

CITY OF WICHITA, KANSAS
SPECIFICATIONS
TRAFFIC SIGNAL INSTALLATION

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 mm
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 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 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 lapped over the original insulation,
except that on high voltage splices two layers of rubber tape con-
forming 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 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 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 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	Yellow 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 #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 Northbound 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 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 #TY546M). The legend shall be made with a
permanent type marking pen.

The pushbutton cables shall be legibly identified with the use of Nylon Identi-
fication 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 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.

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

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. 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-entrable 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.

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, under-
ground or at the controller cabinet) shall be connected together using
shield connectors and a #14 THHN 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.

3				
2				
1				
NO.	DATE	REVISIONS	BY	APP'D
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:	