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**CONSTRUCTION AND MATERIAL REQUIREMENTS FOR TRAFFIC SIGNAL INSTALLATIONS**

1. **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 Plans or as otherwise required by the Engineer.

2. **CONSTRUCTION.**

2.1. **GENERAL.** The traffic signal installation shall be constructed according to Section 801 of the Standard Specifications, as modified by these specifications. All incidental parts which are not shown in the 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 Plans or specified herein. The traffic signal system shall be complete and in operation to the satisfaction of the Engineer and the Maintaining Agency at the time of acceptance of the work. All signs, signals, and markings shall conform to the latest edition of the M.U.T.C.D.

2.2. **COORDINATION OF STANDARD SPECIFICATIONS, PLANS, SPECIAL PROVISIONS, AND PROJECT SPECIAL PROVISIONS.** Coordination of discrepancies between the Standard Specifications, Plans, Special Provisions, shall be in accordance with Section 105.04 of the Standard Specifications. 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.

2.3. **CERTIFICATION OF CONTRACTOR PERSONNEL.** All traffic signal installation work shall be done by, or in the presence of and under the responsible charge of an employee of the Contractor who holds a Level II Traffic Signal Electrician or Level II Traffic Signal Technician certification which has been granted by the International Municipal Signal Association, or an equivalent certification approved by the Bureau of Traffic Engineering.

2.3.1. Before starting work, the Contractor shall provide the Engineer with the names of the Level II Traffic Signal Electricians and/or Level II Traffic Signal Technicians who have been assigned to perform traffic signal related work, and a photocopy of each such person's certification card. If the Level II Traffic Signal Electricians or Level II Traffic Signal Technicians are dismissed from the work, all traffic signal installation work shall cease until the names and photocopies of certification cards for replacement personnel are provided to the Engineer.

2.4. **TRAFFIC SIGNAL MATERIALS LIST.** Before commencement of installation of the traffic signals, the Contractor shall submit, for the approval of the Engineer, a complete list of traffic signal materials proposed for the installation. See the materials section of these specifications for the basis of acceptance. The list should be submitted as soon a practicable.

2.5. **LOCATION OF UNDERGROUND UTILITIES.** The plan location of underground utilities are not guaranteed. Additional existing utilities may also be encountered. The Contractor shall have all underground utilities located and marked before beginning any construction excavation, and will be required to work around any existing utilities located within the right-of-way which do not conflict with the proposed construction. The Contractor will be fully responsible for all damages which may be occasioned by failure to exactly locate and preserve all underground utilities.

2.6. **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 for the particular location. 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 Plans. The fees may include, but are not limited to, costs for conduit, lead-in wire, service pole, meter landing, and power used during testing and until the traffic signals are accepted.

2.7. **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 Engineer prior to construction of each item. This work shall be included in the lump sum bid item Traffic Signal Installation.

2.8. **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:

2.8.1. EXISTING OPERATION. Unless otherwise noted in the Plans, the Contractor shall provide continuous operation of the traffic signals during the signal modifications and improvements except for shutdowns to allow for alterations as required for installation of the proposed improvements.

2.8.2. PERIODS OF DISRUPTION. Some periods of disruption of the existing signal operation can be tolerated during installation of the proposed improvements; however, the Contractor shall coordinate any planned disruption of signal operations with the Engineer at least 48 hours in advance of such disruption of operations.

2.8.3. DISRUPTION TIMES. Planned disruption of signal operations shall be limited to the hours between 9:00 a.m. and 4:00 p.m., unless otherwise noted in the Plans. Traffic control during signal disruptions shall be provided as directed by the Engineer. The signal controls shall be operable during all other periods.

2.8.4. EXISTING WIRING. All existing wiring within existing controller cabinets shall be identified by the Contractor and each conductor properly labeled prior to de-energizing the existing controller to install the proposed modifications and improvements.

2.9. **SALVAGED EQUIPMENT.**

2.9.1. 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 complement the salvaged equipment in the new installation.

2.9.2. NOT REINSTALLED. When salvaged equipment is not to be reinstalled, it shall be stored on site for removal by the owner of the equipment. The Contractor shall notify the owner of the equipment within 24 hours of its removal. The stored equipment shall be the responsibility of the Contractor until the owner removes it from the work site. Unless otherwise agreed between the owner and the Contractor, any equipment that is not retrieved by the owner within 3 working days after notification shall become the property of the Contractor.

2.10. **REMOVAL OF EXISTING FOUNDATIONS.** Existing foundations for traffic signal poles, pedestals and controllers shall be removed a minimum of 600 mm below finished grade, and the area backfilled according to the Standard Specifications.

2.11. **CONDUIT INSTALLATION.** Conduit shall be installed per Section 801.04 of the Standard Specifications and as noted below. The conduit shall be of the type indicated in the Plans. If the Plans do not specify the type of conduit, the Contractor may install any approved conduit of the size noted in the Plans, except as noted below. Conduit shall be of one type from outlet to outlet.

2.11.1. Conduit under existing pavement, sidewalk, or driveways shall be installed using an approved jacking or boring method. Conduit under existing pavement in District One shall be installed by using an approved boring method only.

2.11.2. 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 Bridge Management Engineer.

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

2.11.4. The PVC conduit joints shall be made in accordance with the manufacturer's recommendations.

2.11.5. Polyethylene conduit shall be continuous from outlet to outlet, with no splices allowed. Bend radii shall not exceed the manufacturer's recommendations.

2.12. **PULL BOXES.** Service box and junction box installations shall be per Section 801.04 of the Standard Specifications, and as noted below. The location of boxes may be adjusted during installation to clear obstructions and facilitate wiring as approved by the Engineer. 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.

2.12.1. BEDDING. A 200 mm thick layer of aggregate shall be provided under all pull boxes. The aggregate shall meet the requirements of CA-6 described in Subsection 1102 of the Standard Specifications and will be visually accepted by the Engineer.

2.12.2. CONDUIT ENTRANCES. The area around the conduit entrance in in-ground boxes shall be filled with a mortar grout or a silicone sealant.

2.12.3. CABLE HOOKS. Cable hooks shall be installed in service boxes as detailed in the Plans.

2.12.4. 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 butylrubber sealant (caulking compound). Any attachments to bridges on the state highway system must be approved by the Bridge Management Engineer.

2.13. **FOUNDATIONS.** Concrete foundations for poles, pedestals and cabinets shall be constructed per Section 801.04 of the Standard Specifications, as modified below, and as detailed in the Plans.

2.13.1. Reinforcing steel shall meet the requirements of Subsection 1601 of the Standard Specifications. It shall be free of rust and dirt, and shall be of the size, number and dimensions shown in the Plans.

2.13.2. 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.

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

2.13.4. Foundations shall be constructed in one pour. The top 150 mm of pole and pedestal foundations shall be formed in a square and shall be level with the adjacent sidewalk, or approximately 50 mm above finished grade if no sidewalk is present. The work apron on the controller pad shall be level with the adjacent sidewalk or approximately 25 mm above finished grade if no sidewalk is present.

2.14. **TRAFFIC SIGNAL POLES AND PEDESTALS.**

2.14.1. 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 25 mm. The nuts shall be thoroughly tightened to the manufacturer's recommendations and covered with the nut covers provided with the poles.

2.14.1.1. The mast arm and luminaire arm(s) (on combination poles) shall be attached to the pole with the clamps furnished with the poles. The clamps shall be installed to the manufacturer's recommendations.

2.14.1.2. 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 Subsection 1810 of the Standard Specifications. The 25 mm rubber grommets supplied with the poles shall be installed at all outlets for signal wiring before the wires are installed.

2.14.1.3. Once all loads have been applied and the pole has been plumbed, the Contractor shall grout the area between the top of the concrete foundation and the bottom of the pole base plate with a cement mortar grout. Before the grout sets, weep holes shall be formed by inserting a greased 13 mm dowel through the grout and into the bottom of the pole from each side of the base plate. The weep holes shall be sloped so that moisture will drain out of the base.

2.14.1.4. 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.

2.14.2. PEDESTALS. The cast aluminum pedestal bases shall be bolted to the concrete foundation and tightened to the manufacturer's recommendations.

2.14.2.1. 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.

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

2.15. **TRAFFIC SIGNAL HEAD INSTALLATION.**

2.15.1. GENERAL. Signal heads shall be installed as close to signal turn-on as practicable. All signal heads shall be mounted with their faces directed away from traffic, or be completely covered until signal turn-on. Signal heads shall not be installed more than 10 days prior to the signal turn-on, unless otherwise approved by the Engineer.

2.15.1.1. All heads shall be plumbed as viewed from the direction in which they face. The Engineer shall direct the final positioning of the signal heads for optimum visibility.

2.15.2. MAST ARM MOUNTING. Mast arm signal head assemblies shall be rigidly mounted by approved brackets. The brackets shall be securely attached to the mast arm according to the manufacturer's recommendations. Construction shall be such that all conductors are concealed within the assembly.

2.15.2.1. All mast-arm signal heads shall be attached to the mast arm at the time of mast arm installation to minimize the effects of vibration. 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.

2.15.2.2. Mast arm mounted signal heads shall be installed at a height of 4.6 to 5.8 m from the pavement to the bottom of the signal head, with 5.2 m being the desirable minimum height.

2.15.3. SIDE-OF-POLE MOUNTING. Side-of-pole signal heads shall be supported by approved side-of-pole brackets. All members shall be either plumb or level, symmetrically arranged, and securely assembled. Mounting brackets shall be attached to the pole with heavy duty stainless steel banding and buckles. Construction shall be such that all conductors are concealed within the assembly.

2.15.3.1. Side-of-pole traffic signal heads shall be installed at a minimum height of 3 m from the base of pole to the bottom of signal head. Pedestrian signal heads shall be mounted at a minimum of 2.1 m from the base of pole to the bottom of the signal head.

2.16. **WIRE AND CABLE INSTALLATION.**

2.16.1. GENERAL. Wire and cable shall be installed per Section 801.04 of the Standard Specifications, as modified herein, and in accordance with the wiring diagram in the Plans. No splicing of conductors will be allowed except for the following:

2.16.1.1. 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 carefully waterproofed including the end of the loop wire tubing. An approved loop splice kit may be used. Taped splices will not be permitted. The wires shall be positioned in the pullbox so that the splice is situated in the upper 75 percent of the box.

2.16.1.2. MULTICONDUCTOR CABLE IN PEDESTAL BASES. Multiconductor cable runs to pedestal bases shall be spliced in the pedestal base to the multiconductor cables running up the pedestal shaft to the signal heads and/or push-buttons. Each conductor shall be clearly labeled as to its function with a permanent label and the splices shall be carefully 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.

2.16.2. PULLING WIRES AND CABLES THROUGH CONDUIT. When pulling wires into the conduit, a pulling sock or other similar device shall be used to equalize pulling strain on the conductors.

2.16.3. EXCESS CABLE. A minimum of 1m of slack or excess multiconductor cable, detector lead-in cable, loop detector wire, and lighting distribution wire shall be left in each pull box. The excess cable in service boxes shall be neatly coiled and placed on the cable hooks. The excess cable in junction boxes shall be neatly coiled and placed in the bottom of the box. At least 1m of excess multiconductor cable shall be left in each pole base to allow for connection to the terminal block.

2.16.4. TERMINATION OF FIELD WIRES IN THE CABINET. The Contractor shall clearly identify each field wire coming into the cabinet as to its function with a permanent label, and shall connect all field wires to their respective terminals within the cabinet per the wiring diagram furnished with the cabinet.

2.16.5. POLE WIRING. Each signal head shall have a separate run of multiconductor cable from the terminal block in the pole base to the terminal block in the signal head. A separate five-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 five-conductor cable shall run to each pair of pedestrian heads; a two-conductor cable shall run to each pedestrian push-button. The ends of any unused conductors shall be taped.

2.17. **GROUNDING.** The traffic signal system shall be grounded per Section 801.04 of the Standard Specifications and as specified herein. All traffic signal poles, pedestals, controller cabinets, and service circuit breakers shall be grounded by means of a ground wire bolted to the inside of these devices with a 13 mm internal ground lug. All ground wires shall be attached by means of a ground clamp to a ground rod. Ground rods shall be installed as detailed in the Plans.

2.17.1. The detector lead-in shielding and drain wire shall be electrically floating (not attached to earth ground) at the pullbox. The recommendations of the loop detector manufacturer should be followed concerning whether or not the cabinet end is grounded.

2.18. **DETECTOR LOOP INSTALLATION.**

2.18.1. GENERAL. Detector loops shall be installed as close as practicable to the locations shown in the 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 300 mm of a transverse joint.

2.18.2. PRE-FORMED LOOPS. Pre-formed loops shall be installed in new pavement during the pavement construction in accordance with the manufacturer's recommendations. Special care must be taken to place the loops in their proper location in relation to the final lane configuration.

2.18.3. SAW-CUT LOOPS. Saw-cut loops shall be installed in saw cuts as detailed in the Plans. The location of each loop shall be marked on the pavement with crayon or spray paint and approved by the Engineer prior to loop installation. The Contractor shall drill 50 mm 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

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**KANSAS DEPARTMENT OF TRANSPORTATION**

TRAFFIC SIGNAL SPECIFICATIONS

TEI20ASI 04/28/98

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| FHWA APPROVAL | 05/18/98 | | APP'D | Linda G. Voss, P.E. | |
| DESIGNED J.F.F. | DETAILED J.F.F. | | QUANTITIES | TRACED | |
| DESIGN CK. D.A.C. | DETAIL CK. D.A.C. | | QUAN. CK. | TRACE CK. | |

Plotted By : J. Olson Thacher Bldg., 4th Floor
Plot File : I82\TEI120asi
Plot Date : 7-12-99