FHWA REGION NO.	STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
7	KANSAS	87 N-0061-01	1998	61	91

CITY OF WICHITA, KANSAS
SPECIFICATIONS

TRAFFIC SIGNAL INSTALLATION

01. GENERAL

The contractor shall have a licensed journeyman electrician on site while traffic installation work is performed.

The contractor shall notify the appropriate power company prior to any service connection or attachment to determine the proper type and method of hook-up or installation. 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.

02. CONDUIT

All conductors shall be run between bases, junction boxes pull boxes, and services boxes in rigid conduit conforming to the provisions of Section 2 of these specifications. The size of the conduit used shall be of the size as shown on the plans.

The ends of all conduit shall be well reamed to removes 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 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 copped 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 50 mm to 75 mm 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 shall enter through the sides of a pull box and shall leave the major portion of the box clear. Conduit entering concrete service and junction boxes shall not extend more than 125 mm inside of service or junction box as measured along the longitudinal axis of the conduit. Conduit entering service boxes shall be at least 200 mm above the crushed rock bottom of the service hole. Conduit should be sloped to drain as directed by the Engineer. At all outlets, conduits shall enter from the direction of the run.

Wherever possible, the conduit shall be installed by trenching. 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 600 mm 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 compressor 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.

Conduit placed under existing pavement or sidewalk shall be installed by an approved jacking or drilling method. The existing pavement shall not be disturbed unless otherwise noted on the plans or approved by the Engineer. Excessive use of water such that the pavement might be undermined, or the subgrade softened, will not be permitted.

03. CONCRETE BASE FOR POLES AND CONTROLLER CABINET

Bases for poles and cabinets shall be reinforced concrete as detailed on the plans. The reinforcing bars shall be free of rust and dirt and shall be of the size, number and dimensions shown on the plans.

Anchor bolts shall extend uniformly above the finish grade of the concrete base a height equal to the manufacturer's recommendations (leaving at least three threads exposed when secured).

The anchor bolt sizes for the pole bases are to be standardized as follows:

1. Mast arm lengths 5 m through 11 m
   4 – 37 mm Dia. x 1370 mm long x 150 mm hook
   Bolt Circle = 400 m

2. Mast arm lengths 12 m through 17 m
   4 – 44 mm Dia. x 2130 mm long x 150 mm hook
   Bolt Circle = 500 mm

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.

Steel traffic signal pole bases shall be constructed in two pours. The initial concrete placement shall end 150 mm below finish grade. A 150 mm thick, 914 mm square concrete cap shall be poured when the pole has been erected, plumbed, and approved by the Engineer. The top of the base shall be slightly (6 mm to 12 mm) higher than the adjacent curb and gutter, or finish grade if no curb and gutter. Aluminum pedestal bases shall be constructed in one pour as detailed on the plans.

04. WIRING

Wiring shall conform to the appropriate articles of the National Electric Code or subsequent revisions. The conductors 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 junction boxes, service boxes or pole bases unless otherwise specified in the supplemental specifications, special provisions, or on the plans for an overhead wiring system. All signal cable splices shall be made above ground in pole or pedestal boses.

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. Cable shall not be taped or bundled together to be to be pulled or left in conduit.

2 m of slack or excess coble, as applicable, shall be left in each service box for traffic signal cable, and detector lead-in wire.

1 m of slack or excess coble shall be left in each junction box and at each termination point.

Excess cable to be uniformly bundled and secured with threaded stud, as close as possible to top of service boxes and junction boxes.

A. Splices

1. Signal conductor coble – 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 layers of thermoplastic or neoprene insulation electrical tape bearing the label of the Underwriters Laboratories, Inc., applied to a thickness equal to and well lapped over the original insulation, except that on high voltage splices two layers of rubber tape conforming to the requirements at A.S.T.M. designation: D 119 shall be applied over the conductor before placing the thermoplastic tape. The splice shall then be well covered with two layers of friction or other approved tape. At least 1 m of slack shall be left for each cable splice in pedestal and pole bases.

2. When terminating ends of coble at all terminal blocks an approved #14 insulated spade terminal shall be properly crimped on end of each conductor to provide a secure connection.

3. Locking spade terminals shall not be used.

B. Wiring Notes

1. The Contractor shall furnish and install all loop wire, shielded loop lead-in wire, power supply coble and traffic signal coble for the complete operation of the traffic signal.

2. One seven conductor cable shall be run from the controller to each signal pole for pedestrian movement. The following color codes shall be used:

Red	Don't Walk (Phase 2 or 6)
Green	Walk (Phase 2 or 6)
Orange	Push Button (Phase 2 or 6)
White w/Black	Don't Walk (Phase 4 or 8)
Blue	Walk (Phase 4 or 8)
Black	Push Button (Phase 4 or 8)
White	Common

3. One five conductor cable shall be run from the pole base to each 3-section signal head. The following color codes shall be used:

Black	Not Used
White	Common
Red	Red Ball
Green	Green Ball
Orange	Yellow Ball

4. One seven conductor coble per conflicting movement shall be run from the controller to each signal pole. The following color codes shall be used:

White	Common
Red	Red Ball
Green	Green Ball
Orange	Yellow Ball
Blue	Green Arrow
Black	Yellow Arrow
White w/Black	Street Name Sign (where applicable)

5. Each signal head mounted on a signal pole or mast arm shall have one continuous multi-conductor coble run from the pole base to the signal head. A five-section signal head (left turn signal) shall have a seven conductor cable. A three-section signal head (through movement) shall have a five conductor cable; Pedestrian signal heads shall have a five conductor cable; Each push-button shall have a two conductor cable.

6. A single conductor stranded No. 8 green wire shall carry the equipment ground from the grounding lug of all signal poles to the controller cabinet and the power disconnect box.

7. One five conductor cable shall be run from the pole base to pedestrian signal head. The following color codes shall be used:

White	Common (All Phases)
Red	Don't Walk (Phase 2 or 6)
Green	Walk (Phase 2 or 6)
Orange	Don't Walk (Phase 4 or 8)
Black	Walk (Phase 4 or 8)

8. Identify cable runs in cabinet.

05. 332 CABINET WIRING AND CABLE IDENTIFICATION

The following is the standard City of Wichita specifications for wiring and labeling cables in a 332 cabinet and shall be closely followed, any deviation from these specifications must be approved by the Engineer or his representative:

A. Cabinet Wiring

1. All cables shall have adequate excess cable at their terminations so there is no tension on the conductors.

(a) Traffic signal cables shall be 1.5 m in length and stripped back 1 m.

(b) Pedestrian signal cables shall be the same as the signal cables except the push button conductors shall be 2.5 m in length to reach the proper terminal point without the use of a butt splice.

(c) Detector feeder cable shall be 2.5 m in length and stripped back 200 mm.

2. The cables shall be formed in such a manner so that any access panels can be lowered without interference.

3. There shall not be any use of tape on the stripped out conductors.

4. Nylon-cable ties shall not be used on any field cables except those used for identification.

5. The drain wire of each detector feeder shall be covered with a tube type covering (i.e., shrink tube) not more than three (3) times the diameter of the wire.

6. All cable fillers shall be removed from stripped back cable.

7. Each conductor shall be separately terminated with a non-locking, insulated block fork terminal of the appropriate size.

8. All conduits entering the cabinet base shall be closed with an approved duct seal.

9. All excess cable shall be neatly formed in the bottom of the cabinet.

10. All cables terminating at the input files shall be run in the provided pan ducts.

11. All traffic and pedestrian signal cables, also detector feeders, shall be permanently and legibly identified by the use of Nylon Identification Cable Ties. Traffic signal and pedestrian signal cables shall have a marking pad size of 12 mm x 22 mm (i.e., TY-RAP #TY546M). Detector feeders shall have a marking pad size of 25 mm x 8 mm (i.e., TYP-RAP #TY551M). The legends shall be made with a permanent type marking pen.

The following legends shall be used:

(a) Traffic signal and pedestrian signal cables

"NW Sigs." = Traffic signal cable to NW corner
"NW Peds." = Pedestrian signal cable to NW corner

"NE Sigs." = Traffic signal cable to NE corner
"NE Peds." = Pedestrian signal cable to NE corner

"SW Sigs." = Traffic signal cable to SW corner
"SW Peds." = Pedestrian signal cable to SW corner

"SE Sigs." = Traffic signal cable to SE corner
"SE Peds." = Pedestrian signal cable to SE corner

(b) Detector Feeders

"WBLT" = Phase 1 Westbound Left Turn Loop
"EB FAR" = Phase 2 Eastbound Far Advance Loop
"EB MID" = Phase 2 Eastbound Middle Advance Loop
"EB CLOSE" = Phase 2 Eastbound Close Loop
"EB RT. LN." = Phase 2 Eastbound Right Lane Loop (If Applicable)
"EB LT. LN." = Phase 2 Eastbound Left Lane Loop (If Applicable)
"SBLT" = Phase 3 Southbound Left Turn Loop
"NB FAR" = Phase 4 Northbound Far Advance Loop
"NB MID" = Phase 4 Northbound Middle Advance Loop
"NB CLOSE" = Phase 4 Northbound Close Loop
"NB RT. LN." = Phase 4 Northbound Right Lane Loop (If Applicable)
"NB LT. LN." = Phase 4 Nothbound Left Lane Loop (If Applicable)
"EBLT" = Phase 5 Eastbound Left Turn
"WB FAR" = Phase 6 Westbound Far Advance Loop
"WB MID" = Phase 6 Westbound Middle Advance Loop
"WB CLOSE" = Phase 6 Westbound Close Loop
"WB RT. LN." = Phase 6 Westbound Right Lane Loop (If Applicable)
"WB LT. LN." = Phase 6 Westbound Left Lane Loop (If Applicable)
"NBLT" = Phase 7 Northbound Left Turn Loop
"SB FAR" = Phase 8 Southbound Far Advance Loop
"SB MID" = Phase 8 Southbound Middle Advance Loop
"SB CLOSE" = Phase 8 Southbound Close Loop
"SB RT. LN." = Phase 8 Southbound Right Lane Loop (If Applicable)
"SB LT. LN." = Phase 8 Southbound Left Lane Loop (If Applicable)

12. The traffic signal and pedestrian signal field wires shall terminate at the following locations in all 332 cabinets:

WBLT – RED 125, YELLOW 126, GREEN 127
EB SIGS. – RED 128, YELLOW 129, GREEN 130
EB PEDS. – DW 113, WALK 115
SBLT – RED 116, YELLOW 117, GREEN 118
NB SIGS. – RED 101, YELLOW 102, GREEN 103
NB PEDS. – DW 104, WALK 106
EBLT – RED 131, YELLOW 132, GREEN 133
WB SIGS. – RED 134, YELLOW 135, GREEN 136
WB PEDS. – DW 119, WALK 121
NBLT – RED 122, YELLOW 123, GREEN 124
SB SIGS. – RED 107, YELLOW 108, GREEN 109
SB PEDS. – DW 110, WALK 112

13. The detector feeders and the pedestrian pushbutton field wires shall terminate at the following locations in all 332 cabinets:

a. Detector Feeders

WBLT – I-1-DE
EB FAR ADV – I-2-DE
EB MID ADV – I-2-JK
EB CLOSE – I-3-DE
SBLT – I-5-DE
NB FAR – I-6-DE
NB MID – I-6-JK
NB CLOSE – I-7-DE
EBLT – J-1-DE
WB FAR – J-2-DE
WB MID – J-2-JK
WB CLOSE – J-3-DE
NBLT – J-5-DE
SB FAR – J-6-DE
SB MID – J-6-JK
SB CLOSE – J-7-DE

All drain wires to terminate at terminal L of the corresponding slot.

b. Pedestrian Pushbuttons

EB PEDS. – I-12-D
NB PEDS. – I-12-J
WB PEDS. – I-13-D
SB PEDS. – I-13-J

14. If any additional loop or field wire terminations are necessary, their location will be determined by the Engineer or his representative.

06. MAST ARM AND POLE BASE CABLE IDENTIFICATION

The following is the specification for identifying all cables used in the complete operation of the traffic signals which are located in mast arms and pole bases.

The through traffic and pedestrian signal cables shall be legibly identified with the use of Nylon Identification Cable Ties. The marking pad size shall be 12 mm x 22 mm (i.e., TY-RAP #TY546M). The legend shall be made with a permanent type marking pen.

The pushbutton cables shall be legibly identified with the use of Nylon Identification Cable Ties. The marking pad size shall be 25 mm x 8 mm (i.e., TY-RAP #TY551M). The legends shall be made with a permanent type marking pen.

A. Mast Arm Traffic and Pedestrian Signal Coble Legends

1. Mast Arm Signal Cables

"Lt. Turn Sig." – Left Turn Signal
"Out Bd. Sig." – Farthest Through Traffic Signal from Pole
"Center Sig." – Next Farthest Through Traffic Signal from Pole (If Applicable)
"In Bd. Sig." – Closest Thru Traffic Signal to Pole
"SOP Sig." – Side of Pole Through Traffic Signal

2. Pole Mounted Pedestrian Signals and Pushbuttons

"Ped. Sig." – Pedestrian Signal
"Ph.2 P.B." – All Phase 2 Pushbuttons
"Ph.4 P.B." – All Phase 4 Pushbuttons
"Ph.6 P.B." – All Phase 6 Pushbuttons
"Ph.8 P.B." – All Phase 8 Pushbuttons

07. TRAFFIC SIGNAL HEADS

Traffic signal heads mounted on the side of poles or on pedestals shall be 3 m from the ground to the bottom of the signal head.

Type II side-of-pole pedestrian signal bracket to be mounted on back side of pole 135° clockwise from mast arm.

Traffic signal heads mounted on mast arms or span wire shall be no less than 4.6 m and no more than 5.8 m from the pavement to the bottom of the signal head. In some instances the Engineer may require the signal to be mounted above 4.6 m for better visibility. Under no circumstances shall the bottom of the signal be more than 5.8 m 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, except that the signal heads may be mounted if the faces are not directed toward traffic or if the faces are covered.

08. 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.

09. 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 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 embedded in the pavement shall be twisted with at least six (6) turns per meter, 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 and ground wire, leaving 100 mm of insulated wire exposed.

2. Remove the insulation from each conductor of the lead-in cable and scrape both copper conductors with knife until bright.

3. Remove appropriate length of insulation from the ends of 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 label of the Underwriters Laboratories, Inc., applied to a thickness equal to and well looped over the original insulation.

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 6 mm wide saw cut without damage to adjacent areas. The depth of the saw cut shall be 90 mm deep. 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° 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 clean with a stream of water, and following this, the slots should be cleared of water and dried using oil-free compressed air.

Loop detector conductor shall be installed using a 3 mm to 5 mm thick wood paddle.

Each loop shall be coiled clockwise (or per manufacturer's 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.

Each loop spliced to lead-in cable, checked at control cabinet, shall not measure less than 100 megohms to ground.

Contractor to supply City of Wichita with a typed record of loop inductance and resistance to ground of each loop measured at cabinet. Provide the date each loop was checked.

10. COMMUNICATIONS CABLE

A. Coble

Cable used for intersection communication shall be six pair #19 AWG shielded cable conforming to the requirements of Specification 20-2 of the IMSA. Shielding shall also conform to IMSA Specifications.

B. Splices General

Communications cable splices shall be made at the communications terminal block within the signal controller cabinet whenever possible. Other necessary cable splices shall be made only with approval of the project engineer in the manner dictated below.

C. Underground Splices

Underground communications cable splices shall be made only within service boxes or utility manholes using an approved waterproof, re-enterable splice kit with multiple port and caps if necessary. The splices shall be staggered heat shrinkable insulated butt splices. The splice kits shall be filled with an approved non-hardening, waterproof encopsulant
The enclosure shall be transparent and capable of being racked in the service box or manhole immediately after filling with encopsulant. The contractor shall rack all splice kits after filling with encopsulant.

D. Aerial Splices

Aerial splices shall be made using a terminal block.

E. Shield Grounding

Communications cable shielding shall be grounded at one point only – at the control center in City Hall for CBD zones and at the on-street master cabinet for non-CBD zones. Shielding at all splice points (aerial, underground or at the controller cabinet) shall be connected together using shield connectors and a #14 THNN stranded, white insulated wire with a ring tongue connector on each end as a bonding jumper between the shield connectors. Proper insulation shall be used on all bare parts of the bonding system to prevent contact with the messenger cable or other metal parts in the closure.

F. Testing

A continuity test and an insulation resistance test of each communications pair (including spares) will be conducted in the presence of the project engineer or his representative. During the tests, all transient suppression devices shall be disconnected. If any test fails, repairs shall be made by the contractor and the entire test for that cable circuit shall be repeated.

G. Continuity Test

The continuity test shall be made between a point upstream of where the new communications cable is spliced to the existing cable and each new field termination point. Each conductor in a pair shall show a resistance of not more than 10 ohms per 300 m of AWG #19 conductors. The resistance shall be measured with a meter having a minimum resistance of 20,000 ohms/volt. Contractor to supply City of Wichita with a typed record of the resistance of each paired conductor.

H. Insulation Resistance Test

The insulation resistance test shall be measured with all other connections to the conductor under test removed, and all other conductors in the cable and the shield grounded. The measurement shall be made with a direct current potential of not less than 360 volts nor more than 550 volts applied for one minute. Insulation resistance shall exceed 3,000 megohm-km. The contractor to supply City of Wichita with typed record of the resistance of each conductor.

NO.	DATE:	REVISIONS	BY	APP'D
3				
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1				

CITY OF WICHITA
DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGNAL SPECIFICATION

FHWA APPROVAL	SCALE	APP'D	
DESIGNED	DETAILED	QUANTITIES	
DESIGN CK.	DETAIL CK.	QUAN. CK.	DATE: