

FHWA REGION NO.	STATE	PROJECT NUMBER	FISCAL YEAR	SHEET NUMBER	TOTAL SHEETS
7	KANSAS	87N-0195-01	2001	85B	127

CITY OF WICHITA, KANSAS  
SPECIFICATIONS  
TRAFFIC SIGNAL INSTALLATION

DATE	BY	REFERENCES NOTED	CHECKED

01. GENERAL

The contractor shall have a licensed journeyman electrician on site while traf-  
fic 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 con-  
tractor. 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 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 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 m

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 con-  
structed 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 con-  
troller 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 bases.

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 pulled or left in conduit.

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

1 m of slack or excess cable 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 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 layers of thermoplastic or neoprene insulation electrical  
tape bearing the label of the Underwriters Laboratories, Inc., applied  
to a thickness equal to and well taped over the original insulation,  
except that on high voltage splices two layers of rubber tape con-  
forming to the requirements of 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 cable 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 cable and traffic signal cable 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 8)
Orange	Walk (Phase 2 or 8)
White w/Black	Push Button (Phase 4 or 8)
Blue	Don't Walk (Phase 4 or 8)
Black	Walk (Phase 4 or 8)
White	Push Button (Phase 4 or 8)
	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 cable 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 cable 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 representa-  
tive:

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 Identifi-  
cation Cable Ties. Traffic signal and pedestrian signal cables shall  
have a marking pad size of 12 mm x 22 mm (i.e., TY-RAP #1Y546M).  
Detector feeders shall have a marking pad size of 25 mm x 8 mm  
(i.e., TYP-RAP #1Y551M). 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 Northbound Left Lane Loop (If Applicable)  
"EBLT" = Phase 5 Eastbound Left Turn Loop  
"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 - 1-1-DE  
EB FAR ADV - 1-2-DE  
EB MID ADV - 1-2-JK  
EB CLOSE - 1-3-DE  
SBLT - 1-5-DE  
NB FAR - 1-6-DE  
NB MID - 1-6-JK  
NB CLOSE - 1-7-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. - 1-12-D  
NB PEDS. - 1-12-J  
WB PEDS. - 1-13-D  
SB PEDS. - 1-13-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 com-  
plete 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 #1Y546M). The legend shall be made with a  
permanent type marking pen.

The pushbutton cables shall be legibly identified with the use of Nylon Identifi-  
cation Cable Ties. The marking pad size shall be 25 mm x 8 mm (i.e.,  
TY-RAP #1Y551M). The legends shall be made with a permanent type marking pen.

A. Mast Arm Traffic and Pedestrian Signal Cable 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 equip-  
ment, 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 hand-  
holes.

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 elec-  
trical 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 handle 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. Cable

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 encapsulant.  
The enclosure shall be transparent and capable of  
being racked in the service box or manhole immediately after filling with  
encapsulant. The contractor shall rack all splice kits after filling with  
encapsulant.

D. Aerial Splices

Aerial splices shall be made using a terminal block.

NO.	DATE	REVISIONS	BY	APP'D
3				
2				
1				
KANSAS DEPARTMENT OF TRANSPORTATION BUREAU OF TRAFFIC TRANSPORTATION				
TRAFFIC SIGNAL SPECIFICATION				
FHWA APPROVAL	SCALE	APP'D		
DESIGNED	DETAILED	QUANTITIES		
DESIGN CK.	DETAIL CK.	QUAN. CK.	DATE	