

## **SECTION 9200 - TRAFFIC SIGNAL**

**9201 DESCRIPTION.** These specifications are intended to describe the equipment, material, and construction requirements for the lump sum bid item Traffic Signal Installation. The installation shall include all poles, foundations, conduit, pull boxes, wiring, signal heads, detectors, control equipment and such other miscellaneous parts and materials as shown in the approved plans or as otherwise required by the City Engineer.

**9202 GENERAL CONSTRUCTION.** The traffic signal installation shall be constructed per the following specifications, as directed by the City Engineer, and the latest edition of the City of Gardner's *Technical Specifications and Design Criteria for Public Improvement Projects* (hereinafter referred to as "General Provisions" or "Technical Specifications"), the latest edition of the Kansas Department of Transportation *Standard Specifications for State Road and Bridge Construction* (hereinafter referred to as "Standard Specifications"), and the latest edition of the Kansas Department of Transportation Traffic Signal Specifications included in the standard details TE120A, TE120B, TE120C, and TE120D (hereinafter referred to as "KDOT Signal Specifications") that are either directly or by reference included herewith. All incidental parts which are not shown in the approved plans or in the Specifications and which are necessary to complete the traffic signal installation shall be furnished and installed as though such parts are shown in the approved plans. The traffic signal system shall be complete and in operation to the satisfaction of the City Engineer at the time of acceptance of the work. All signs, signals, and markings shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

**9203 COORDINATION OF TECHNICAL SPECIFICATIONS, PLANS, SPECIAL PROVISIONS, AND PROJECT SPECIAL PROVISIONS.** Coordination of discrepancies between the Technical Specifications, Plans, and Special Provisions, shall be in accordance with the City of Gardner *Technical Specifications and Design Criteria for Public Improvement Projects*. In the case of a discrepancy within the Plans, the plan notes shall govern over the standard installation details, and the installation details shall govern over these specifications.

**9204 CERTIFICATION OF CONTRACTOR PERSONNEL.** All traffic signal installation work shall be done by, or in the presence of and under the responsible charge of a Contractor with proof of International Municipal Signal Association (IMSA) Level II Traffic Signal Construction Certification.

Before starting work, the Contractor shall provide the City Engineer with the names and certification credentials of the Level II Traffic Signal Electricians and/or Level II Traffic Signal Technicians assigned to perform traffic signal related work. If the Level II Traffic Signal Electricians or Level II Traffic Signal Technicians are dismissed from the project, all traffic signal installation work shall cease until the names and photocopies of certification cards for replacement personnel are provided to the City Engineer.

**9205 TRAFFIC SIGNAL PRODUCTS & MATERIAL LIST.** Prior to commencing traffic signal installation, the Contractor shall submit a complete list of traffic signal products and materials proposed for the installation. All equipment supplied for the traffic signal installation shall be listed on the most recent edition of the City of Gardner's Approved Products List (APL). Products not included on the APL shall be tested and approved in accordance with Section 9227 prior to construction.

**9206 LOCATION OF UNDERGROUND UTILITIES.** The location of underground utilities on the approved plans is not guaranteed. Additional existing utilities may also be encountered. The Contractor shall have all underground utilities marked and located, potholing where necessary, before beginning any construction excavation, and shall work around any existing utilities located within the right-of-way which do not conflict with the proposed construction. The Contractor shall be responsible for all damages to underground utilities due to his failure to preserve the utility markings.

**9207 NOTIFICATION OF LOCAL POWER COMPANY.** The Contractor shall notify the local power company prior to beginning work to determine the proper type and method of hook-up. The Contractor shall be responsible for payment of any fees assessed by the power company for the power hook-up, regardless of whether these costs have been listed in the approved plans. The fees may include, but are not limited to, service connection fees, conduit, lead-in wire, service pole, meter landing, and power used during installation and testing until the traffic signals are accepted.

**9208 STAKING OF POLES, PEDESTALS, PULL BOXES, CONTROLLER, AND LOOP LOCATIONS.** The locations for signal poles, pedestals, service boxes, junction boxes, controller and detector loops shall be staked by the Contractor. Staked locations shall be approved by the City Engineer prior to construction.

**9209 TRAFFIC SIGNAL IMPROVEMENT POLICIES.** The work included in this project may involve replacement and/or modification of existing traffic signal equipment at a location which is presently controlled by operating traffic signals. The following policies are to be observed during the proposed modifications and improvements:

**Existing Operation:** Unless otherwise noted in the approved plans, the Contractor shall provide continuous operation of the existing traffic signals during the signal modifications and improvements except for shutdowns as required for installation of the proposed improvements.

**Periods of Disruption:** The Contractor shall coordinate any planned disruption of signal operations with the City Engineer and Traffic Operations staff (913-971-5180) at least forty-eight (48) hours in advance of such disruption of operations.

**Disruption Times:** Planned disruption of signal operations shall be limited to the hours between 9:00 a.m. and 3:00 p.m., unless otherwise noted in the approved plans. Traffic control during signal disruptions shall be provided as directed by the City Engineer. The signal controls shall be operable during all other periods.

**Existing Wiring:** All existing wiring within existing controller cabinets shall be identified by the Contractor and each conductor properly labeled in accordance with the Standard Details prior to de-energizing the existing controller.

**9210 SALVAGED EQUIPMENT.**

**Reinstalled:** When salvaged equipment is to be reinstalled, the Contractor shall furnish and install all necessary new materials and equipment including anchor bolts, nuts, washers, concrete, etc. required to install the salvaged equipment in the existing or new location.

**Non-Reinstalled:** When salvaged equipment is not to be reinstalled, it shall be returned to the City of Gardner Traffic Operations Center (TOC) located at 309 N. Rogers Rd. The Contractor shall notify the TOC Supervisor within forty-eight (48) hours prior to delivery of the equipment. The stored equipment shall be the responsibility of the Contractor until it is delivered to the TOC.

**9211 REMOVAL OF EXISTING FOUNDATIONS.** Existing foundations for traffic signal poles, pedestals and controllers shall be removed a minimum of twenty-four (24) inches below finished grade, and the area backfilled in accordance with the Technical Specifications.

**9212 CONDUIT INSTALLATION.** Conduit shall be installed in accordance with the City of Gardner Technical Specifications and the Standard Details. The conduit shall be of the type indicated in the approved plans, and shall be of one type from outlet to outlet.

Conduit under existing pavement, sidewalk, or driveways shall be installed using an approved jacking or boring method.

All conduit installed above ground shall be metallic. Conduit attached to bridges shall have expansion fittings installed at the end of the bridge and at each expansion joint on the bridge. Any attachments to bridges on the state highway system must be approved by the applicable regulatory agency.

All metallic conduits shall be electrically bonded by a grounding bushing and ground wire as detailed in the approved plans.

High Density Polyethylene (HDPE) SDR9 conduit joints shall be made with either a Shur-Lock II coupler or fusion welder.

HDPE conduit shall be continuous from outlet to outlet, with no splices allowed. Bend radii shall not be less than the manufacturer's recommendations.

**9213 PULL BOXES.** Service box and junction box installations shall be per the Standard Details, and as noted below. The location of boxes may be adjusted during installation to clear obstructions and facilitate wiring as approved by the City Engineer but shall be installed no closer than twenty-four (24) inches from the back of curb. The quantity of boxes as shown in the Plans may not be reduced. Additional boxes may be provided at the Contractor's expense. Boxes shall not be located in sidewalk ramps. All boxes shall be free of trash, wire scraps, etc.

**Bedding:** An eighteen (18) inch thick layer of aggregate shall be provided under all pull boxes. The aggregate shall meet the requirements of PB-2 described in the Standard Specifications and shall be visually accepted by the City Engineer.

**Conduit Entrances:** The area around the conduit entrance in in-ground boxes shall not be larger than one (1) inch and shall be sealed with a mortar grout or a silicone sealant (spray foam is not allowed).

**Cable Hooks:** Cable hooks shall be installed in service boxes as detailed in the approved plans.

**Bridge Mounted:** Junction boxes mounted to bridges shall be mounted with wedge anchor bolts of sufficient size and strength to safely secure the box to the structure. The surface of the junction box which comes in contact with concrete shall be covered with aluminum colored butyl rubber sealant (caulking compound). Any attachments to bridges on the state highway system must be approved by the applicable regulatory agency.

**9214 FOUNDATIONS.** Concrete foundations for poles, pedestals and cabinets shall be constructed per the Standard Specifications, as modified below, and as detailed in the approved plans.

Reinforcing steel shall meet the requirements of the Standard Specifications, and shall be free of rust and dirt, and shall be of the size, quantity and dimensions shown in the approved plans.

Before placing the concrete for the foundation, the Contractor shall ensure that the appropriate anchor bolts are placed in proper orientation, elevation and verticality. This may be accomplished by using positioning plates and/or tying or welding the anchor bolt assembly to the reinforcing steel cage. "Stabbing" of anchor bolts will not be permitted.

The anchor bolt threads shall be protected from concrete fouling when the concrete is poured.

All piers for foundations shall be drilled and constructed in one pour. The top six (6) inches of pole and pedestal foundations shall be formed in a square and shall be level with the adjacent sidewalk, or approximately two (2) inches above finished grade if no sidewalk is present. The work apron on the controller pad shall be level with the adjacent sidewalk or approximately one (1) inch above finished grade if no sidewalk is present.

**9215 TRAFFIC SIGNAL POLES AND PEDESTALS.**

**Traffic Signal Poles:** The traffic signal poles shall be plumbed after the mast arm and other loads have been applied. Adjustment shall be made using the leveling nuts on the anchor bolts. The final distance between the top of the concrete foundation and the bottom of the leveling nuts shall not exceed one (1) inch. The nuts shall be thoroughly tightened to the manufacturer's recommendations and covered with the nut covers provided with the poles.

The mast arm and luminaire arm(s) (on combination poles) shall be attached to the pole by a suitable mast arm connection. Clamp on connections will not be accepted. Connections shall be installed to the manufacturer's recommendations.

All other attachments to the poles and mast arms shall be located in the field, and all wire entrances into the pole or mast arm shall be drilled or punched in the field. All drilled or punched surfaces shall be carefully reamed to remove any sharp edges or burs before application of a field coat of organic zinc rich paint as described in the Standard Specifications. The one (1) inch rubber grommets supplied with the poles shall be installed at all outlets for signal wiring before the wires are installed.

Poles shall not be installed until the utility company has installed power for the traffic signal. Contractor shall provide a screen to keep rodents from entering the pole through the gap at the base. The screen material shall be a stiff, welded steel wire mesh with ¼" square openings, and shall be wrapped around the pole anchor bolts, securing ends together with wire ties or other suitable banding material as approved by the City. The screen shall be wedged between the base of the pole and the surface of the foundation after the pole is plumb.

The end caps provided with the poles shall be securely installed on the end of the arms and the top of the pole prior to acceptance of the signals.

**Pedestals:** The cast aluminum pedestal bases shall be bolted to the concrete foundation using ¾" by 2" galvanized square washers and tightened to the manufacturer's recommendations.

All attachments to the pedestal shall be located in the field and all wire entrances into the pedestal shaft shall be drilled or punched in the field. All drilled or punched surfaces shall be carefully reamed to remove any sharp edges or burs. Plastic or rubber bushings shall be installed at each opening before the wires are installed.

The post cap and hand hole cover provided with the pedestal shall be securely installed prior to acceptance of the signals.

The pole shall be screwed into the pedestal base and have a pole and base collar assembly affixed, to prevent the pole from loosening.

**9216 TRAFFIC SIGNAL HEAD INSTALLATION.** The faces of all signal heads shall be completely covered with orange mesh lens covers until signal turn-on. Signal heads shall not be installed more than ten (10) days prior to the signal turn-on, or before power is installed, unless otherwise approved by the City Engineer. All heads shall be plumbed as viewed from the direction in which they face and in the vertical plane. The City Engineer shall direct the final positioning of the signal heads for optimum visibility.

**Mast Arm Mounting:** Mast arm signal head assemblies shall be rigidly mounted in accordance with the approved plans. The brackets shall be securely attached to the mast arm according to the manufacturer's recommendations. All conductors shall be concealed within the assembly.

All mast arm signal heads shall be attached to the mast arm prior to attaching the mast arm to the pole. Special care must be taken before drilling the arm for attaching the signal heads in order to assure that the signal heads will be in proper orientation over the intended traffic lanes.

Mast arm mounted signal heads shall be installed at a height of 17 to 19 feet from the pavement to the bottom of the signal head, with 17 feet being the desirable minimum height.

**Side-Of-Pole Mounting:** Side-of-pole signal heads shall be supported in accordance with the standard details. All members shall be plumb, symmetrically arranged, and securely assembled. Mounting brackets shall be attached to the pole with heavy duty stainless steel banding and buckles. All conductors shall be concealed within the assembly.

Side-of-pole traffic signal heads shall be installed at a minimum height of ten (10) feet from the base of pole to the bottom of signal head. Side of pole heads shall be back-mounted (opposite side of pole from traffic). Doors shall swing away from pole and, if inverted, shall have weep holes plugged to prevent moisture from entering head. Pedestrian signal heads shall be mounted at a minimum of seven (7) feet from the base of pole to the bottom of the signal head.

**9217 WIRE AND CABLE INSTALLATION.** Wire and cable shall be installed per the Standard Specifications, as modified herein, and in accordance with the wiring diagram in the approved plans. No splicing of conductors will be allowed except for the following:

**Loops:** The ends of the wire forming each loop shall be spliced in the nearest pull box to a detector lead-in cable. Splices between loops and lead-in cables shall be twisted and secured with a wire nut, and the splice shall be waterproofed, including the end of the loop wire tubing, using an approved loop splice kit. Taped splices will not be permitted. The splice shall be located in the upper seventy-five (75) percent of the box.

**Multi-conductor Cable in Pedestal Bases:** Multi-conductor cable runs to pedestal bases shall be spliced in the pedestal base to the multi-conductor cables running up the pedestal shaft to the signal heads. Each conductor shall be clearly labeled as to its function with a permanent label per the Gardner color code and the splices shall be waterproofed. The wires shall be arranged in the base to prevent the splices from coming into contact with the sides of the base or top of the foundation. Any unused conductors shall be taped.

**Pulling Wires and Cables through Conduit:** Separate three (3) inch conduits shall be provided for both low and high voltage wire bundles. When pulling wires into the conduit, a pulling sock or other similar device shall be used to equalize pulling strain on the conductors.

**Excess Cable:** A minimum of 6 feet of slack or excess multi-conductor cable, detector lead-in cable, loop detector wire, and lighting distribution wire shall be provided in each pull box. The excess cable in service boxes shall be logically grouped, taped, and neatly coiled and placed on the cable hooks. The excess cable in junction boxes shall be logically grouped, taped, and neatly coiled and placed in the bottom of the box. At least 6 feet of excess multi-conductor cable shall be left in each pole base to allow for connection to the terminal block.

**Termination of Field Wires In the Cabinet and Pole Bases:** The Contractor shall clearly identify the function of each field wire entering the cabinet or pole with a permanent label per the Gardner color code. Contractor shall leave 20 feet of slack

for cabinets and 6 feet of slack for poles, for termination. Refer to Bill of Materials for wire termination responsibility. If not defined in Bill of Materials, City of Gardner staff are responsible for termination, to be coordinated by contractor.

**Pole Wiring:** Each signal head shall have a separate run of multi-conductor cable from the terminal block in the pole base to the terminal block in the signal head. A separate seven-conductor cable shall run to each three-section signal head; a separate seven-conductor, cable shall run to each four- or five-section signal head; a seven-conductor, or three-conductor, cable shall run to each pair of pedestrian heads leaving 6 feet of spare cable out of the hand hole for termination; a separate two-conductor shall run continuously (no splices shall be allowed) from the pedestrian push button to the field terminal in the cabinet. All four-section heads shall have their own neutral run back to the cabinet. The ends of any unused conductors shall be taped.

- 9218 GROUNDING/BONDING.** The traffic signal system shall be grounded per the Standard Specifications and as specified herein. All traffic signal poles, pedestals, controller cabinets, and service circuit breakers shall be grounded using a ground wire bolted to the inside of these devices with a 0.5 inch internal ground lug. All ground wires shall be attached to the ground rod using a ground. Ground rods shall be installed as detailed in the approved plans.

The detector lead-in shielding and drain wire shall be electrically floating (not attached to earth ground) at the pull box. Grounding the cabinet shall be in accordance with the manufacturer's recommendations.

- 9219 DETECTOR LOOP INSTALLATION.** Detector loops shall be installed as close as practicable to the locations shown in the approved plans. Loops shall be centered in their respective lanes; or if they cover more than one lane, they shall be centered over the width of the intended zone of detection. The longitudinal orientation of loops installed in concrete pavement shall be adjusted such that no loop begins or ends within twelve (12) inches of a transverse joint.

**Pre-Formed Loops:** Pre-formed loops shall be installed in new pavement during the pavement construction in accordance with the manufacturer's recommendations.

**Saw-Cut Loops:** Saw-cut loops shall be installed in saw cuts as detailed in the approved plans. The location of each loop shall be clearly marked on the pavement and approved by the City Engineer prior to loop installation. The Contractor shall drill two (2) inch diameter holes centered on each point of intersection of the loop slots prior to cutting the slots. The slots shall be cut using a saw equipped with a depth gauge and horizontal guide to assure proper depth and alignment of the slot. The blade used for the saw cut shall provide a clean, straight, well-defined saw cut of the width and depth indicated in the approved plans without damage to adjacent areas. Where the loop changes direction, the saw cuts shall be overlapped to provide full depth at all points of intersection.

Before installing the loop wire, all rough edges and protrusions shall be removed from the saw cut. The slots must be cleaned and dried to remove cutting dust, grit, oil, moisture or

other contaminants. Cleaning shall be achieved by flushing the slot with a high-pressure water jet stream. The slot shall then be cleared of water and dried using oil-free compressed air.

Loop wire shall be installed in the slot using a dull edge wooden paddle or wheel to prevent damage to the loop jacket. Conductors of each loop shall be run continuously from the nearest pull box with no splices permitted. All loops shall be wound in the same direction with the start and end of each clearly marked with a permanent label at the pull box. The loop conductors running from the loop to the adjacent pull box shall be twisted a minimum of 3 turns per foot/10 turns per meter. In addition, each loop conductor shall be permanently identified by the loop number shown in the approved plans. Paired loops shall be joined in the pull box in series or parallel as recommended by the manufacturer to obtain optimum sensitivity at the sensor unit.

After the conductors are installed in the slots, the loops shall be tested for continuity and shorts with a meg-ohm-meter set at 500 volts. Any defective wire shall be replaced. After testing, the slots shall be filled with an approved loop sealant to within 0.125 inches of the pavement surface. Before setting, surplus sealant shall be removed from the adjacent road surfaces without the use of solvents.

The Contractor may, at his own expense, use approved pre-formed loops instead of saw cut loops.

The loop conductors for each loop shall be spliced in the pull box to a detector lead-in cable in accordance with Section 9217 of these specifications. The detector lead-in cable shall run continuously from the pull box to the field terminal in the cabinet with no splices permitted.

## **9220 SIGNS.**

**Overhead Street Name Signs:** Street name signs shall be installed on mast arms after all other loads are applied to the mast arm. The signs shall be located in accordance with the Standard Details. Signs shall be mounted so that the legend is level. The final location shall be determined by the City Engineer.

Installation of signs on mast arms shall be accomplished with suitable stainless steel banding, clamps, and brackets capable of withstanding 100 mph winds. Street name signs over eighteen (18) inches in height shall be installed using approved sign mounting brackets in accordance with the approved plans. All bolts inserted through sign faces shall be stainless steel with flat fiber washers installed between the reflective sheeting and bolt heads. Bolt holes shall be drilled in the field.

**Regulatory Signs:** The R10-Series signs shall be mounted on the mast arm to the right of the left turn signal head using an approved sign mounting bracket in accordance with the Standard Details.

**R10-3E Pedestrian Push-Button Signs:** Pedestrian push-button signs shall be mounted to



the traffic signal pole above the appropriate pedestrian push-button. Mounting shall be accomplished using suitable stainless steel banding, clamps and brackets capable of withstanding 100 mph winds. As an alternative, the pedestrian sign mounting bracket may be constructed integral to the pedestrian push-button assembly.

**9221 PEDESTRIAN PUSH-BUTTONS.** Pedestrian push-buttons shall be installed on the poles or pedestals indicated in the approved plans at a height of 3.5 feet above the adjacent sidewalk (or ground if no sidewalk is present). The push-button shall be located on the side of pole nearest the pedestrian walkway, and perpendicular to the intended crossing direction. The push button shall be installed on a level landing area, not in an ADA ramp, and located within twenty-four (24) inch maximum (12" desirable) of the level landing area.

**9222 TRAFFIC SIGNAL TURN-ON.**

**Flashing Operation:** At locations without previous traffic signal control, the new traffic signals shall be flashed 2 to 3 business days prior to full signal system turn-on.

**System Turn-On:** The signal system turn-on shall not occur on Mondays, Fridays, weekends, or holidays and shall be completed prior to 3:00 p.m. on the day of the turn-on.

**Supplier Representative:** The supplier of the control equipment shall have a representative present at the signal system turn-on.

**Traffic Engineering Notification:** The City Engineer shall be notified at least one week in advance of the date of signal turn-on.

**9223 TEST PERIOD.** Following completion of all electrical apparatus hook-ups and the system turn-on, the signals shall operate satisfactorily for thirty (30) days under normal conditions prior to acceptance by the City Engineer. During the test period, the signals shall operate trouble-free with no failures of the controller or its components. Should any defect develop under normal and proper operating conditions during the testing period and prior to acceptance by the City Engineer, this malfunction shall be corrected by and at the expense of the Contractor, including all labor, materials and associated costs. Minor failures, such as loop detector re-tuning, will not be the basis for starting a new test period provided the failures are repaired immediately and the same failures do not recur during the remainder of the test period. A major malfunction or failure of the controller and its components will result in a new thirty (30) day test period being implemented after the repairs have been made.

**9224 GUARANTEE.** All equipment furnished on a project by the Contractor shall be guaranteed against any imperfections in workmanship and materials. The customary manufacturers' warranties shall be assigned to the City.

**9225 MANUALS.** A minimum of two (2) manuals shall be provided for each controller and shall include complete nomenclature, wiring diagrams, schematics showing test voltages, functional description of circuits, parts list and cross reference to standard part numbers, appropriate testing procedures, and other pertinent data.

**9226 MATERIALS DESCRIPTION.** These specifications cover the general materials and miscellaneous hardware for the installation of a traffic signal to be constructed in accordance with and at locations indicated in the contract, shown in the approved plans or designated by the City Engineer.

**9227 MATERIAL REQUIREMENTS.**

**General:** All equipment supplied for the traffic signal installation shall be listed on the most recent edition of the City of Gardner's APL. In the case of a discrepancy between the product specifications listed below and the APL, the APL shall govern over these specifications. All materials used in the fabrication or assembly of the items listed below shall be new, shall be of the best quality and workmanship and shall be the manufacturer's latest approved design. Major items of electronic equipment installed under this contract shall be of the same type and consist of products supplied by the same supplier.

The traffic signal shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of the signal system whether specifically mentioned or not.

All electrical devices shall be purchased within 90 days of install.

**Responsible Parties:** Any reference to the State, State of California, or Agency shall mean the local agency responsible for maintaining the traffic signal. Any reference to the Contractor shall mean equipment manufacturer or supplier.

**Cabinets:** The pole mounted cabinets shall be Model 336A, and the pad mounted cabinets shall be either Model 332BPDA2 single cabinet or Model 332DBLPDA2 double cabinet, in accordance with Chapter 6 of the Caltrans Traffic Signal Control Equipment Specifications (TSCES) with the following additions or modifications.

Finish The cabinet finish shall be black in color.

Lift Eyes The cabinet lift eyes shall be removable and shall be turned down after installation of the cabinet.

Light Fixtures Cabinets shall be furnished with LED light fixtures with a length of 21.5 inches, including lamps, over the front and back doors that are controlled by door- activated switches.

AC Surge Suppression The cabinet shall be furnished with a RackPro 20Amp rack mounted AC surge suppressor model 35319 or equivalent. The unit shall be 1U in height and 19" wide, having a minimum 8 rear outlets and 1 front outlet.

Plan Drawer/Work Surface A drawer shall be mounted in the EIA rack between the controller and the top input file. It shall be mounted on sliding tracks with lockout and quick-disconnect features. The drawer shall extend a minimum of 14 inches, and shall be capable of supporting a 40 lb. load when fully extended. The drawer shall be provided with a hinged aluminum top covered with a chemical proof Formica-type plastic sheet. The interior of the drawer shall have nominal dimensions of 1 inch high, 13 inches deep and 15.75 inches wide.

Additional Model 336s Requirements The Model 336S cabinets shall be furnished with a continuously welded bottom of the same material as the cabinet, and all of the hardware necessary to accommodate mounting to a 12 inch outside diameter pole.

Additional Model 332B Requirements The Model 332B cabinets shall be furnished with the power distribution assembly #2 in lieu of the power supply and power distribution #1 assemblies. The cabinets shall be supplied with the circuit breaker option per Section 6.4.3.9 of the Caltrans TSCES. The cabinet shall be furnished with anchor bolts, nuts and washers.

Additional Output File #1 Requirement The output file #1 supplied with the cabinet shall be modified to provide compatibility with the red monitoring features of the conflict monitor.

Input File Requirements The input files shall be split input files equipped with an RJ-45 connector on the backside of the input file.

**Controller:** The controller shall be in accordance with the APL.

**Conflict Monitor:** The conflict monitor shall be in accordance with the APL.

**Flasher:** The flasher shall meet the requirements of a Model 204 flasher per Chapter 3 of the Caltrans TSCES.

**Load Switch:** The load switch shall have modular switches that can be easily replaced using a screwdriver, and meet the requirements of a Model 200 switch pack per Chapter 3 of the Caltrans TSCES, and shall also be dual indication.

**Flash Transfer Relays:** The flash transfer relays shall be heavy duty relays meeting the requirements of the Model 430 per Section 6.4.6 of the Caltrans TSCES.

**Surge Protector:** The surge protector shall be as per City of Gardner Specifications.

**DC Isolator:** The DC isolator shall meet the requirements of a Model 242 two-channel DC isolator per Chapter 5 of the Caltrans TSCES.

**AC Isolator:** The AC isolator shall meet the requirements of a Model 252 two-channel AC isolator per Chapter 5 of the Caltrans TSCES.

**Detector:** The detector sensor units provided shall be a Reno A&E Model C-1103-SS or approved equal.

**Battery Back-Up System:** The BBS / UPS system shall be comprised as noted below and shall include, but not limited to: inverter/charger (UPS), power transfer switch (PTS), batteries, a separate manually operated non-electronic bypass switch, 30 amp 4 prong external reverse service plug with weatherproof cover for connection to generator, and all necessary hardware and interconnect wiring. The BBS shall meet the following requirements:

- The BBS shall be capable of powering the intersection in normal operation for a minimum of three (3) hours. Intersection loads shall be calculated to assess proper battery size and quantity to meet this requirement; 850W for three (3) hours shall be the minimum allowed capacity. The system shall be capable of providing power for full run-time operation, flashing mode operation, and a combination of both full and flash mode operation of an intersection. The operation of the flash mode shall be field programmable to activate at various times, battery capacities, or alarm conditions locally using the pad or using a standard PC interface.
- The BBS shall make available a minimum of four (4) dry contacts rated at 1 Amp 120 VAC. Each relay shall be programmable with a minimum being the following: "On Batt", "Low Batt" (40% remaining charge), "Timer", and "Alarm".
- BBS Batteries. Batteries shall be hot-swappable.

**Signal Heads:** All signal heads on a project shall be supplied by one manufacturer. The signal heads shall be in general conformance with the latest edition of the Equipment and Materials Standards of the Institute of Transportation Engineers - Vehicle Traffic Control Signal Heads, and as specified below.

Standard Vehicle Traffic Signal Heads - The housing for each vehicle traffic signal section shall be made of a durable polycarbonate. The housing shall be yellow, or black, with black doors. The visors for each signal section shall be of the tunnel type, and be made of a durable black polycarbonate of not less than 0.1 inch/2.5 mm in thickness.

Arrow indications shall have an incandescent look.

Pedestrian Traffic Signal Heads - All pedestrian traffic signal heads shall include a countdown display (IDC Model LEDP-HMC-002 or approved equal). The housing shall be a one piece polycarbonate, yellow with a flat black one piece polycarbonate door, without the standard Z-Crate visor. Head units shall be installed with the clamshell 2 mounting (Model 4805). The pedestrian signal indications shall be in general conformance with the latest edition of the E.T.L. and Institute of Transportation Engineers - Pedestrian Traffic Control Signal Indications. Pedestrian lenses shall be rectangular, with a dimension of 16 x 18 inches. The message shall consist of a Don't Walk "HAND" symbol in portland orange, and a Walk "WALKING PERSON" symbol in lunar white and have an incandescent look. The pedestrian symbols shall be a minimum of 9 inches high. The lens housing shall be designed to accommodate 16-inch LEDs.

Pedestrian Light Emitting Diodes (LED) Walk and Don't Walk indications, when specified on the plans, shall be sealed and the hand and walking man shall be filled completely. No

outlines will be accepted.

**Signal Lamps:** All red, yellow, and green vehicle traffic signal indications in each signal head shall be a 12- inch LED lens meeting the requirements of the ETL (<http://www.intertek.com/marks/etl/>) verified certification program and latest ITE Specifications for LED's for Vehicle Traffic Signals. In addition they shall be the product of one manufacturer and be pre-approved by the City of Gardner.

**Signal Mounting Brackets:**

Mast Arm Bracket - The mast arm signal mounting brackets shall be fabricated of high strength aluminum, and shall provide for rigid mounting of the traffic signal heads while allowing signal aiming adjustment in all planes. The brackets shall be designed to strap to the mast arm using aircraft-type cable which shall be pinned to the bracket at one end and which shall provide a turnbuckle style tightening adjustment on the other skybracket adjustable steel banding. The brackets shall incorporate wiring channels so that after installation, all signal cables shall be protected from the effects of exposure to the weather.

Side-Of-Pole Brackets - Side-of-pole signal mounting brackets shall be molded of yellow or black polycarbonate and shall incorporate a mounting arm and pole plate into a single member which shall include guides to correctly position the banding material on the pole plate. The dimensions of the mounting brackets shall be as required to provide proper signal head alignment. Each bracket shall have molded serrations to assure a positive lock with the signal head and allow positioning of the traffic signal heads in increments of five (5) degrees. The bracket shall be designed to provide a wiring raceway for signal cable exiting the support pole and entering the signal head.

**Backplates:** Backplates shall be of sufficient size to provide a minimum of 5 inches/125 mm of dark background for the signal indications and shall be fabricated from a minimum of 0.125 inch black ultraviolet stabilized ABS plastic. Backplates shall be capable of withstanding a 100 mph wind. Backplates shall be furnished with all necessary hardware to attach to the signal heads.

**Pedestrian Push-Button:** The pedestrian push button assembly shall be black in color, with a low profile mount. It shall contain a silicon or neoprene cover to body gasket. Cover screws shall be stainless steel. The switch and actuator shall be protected from dust and moisture with a silicon or neoprene cover. Assembly shall not possess an L.E.D. light.

**Pedestrian Sign:** The pedestrian information signs shall be MUTCD R10-3e as detailed in the approved plans. The sign blank shall be constructed of minimum 0.075 inch thick aluminum alloy. The sign face shall have a non-reflective black legend direct screened on high intensity prismatic sign sheeting. The sign shall be visually accepted by the City Engineer.

**Steel Traffic Signal Poles:**

Tapered Tubular Shafts - Steel traffic signal pole and mast arm shafts shall conform to Division 1600 of the Standard Specifications and the requirements in the approved plans. All pole and mast arm shafts shall be constructed of one of the following methods:

- No Transverse Welds. Pole and mast arm shafts shall be tapered tubular members made only of one length of structural steel sheet of not less than No. 7

Manufacturing Standard Gauge (Exception: Signal arms designed for lengths of 40 feet or greater may have arm extensions of not less than No. 11 gauge steel, with bolted telescopic field joints so as to develop full strength of the adjacent shaft sections to resist bending action). Round (Type I) members shall meet the requirements of the latest edition of A.S.T.M. A595 Grade A or B. Multi-sided (Type II) members have a minimum of 12 sides and meet the requirements of the latest edition of A.S.T.M. A570 or A.S.T.M. A572 with a minimum yield strength of 55,000 psi and a maximum silicone content of 0.06 percent. Only one longitudinal weld, and no transverse welds, shall be permitted in the fabrication of the tubular members consisting only of one length of structural steel.

- Transverse Welds. Pole and mast arm shafts shall be fabricated from hot rolled basic open hearth steel conforming to A.S.T.M. A570 for thickness of No. 11 and No. 7 Manufacturing Standard Gauge, A283 Grade D for No. 3 gauge and A36 modified for 0 gauge. The shaft shall be longitudinally cold rolled to flatten the weld and increase the physical characteristics so that the metal will have minimum yield strength of 48,000 psi. Where transverse full penetration circumferential welds are used, the fabricator of the shaft shall certify: (1) that all such welds have been magnetic particle tested by an independent testing laboratory using a qualified Nondestructive Testing (NDT) Technician and (2) that the NDT equipment has been calibrated annually.

Poles - The poles shall include a suitable connection for attaching the mast arm to the pole shaft, a reinforced hand hole with gasket cover located near the bottom of the pole and oriented 180 degrees from the mast arm, a grounding lug in the hand hole or inside the pole near the hand hole, a J or C hook wire support inside the pole near the top of the pole, 4 nut covers and a removable pole cap. The poles shall be pre-drilled for the mast arm attachments prior to galvanizing. Rubber grommets shall be furnished for all wire entrances into the pole. A clamp-on connector shall not be permitted.

Combination Poles - When combination lighting and signal poles are specified in the approved plans, the poles shall also have suitable clamps for attaching the luminaire arm to the pole shaft. The pole shaft shall be pre-drilled for the luminaire arm attachment prior to galvanizing, with the luminaire arm to be mounted in the same vertical plane as the signal arm. In addition, a reinforced nominal 3 inch by 5 inch hand hole shall be located 180 degrees from and just above the mast arm, and a J or C hook wire support shall be welded inside the pole immediately above the mast arm.

Mast Arms - All signal mast arms shall have suitable attachment devices for attaching to the pole shaft, and a removable end cap. Clamp-on connectors shall not be permitted. Rubber grommets shall be furnished for all wire entrances into the mast arm.

Luminaire Arms - Luminaire arms shall be either single tube or truss-type arms as indicated in the approved plans. All luminaire arms shall have suitable clamp-on

attachment devices for attachment to the pole shaft. Single tube arms shall be welded to one half of the luminaire arm clamp. Truss-type arms shall be furnished with two clamp- on simplex fittings in accordance with the Standard Details.

Galvanizing - The poles, mast arms, luminaire arms and all steel accessories shall be galvanized to the requirements of the latest edition of A.S.T.M. A123.

Epoxy Coating - When epoxy coating for steel poles, mast arms, luminaire arms and all other steel accessories is specified in the approved plans, the Contractor shall conform to Valmont F-306 Rev 1 specifications for epoxy top coat. Contractor shall repair any damage to the finish of any structure with the base primer and finish coat materials furnished by manufacturer. No other products shall be used unless otherwise approved by the City Engineer.

Design Load - All traffic signal poles shall be designed to accommodate the standard signal head, signing, and luminaire arm loadings established by the Bureau of Traffic Engineering. The design shall conform to the latest edition of AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals handbook with a wind load of 90 mph / 145km/h and a minimum of 1.14 gust effect factor. The poles shall also accommodate wind loadings which may cause deflections of the mast arm in the vertical plane. These deflections shall never result in less than a 15 foot clearance between the roadway and the lowest point of the signal assembly.

Anchor Bolts - High strength anchor bolts, washers, and nuts, conforming to the Standard Specifications shall be included. The leveling nuts may be either Heavy Square or Heavy Hex nuts. Anchor bolt washers conforming to the requirements of the latest edition of A.S.T.M. F436 shall also be acceptable.

#### Basis of Acceptance

- Standard Shop Drawings - All traffic signal poles shall be detailed by the manufacturer on shop drawings. The drawings shall include the pole, mast arm and luminaire arm (on combination poles) dimensions, arm attachment details, hand hole details, and anchor bolt details, along with the signal weight, projected areas and mounting arrangement. Design calculations shall be submitted with the shop drawings. Approved shop drawings shall be included with the Pre-qualified Traffic Signal Materials List.

For traffic signal poles that are not covered by the approved manufacturer's standard shop drawings, the Contractor shall submit three copies of detailed shop drawings and an electronic copy as a PDF, along with the design calculations to the City Engineer for approval.

- Poles and Mast Arms - See the Design Criteria for the basis of acceptance.

- Anchor Bolts - See Design Criteria for the basis of acceptance of anchor bolts for traffic signal poles. If Type "B" certification is not provided according to the Design Criteria, the City Engineer may require testing of an anchor bolt.
- Traffic Signal Materials List - Along with the Traffic Signal Materials List, the Contractor shall submit the necessary traffic signal pole ordering information. The City Engineer will review the information for compliance with the plan dimensions for pole height, mast arm length and mounting height, and luminaire arm length and mounting height.

**Traffic Signal Pedestals:** Traffic signal pedestals shall consist of an aluminum shaft of the length specified in the approved plans, a cast aluminum base, anchor bolts with nuts and washers, and shall be provided with a pole cap.

The shaft shall be of Type 6061-T6, 6063-T6 or 6063-T832 aluminum alloy, and shall be a single piece of drawn seamless tubing having a nominal 4.5 inch outside diameter and 0.25 inch wall thickness. The shaft shall be threaded at one end for attaching the shaft to the base. The shaft shall have a uniform polished finish.

The pedestal base shall be AASHTO certified and be cast of Type 356.0-T6 aluminum alloy. It shall have a threaded collar with a set screw, and plastic hand hole cover.

Anchor bolts for traffic signal pedestals shall be of the dimensions detailed in the approved plans and shall meet the requirements of the latest edition of A.S.T.M. A36. The threaded ends of the anchor bolts, nuts, and 3/4" x 2" square washers shall be galvanized. Anchor bolts for traffic signal pedestals will be visually accepted by the City Engineer.

**Terminal Block:** Terminal blocks in the poles shall be U.L. recognized barrier type or dead-front type terminal strips having terminals of sufficient size and quantity to connect the individual conductor run between the cabinet and the pole to the conductor run between the pole and the signal heads. Terminal blocks shall be rated for at least 30 amps current.

**Junction Boxes (In-Ground):** The junction box shall be of sufficient size to facilitate the conduit and wiring as indicated in the approved plans. Junction boxes shall have nominal dimensions as shown on the approved plans. In-ground junction boxes shall be constructed of fiberglass reinforced polymer box and cover.

Type I and II boxes and covers shall support, without damage to the box or cover, a static load of 22,000 pounds distributed over a 10 inch by 10 inch area in the center of the cover.



The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover.

Type III and IV boxes and covers shall support, without damage to the box or cover, a static load of 22,000 pounds distributed over a 10 inch by 10 inch area in the center of the cover.

**Junction Boxes (Above-Ground):** Above ground junction boxes shall have the nominal dimensions of 12 inch by 12 inch by 6 inch. The junction box shall be made of minimum 0.075 inch/2 mm thick sheet metal (steel) with welded seams, knockouts and weather proof screw cover. Junction boxes shall be hot dipped galvanized in accordance with ASTM A-123 after fabrication.

**Service Boxes:** The service box shall have the minimum nominal internal diameter of 24 inches diameter with a minimum depth of 36 inches. Service boxes shall be provided with cable hooks as detailed in the approved plans. The box may be constructed of one of the following methods: polymer concrete with a polymer concrete cover or a fiberglass reinforced polymer body with a polymer concrete ring and cover. The ring shall be securely attached to the body.

The box and cover shall support, without damage to the box or cover, a static load of 22,000 pounds distributed over a 10 inch by 10 inch area in the center of the cover.

The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover.

**Luminaires:** Luminaires shall be in accordance with the Technical Specifications.

**Un-Fused Street Light Connector Kit:** Un-fused connector kits shall be of the set-screw type in accordance with the approved plans and shall be furnished with waterproof rubber boots.

**Fused Street Light Connector Kit:** Fused connector kits shall be in accordance with the approved plans and shall be supplied with molded rubber boots for waterproofing. The connector shall be capable of withstanding multiple disconnects without damage to the watertight seals or terminals. Each connector shall include all parts and materials necessary to complete its installation, such as fuses, lubricating compound, and assembly devices.

The fuse shall be a minimum of 5 amp cartridge type as recommended by the connector manufacturer.

**Overhead Street Name Signs:** Overhead street name signs shall bear the message indicated in the approved plans. The legend shall be centered on the sign face. The border shall be 0.75 inches wide.

Blank - The sign blank shall be of 0.125 inch thick Type 5052-H38 aluminum alloy. All corners on the sign blank shall be rounded.

Sheeting - The sign faces shall be either direct-applied white enclosed lens high performance

retro-reflective legend and borders on a green enclosed lens 3M high intensity prismatic sheeting background, or transparent green cuttable film over white enclosed lens 3M high intensity prismatic sheeting. The use of the transparent film shall in no way limit the manufacturer's warranty on the 3M prismatic sheeting over which it is applied. The green sheeting or film shall conform to Federal Color Standard 595A, Color No. 14109.

Lettering – The font size for the legends shall be as follows: 6 inch mm series E-Modified upper case for SW, ST, AV; 8 inch upper case with 6 inch lower case series E-Modified for names; 8 inch series E-Modified for numerals.

Acceptance - Before final fabrication and shipment, the manufacturer or supplier shall provide, for the City Engineer's approval, a layout of each sign showing the exact street name lettering to be placed on the sign. The signs shall be visually accepted by the City Engineer.

**Regulatory Signs:** The design details (color, letter height, and letter series) for all regulatory signs shall be as shown in the latest edition of the Standard Highway Signs Manual. Special signs not included in the Standard Highway Signs Manual shall be as shown in the approved plans. Sign blanks shall be a minimum of 0.075 inch thick aluminum alloy. The sign face shall be of 3M high intensity prismatic sheeting meeting the requirements of the Standard Specifications.

Regulatory signs shall be accepted in accordance with Section 9228 of these specifications, with additional certification stating that the retro-reflective sheeting used to manufacture the signs in accordance with the Standard Specifications.

**Entrance Head:** The entrance head shall be of cast aluminum and shall be of the clamp-on type for use with rigid conduit of the type specified in the approved plans. It shall be U.L. listed.

**Service Enclosure:** The service enclosure shall be A PUP meter pedestal, product no. USPAR-M2100-108C-OLA-AL or approved equal.

**Circuit Breakers:** The circuit breakers shall be standard plug-in, single pole, molded case, of the trip rating as shown in the approved plans.

**Ground Rod:** The ground rod shall be 0.75 inch diameter by 10 foot long copper bonded steel rod and bear the U.L. label.

**Ground Rod Clamp:** The ground rod clamp shall be a 0.75 inch clamp cast of high strength copper alloy and be U.L. listed for direct burial.

**Service Wire:** The service wire shall be Type USE-2 standard, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the approved plans.

**Lighting Distribution Wire:** The lighting distribution wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the approved plans.

**Pole & Bracket Wire:** The pole and bracket wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM. B-8 and be of the size specified in the approved plans.

**Ground Wire:** The ground wire shall be No. 6 AWG solid bare copper wire meeting the requirements of ASTM B-3.

**Multi-conductor Cable:** The multi-conductor cable shall meet the requirements of IMSA 19-1. Conductors shall be stranded No. 14 AWG. The quantity of conductors shall be in accordance with the approved plans.

**Shielded Detector Lead-In Cable:** Shielded detector lead-in cable shall be a stranded, four conductor, No. 18 AWG, using water blocking tape with drain wire. Conductors shall be color coded red, green, black, and white. Wire shall not be gel filled and must be pre-approved by the City Engineer.

**Detector Loop Wire:** The detector loop wire shall meet the requirements of IMSA 51-5. The conductor shall be No. 14 AWG, and the tube shall be polyethylene.

**Loop Sealant:** The loop sealant shall be a one-part polyurethane, moisture curing, elastomeric compound requiring no mixing or measuring, prior to or during application. It shall be specifically designed for sealing and protecting detector loop wires in both asphalt and concrete pavements. It shall not chemically attack or damage the pavement, yet shall sufficiently bond with the pavement to effectively seal the saw cut and prevent the infiltration of moisture into the slot. The cured loop sealant shall exhibit resistance to the normally encountered effects of weather, vehicular abrasion, motor oils, gasoline, antifreeze solution, brake fluid, deicing chemicals, and salt in such manner that the performance of the detector loop is not adversely affected. The loop sealant shall provide compressive yield strength to withstand normal vehicular traffic and prevent the intrusion of rocks, glass, and other road debris into the slot. It shall remain sufficiently flexible at all normally encountered temperatures to withstand normal movement in asphalt and concrete pavements while protecting the loop wire from fracture and shear.

**Pre-Formed Loops:** Pre-formed loops shall be factory assembled loops having the dimensions and number of turns of wire specified in the approved plans. The loops shall be constructed of a minimum No. 16 AWG Type TFFN/THWN copper wire meeting the requirements of A.S.T.M. B-8, and encased in heavy duty tubing compatible with the paving material being used on the project. The tubing shall be completely filled with asphalt sealant material after the wire is installed. The loop tail shall be of flexible tubing of the length specified in the approved plans and shall also be filled with asphalt sealant material. The detector wire within the loop tail shall be twisted a minimum of 3 turns per foot/10 turns per meter.

**High Density Polyethylene (HDPE) Conduit:** Polyethylene conduit shall be coil-able, smooth wall, SDR 9 rating, high density polyethylene duct meeting the requirements of NEMA Standard TC-7. Conduit joints shall be made with either a Shur-Lock II coupler

or a fusion welder. Conduit shall be black and be preapproved by the City Engineer.

**Expansion Fittings:** Expansion fittings shall be as detailed in the approved plans.

**9228 BASIS OF ACCEPTANCE.** Acceptance of materials furnished under these specifications shall be based upon the following: Any product called for in the Bill of Materials in the approved plans that is being furnished for the project must be approved. A manufacturer or supplier intending to supply traffic signal materials under these specifications shall submit an original copy of any catalog cuts, shop drawings, drawings, and/or data sheets certifying that the material meets the applicable specifications. This information shall be submitted to the City Engineer for approval.

**Visual Inspection:** Items will be visually inspected by the City Engineer at the job site for condition and conformance with the requirements of these specifications.

All poles, fixtures, and cabinets need to be black in color.

**Additional Requirements:** Additional requirements noted for specific material requirements are provided in Section 9227 of these specifications.