Refer to applicable City Standard Drawings.

3.12 CONDUCTORS AND WIRING

A. Conductors for the signals and electrical services shall be installed as shown on the plans and as directed by the Engineer. A pull rope shall be installed in all conduits.

B. Provide six feet (6') of slack in each conductor in each pull box and adjacent to the standards. All conductors shall be tagged as specified herein.

C. As required, conductors shall be spliced at the pole's pull box before the conductors enter the pole circuit.

D. Looping or paralleling of conductors from a terminal box on a pole from pole to pole will not be allowed.

E. Neutral conductors and commons for pedestrian push buttons shall be spliced in the adjacent pull boxes.

F. Service connections to the power supply will be made by the utility company. Contractor shall apply for and coordinate the same at no additional cost to the City.

G. Conductors between pull boxes shall be the size indicated on the Plans.

H. No conductors shall be installed until all pull boxes are set to grade and drain rock installed.

I. Conductors shall be hand drawn into the conduit after the conduit has been completed.

J. Immediately before drawing the conductors into the conduit, the conduit shall be cleaned, swabbed, or blown out.

K. Conductors shall be installed without injury to insulation.

L. Where two or more conductors are to be installed in the same conduit, all conductors shall be drawn into the conduit at the same time.

M. If the conduit is installed in a concrete foundation, conductors shall not be installed until after the concrete has attained a compressive strength of at least one thousand pounds per square inch (1,000 psi.)

3.13 INTERNALLY ILLUMINATED STREET NAME SIGNS

A. Perform installation in accordance with the applicable City Standard Drawings, and as directed by the Engineer.

3.14 UNDERGROUND ELECTRIC SERVICE

A. Underground electric service equipment shall be installed by the Contractor.

B. The meter socket and circuit breaker enclosure, shall be mounted on the controller cabinet by the Contractor so that a conduit from an underground service point can be installed up the same side of the cabinet and enter the meter socket enclosure. A bushed opening shall be provided in the back, near the bottom of the circuit breaker enclosure, so that the load conductors can enter the controller cabinets.

C. Existing signal equipment and loop detector damaged during construction operation shall be repaired and restored by the Contractor to the satisfaction of the Engineer.

3.15 TESTING

A. Testing shall conform to the provisions in Section 86-2.14, *"Testing,"* of the *State Specifications* and these specifications.

B. Where the inductive loop detector conductors are to be installed in an area that is to be resurfaced with asphalt concrete, the loop detector conductors shall be placed in slots cut in the existing pavement. The conductors shall be installed as shown on the plans. Testing of the detector loops shall conform to the requirements of Section 86-2.14B, *"Field Testing,"* of the *State Specifications* and Paragraph 3.04, *"Vehicle Detectors,"* of this Section.

C. Section 86-2.14C, *"Functional Testing,"* of the *State Specifications* is modified as follows:

"A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein prior to actual signal turn-on.

Field wiring and signal phases shall be tested by individual color display, phase by phase, prior to full connection of all field wiring and system operation.

The functional test for the traffic signal system shall consist of not less than five (5) working days of continuous satisfactory service. The functional test shall not begin until the entire installation is complete and in place, to include signal face alignment, in accordance with all requirements of the plans and these specifications, to the satisfaction of the Engineer.

During the five (5) working day test period, City forces will maintain the signal system. The cost of any maintenance or repair necessary, except electrical energy, shall be deducted from any monies due or to become due the Contractor.

If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated again until the five (5) working days of continuous satisfactory performance is obtained.

The test schedule shall be as approved by the Engineer.

A shutdown of the electrical system resulting from damage caused by public traffic, from a power interruption, or from unsatisfactory performance of City-furnished materials shall not constitute discontinuity of the functional test.

Upon successful completion of the five (5) working day field test and throughout the remainder of the construction period and during the guarantee period, the Contractor shall replace or repair defective parts or equipment within seventy-two (72) hours of being notified of such defective condition and provide such maintenance and repair assistance to the City as may be reasonably necessary."

End of Section