FHWA REGION NO.	STATE	PROJECT NUMBER	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	KANSAS	618-34	1998	90	169

DESCRIPTION.

This work shall cosist of furnishing and installing all necessary equipment and materials to complete a traffic signal installation in accordance with this Special Provision and as shown on the Plans or established by the Engineer.

SECTION 1: INSTALLATION

1.0 GENERAL: This specification is intended to describe the method and construction requirements for the installation of a traffic signal. The installation shall include all poles, bases, cabinets, controllers, cables, conduits, service boxes, junction boxes, wiring, signal heads, detectors and such other miscellaneous parts or materials as shown on the plans or as otherwise required or specified.

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

The Contractor shall contact any and all local agencies having jurisdiction over such installations and acquire any permits or licenses that may be required. Copies of any permits or licenses shall be supplied to the engineer prior to beginning any construction or installation. The Contractor shall comply with all local ordinances or applicable building codes.

The Contractor shall notify the appropriate power company prior to any service connection to determine the proper type and method of hook-up for the particular locale. The cost of any initial hook-up charge shall be borne by the Contractor. This shall include, but not be limited to, the cost of power supplied for all testing until the signal installation is accepted.

In so far as practicable, major items of electronic equipment such as the traffic signal controller and loop detector units provided and installed under this contract shall be of one type and consist of products from the same supplier in order to secure uniformity, single responsibility, and most satisfactory service.

The Contractor shall arrange for the supplier of the major items of electronic equipment to have a representative at the site prior to turning on the signal.

The Contractor shall notify any utility companies which may have facilities in the work area. Adjustments in elevation of service boxes shall be the responsibility of the Contractor.

2.0 CONSTRUCTION SEQUENCE: The construction sequence for traffic signal installation shall be as listed below unless otherwise directed by the Engineer.

The contractor may submit written request(s) for modifications to this sequence to the Engineer for consideration of approval. No modifications shall take place until approval is granted by the Engineer.

Construction Sequence

(1) Install conduit, service boxes and junction boxes.
(2) Install pole bases and controller pad.
(3) Install controller cabinet and poles. Poles shall be installed without signal heads if more than 15 days will elapse prior to the signal being turned on.
(4) Pull all wire.
(5) Install detector loops.
(6) Terminate wiring and install signal heads if not done in step three.
(7) Turn on signal. Supplier representative shall be present.

When signals are being installed or modified in conjunction with major road construction or geometric improvements, no signal work shall be performed prior to the completion of all dirt work or paving except as noted in the plans.

3.0 CONDUIT: All conductors shall be run between bases, junction boxes, pull boxes, and service boxes in rigid conduit conforming to the provisions of Section 2 of these specifications. The sizes of the conduit used shall be of the sizes shown on the plans except that the Contractor may, at his own expense, use a larger size of conduit if desired. Where larger size conduit is used, it shall be for the entire run from outlet to outlet. No reducing couplings will be permitted.

The ends of all conduit shall be well reamed to remove burrs and rough edges. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used, an approved threaded union conduit shall be used. The threads on all conduit shall be painted with a good quality of lead or rust preventative paint before couplings are made. All couplings shall be fitted and tightened until the end of the conduits are brought together. Where coating on conduit has been injured in handling, or installing, such injured places shall be thoroughly painted with rust preventative paint.

All conduit ends shall be threaded and capped with standard pipe caps until wiring is started. When caps are removed, the threaded ends shall be provided with approved conduit bushings.

Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit bends shall be made without crimping or flattening, using the longest radius practicable.

Conduit set in bases shall extend two (2) to three (3) inches vertically from the top of the base. A plastic or metal conduit bushing shall be installed on the end of all conduit terminating within a base. Conduit entering through the bottom of a pull box shall be located near the ends to leave the major portion of the box clear. Conduit entering concrete service boxes shall not extend more than 5" inside of service box. Conduit entering pull boxes shall terminate in a threaded bell fitting flush with the inside of the box wall and not less than two (2) inches above the bottom. Conduit should be sloped to drain as directed by the Engineer. At all outlets, conduits shall enter from the direction of the run.

Whenever possible, the conduit shall be installed by trenching, and trenches shall run in straight lines between pull boxes and bases. The location of the conduit shall be as shown on the plans, except that where physical obstructions dictate, the location shall be determined by the engineer. Conduit shall be installed to a depth of at least twenty-four (24) inches below finish grade. This requirement may be waived by the engineer where physical conditions or obstructions warrant.

Trenches shall be backfilled with material free of rock and compacted in lifts by hand tamping or with mechanical tampers to the density noted on the plans. If a density is not specified on the plans, trench backfill shall be compacted until, in the opinion of the Engineer, no significant future settlement will occur.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

Conduit runs shown on the plans are for bidding purposes only, and may be changed with permission of the Engineer to avoid underground obstructions. Any additional conduit lengths resulting from approved relocations shall be supplied and installed at Contractor expense.

Conduit placed under existing pavement or sidewalk shall be installed by an approved boring or drilling method. Hydro-boring will not be allowed. The existing pavement shall not be disturbed unless otherwise noted on the plans or approved by the Engineer.

4.0 CONCRETE BASE FOR POLES AND CONTROLLER CABINET: Bases for poles and cabinets shall be reinforced concrete as detailed on the plans. The concrete shall be Commercial Grade. The reinforcing steel shall be free of rust and dirt and shall be of the size, number and dimensions shown on the plans.

Anchor bolts shall be of the size and design recommended by the manufacturer of the particular pole to be installed. They shall extend uniformly above the top of the concrete base a height equal to the manufacturers recommendations.

A 3/4" x 12'-0" copperweld ground rod shall be installed in each base as shown on the plans.

The Contractor shall design an anchor bolt assembly which shall be welded to the rebar cage and the resulting unit inserted in the form for the concrete base. The unit shall be designed and constructed such that, after insertion in the form, it can be checked for proper orientation, elevation and verticality. "Stabbing" of anchor bolts or ground rods will not be permitted.

The location of the bases shall be as shown on the plans. Any variation from the plan location shall be only with the approval of the Engineer.

Traffic signal pole bases shall be constructed in two pours. The initial concrete placement shall end six (6) inches below finish grade. A six (6) inch thick square concrete cap shall be poured when the pole has been erected and plumbed. The top of the base shall be slightly (1/4" to 1/2") higher than the adjacent curb and gutter, or finish grade if no curb and gutter exists.

5.0 WIRING: Wiring shall conform to the appropriate articles of the National Electric Code or subsequent revisions. The conductor from the terminal block in the controller to the signal base shall be a continuous run. No splices of cable will be permitted in conduit or outside of the junction boxes or pole bases unless otherwise specified in the special provisions or on the plans for an overhead wiring system. All splices shall be made above ground in pole or pedestal bases, unless otherwise approved by the engineer.

When conductors and cables are pulled into the conduit, all ends shall be taped to exclude moisture, and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall remain taped.

When pulling conductors through conduits, a powdered soapstone, talc or other approved lubricant shall be used.

A minimum of six (6) feet of slack or excess cable, as applicable, shall be left in each service box for traffic signal cable and detector lead-in wire.

A. SPLICES:

1. SIGNAL CONDUCTOR CABLE: Conductors shall be joined by twisting the conductors. Conductor insulation shall be penciled, trimmed to conical shape, before applying splice insulation. Splice insulation shall consist of an approved waterproof polyurethane insulating compound. The insulation shall be applied to a thickness equal to and well lapped over the original insulation. On high voltage splices two layers of rubber tape conforming to the requirements of A.S.T.M. Designation: D 119 shall be applied over the conductor before placing the polyurethane compound. A minimum of two (2) feet of slack shall be left for each cable at each splice.

2. MULTI-CONDUCTOR CABLE: Where multi-conductor cable is used all conductor splices shall be neatly cabled together and covered with a hot vulconized layer of material suitable to bond with the cable covering. When finished, the joint shall present a covering continuous with original cable covering and shall be completely waterproof. An approved type of water tight splicing box may be used in place of vulcanizing.

When terminating ends of cable at all terminal blocks, the terminal blocks shall be of dead front construction with screws and tubular contacts recessed in a polyethylene housing. The polyethylene housing shall be flexible. The terminal block shall be capable of easily being cut into smaller sections without altering electrical properties. After all connections have been made at the terminal block, the tubular contact areas shall be filled and sealed with an approved clear compound sealant or clear RTV silicone sealant.

6.0 TRAFFIC SIGNAL HEADS: Traffic signal heads mounted on the side of poles or on pedestals shall be ten feet (10') from the ground to the bottom of the signal head.

Traffic signal heads mounted on mast arms or span wire shall be no less than fifteen (15) feet and nor more than nineteen (19) feet from the pavement to the bottom of the signal head. In some instances the Engineer may require the signal to be mounted above fifteen (15) feet for better visibility. Under no circumstances shall the bottom of the signal be more than nineteen (19) feet above the pavement.

The Engineer shall direct the final positioning of the signal heads. Signal heads shall not be installed at any intersection until all other signal equipment, including the controller, is in place and ready for operation at that intersection. As an exception, and only with the prior approval of the Engineer, the signal heads may be mounted if the faces are not directed toward traffic or if the faces are covered.

7.0 POLE INSTALLATION: When installed, the traffic signal poles shall be back raked according to the manufacturer's recommendation to allow for deflection such that the pole will be plumb when loaded.

8.0 LOOP DETECTOR INSTALLATION: The field loop conductor installed in the pavement shall run continuously from the terminating service box, junction box, or base with no splices permitted. The field loop conductors shall be spliced to the lead-in cable and the lead-in cable shall run continuously from the terminating service box, junction box, or base to the detector sensing unit except on multiple loop installations where additional loop conductors may be spliced to the lead-in cable as directed by the Engineer.

All lengths of loop wires that are not imbedded in the pavement shall be twisted with at least two (2) turns per foot, including lengths in conduits and handholes.

The electrical splice between the loop lead-in cable to the controller and the loop wire shall be made by the following method:

(1) Remove all lead-in cable coverings leaving four (4) inches of insulated wire exposed.
(2) Remove the insulation from each conductor of a pair of lead-in cable conductors and scrape both copper conductors with knife until bright.
(3) Remove the insulation from the loop wires and scrape both copper conductors with knife until bright.
(4) Conductors shall be joined by using a #14 butt splice. The two splices shall be staggered to provide adequate insulation. Each splice shall be insulated with layers of thermoplastic or neoprene insulation electrical tape bearing the UL label and encapsulated in an approved polyurethane compound. The tape shall be applied to a thickness equal to and well looped over the original insulation.
(5) The two splices shall then be over wrapped with layers of thermoplastic or neoprene insulation as above and then coated thoroughly with a water proof electrical coating.

The location of each loop shall be marked on the pavement with crayon or spray paint. The contractor shall obtain the approval of the Engineer prior to cutting the saw slots.

The saw shall be 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 1/4" to 3/8" wide saw cut without damage to adjacent areas. A 3/8" wide saw cut is required when the THHN loop wire is inserted into polyvinyl chloride (PVC) tubing. The saw cut shall have sufficient depth to provide a minimum 1" sealant cover above the top wire. Where the loop changes direction, the saw cuts shall be overlapped to provide full depth at all corners. Right angle or corners less than 90 degrees shall not be used.

Before installing the loop wire, the saw cuts shall be checked for the presence of jagged edges or protrusions. Should these exist, they must be removed. 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 system. The slots shall then be cleared of water and dried using oil-free compressed air.

Loop detector conductor shall be installed using a one-eighth (1/8) inch to three-sixteenth (3/16) inch thick wood paddle. If the wire does not lay close to the bottom of the saw cut, it shall be held down by means of a material such as tape or doubled-over pieces of plastic.

Each loop shall be coiled clockwise (or per manufacturers recommended practice) and the beginning conductor banded in the terminating handhole or base with a symbol "S" to denote start of conductor. Each loop shall be further identified by phase or function, as shown on the project plans, with durable tags or as directed by the Engineer.

9.0 GROUNDING: All traffic signal poles, strain poles, pedestals, controller cabinets, and power sources shall be grounded by means of a No. 6 AGW solid bare copper wire bolted to the inside of these devices with a 1/2 inch internal ground lug. All ground wires shall be attached by means of a ground clamp to a copperweld rod unless otherwise shown on the plans. The ground rod shall have a 3/4 inch diameter and a length of 10 feet as minimum dimensions.

SECTION 2: EQUIPMENT

1.0 NEMA CONTROLLER SYSTEM: Each NEMA type traffic signal controller system shall meet all specifications detailed in NEMA Specifications TS2-latest edition including Sections 13 and 14 in their entirety as well as the additional requirements noted below.

A. CONTROLLER UNIT: The controller(s) supplied shall meet requirements outlined in NEMA Specifications TS2-latest edition, and the following requirements:

(1) The controller(s) shall have fully prompted, menu driven programmability. All programming shall be via a front panel 16 pad key board.
(2) The controller(s) shall have a LCD alpha-numeric display. The display screen shall be able to display a minimum of eight (8) lines by forty (40) characters.
(3) The controller(s) shall be capable of time base coordination, standard hard wire coordination, pre-emption, internal diagnostics and internal alarm logging of up to 80 events.
(4) The controller(s) shall use EEPROM for retention of all timing and control parameters. Batteries shall not be used for retention of traffic parameters.
(5) The controller(s) shall be compatible with the most recent version of the Eagle Signal MARC software.

B. CONFLICT MONITOR:

The Conflict Monitor(s) supplied shall meet requirements outlined in NEMA Specifications TS2-latest edition, Part 6, and be capable of detecting the following error conditions:

(1) Simultaneous sensing of active yellow and green or walk inputs on a channel.

(2) Simultaneous sensing of active red and green or yellow or walk inputs on a channel.

If either of these conditions exist for less than 200 msec, the unit shall not trigger. If either of these conditions exist for more than 500 msec, the unit shall trigger.

(3) Absence of a 2.8 second period of an active yellow input on a channel during a red to green to yellow to red sequence.

Functions #1 and/or #2 and #3 shall be enabled on a per channel basis via front panel accessible programming devices. One or both of the above dual combinations (#1 & #2) shall be selectable via front panel accessible programming devices.

(4) Absence of a logic input transition from the cabinet controller watchdog circuitry for 1500 msec (+/- 100 msec) shall cause the unit to trigger. This function shall be enabled via a front panel accessible programming device.

(5) Absence of or an improperly seated Programming Card shall cause the unit to trigger.

Should one of these conditions exist which triggers the unit, it shall cause the output relay contacts to transfer. These contacts shall remain in this state until the unit is reset by activation of the front panel control or the external reset input. AC+ power interruption shall not reset the unit once it has been triggered. Upon restoration of AC+ power to the unit all display indicators shall return to their original state before the interruption.

TRAFFIC SIGNAL SPECIFICATIONS

PREPARED BY
SEDGWICK COUNTY BUREAU OF PUBLIC SERVICES
HIGHWAY DIVISION

DAVID C. SPEARS, P.E. — DIRECTOR/COUNTY ENGINEER

REVISED	SCALE	DESIGNED	TRACED	CHECKED	SHEET NO.
				WDH	
	DATE				
	PLANFILE		TOTAL SHEETS		

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Plotted by: DAW 11-1-97