Inspector's Manual For Signal Construction

2016

Oregon Department of Transportation
Technical Services
Traffic-Roadway Section
Traffic Standards Unit

Oregon Department of Transportation

The objective of this manual is to provide Project Managers and Inspectors with general information to assist in the successful installation and completion of traffic signals and other highway electrical projects on the state highway system in compliance with the contract documents. This manual assumes that Preliminary Engineering and Design Engineering have been done correctly.

The material contained herein is for informational purposes only and does NOT replace, modify or supersede any contract document. As such, this material may or may not apply to any particular signal design or installation depending upon the individual factors present at each location.

In case of conflict between this manual and any of the contract documents, the priority stated in subsection 00150.10 of the Specifications is used:

00150.10(a) Order of Precedence - The Engineer will resolve any discrepancies between these documents in the following order of precedence:

- Contract Change Orders;
- Special Provisions;
- Agency-prepared drawings specifically applicable to the Project and bearing the Project title;
- Reviewed and accepted, stamped Working Drawings;
- Standard Drawings;
- Approved Unstamped Working Drawings;
- Supplemental Specifications;
- Standard Specifications; and
- All other contract documents not listed above

For additional traffic signal information and to find the most current version of this manual (updated each year in January) visit the Traffic Signal Standards website:

http://www.oregon.gov/ODOT/HWY/TS/pages/signals.aspx

- Signal Operational Approvals
- Flashing Yellow Arrows
- Traffic Signal Policy & Guidelines
- Traffic Signal Design Manual
- Drafting Manual
- Technical Advisors & Bulletins
- Microstation Cabinet Prints
- Std. Dwgs. and Details
- **Product Approval & Evaluation (Blue, Green, & Red Sheets)**
- Drawings & Database (FileNet)

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Materials

Blue, Green and Red Sheets

- The "Blue" Sheets are described in detail, starting on page 3.
- The "Green" sheets are described in detail, starting on page 57.
- The "Red" sheets are described in detail, starting on page 2.

Pre-qualified materials (QPL)

There are several items used for traffic signal installations that are specified from the standard Qualified Products List (QPL):

- Backer rod material (used in loop detector sawcut): 00990.10
- Hot-melt loop sealant: 00990.10
- Crosswalk Closure Barricade Support (i.e. Mailbox supports): 00902 then 01070
- Portable Temporary Traffic Signal: 00225.15(b)
- Qualified manufacturers for reinforcing steel (for foundations): 00963.10 then 00530 & 02510

The QPL on-line at:
http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/Pages/qpl/QPIndex.aspx

Pole & Luminaire Submittals

The following materials require submittals (00962.02 then 00150.35):

- Mast arm poles & arms (drawings and calculations)
- Strain poles (drawings and calculations)
- Luminaire extensions & arms (drawings)
- Luminaires and lamps (sample and cut sheets). 00970.02 & 00970.03.

Pole shop drawings must be stamped by an Oregon Registered Professional Engineer. Pre-approved manufacturing shop drawings must bear a "reviewed" stamp from the ODOT Traffic Structures Engineer prior to use on the project.

Non Field-Tested Materials Acceptance Guide

The NonField-Tested Materials Acceptance Guide contains a summary of information on required acceptance documents (00960 thru 00990). See 00165.10(b). On-line:
http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/docs/nftmag.pdf

Verifying Stainless Steel

The majority of fasteners and hardware used for traffic signal installation are required to be stainless steel (Type 304 or 316). A quick and easy way to verify a material is stainless steel is to use a magnet. Stainless steel is NOT magnetic.

Red Sheet Materials

Pursuant to **ORS 479.540** and **OAR 918-261-0037** the following "qualified products list" now known as the "RED SHEETS" was created. This list **IS NOT** used for construction qualification or approval of products during construction, but as a statewide list of certification exempt traffic management systems components used by ODOT and other applicable public agencies. The exemption from certification removes the UL or NRTL certification requirements of RED SHEET listed items used in traffic management systems. The current version of the RED SHEETS can be found http://egov.oregon.gov/ODOT/HWY/TRAFFIC/Signals.shtml

The red sheets should be given to the State Building Code, City or County Electrical Inspector on the project if there are issues about a lack of UL or NRTL certification for traffic signal equipment.

Red Sheet List – Revised 7/16/14

Any item that is listed in the ODOT maintained prequalified products list known as the BLUE SHEETS.

Any item that is listed in the ODOT maintained prequalified products list known as the GREEN SHEETS.

BRAND / MANUFACTURER	MODEL	PART#	CODE*
CONTROLLER CABINET			
Safetran	337		COP
McCain	337	M30730	COP
PREEMPTION INTERFACE (Cabinet)			
3M Opticom	754		COP
CONDUIT REPAIR			
Carlon	Split Duct		ODOT
BRIDGE SUBMARINE CABLE			
Draka	Standard Bridge Submarine Cable		ODOT
MOVABLE BRIDGE VERTICAL WARNING GATES			
B&B Roadway	VW-4		ODOT
GROUND/BOND CONNECTORS			
Hubbell/Anderson/Fargo	GC5004		COP
Hubbell/Anderson/Fargo	LC522AXB		COP
Thomas & Betts	TTC2		COP

*** Agency Code:**
ODOT = Oregon Department of Transportation
COP = City of Portland

Blue Sheet Materials

The "Submittals for Field Qualification Equipment and Materials – Electrical Equipment and Materials" (commonly referred to as the "Blue Sheets") contain a list of materials and equipment that are normally qualified by the Inspector. Brand names and model numbers are listed for most types of equipment. As per standard specification 00960.02, the contractor must submit two copies of the current version of the Blue Sheets **prior to starting work**.

The Blue Sheets are updated frequently by the Traffic Signal Standards Unit. Use the most current version that is in effect at the date of the bid let. Verify the date of the current version at the website below or contact the Traffic Signal Engineer: http://www.oregon.gov/ODOT/HWY/TS/pages/signals.aspx.

The inspector is responsible for:

- The initial qualification of materials before they are installed. This is documented on the blue sheet's "Initial Submittal" box for each material. Exception: Write-in materials require initial qualification by the TRAFFIC SIGNAL ENGINEER (NOT the Engineer of Record).
- Obtaining CMO's, if required. This is documented on the blue sheet's "CMO Required" box for all applicable materials.
- Inspecting and accepting all blue sheet materials that are installed on the project. This is documented on the blue sheet's "Inspected & Accepted on Project" box for each material.

Materials arriving at the project site should be accompanied by proper certifications. No materials shall be installed until certifications are received and checked for compliance by the Inspector. Field verify that materials checked on the Blue Sheets are the same parts to be incorporated into the project; if not, NEW submittals will need to be submitted.

Catalogue Cut Sheets/Write-in Materials

If the contractor proposes to use a material that is not listed in the Blue Sheets (write-in material), the contractor shall submit a catalogue cut sheet for that material. The cut sheet shall identify the specific product intended to be used; manufacturer's name, identifying number, size, detailed scale drawings, wiring diagrams, etc. **Mail, Fax, or e-mail the Blue Sheet for the material & the cut sheet(s) to the TRAFFIC SIGNAL ENGINEER (NOT the Engineer of Record) for initial qualification of the material.**

Read the instructions included in the Blue Sheets carefully.
They are up-to-date and always printed with the sheets.

This page intentionally left blank

Blue Sheet Example

Table of Contents

The contractor will check boxes if the material is NOT on the project. For all boxes checked, the material page(s) for these items should be deleted from the submittal.

Table of Contents page

BLUE SHEETS

Page 3

CONTENTS

PAGE NO.		NOT ON PROJECT
COMMON ELECTRICAL		
7.	BOND WIRES	☐
8.	BONDED BUSHINGS	☐
9.	CABLE TIES	☐
10.	CONDUIT (METALLIC)	☐
11.	CONDUIT (NON-METALLIC)	☐
12.	CONDUIT BUSHINGS	☐
13.	CONDUIT HUB & CONDULET	☐
14.	CONDUIT PLUG	☐
15.	EXPANSION FITTING	☐
16.	GROUND ROD & CLAMP	☐
17.	JUNCTION BOXES (CAST IRON)	☐
18.	JUNCTION BOXES (CONCRETE)	☐
19.	JUNCTION BOXES (HYBRID)	☐
20.	JUNCTION BOXES (HAND HOLE)	☐
21.	TERMINAL BLOCKS	☐
22.	TI IWN WIRE	☐
23.	UNDERGROUND WARNING TAPE	☐
24.	XTRA BLANK FORM	☐

INITIAL SUBMITTAL

☐ AGREE WITH "NOT ON PROJECT"

☐ RETURNED FOR CORRECTION

Date:_____

Name:_____

CTSI Card#_____

Qualifications or corrections are subject to all requirements of the current issue of the Standard Specifications for Highway Construction as modified by the Project Special Provisions.

Revised July 22, 2014

Contract No._____

Always check the revision date! Use the most current version.

The "Initial Submittal" box is for inspector use only.

Complete this after contract is awarded and BEFORE work starts.

Inspector will review the contents page. If it looks correct check "agree" box. If it doesn't look correct check "returned" box and send back to contractor for correction.

The material name, description, and use are described for each material.

BLUE SHEETS

BONDED BUSHINGS

DESCRIPTION: Metallic conduit bushings with a lug to clamp bond wires, Insulated throat. Aluminum not allowed.

USE: On ends of conduit allowing bonding of the conduit system.

BRAND/MANUFACTURER	CATALOGUE/PART NO.
☐ Blackjack (T&B)	'BG' series
☐ Appleton	'GIB' series
☐ Crouse-Hinds (Lazy Lug)	'GLL' series
☐ Arlington Industries	452 thru 457
☐ Bridgeport	#383 thru 390
☐ RACO	1214
☐ RACO	1216
☐ RACO	1218
☐ RACO	1290
☐ RACO	1292
☐ O-Z/Gedney	BLG
☐ O-Z/Gedney	HBLG
☐ _____	_____
☐ _____	_____

Contractor may also write-in materials proposed for installation based on the project plans and specs. **A catalogue cut sheet MUST be submitted for write-in materials.**

Revised July 22, 2014 Contract No._____

Contractor will check box(es). Except for conduit and wire, DO NOT CHECK MORE THAN 2 BOXES.

Always check the revision date! Use the most current version.

Blue Sheet Example

Material Page for Bonded Bushings

Complete this after contract is awarded and BEFORE work starts.

Inspector will review the material page. If it looks correct check "Qualified" box. If it doesn't look correct check "returned" box and send back to contractor for correction.

Submit write-in materials and cut sheet to the Traffic Signal Engineer for approval.

The "Qualified as Noted" box typically only used by the Traffic Signal Engineer for write-ins.

Page 8

INITIAL SUBMITTAL

☐ QUALIFIED
☐ QUALIFIED AS NOTED
☐ RETURNED FOR CORRECTION

Date:_____

Name:_____

CTSI Card#_____

Qualifications or corrections are subject to all requirements of the current issue of the Standard Specifications for Highway Construction as modified by the Project Special Provisions.

Complete this after work is installed for the entire project.

Inspector will check one of the two boxes.

Write-in the "quantity accepted" and/or "quantity rejected". Writing in "ALL" is acceptable.

INSPECTED & ACCEPTED ON PROJECT

Date:_____

Name:_____

CTSI Card#_____

☐ Verified Materials By Markings/Packaging
Quantity accepted _____
Quantity rejected _____

☐ Materials Accompanied By Manufacturer's or Supplier's Certification (Copy attached)
Quantity accepted _____
Quantity rejected _____

CMO REQUIRED (If steel or iron, see specifications)

☐ Received Date: _____

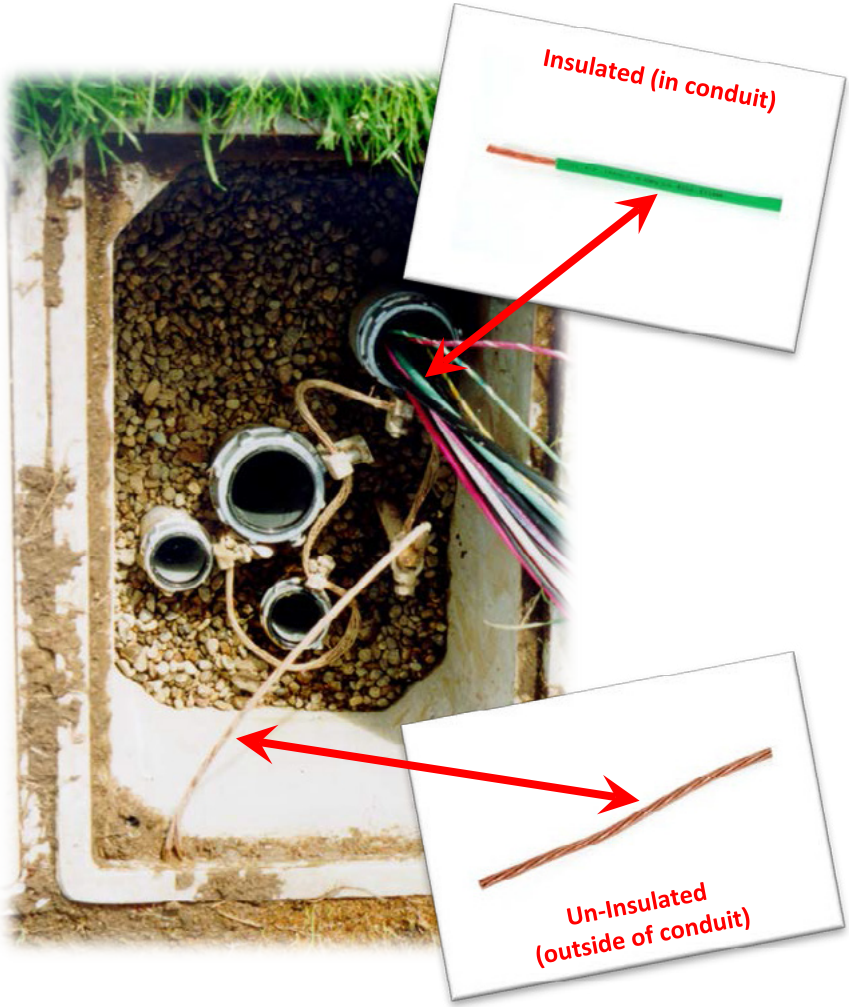
If CMO is required for a material, this check box will be on the page. Inspector will check box and date when CMO is received.

Bond Wire

DESCRIPTION: Typically 6 AWG, 7 Strand copper wire. THWN insulated required when installed in conduit.

USE: Bond/grounding wire for 120V AC circuits.

Typical Sources of Info:
Specs: 00960.50(a) & 02920.23
Std. Dwg: TM450, TM452, & TM472
Plan Sheets: NO
Additional Installation Info: pg. 144



Bonded Bushings

DESCRIPTION: Metallic conduit bushings with a lug to clamp bond wires and an insulated throat. Aluminum not allowed.

USE: On the ends of conduit, allowing bonding of the conduit system.

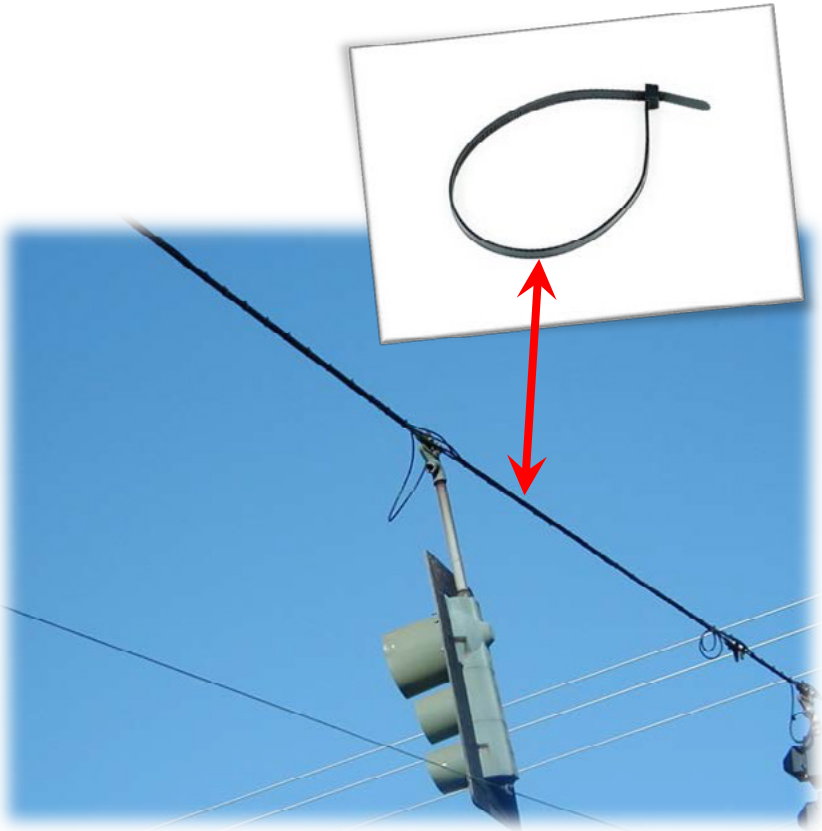
Typical Sources of Info:
Specs: 00960.42(4) & 02920.12
Std. Dwg: TM472
Plan Sheets: NO
Additional Installation Info: pg. 144

Cable Ties

DESCRIPTION: Black nylon or plastic strips UV resistant, with a positive, non-release binding. No metal grippers allowed.

USE: Strapping control cable/wire to messenger cable on spans. Installed at 6" spacing.

Typical Sources of Info:
Specs: 00990.40(b) & 02920.22
Std. Dwg: TM452
Plan Sheets: NO
Additional Installation Info: pg. 148



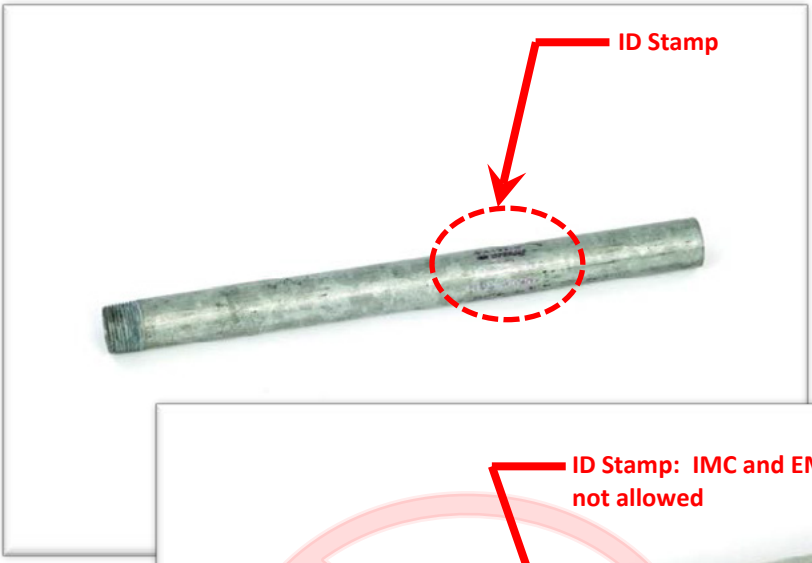
Conduit (Metallic)

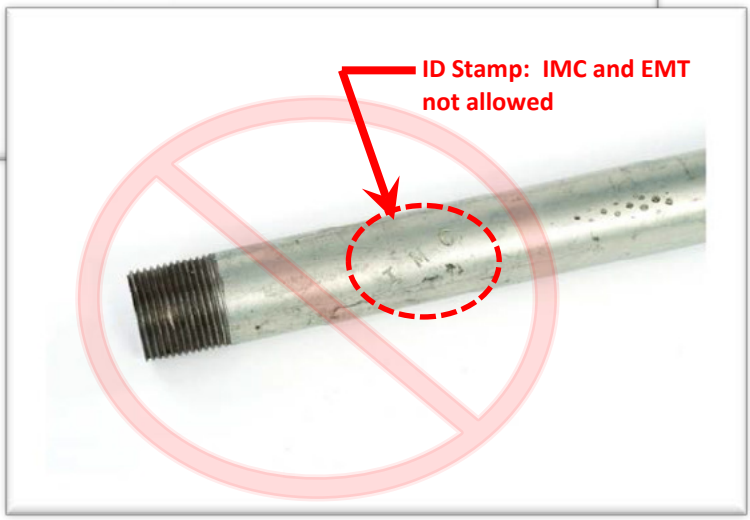
DESCRIPTION: Galvanized rigid conduit and fittings and liquid-tight flexible metal conduit. IMC (Intermediate Metallic Conduit) or EMT (Electrical Metallic Tubing) not allowed.

USE: Houses electrical conductors.

Typical Sources of Info:
Specs: 00960.41, 00960.42 & 02920.10
Std. Dwg: NO
Plan Sheets: YES (size & location), Typically NO (material type)
Additional Installation Info: pg. 124

S CS W





Conduit (Non-Metallic)

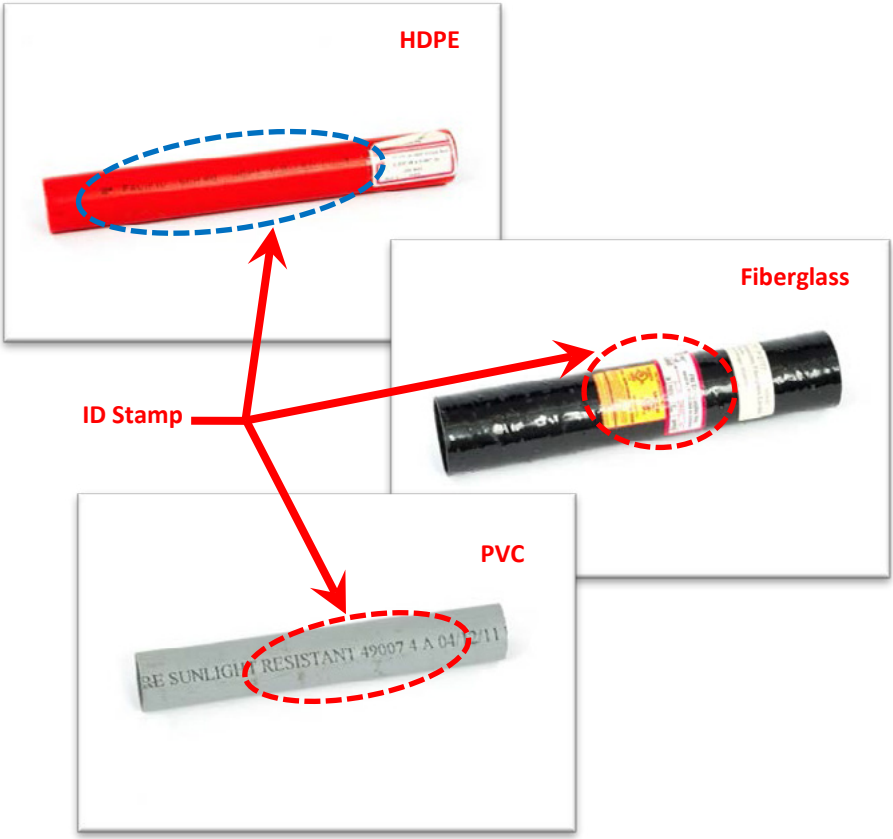
DESCRIPTION:

- High Density Polyethylene (HDPE) , schedule 40 standard
- Fiberglass rigid non-metallic conduit and fittings, schedule 40. Typically used for elbows
- PVC (marked for electrical use, typically Grey), schedule 40 standard

USE: Houses electrical conductors.

Typical Sources of Info:
Specs: 00960.42 & 02920.11
Std. Dwg: NO
Plan Sheets: YES (size & location), Typically NO (material type)
Additional Installation Info: pg. 124

S CS W

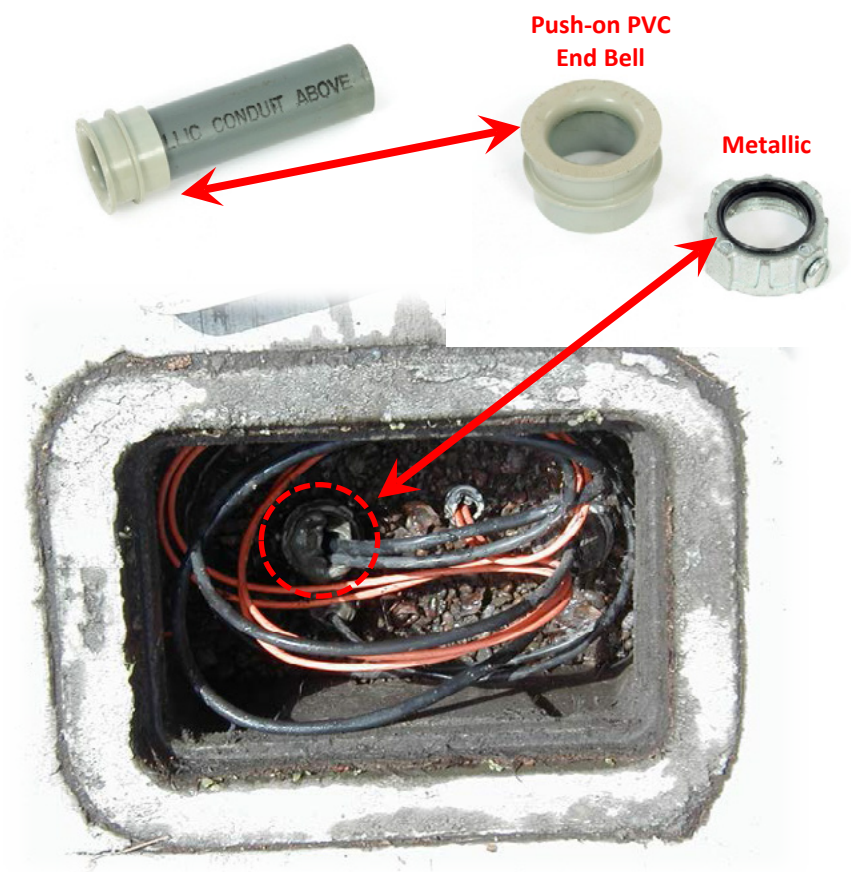


Conduit Bushings

DESCRIPTION: Conduit bushings with insulated throat but no bonding lug. Metallic style has an insulated throat.

USE: Used on the ends of conduit when bonding lugs are not required to protect the electrical wiring.

Typical Sources of Info:
Specs: 00960.42(g)(4) & 02920.12
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pg. 146



Conduit Hub and Conduit Body

DESCRIPTION:

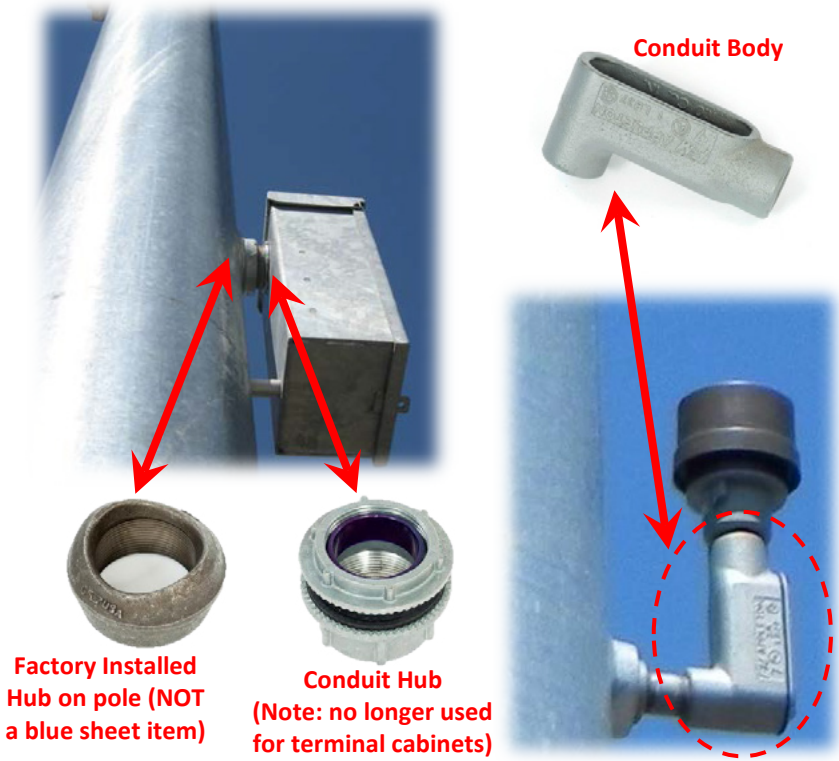
- Hub: Nylon insulated steel or malleable iron connector, with neoprene "O" ring
- Conduit Body: Malleable iron conduit body hot dip galvanized with cover and moisture-proof gasket

USE:

- Hub: To provide a watertight connection to cast iron junction boxes. In the past, was used for meter bases, service cabinets, & terminal cabinets - NOT a common item used on current projects.
- Conduit Body: To provide a conduit transition/pull point. Typically used for installing a photoelectric cell.

Typical Sources of Info:

Specs: 02920.12
Std. Dwg: TM465 & TM488
Plan Sheets: NO
Additional Installation Info: NO

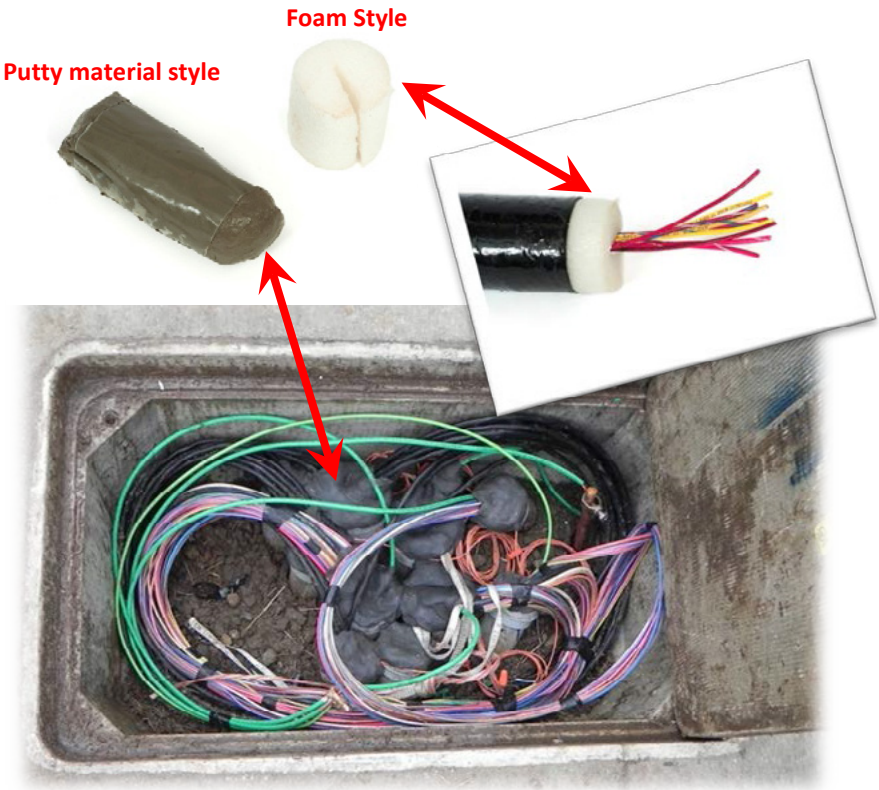


Conduit Plug

DESCRIPTION: Closed cell polyethylene foam style is pre-formed for a specific conduit size. Spray foam not allowed. Cut to a supplier suggested length for conduit sizes. Mechanical device (clay/putty material called Duct Seal) style fits into conduit opening to form a seal to conduit and wires/cables.

USE: Inserted into exposed end of conduit in foundations and junction boxes, to keep debris out of the conduit. Not watertight.

Typical Sources of Info:
Specs: 00960.42(g) & 02920.28
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pgs. 124, 126 & 146

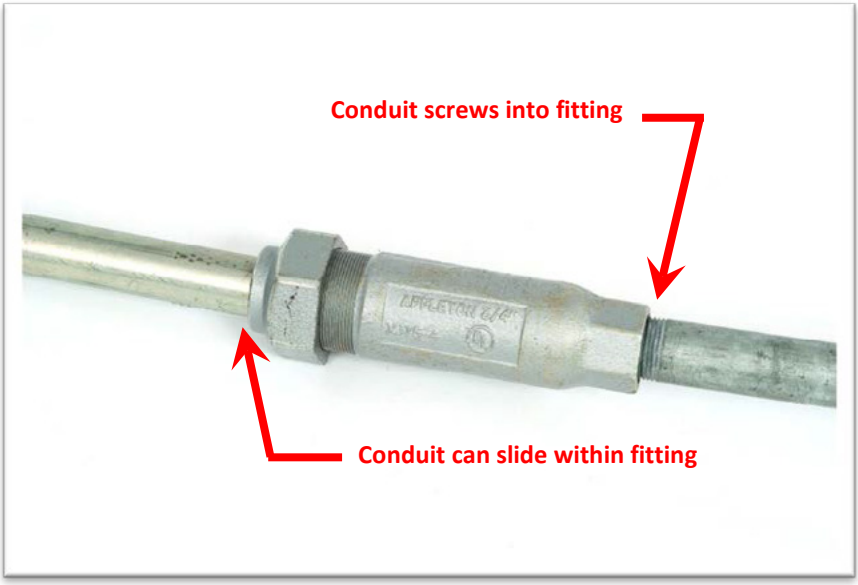


Expansion Fitting

DESCRIPTION: Weatherproof, malleable iron with a hot-dip galvanized finish.

USE: To provide for limited conduit expansion movement when crossing expansion joints in/on structures and between fitted enclosures.

Typical Sources of Info:
Specs: 00960.42(k) & 02920.12
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: pg. 124

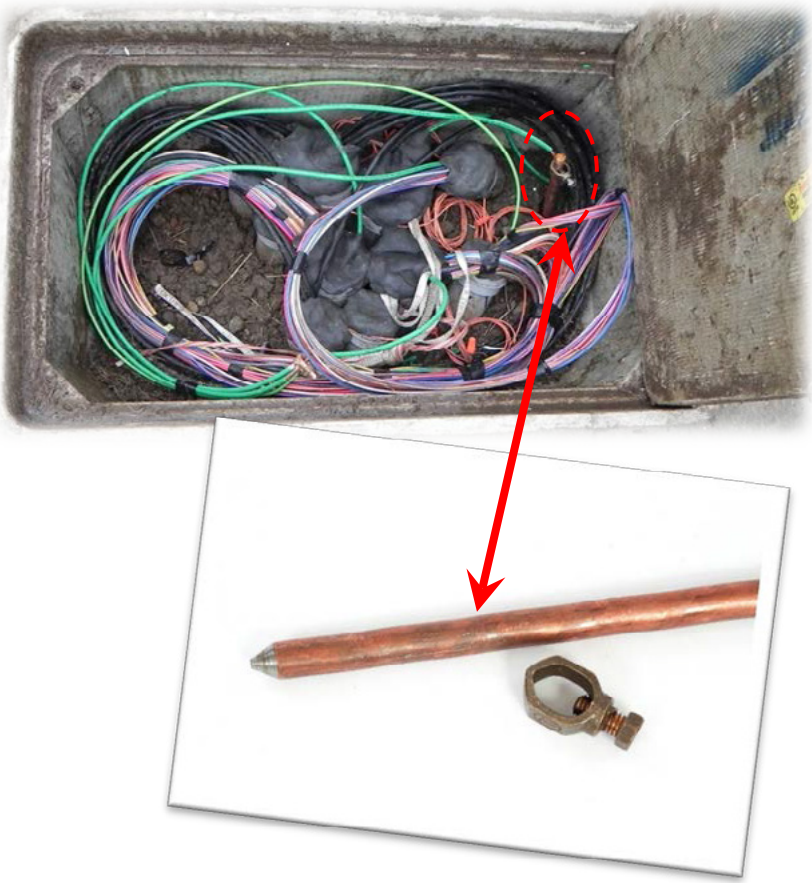


Ground Rod & Clamp

DESCRIPTION: Copper coated 5/8 inch metal rod, 8 feet to 10 feet long with clamp.

USE: To ground electrical installation. All poles, conduit runs with 120V+ AC, and controller cabinet must be bonded to ground rod using full-contact clamps.

Typical Sources of Info:
Specs: 00960.50(b) & 02920.27
Std. Dwg: TM450, TM452, TM455, TM457, TM482, TM485 &TM492
Plan Sheets: NO
Additional Installation Info: pg. 144



Junction Boxes (Cast Iron)

DESCRIPTION: Watertight boxes of cast iron, gasketed lid held down with stainless steel screws. For traffic areas the lids shall be recessed type and for surface mounted the lids shall be overlapping.

USE: As a pull point or wire access point in traffic areas (pavement).

Typical Sources of Info:
Specs: 00960.44 & 02920.14(b)
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

JB/4 JB/5 JB/6
JB/7 JB/8 SB/S

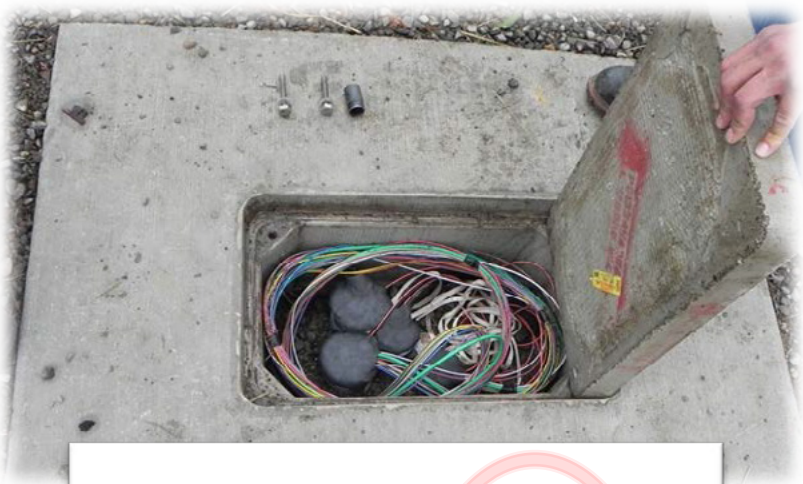
Junction Boxes (Concrete)

DESCRIPTION: Open-bottom boxes of pre-cast reinforced concrete with brass or stainless steel fasteners. Polymer concrete also allowed.

USE: As a pull point or wire access point.

Typical Sources of Info:
Specs: 00960.44 & 02920.14(c), (d)
Std. Dwg: TM472
Plan Sheets: YES (location & size), Typically NO (material)
Additional Installation Info: pgs. 128 & 130

JB 1 | JB 1A | JB 2 | JB 2A | JB 3 | JB 3A | JB 3/T | JB 3/TA



Junction Boxes (Hybrid)

DESCRIPTION: Open-bottom boxes made of polymer, fiberglass, and/or polymer concrete.

USE: As a pull point or wire access point.

Typical Sources of Info:
Specs: 00960.44 & 02920.14(e)
Std. Dwg: TM472
Plan Sheets: YES (location & size), Typically NO (material)
Additional Installation Info: pgs. 128 & 130

JB 1 | JB 1A | JB 2 | JB 2A | JB 3 | JB 3A | JB 3/T | JB 3/TA

Junction Boxes (Hand Hole)

DESCRIPTION: Open bottom boxes made of polymer, fiberglass, and/or polymer concrete.

USE: As a pull point/wire access point for communication cables like fiber optic, etc.

Typical Sources of Info:
Specs: 00960.44 & 02920.14(e)
Std. Dwg: TM472
Plan Sheets: YES (location & size), Typically NO (material)
Additional Installation Info: pgs. 128 & 130

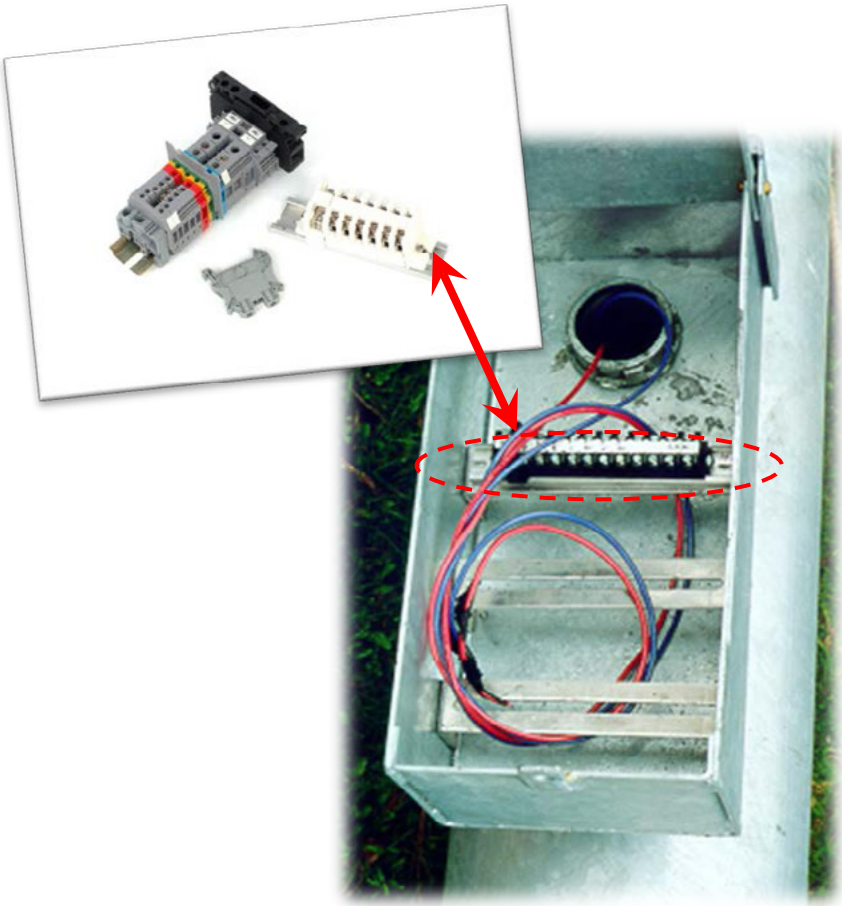
HH 1 HH 2 HH 3

Terminal Blocks

DESCRIPTION: Sectional wire termination points, 600 Volt rated, solder-less connections, tubular clamp, sized for wire being terminated, channel mount assembly.

USE: For terminating wires/cables in the terminal cabinet on a signal pole and in the 332S signal controller cabinet.

Typical Sources of Info:
Specs: 00990.41(a) & 02925.41(c)
Std. Dwg: TM488
Plan Sheets: NO
Additional Installation Info: pg. 120



THWN & XHHW Wire

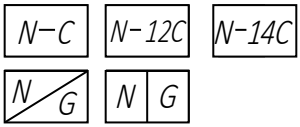
DESCRIPTION: Stranded copper conductor, color coded wire.

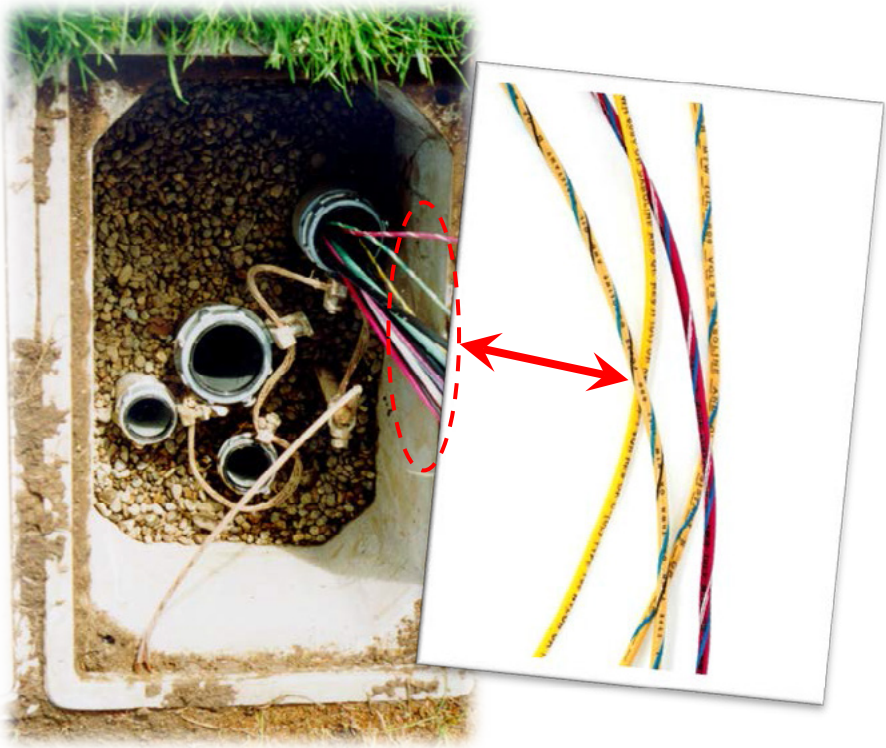
- THWN wire has PVC insulation and nylon jacket. Visually, this insulation is "shinier" than XHHW
- XHHW wire has cross-linked polyethylene insulation. This insulation is more durable than THWN

USE: To provide electricity to equipment for all single conductor applications.

Typical Sources of Info:

Specs: 00960.45, 02920.20, 02920.21 & 02920.23
Std. Dwg: TM470
Plan Sheets: YES
Additional Installation Info: pgs. 146 & 148





Underground Warning Tape

DESCRIPTION: Red polyethylene film, 6” wide, 4 mils thick. Printed with “CAUTION BURIED ELECTRICAL LINE” legend (or similar legend).

USE: To warn of buried electrical line for any conduit located outside of the paved roadway. Placed the full length of the conduit, 6” below the ground surface.

Typical Sources of Info:
Specs: 00960.42(e) & 02920.13
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pg. 126

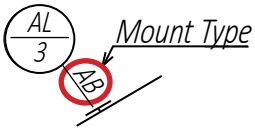
Aluminum Sign Mounting Framework

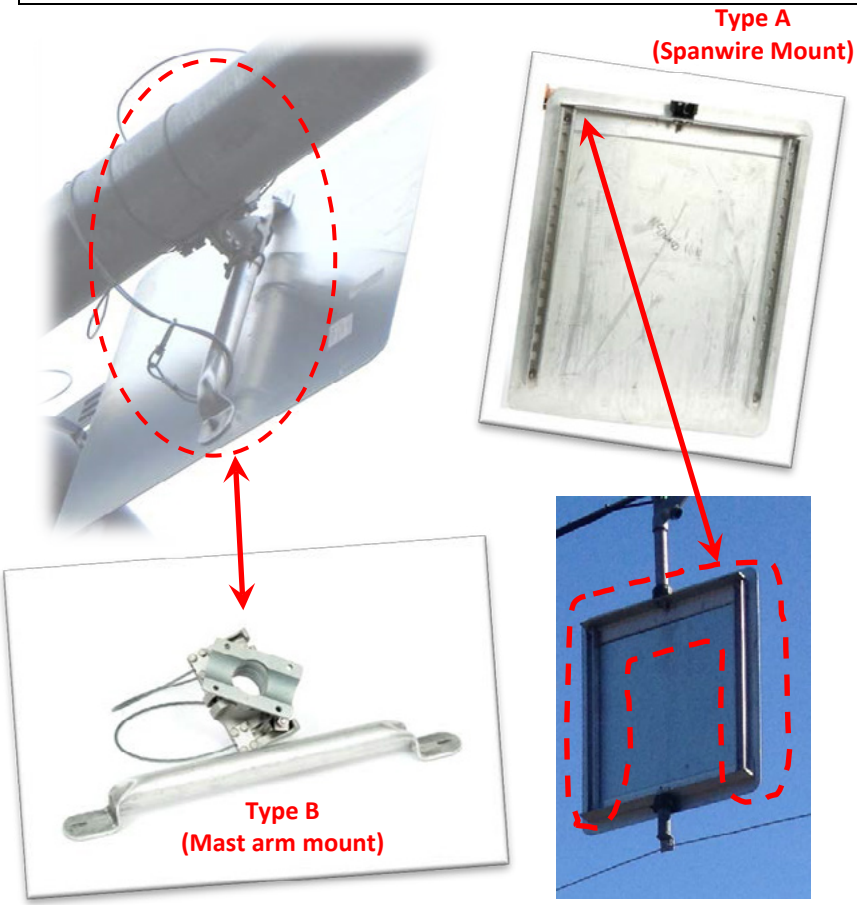
Blue Sheets
Traffic Signal Specific

DESCRIPTION: An aluminum assembly for mounting signs on a mast arm, pole and spanwire installations. The Type A mount is used on spanwire installations and the Type B mount is used on mast arm and pole installations (an adjustable bracket without tenon).

USE: To attach signs to a mast arm or span wire

Typical Sources of Info:
Specs: 02925.62(a),(c),(d) & 02925.67(c)
Std. Dwg: TM465
Plan Sheets: Typically YES
Additional Installation Info: NO



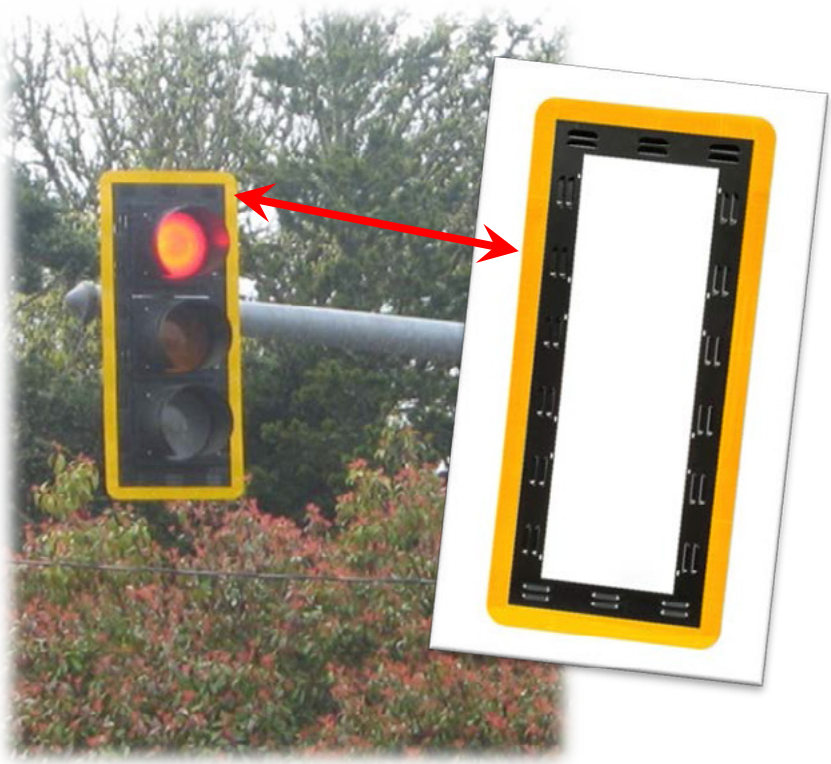


Backplates

DESCRIPTION: Aluminum sheet powder-coated flat black louvered or black polycarbonate attached with stainless steel screws and washers with reflective sheeting installed along the edge.

USE: Shield around vehicle signal to provide a contrast to the background.

Typical Sources of Info:
Specs: 00990.42(a) & 02925.64(e)
Std. Dwg: TM460
Plan Sheets: NO
Additional Installation Info: pg. 154



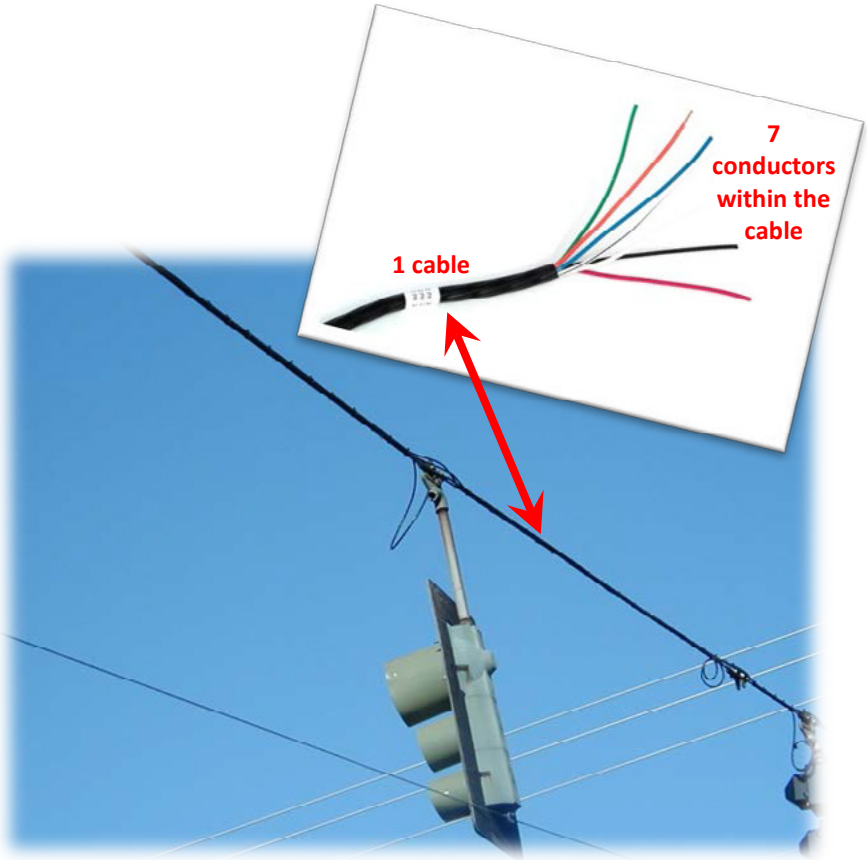
Control Cable

DESCRIPTION: Multi-conductor bundled cable with assorted stranded copper wires (typically 14 AWG, but may be other sizes). Must meet color code on standard drawings.

USE: Used to provide electrical energy. Strapped to messenger cable on spans, used in mast arms. May also be used in conduit runs.

Typical Sources of Info:
Specs: 02920.20, 02920.21, 02920.22, & 00990.40(a)
Std. Dwg: TM470
Plan Sheets: YES
Additional Installation Info: pgs. 146 & 148

X-N / G



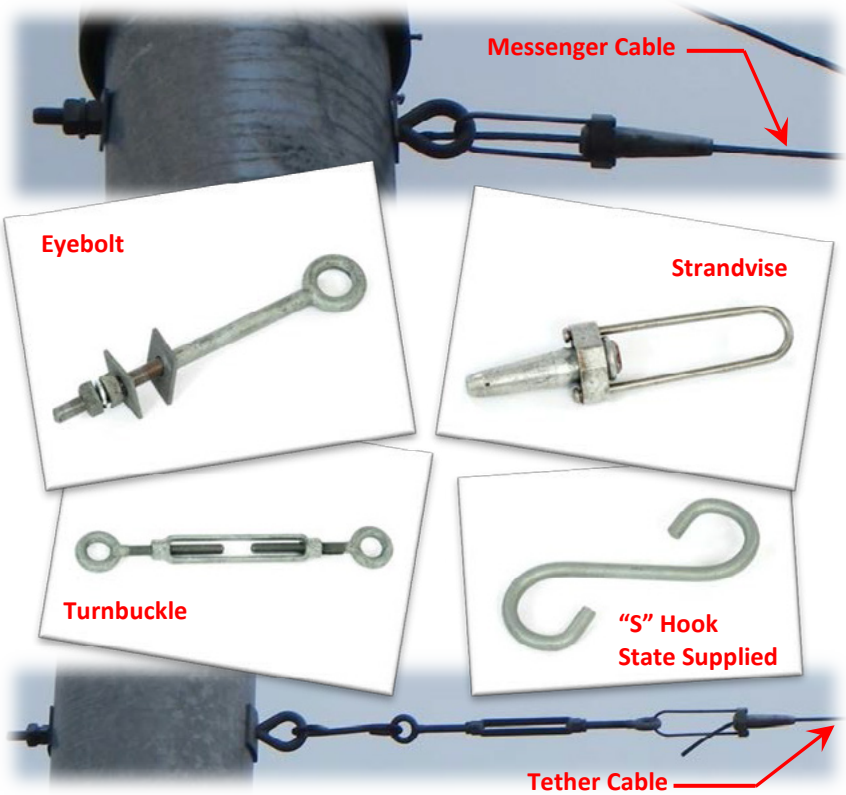
Eyebolt, Turnbuckle, Strandvise

DESCRIPTION: Hardware for attaching spanwire installations to strain poles. Hot-dip galvanized.

USE:

- To hang messenger cable (the cable above signal heads): An eyebolt + strandvise.
- To hang tether cable (the cable below signal heads): An eyebolt + "S" hook (state supplied, designed to yield if the tether cable is struck by a high load) + turnbuckle + strandvise.

Typical Sources of Info:
Specs: 00990.40(c), 00990.40 (d), & 02920.24
Std. Dwg: TM452
Plan Sheets: NO
Additional Installation Info: pgs. 136 & 138



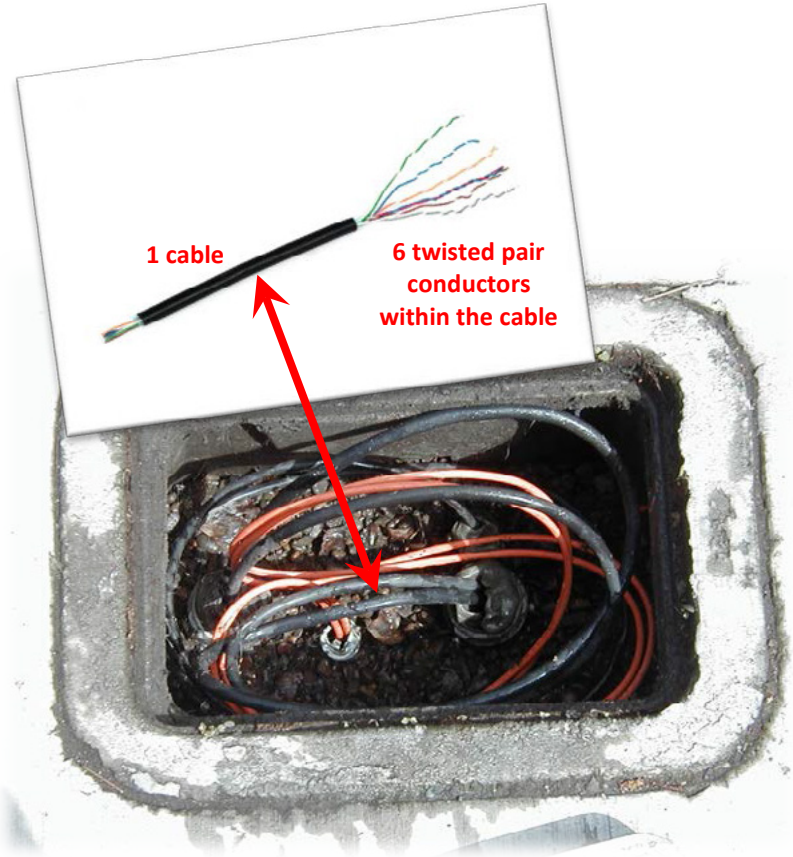
Interconnect Cable

DESCRIPTION: Shielded cable containing 6+ twisted pairs of No. 19 AWG wires. REA spec. PE-22 (air-core, for overhead) or PE-39 (gel-fill, for underground), polyethylene jacket.

USE: For communication between traffic signal controllers. Installed with no splices between separate signal controllers.

Typical Sources of Info:
Specs: 00990.40(e) & 02920.22
Std. Dwg: TM498
Plan Sheets: YES
Additional Installation Info: pg. 146

N / P



LED Modules (Vehicle & Ped)

DESCRIPTION: Light Emitting Diode (LED) Unit which replaces incandescent bulbs in signal heads and pedestrian heads. Flange mount type, clear.

USE: To illuminate vehicle and pedestrian signals.

Typical Sources of Info:
Specs: 00990.42(a), 00990.42 (b), & 02925.51(b)
Std. Dwg: TM460
Plan Sheets: NO
Additional Installation Info: pgs. 152 & 154

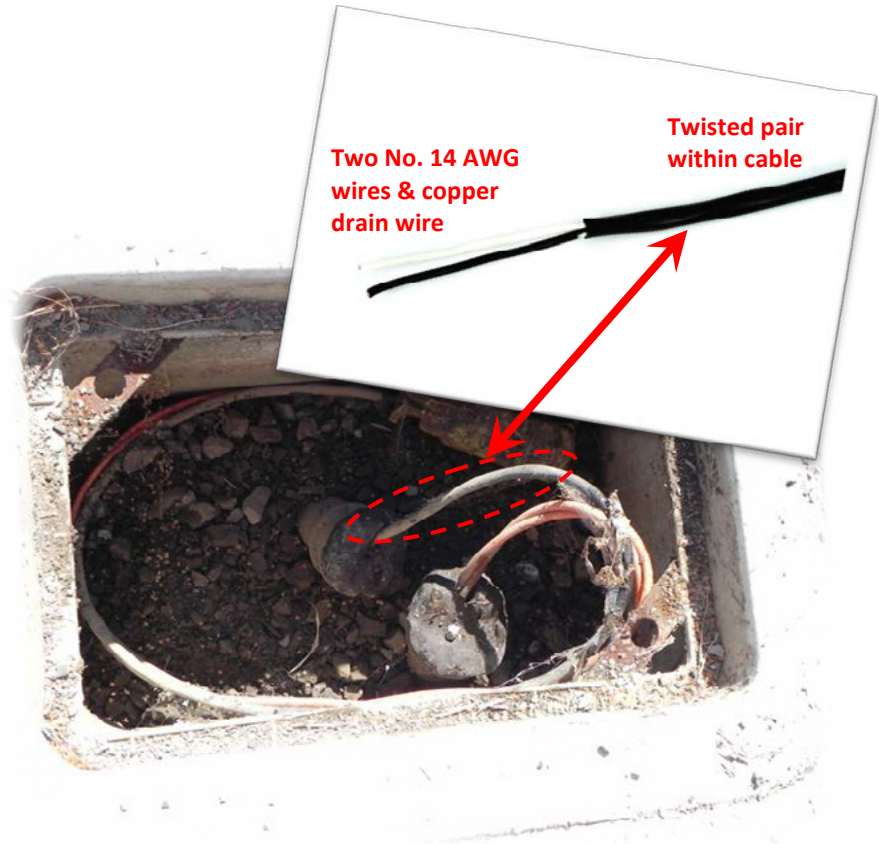
Loop Feeder Cable

DESCRIPTION: Polyethylene jacketed, shielded cable with two twisted No. 14 AWG wires and bare tinned copper drain wire or No. 14 AWG wires wrapped with mylar tape. IMSA Spec. No. 50-2. May also be No. 18 AWG wires if shown in the plans.

USE: Connects pairs of loop wires to controller, splice only at the junction box nearest the loop wires.

Typical Sources of Info:
Specs: 02920.22
Std. Dwg: TM475
Plan Sheets: YES
Additional Installation Info: pg. 146 & 168

LF/X-Ph LF/M-Ph F18/X-Ph LF/X-F

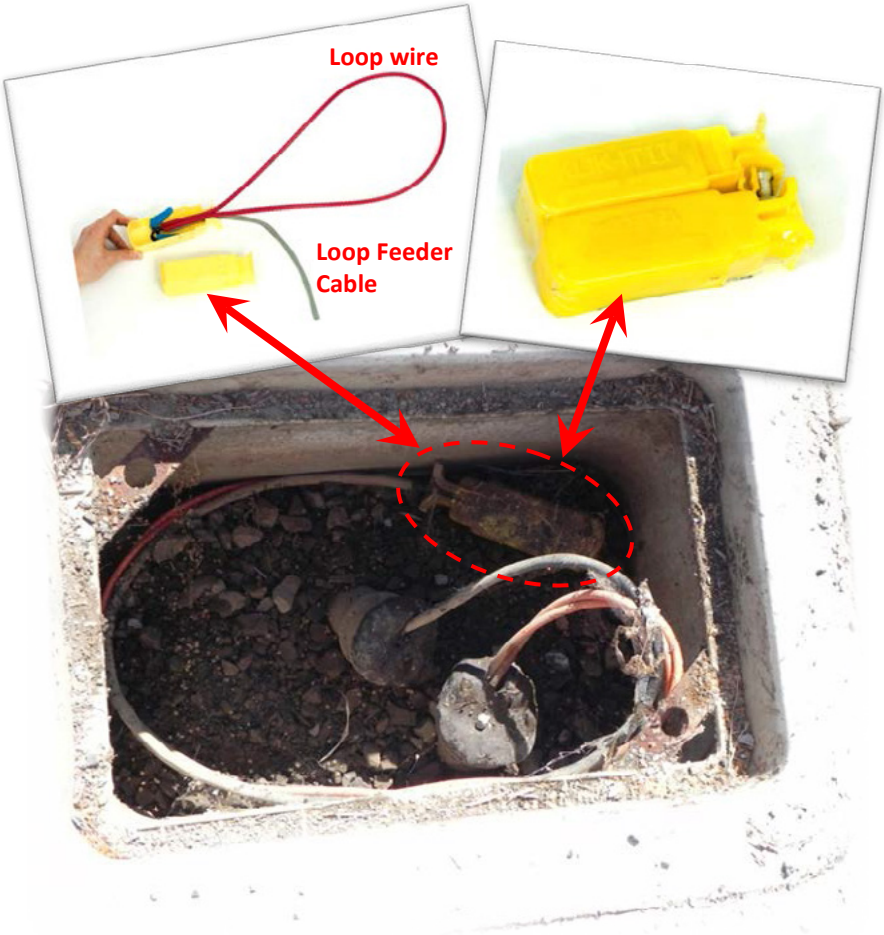


Loop Splice

DESCRIPTION: Two-piece plastic enclosure flooded with silicon grease. Includes screw on silicon grease filled wire connectors.

USE: Used to connect loop feeder and loop wire (splice point).

Typical Sources of Info:
Specs: 00990.43(b)(4)
Std. Dwg: TM475
Plan Sheets: NO
Additional Installation Info: pg. 168



Loop Wire (XHHW/DUCT)

DESCRIPTION: Stranded copper conductor, with cross-linked polyethylene insulation, No. 14 AWG wire. Encased in a polyethylene tube (sleeve). Wire and tube must be stamped with proper IMSA 51.7.

USE: Used to detect vehicles. Loop wire is installed in the pavement in a circle or diamond pattern. The pair of loop wires, from the pavement to the junction box, is manually twisted 4 to 6 turns per foot.

Typical Sources of Info:
Specs: 00990.43(2) & 02920.23
Std. Dwg: TM475 & TM480
Plan Sheets: YES
Additional Installation Info: pgs. 160, 162, & 168

N
LW

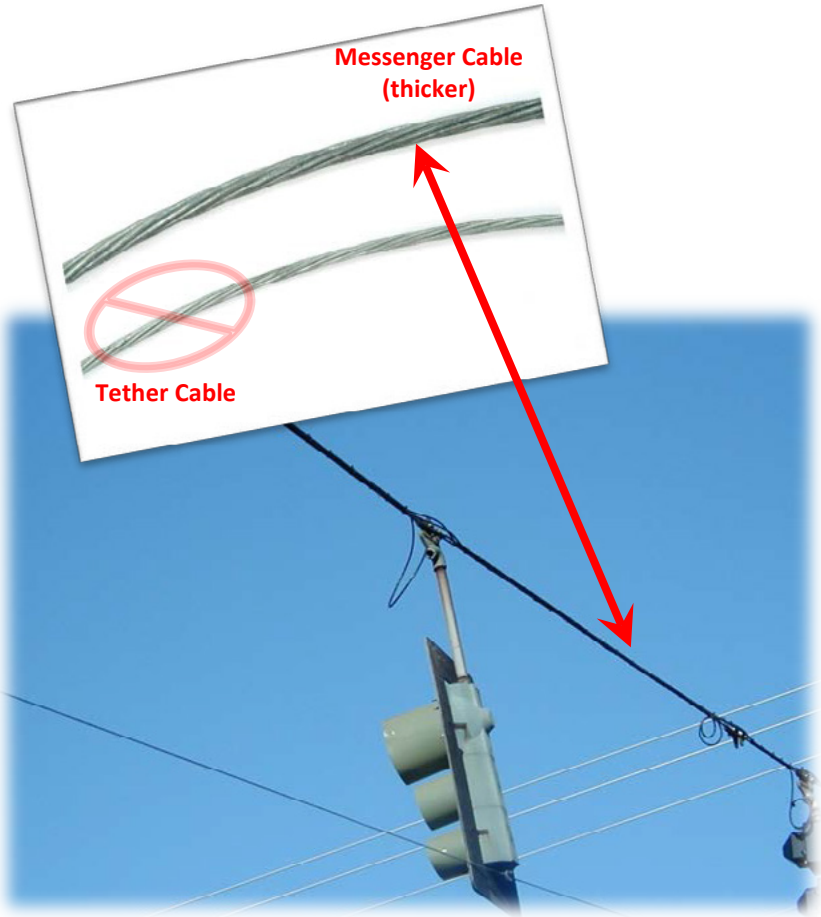
Messenger Cable

DESCRIPTION: Bare steel cable comprised of 7 strands of galvanized wire. Utilities grade 3/8 inch diameter with 11,500 lbs. break.

USE: Supports control cables, signal heads and signs on a spanwire installation.

Typical Sources of Info:
Specs: 00990.40(c) & 02920.22
Std. Dwg: TM452
Plan Sheets: YES
Additional Installation Info: pg. 136

38 39 42



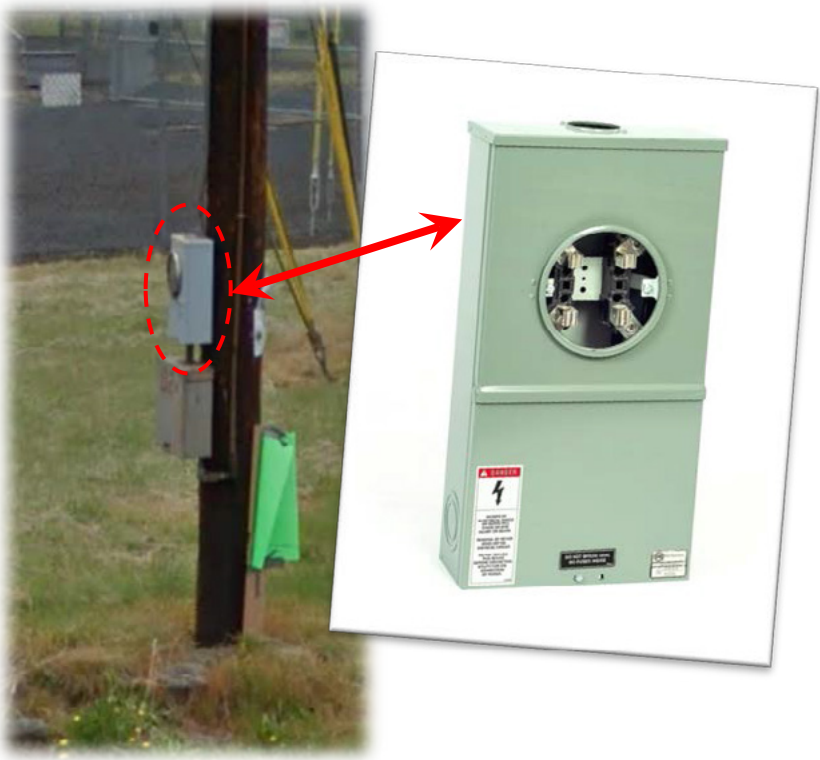
Meter Base

DESCRIPTION: Socket into which the power company's meter will be installed. Stainless steel or powder coated base.

USE: For power companies to meter power. Used between power source and service cabinet for temporary signals only (located on a temporary signal pole). Note: for permanent installations, the meter base is inclusive to the "Service Cabinet" (see pgs. 44 & 174 for more info).

Typical Sources of Info:
Specs: 00960.49(a)
Std. Dwg: TM455 & TM485
Plan Sheets: YES
Additional Installation Info: NO

MS



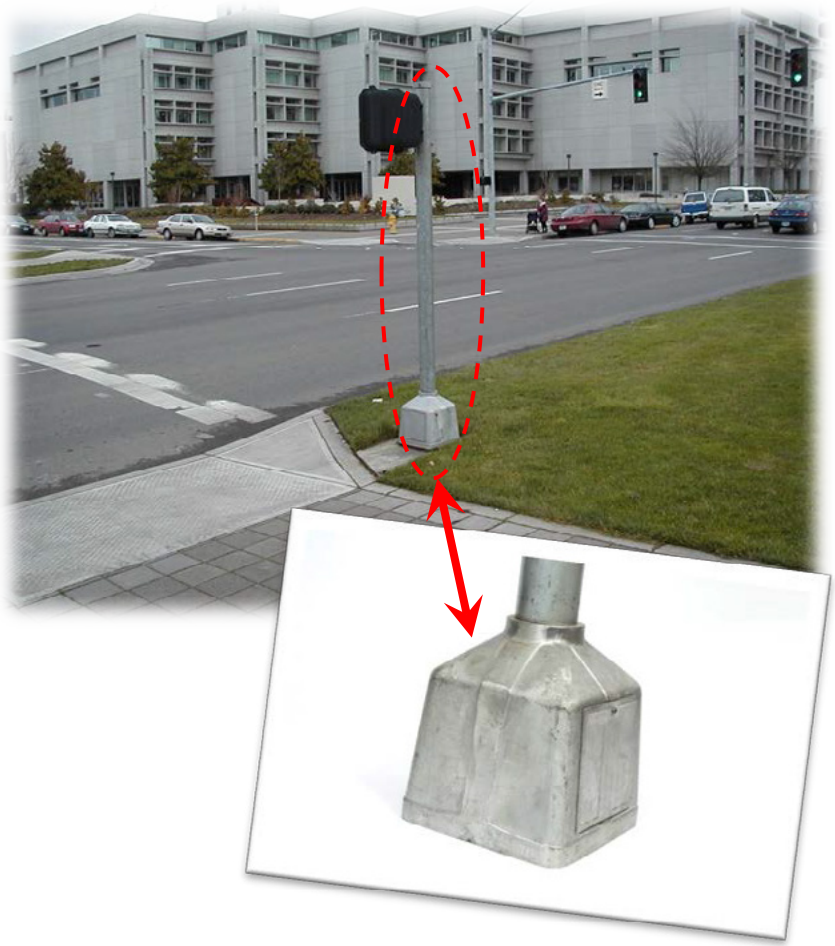
Pedestal (Pedestrian Signal)

DESCRIPTION: Four inch diameter galvanized steel pipe mounted on a cast aluminum or galvanized cast iron base.

USE: Freestanding pole for mounting of pedestrian signals.

Typical Sources of Info:
Specs: 02925.33 (a) & 02925.33(c)
Std. Dwg: TM457
Plan Sheets: YES
Additional Installation Info: pgs. 106 & 116

PP PS XR/PP XS/PP



Pedestal (Vehicle Signal)

DESCRIPTION: Four inch diameter galvanized steel pipe with welded base plate bolted to a cast aluminum or galvanized cast iron transformer base.

USE: Freestanding pole for mounting vehicle signals. Other equipment may be mounted with vehicle signal.

Typical Sources of Info:
Specs: 02925.33(a) & 02925.33(b)
Std. Dwg: TM457
Plan Sheets: YES
Additional Installation Info: pgs. 106 & 116

VP

XR/VP

Pedestrian Signal

DESCRIPTION: Pole mounted signals. Aluminum powder coated black or black polycarbonate with stainless steel hardware.

USE: To indicate walk/don't walk pedestrian phases at marked crosswalks.

Typical Sources of Info:
Specs: 00990.42(d) & 02925.65(a) thru (c)
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: pg. 152

P/Ph | P/B/Ph | P/A/Ph
C/Ph | C/B/Ph | C/A/Ph

Pedestrian Signal Mount

DESCRIPTION: Swing open clam shell compartment.

USE: To connect pedestrian signal to pole, with wire terminals.

Typical Sources of Info:
Specs: 02925.65(d)
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: pg. 150

P/Ph | P/B/Ph | P/A/Ph
C/Ph | C/B/Ph | C/A/Ph

Preformed Vehicle Detector Loop

DESCRIPTION: Five turns of No. 14 AWG XHHW or No. 16 AWG TFFN wire encased in either schedule 40 PVC or rubber hydraulic hose totally filled with sealant.

USE: Used to detect vehicles in thin, poor pavement or concrete bridge decks.

Typical Sources of Info:
Specs: check special provisions
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: pg. 166

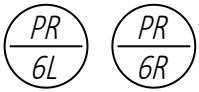
PD/Ph PL/Ph

PTR (Part Time Restriction) Signs

DESCRIPTION: Flat black, painted, aluminum alloy case with part-time legend when lit. LED illuminated legend.

USE: To indicate part time restrictions when applicable. Typically used for restricted turn moves when signals have railroad preemption.

Typical Sources of Info:
Specs: NO
Std. Dwg: TM497
Plan Sheets: YES
Additional Installation Info: NO



PTR sign ON
(Typical LED sign Message)

Push Button

DESCRIPTION: Push button with mounts. Note the new standard, which has replaced the type "H" mount used in the past.

USE: For pedestrians to request the walk phase.

Typical Sources of Info:
Specs: 00990.43(a) & 02925.66
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: pg. 152

PBH | A/Ph | B/Ph | C/A/Ph | P/B/Ph | C/B/Ph | P/A/Ph

New Standard
(9"x12" mount)

"H" mount style –
no longer used

Riser Frames

DESCRIPTION: Aluminum framework of ¼ inch channel or 1/8 inch sheet stock. One piece welded construction for newer installations, two-piece bolt together for retro-fit. Both styles anodized after fabrication.

USE: To raise the controller cabinet from the foundation 8 inches, providing additional work space under the cabinet. Use building paper gasket and non-hardening water tight seal between riser and cabinet and between foundation and riser.

Typical Sources of Info:
Specs: NO
Std. Dwg: TM482
Plan Sheets: Typically NO
Additional Installation Info: pg. 176

RF

Service Cabinet

Blue Sheets
Traffic Signal Specific

Blue Sheet Materials

DESCRIPTION: Stand-alone (temporary installations) or Base mounted service cabinet with integral meter base. Includes circuit breakers, contactors, test switches, neutral and ground bars. Stainless, powder coated aluminum, or galvanized steel cabinet.

USE: Used to provide fused electrical service for permanent installations.

Typical Sources of Info:
Specs: 00990.41(c) & 02925.40
Std. Dwg: TM485
Plan Sheets: YES
Additional Installation Info: pg. 174

BMC BMCL BMCF
SC SCL

Stand Alone Service Cabinet Types:

- SC
- SCL

Base Mounted Service Cabinet Types:

- BMC
- BMCL
- BMCF
- BMCFL

Signal Head Covers

Blue Sheets
Traffic Signal Specific

DESCRIPTION: Yellow prefabricated nylon "bag". Includes a fine mesh insert for signal testing with integral elastic bands and clips to secure the covers to the signal head visors (may cover the complete head and backboard).

USE: To cover vehicle and pedestrian signal heads until the signal is turned on.

Typical Sources of Info:
Specs: 00990.42(g) & 02925.68
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pgs. 152 & 154

Cover for Vehicle Signal

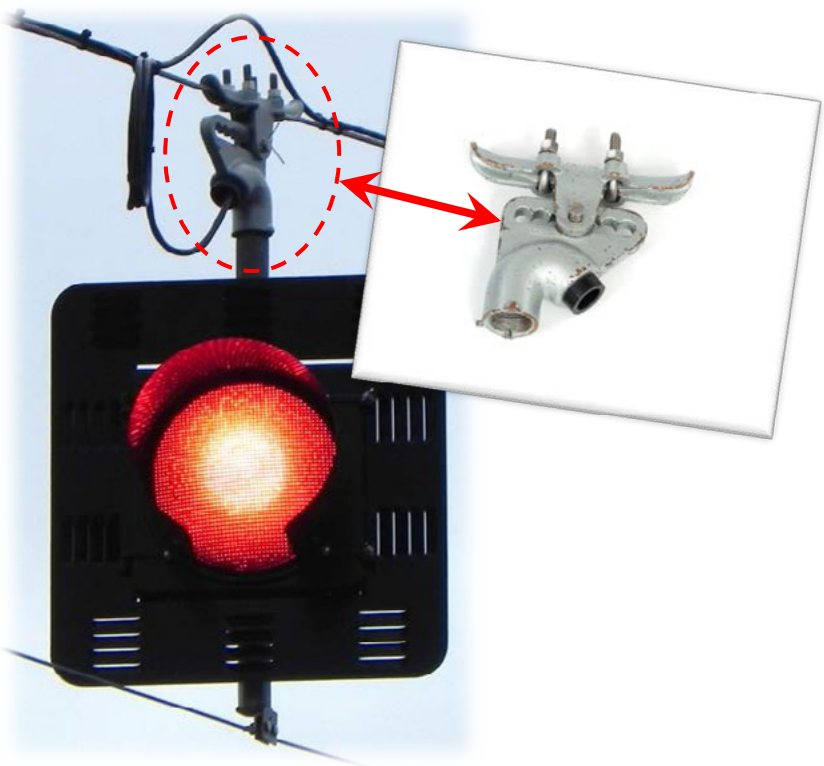
Cover for Pedestrian Signals

Spanwire Hanger

DESCRIPTION: A fitting of cast bronze that attaches to the messenger cable with two "U" bolts. A wire outlet body hangs from this with a clevis pin through adjustable slot. All fasteners shall be type 304/316 stainless steel.

USE: To mount vehicle signal and signs on span wires. Allows equipment to hang plumb from spanwire, provides cable entrance when wire is installed with correct drip loop.

Typical Sources of Info:
Specs: 02925.62(c)
Std. Dwg: TM463
Plan Sheets: NO
Additional Installation Info: pg. 140



Terminal Cabinet

DESCRIPTION: Constructed of 1/8 inch stainless, galvanized steel, or powder coated aluminum. Contains terminal blocks. Weatherproof fittings at the bottom for span wire installations. Project plans may call for a recessed terminal cabinet (RTC), which is part of the signal pole shop drawings, not a blue sheet item.

USE: To house terminal blocks on poles for all signal circuits.

Typical Sources of Info:
Specs: 00990.41(a) & 02925.40
Std. Dwg: TM488
Plan Sheets: YES
Additional Installation Info: pg. 120

TC RTC

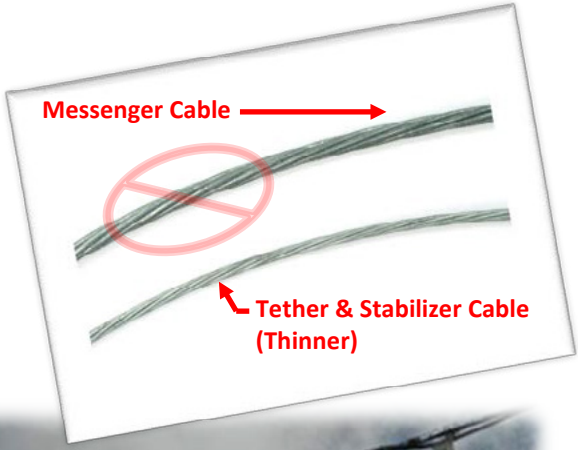
Tether & Stabilizer Cable

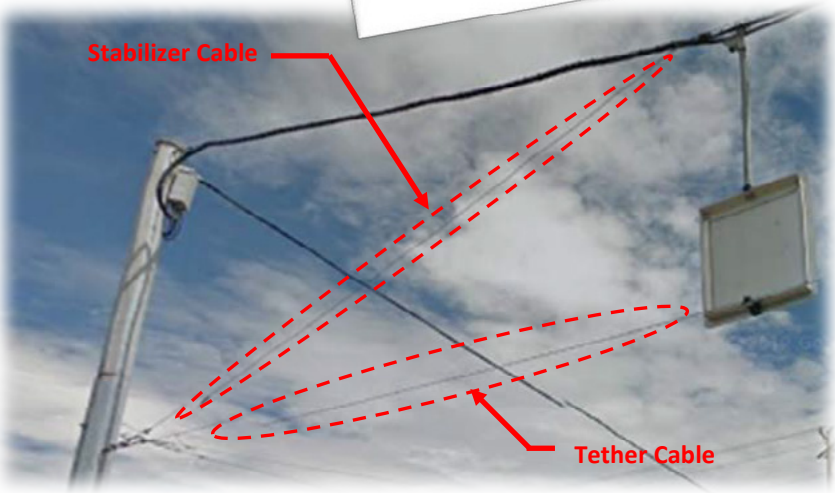
DESCRIPTION: ¼ inch galvanized steel cable comprised of 7 strands of galvanized wire. Class A coating conforming to ASTM A 475.

USE: Attached at the bottom of equipment to stabilize and prevent wind movement.

Typical Sources of Info:
Specs: 00990.40(d) & 02920.22
Std. Dwg: TM452
Plan Sheets: YES
Additional Installation Info: pg. 138

38 41



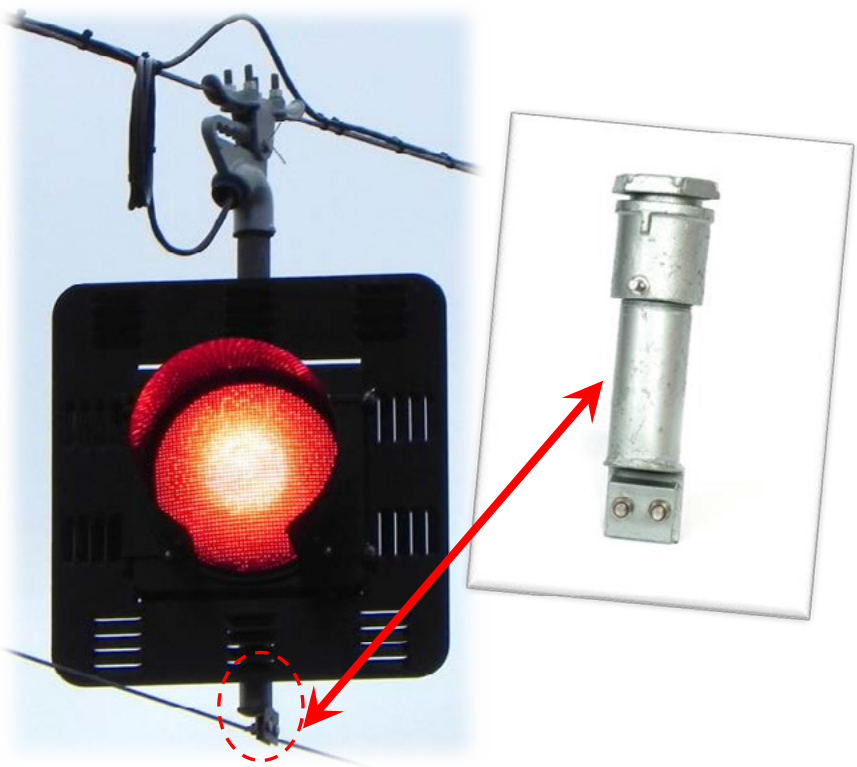


Tether Clamp

DESCRIPTION: Fitting on bottom of span mounted signal or sign constructed of 1 ½ inch galvanized steel pipe or galvanized metal conduit with plate welded on bottom, tether wire keeper bolted to plate. Galvanized after fabrication. All fasteners type 304/316 stainless steel.

USE: To attach tether cable to vehicle signals and signs.

Typical Sources of Info:
Specs: NO
Std. Dwg: TM463
Plan Sheets: NO
Additional Installation Info: pg. 138



Tri-Stud Adaptors

DESCRIPTION: Fitting of cast aluminum with steel insert, powder coated as per spec. Three bolts, split washers, nylon insert lock-nuts if stainless steel, with 2 stainless steel backing washers.

USE: To attach vehicle signals and signs to a 1 ½ inch conduit riser which is supported by a spanwire hanger.

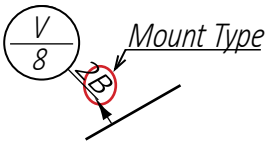
Typical Sources of Info:
Specs: 02925.62(e)
Std. Dwg: TM463
Plan Sheets: NO
Additional Installation Info: pg. 140

Vehicle Signal Bracket (Adj.)

DESCRIPTION: An extruded aluminum assembly that is adjustable. Its full length supports a vehicle signal on a mast arm and attaches to the arm by means of stainless steel cables.

USE: To mount vehicle signals and signs on a mast arm. Allows for adjustment of signal for height and full support of signal sections. 4" side pole mount used to mount vehicle signals on vehicle pedestals.

Typical Sources of Info:
Specs: 00990.42(f) & 02925.62(d)
Std. Dwg: TM462
Plan Sheets: YES
Additional Installation Info: pg. 134

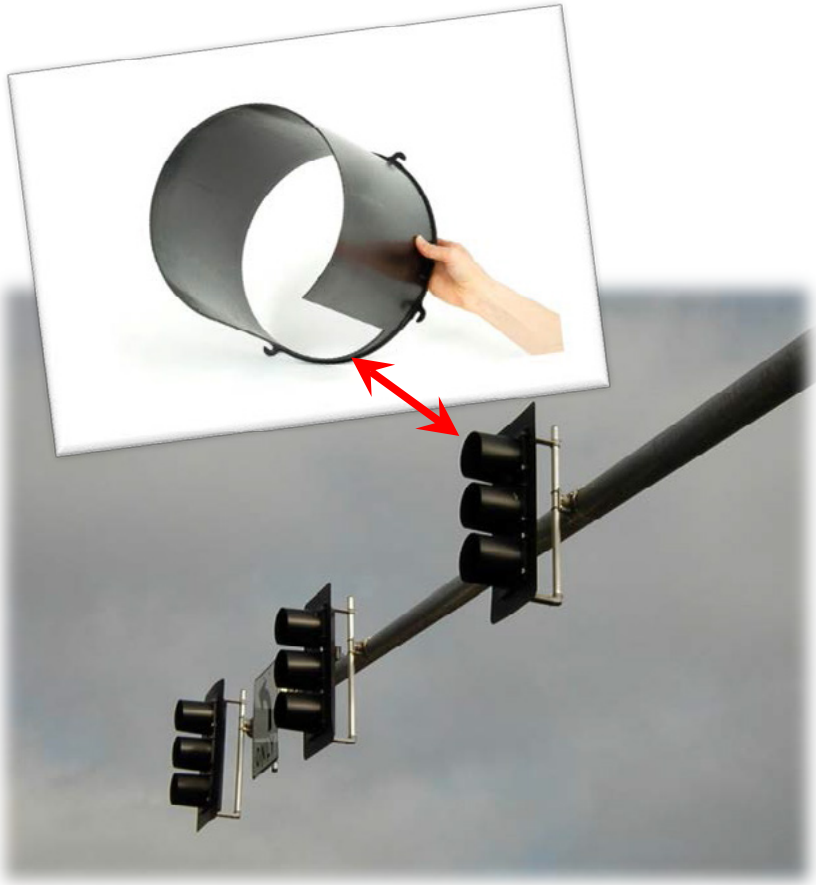


Vehicle Signal Visor

DESCRIPTION: Aluminum powder coated black or black polycarbonate open at bottom standard (tunnel). Visor must attach to signal heads with stainless steel screws.

USE: On all signal heads to direct the illumination to the motorist.

Typical Sources of Info:
Specs: 00990.42(a) & 02925.64(d)
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pg. 154

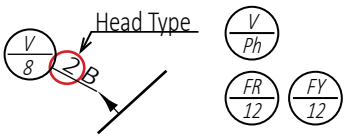


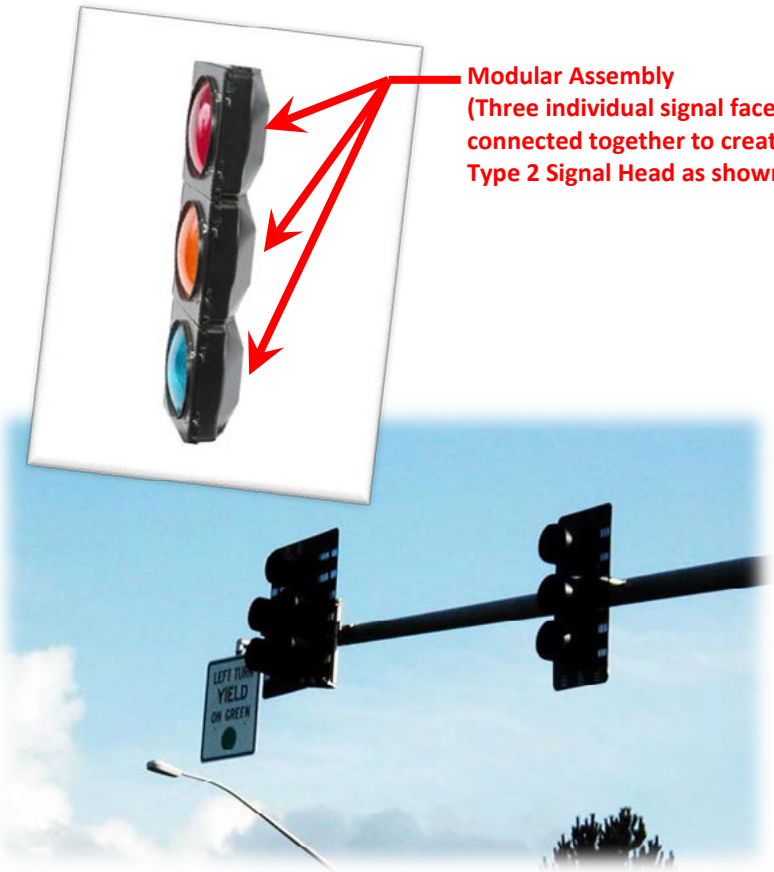
Vehicle Signals

DESCRIPTION: Aluminum powder coated black or black polycarbonate. May have 1,2,3,4, or 5 signal faces, defined on plan sheets and TM460 by Signal Head Type. All fasteners shall be type 304/316 stainless steel except for brass terminal screws.

USE: To direct vehicles at intersections.

Typical Sources of Info:
Specs: 00990.42(a), (c), 02925.64, & 02925.67(a)
Std. Dwg: TM460
Plan Sheets: YES
Additional Installation Info: pgs. 154 & 156





In-line Fuse Holder

DESCRIPTION: 30A 600V single pole or double pole in-line fuse holder with KTK fuse, insulating boots, and set-screw terminations.

USE: To splice illumination wires and provide a fused disconnect in the luminaire/signal pole base.

Typical Sources of Info:
Specs: 00970.42 & 02920.26
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pg. 172

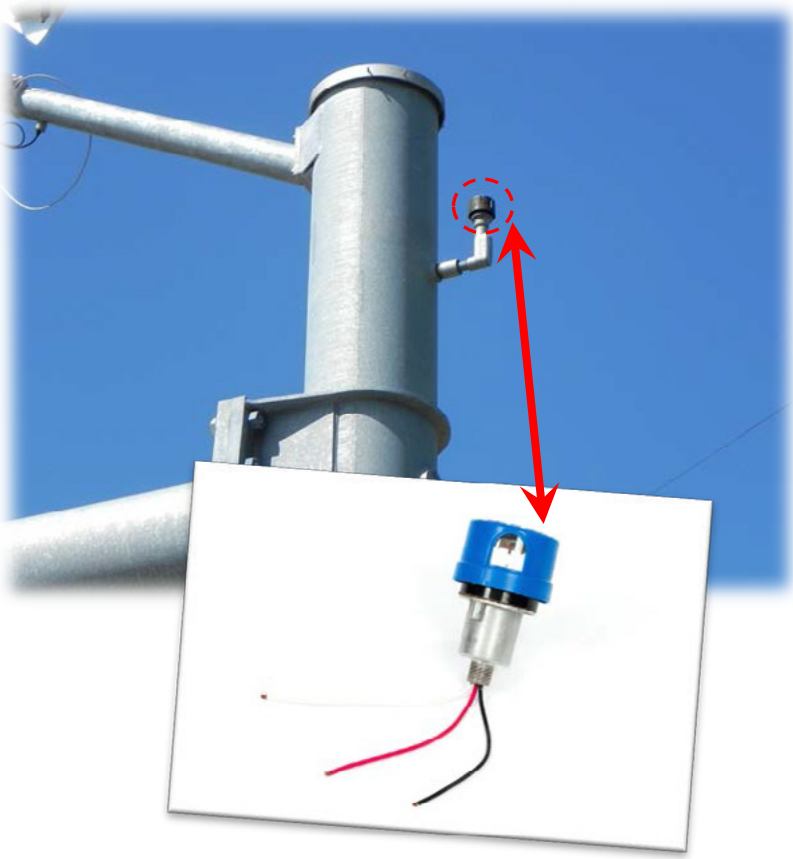
Photoelectric Cell

DESCRIPTION: A photoelectronic device used for turning on illuminated signs or luminaires meeting specifications under 00970.

USE: To activate illumination systems, luminaires at traffic signals and interior illuminated signs.

Typical Sources of Info:
Specs: 00970.43 & 02926.41(e)
Std. Dwg: TM465
Plan Sheets: YES
Additional Installation Info: pg. 172

PE 1 PE 2

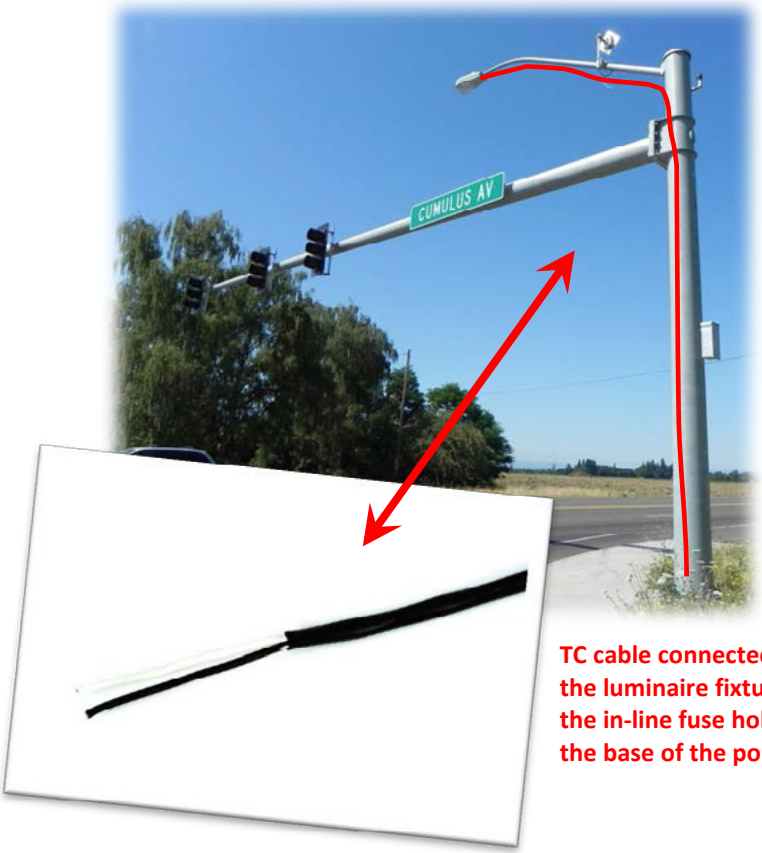


TC Cable

DESCRIPTION: Typically a three conductor No. 10 AWG cable with XHHW conductors and overall PVC jacket.

USE: Illumination cable between the luminaire and the in-line fuse holder in the pole base.

Typical Sources of Info:
Specs: 00970.42
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: pg. 172



TC cable connected from the luminaire fixture to the in-line fuse holder in the base of the pole.

Green Sheet Materials

The "Submittals for Conditional Qualification – Controller Equipment" (commonly referred to as the Green Sheets) contain a list of materials and equipment that are normally tested for environmental and functional requirements (chamber testing) by the Traffic Signal Services Unit (TSSU). As per standard specification 00960.02, the contractor must submit three copies of the current version of the Green Sheets **prior to starting work** .

The Green Sheets are updated frequently by the Traffic Signal Standards Unit. Use the most current version that is in effect at the date of the bid let. Verify the date of the current version at the website below or contact the Traffic Signal Engineer: http://www.oregon.gov/ODOT/HWY/TS/pages/signals.aspx.

The inspector is responsible for:

- The conditional qualification of materials before they are installed. This is documented on the Green Sheet's "Initial Submittal" box for each material. Exception: Write-in materials require conditional qualification by the TRAFFIC SIGNAL ENGINEER (NOT the Engineer of Record).

TSSU or Agency Electricians are responsible for:

- The initial chamber testing acceptance of materials before they are installed. This is documented on the Green Sheet's "TSSU Initial Chamber Testing Acceptance" box for each material.
- Inspecting and accepting of the materials installed on the project. This is documented on the Green Sheet's "TSSU/Agency Electrician Inspected & Accepted" box for each material.

Catalogue Cut Sheets/Write-in Materials

If the contractor proposes to use a material that is not listed in the Green Sheets (write-in material), the contractor shall submit a catalogue cut sheet for that material. The cut sheet shall identify the specific product intended to be used; manufacturer's name, identifying number, size, detailed scale drawings, wiring diagrams, etc. **Mail, Fax, or e-mail the Green Sheet for the material & the cut sheet(s) to the TRAFFIC SIGNAL ENGINEER (NOT the Engineer of Record) for conditional qualification of the material.**

Read the instructions included in the Green Sheets carefully. They are up-to-date and always printed with the sheets.

Contractor will check one box per sub-category

The material name

Example of Sub-category (332 cabinets)

CONTROLLER CABINET

	BRAND / MANUFACTURER	MODEL
	332 Cabinets	
	Safetran Brand by Econolite	332
	McCain	332A
	PSI (Phillips/Sisson Industries)	332
	Siemens	332
	334 Cabinets	
	Safetran Brand by Econolite	334
	McCain	334
	336 Cabinets	
	Safetran Brand by Econolite	336A
	McCain	336a
	336S Cabinets	
	Safetran Brand by Econolite	336S
	McCain	336s
	NONE ON THIS PROJECT	

Contractor will check this box if material is NOT on project

REVISED 7/29/2013

Always check the revision date! Use the most current version (when the contract is awarded)

Contractor may also write-in materials proposed for installation based on the project plans and specs. **A catalogue cut sheet MUST be submitted for write-in materials.**

Complete this after contract is awarded and BEFORE work starts.

Inspector will review the material page. If it looks correct check "Conditionally Qualified" box. If it doesn't look correct check "returned" box and send back to contractor for correction.

Submit write-in materials and cut sheet to the Traffic Signal Engineer for approval.

The "Chamber Testing Acceptance" is completed by TSSU after the materials are tested and before they are installed

INITIAL SUBMITTAL

☐ ***CONDITIONALLY QUALIFIED***

☐ ***RETURNED FOR CORRECTION***

Date
Name
CTSI Card#

TSSU Initial Chamber Testing Acceptance

Date
Name
Oregon BCD License #

TSSU/Agency Electrician Inspected & Accepted

Date
Name
Oregon BCD License #

The "Inspected & Accepted" is completed by TSSU or the Agency Electrician after the materials are tested and installed in the field

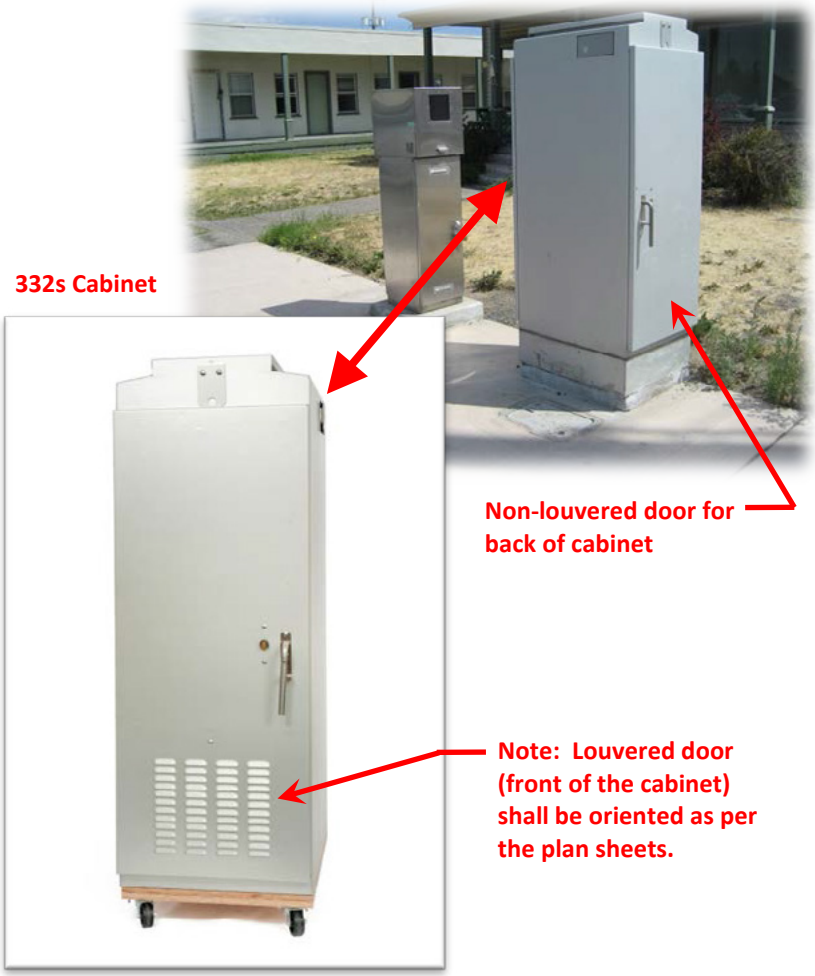
Controller Cabinet

DESCRIPTION: 332S, 332 and 334 are ground mounted. 336s are pole mounted.

USE: Houses the equipment to run the traffic signal.

Typical Sources of Info:
Specs: 02925.40 & 02925.67(b)
Std. Dwg: TM482
Plan Sheets: YES
Additional Installation Info: pgs. 176 & 178

332S 334 CC
332 336S C/T



Controller

DESCRIPTION: Model 2070 standard. Model 170E may be used if shown in plans.

USE: The brains of the traffic signal.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

C/170 C/2070

Conflict Monitor

DESCRIPTION: Model 210

USE: Monitors the green indications (vehicle) and walk indications (pedestrian) to ensure conflicting movements are not serviced at the same time. Also monitors voltages.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Load Switch

Green Sheets

DESCRIPTION: Model 200

USE: Powers the signal and pedestrian indications in the field.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: NO

LS / N

Flasher

DESCRIPTION: Model 204

USE: Powers the signal indications when in flash mode.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

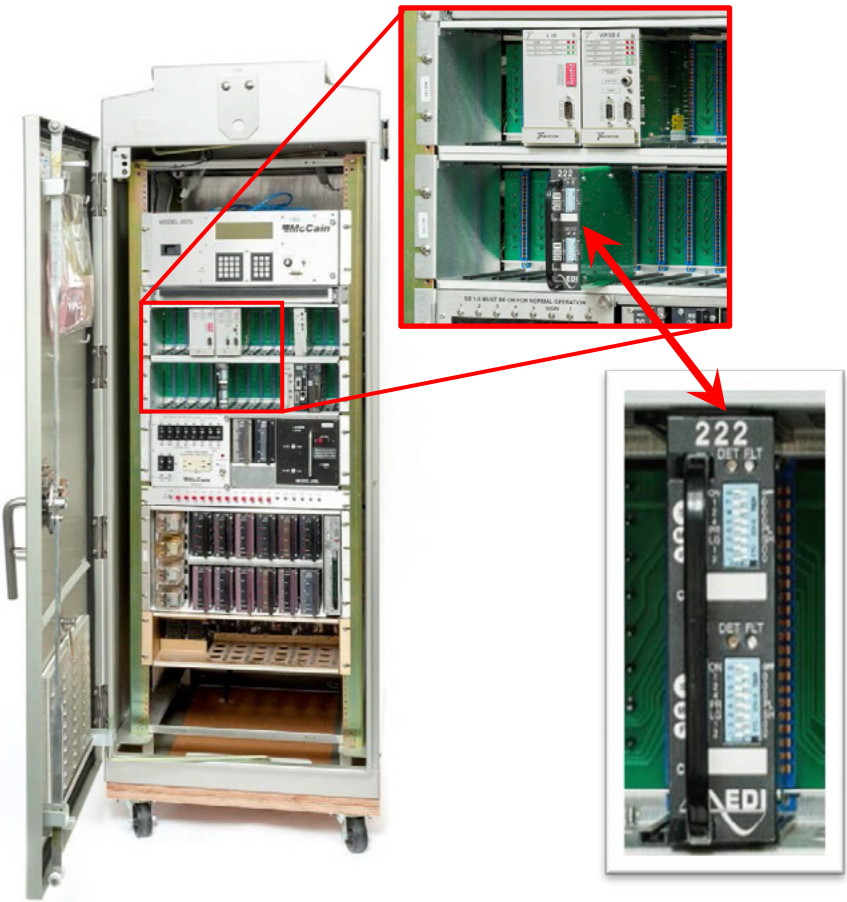
Detector Amplifier

DESCRIPTION: Model 222

USE: A device that is capable of detecting the changes in the electrical energy produced by a sensor. Detects the change in inductance when vehicles move over a loop detector and places a "call" into the controller.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: NO

DA
N



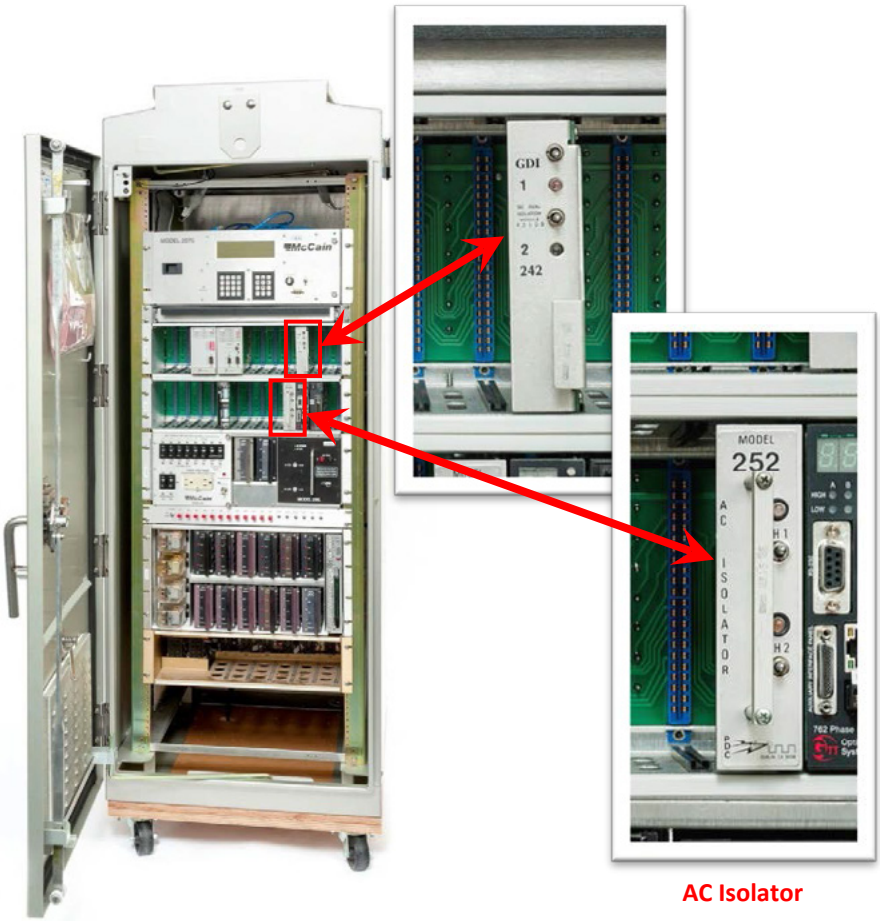
Isolator (DC and AC)

DESCRIPTION: Model 242 (24 VDC pedestrian push button) and Model 252 (120 VAC railroad preemption).

USE: Detects when a pedestrian pushes a button or when a train is approaching and puts a "call" into the controller.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

DC Isolator



AC Isolator

Modem

DESCRIPTION: Model 400 and stand-alone.

USE: Provides communications between traffic signals and/or to the central traffic signal operations office.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: NO

Located behind controller panel

Stand alone: located on top of controller

Relay (FTR)

DESCRIPTION: Model 430

USE: Switches the power from the load switches (normal operation) to the flashers (flash operation).

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

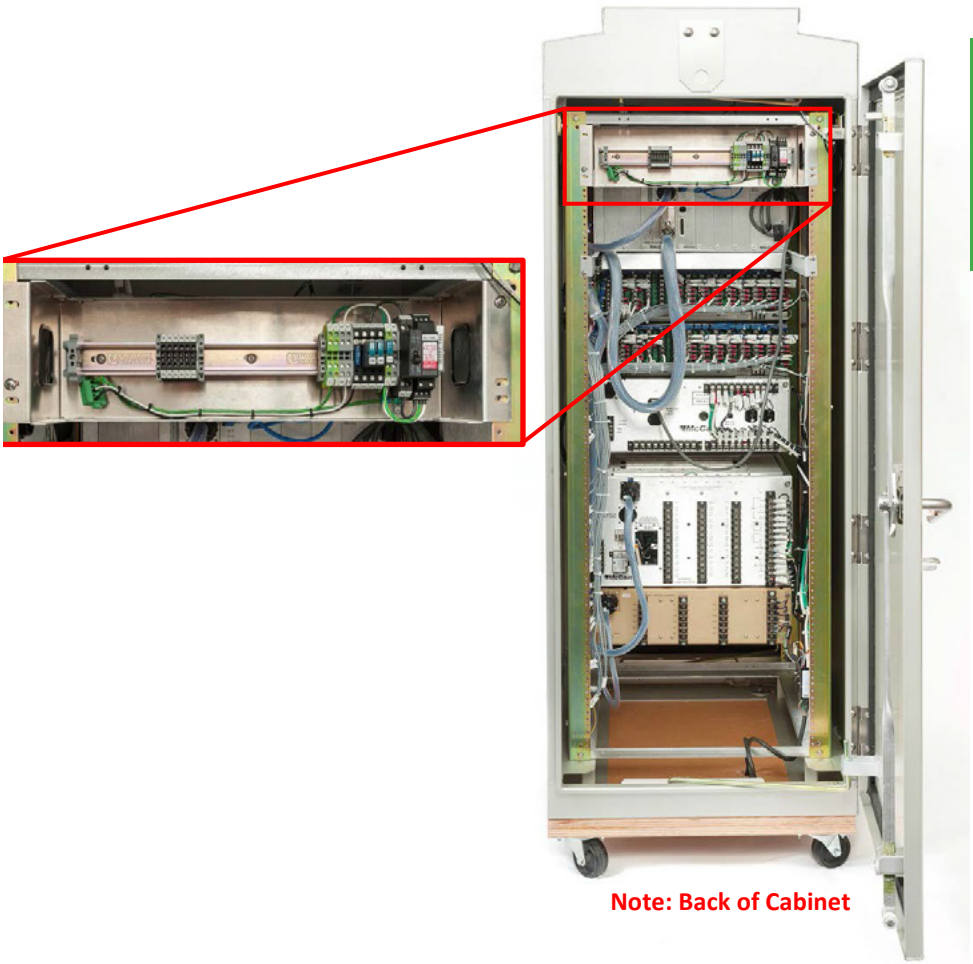
Communications Bracket

DESCRIPTION: Mounting assembly with a din rail.

USE: Used to mount communication equipment inside the controller cabinet.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

DIN F DIN C



Note: Back of Cabinet

Preemption Interface (Cabinet)

DESCRIPTION: Several models acceptable for use.

USE: Detects an emergency vehicle (that is using a preemption emitter in their vehicle) and puts a "call" into the controller.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: NO

FP

Preemption Detector (Field)

DESCRIPTION: Several models acceptable for use. Either one barrel or two barrels (as detailed on the plans), typically only assigned to a single channel (two barrel models can be assigned to two separate channels).

USE: Detects an emergency vehicle (that is using a preemption emitter in their vehicle) which is recognized by the preemption interface in the cabinet.

Typical Sources of Info:
Specs: 00990.46
Std. Dwg: TM465
Plan Sheets: YES
Additional Installation Info: pg. 170

FN/Ch FF/Ch

GPS Time Sync Module

DESCRIPTION: Model 412

USE: To keep accurate time in the traffic signal controller. Accurate time is critical when the traffic signal is interconnected with other signals and/or operates in time-of-day, day-of-week plans.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

GPS

Mounted outside, on top of cabinet

Mounted inside, in back of cabinet

Note: Back of Cabinet

Video Detection

DESCRIPTION: Camera mounted to mast arm or luminaire arm. Green sheet item includes all specified components in the controller cabinet and wiring.

USE: Alternative detection mode for vehicles.

Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES (green sheet listed systems only)
Additional Installation Info: NO

PhT/X CAM/T VDF/T PhT

Audible Pedestrian Signal

DESCRIPTION: Audio unit mounted near signal head and/or pushbutton.

USE: Provides sight impaired pedestrians' audible information regarding the pedestrian phases.

Typical Sources of Info:
Specs: 00990.42(h) specials only
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

A/Ph P/A/Ph C/A/Ph

Unit mounted on ped head

Unit contained within pushbutton frame

Back **Front**

Battery Back-up System

DESCRIPTION: Model FXM1000/CE

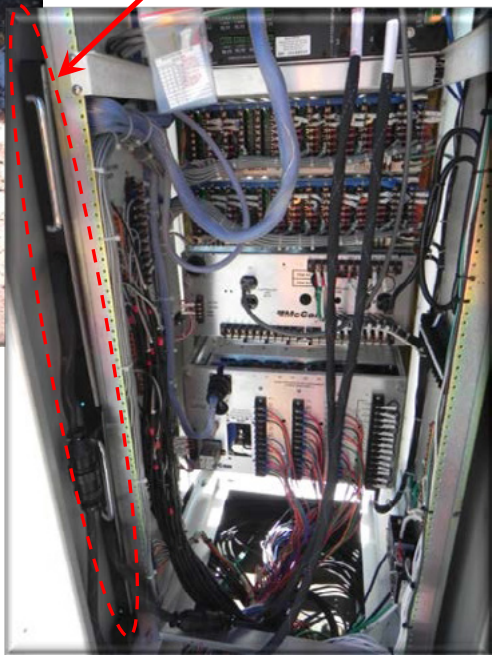
USE: Provides power to the traffic signal when commercial power is out.

Typical Sources of Info:
Specs: 02925.42
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

BAT

Stand-alone system

332S Integrated system



Beacon Assemblies (Various)

DESCRIPTION:

- Solar Powered 24/7 Flashing Beacon System
- School Zone & Actuated Solar Flashing Beacon Systems
- RRFB (Rapid Rectangular Flashing Beacon) Systems

USE: To provide emphasis of a sign or indicate when the sign restrictions are active (e.g. school zone).

Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES (Green sheet listed systems only)
Additional Installation Info: NO

XS/PP XR/PP XR/MA
XR/VP XR/SP XR/A

24 / 7

School Zone

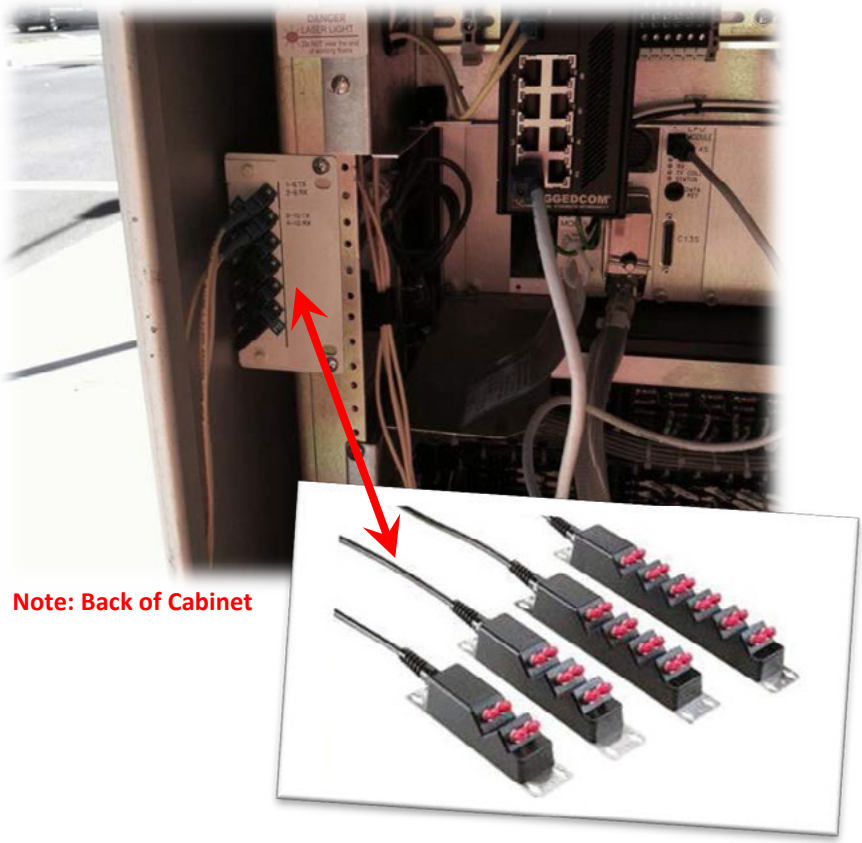
RRFB

Fiber Optic Connection Patch Panel

DESCRIPTION: A factory terminated patch panel that eliminates the need for field terminations in controller cabinet.

USE: to connect the fiber optic wiring from the junction box to the controller cabinet.

Typical Sources of Info:
Specs: See ITS special provisions
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO



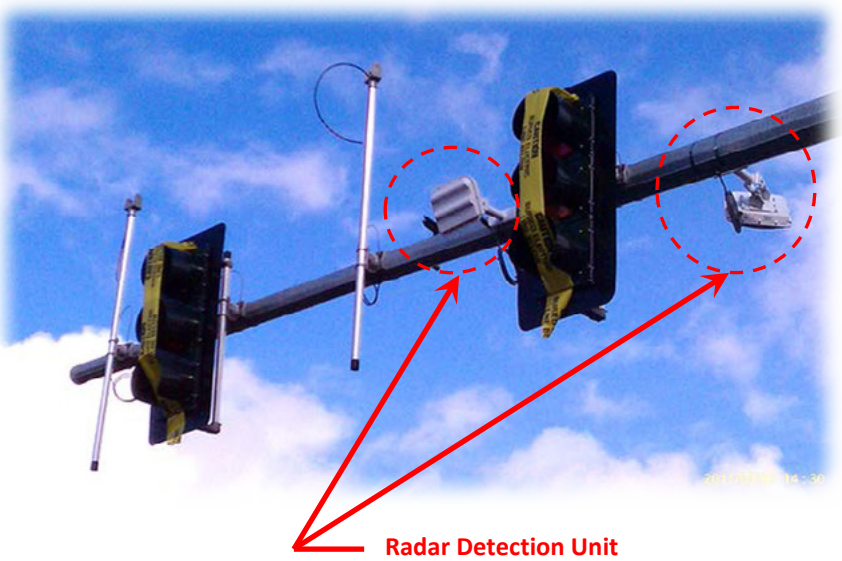
Radar Detection

DESCRIPTION: Radar unit mounted to mast arm or luminaire arm. Green sheet item includes all specified components in the controller cabinet and wiring.

USE: Alternative detection mode for vehicles.

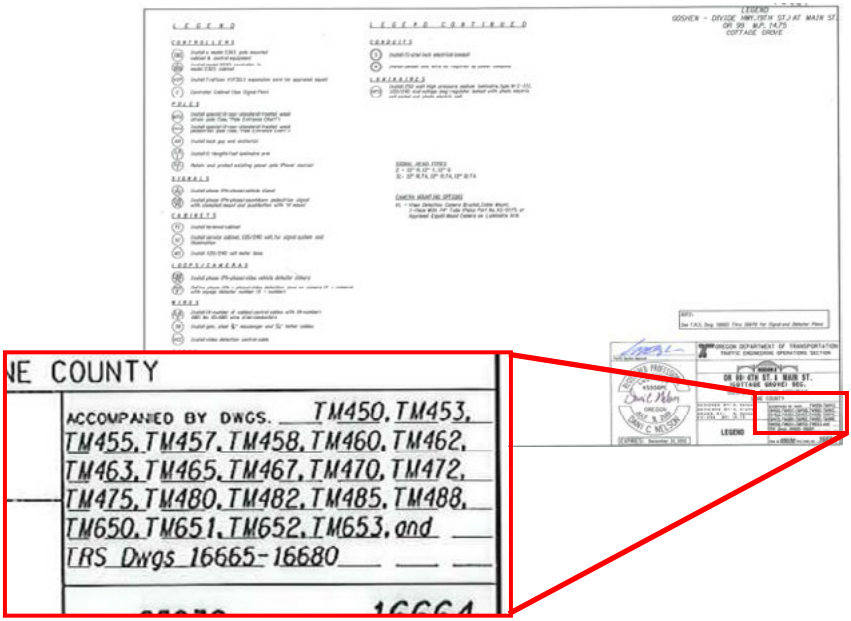
Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES (green sheet listed systems only)
Additional Installation Info: NO

PhT/X R-S/T RCC/T R-F/T R-N/T



Standard Drawings

Each project will contain a list of applicable traffic signal standard drawings to be used, shown on first plan sheet of the signal plan set:



The applicable Standard Drawings should be contained within the contract plans, but they can also be downloaded as a PDF file from the following website:
http://www.oregon.gov/ODOT/HWY/ENGSERVICES/pages/traffic_drawings.aspx

Traffic 400 - Signals

TRAFFIC 400 - SIGNALS					
2008 Specifications				2008 Specifications	
NEW Entire Series -pdf				Entire Series - pdf	
1 June 14 - 30 Nov 14		Description | Baseline Report		1 Dec 13 - 31 May 14	
Number	File Type			Number	File Type
TM450	dgn | pdf	Mast Arm Pole Details	pdf	TM450	dgn | pdf
TM452	dgn | pdf	Strain Pole Details	pdf	TM452	dgn | pdf
TM455	dgn | pdf	Temporary Signal Details	pdf	TM455	dgn | pdf
TM457	dgn | pdf	Vehicle, Pedestrian Signal and Push Button Mounting Option Details	pdf	TM457	dgn | pdf

Effective Date of Dwgs. (Older versions available on-line in the archives)

PDF File for each drawing

Baseline report for each drawing

PDF File for each drawing

Std. Drawing & Specifications

List of Traffic Signal Related Standard Drawings

TM400 Series: Signals

TM450 – Mast Arm Pole Details
TM452 – Strain Pole Details
TM455 – Temporary Signal Pole Details
TM457 – Vehicle, Pedestrian Signal and Push Button Mounting Option Details
TM458 – Pedestrian Ramp Placement Details
TM460 – Vehicle Signal Details
TM462 – Adjustable Signal Head Mounting Details
TM463 – Spanwire Mounting Details
TM465 – Overhead Sign, Fire Preemption, and Photoelectric Control Details
TM467 – Pedestrian Signal and Pedestrian Push Button Details
TM470 – Color Code Charts
TM472 – Traffic Signal Junction Boxes/Hand Holes
TM475 – Loop Details
TM480 – Loop Entrance Details
TM482 – Controller Cabinet & Foundation Details
TM485 – Service Cabinet and Service Cabinet Wiring Details
TM488 – Terminal Cabinet Detail
TM490 – Crosswalk Closure Detail
TM492 – Ramp Meter Pedestal Details
TM495 – LED PTR Signs and Details
TM497 – Ramp Meter Layout and Details

TM600 Series: Sign, Illumination, and Signal Support Structures

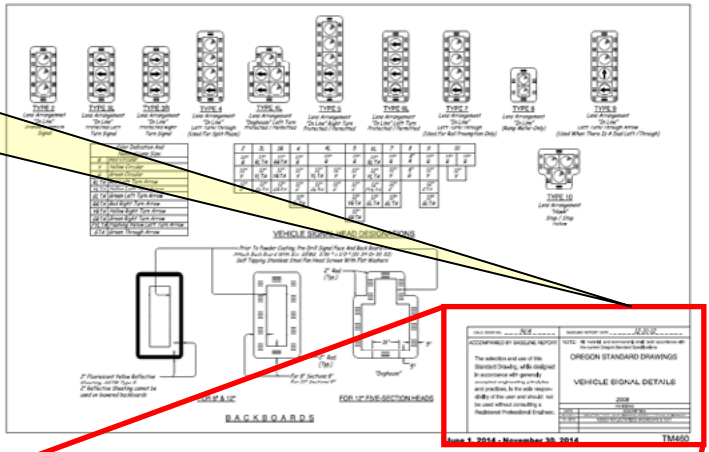
TM650 – Traffic Signal Supports General Details & Design Criteria
TM651 – Traffic Signal Supports Notes and Reactions
TM652 – Traffic Signal Supports Steel Details
TM653 – Traffic Signal Supports Foundation Requirements
TM660 – Traffic Strain Pole Supports General Details & Design Criteria
TM661 – Traffic Strain Pole Supports Notes, Reactions, and Details

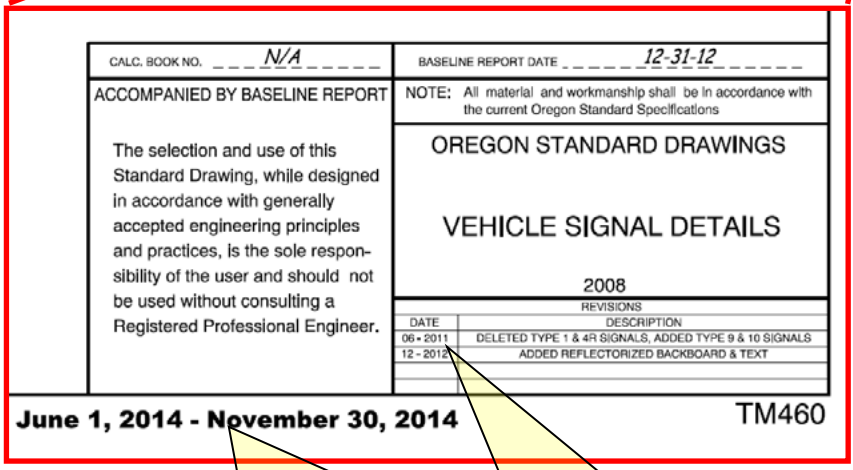
TM800 Series: Temporary Traffic Control

TM870 – Bridge Construction (Using Signals, 1 lane, 2-way)

Standard Drawings are updated twice a year, once in January and once in July. The effective date of the standard drawing is updated at each revision, **EVEN IF THERE ARE NO CONTENT CHANGES**. Check the title block of the standard drawing to find out if any content revisions have occurred. The baseline report for each drawing (found on-line) also provides info on content changes.

Standard Drawing Title Block





CALC. BOOK NO. N/A

BASELINE REPORT DATE 12-31-12

ACCOMPANIED BY BASELINE REPORT

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

NOTE: All material and workmanship shall be in accordance with the current Oregon Standard Specifications

OREGON STANDARD DRAWINGS

VEHICLE SIGNAL DETAILS

2008

REVISIONS

DATE	DESCRIPTION
06 - 2011	DELETED TYPE 1 & 4R SIGNALS, ADDED TYPE 9 & 10 SIGNALS
12 - 2012	ADDED REFLECTORIZED BACKBOARD & TEXT

June 1, 2014 - November 30, 2014

TM460

Effective Date (reference to the bid date of the project)

Date & description of any content revisions

ALWAYS CHECK THE STANDARD DRAWINGS FOR CONTENT CHANGES PRIOR TO USE!

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Specifications & Special Provisions

General

Standard Specifications are contained in a published book that is updated roughly every 5 to 10 years. Each edition of the Standard Specifications lists the year that it is produced for easy identification. Each project will list state the specific edition to be used.

Special Provisions are specific to each project; they add, modify, or delete information that is contained in the standard specifications or standard drawings. The Engineer of Record will produce the special provisions for each project from Special Provision Boiler Plates. There are several different reasons why the Engineer of Record may need to add modify or delete information in the Standard Specifications:

- Correcting typos or errors
- Adding unique features to project (i.e. ornamental pole treatments)
- Deleting information that is not relevant to the project
- Limiting construction methods or materials that may be used (i.e. requiring polycarbonate material for vehicle signal heads or requiring horizontal directional drilling instead of open trenching)
- A change in standards

Note that in specification 00150.10(a) Order of Precedence, the Standard Specifications are near the bottom of the list because they are updated on infrequent basis and are typically generic (to make them useful for the majority of installations). Special Provisions, on the other hand are near the top of the list because they are specific to each project.

The Standard Specifications and Special Provision Boiler Plates can be found at the following website:
http://www.oregon.gov/ODOT/HWY/SPECS/Pages/index.aspx

ALWAYS CAREFULLY READ THE SPECIAL PROVISIONS FOR YOUR PROJECT!

List of Traffic Signal Related Specification Sections

The specifications are organized by sections. The following section lists the major specification sections that are related to traffic signals. As noted in the list below in parenthesis, the major specification sections related to traffic signals may reference additional specifications for certain components of the work.

00225: Work Zone Traffic Control (references numerous other sections)

00902: Crosswalk Closure Barricades

00950: Removal of Electrical Systems

00960: Common Provisions for Electrical Systems (references 00440 & 00442)

00962: Metal Illumination & Traffic Signal Supports (references 00440 & 02560)

00963: Signal Support Drilled Shafts (references 00440 and 02510)

00965: Camera Poles and Foundations (references 02560)

00970: Highway Illumination (references 00960, 00962, & 02926)

00990: Traffic Signals (references 00960, 00962, 02920, 00963, & 02925)

02920: Common Electrical Materials

02925: Traffic Signal Materials

Specification Division Format

Each section of the specifications is organized by divisions. There are ten divisions:

XXXXX.00 = Description (work scope & definitions)

XXXXX.10 = Materials (material properties & testing requirements)

XXXXX.20 = Equipment (unique equipment requirements)

XXXXX.30 = Labor (unique labor requirements/qualifications)

XXXXX.40 = Construction (sequence of construction & end product requirements)

XXXXX.50 = Temporary (unique temporary measures that are required)

XXXXX.60 = Maintenance (maintenance & repair responsibilities)

XXXXX.70 = Finishing and Clean-up (restoration responsibilities & warranties)

XXXXX.80 = Measurement (components that are to be measured for payment)

XXXXX.90 = Payment (bid items for which payment will be made)

Using Standard Specifications & Special Provisions

Both the Standard Specifications and the Special Provisions are required to properly inspect the project. The example below shows how the two documents are used together to make a complete project specific specification.

Standard Specification 02925.64(b):

02925.64 Vehicle Signal

(b) Visors – Construct visors of sheet aluminum alloy 3003-H16 (ASTM B 209), nominal thickness 16 gauge or polycarbonate. Visors shall be of one piece construction and attach to the signal housing doors with Type 304 or 316 stainless steel screws. Provide 8 inch lenses with a 7 inch visor and 12 inch lenses with a 9 ½ inch visor. Signal housing doors, with visors attached, shall be capable of being opened a minimum of 90 degrees.

+

Special Provision 02925.64(b):

02925.64(b) Vehicle Signal Visors – In the first sentence, remove "sheet aluminum alloy 3003-H16 (ASTM B 209), nominal thickness 16 gauge or".

=

Combining the two = Complete & Useable Specification on Project:

02925.64 Vehicle Signal

(b) Visors – Construct visors of ~~sheet aluminum alloy 3003-H16 (ASTM B 209), nominal thickness 16 gauge or~~ polycarbonate. Visors shall be of one piece construction and attach to the signal housing doors with Type 304 or 316 stainless steel screws. Provide 8 inch lenses with a 7 inch visor and 12 inch lenses with a 9 ½ inch visor. Signal housing doors, with visors attached, shall be capable of being opened a minimum of 90 degrees.

Measurement and Payment

The last two divisions of each specification section contain information on measurement and payment. Read payment section (XXXXX.90) closely to determine what IS included and what is NOT included in the bid item payment.

Bid Item	Spec. No.	Measurement (XXXXX.80)	Payment (XXXXX.90)
Temporary Traffic Signal	00225	None	Lump Sum (per specific intersection)
Portable Temporary Traffic Signal	00225	Unit	Each
Removal of Electrical Systems (method "A")	00950	None	Typically no separate payment
Removal of Electrical Systems (Method "B")	00950	None	Lump Sum (per specific intersection)
36" Diameter Signal Support Drilled Shaft	00963	Length	Foot
42" Diameter Signal Support Drilled Shaft	00963	Length	Foot
Traffic Signal Installation	00990	None	Lump Sum (per specific intersection)
Traffic Signal Modification	00990	None	Lump Sum (per specific intersection)
Detector Installation	00990	None	Lump Sum (per specific intersection)
Ramp Meter Installation	00990	None	Lump Sum (per specific intersection)
Interconnect System	00990	None	Lump Sum (entire project)
Flashing Beacon Installation	00990	None	Lump Sum (per specific intersection)
Automatic Traffic Recorder Installation	00990	None	Lump Sum (per specific intersection)

Note: Work **DETAILED** on the signal plan is included in the traffic signal lump sum bid item. Work **REFERENCED** on the signal plan is **NOT** included in the lump sum bid item. This typically applies to signs:

- Guide signs/street name signs are only referenced on the signal plans and therefore measured and paid for under the signing bid items.
- Standard regulatory signs are usually detailed (showing substrate, size, sheeting type, sign design, & mounting info) on the signal plans and therefore measured & paid for under the traffic signal lump sum bid item.

Typical anticipated items for traffic signal work include:

- Electrical Power Hook-up
- ITS & communication equipment

Construction

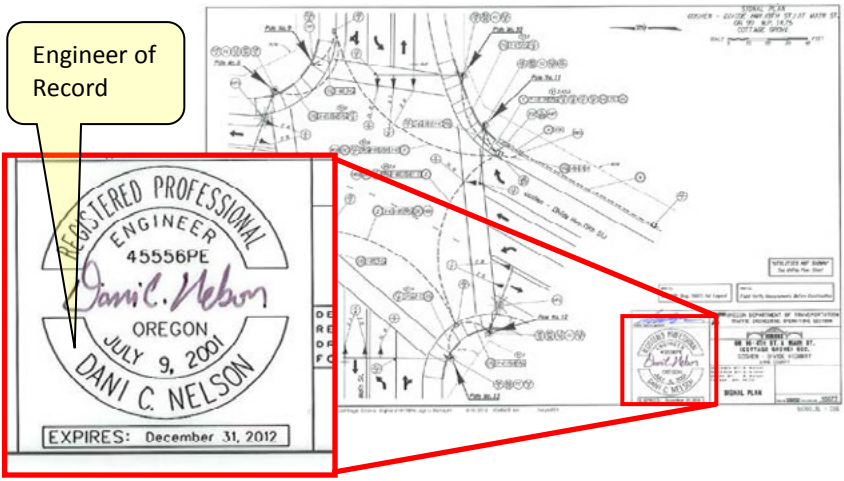
Each of the following pages in this section acquaints the inspector with an area/phase of construction or type of equipment used when installing a traffic signal. The pages are grouped by similar topics for ease of use.

Each page suggests action to be taken prior to construction, installation sequence or tips, and cautions against common pitfalls and oversights. A "typical sources of info" has also been included for easy referencing to the relevant contract documents. The information given is meant to be used in conjunction with the appropriate section(s) of the Standard Specifications, Special Provisions, project specific plan sheets and/or standard drawings.

Illustrations have been provided to demonstrate construction practices and clarify equipment installation procedures.

Changes to the Plans and Specifications

Any changes made in the field are subject to the approval of the **ENGINEER OF RECORD**. Exception: The TRAFFIC SIGNAL ENGINEER (**NOT** the Engineer of Record) is responsible for the approval of write-in products on the Blue and Green Sheets. The Inspector should note the changes as they occur, so that it will be easier to record these changes on the As-Constructed drawings (see page 181).



Coordination & Supplemental Inspection

It is critical that the Project Manager/Inspector coordinates supplemental inspection (as recommended/required in the table on the following page) with the appropriate personnel:

1. **ODOT Region Traffic*** is responsible for the signal timing and operation of the traffic signal.
2. **ODOT Agency Electricians*** are responsible for the maintenance and power cost of the traffic signal.
3. **ODOT Traffic Signal Services Unit (TSSU)*** is responsible for the environmental testing of the traffic signal controller cabinet (and components) and installation of the components during signal turn-on.
4. **Electrical Permitting Agencies (Building Codes Division, City, or County)** are responsible for permitting and inspecting electrical work.

***The Local Agency** (city or county) may provide these services if an intergovernmental agreement (IGA) is in effect. Verify who is (or will be) responsible for the maintenance and signal timing with the appropriate Region Traffic Signal Timing contact.

Electrical Permits

Electrical permits are required for **ANY TYPE** of traffic signal work as per the Oregon Electrical Safety Law (ORS 479). The contractor is required to obtain all necessary permits to accomplish the work as per ODOT Standard Specification 00170.02. However, some exceptions may apply at the discretion of the Electrical Permitting Agency (a typical example is not requiring a permit for loop detector installation). If in doubt, contact the Agency Electricians who can help verify if electrical permits are required.

The Electrical Permitting Agency issues the permits and provides inspection as required by state law. Inspection is required before a new service cabinet can be energized. **Note that their inspection protocol may vary based on the type of work that is done.**

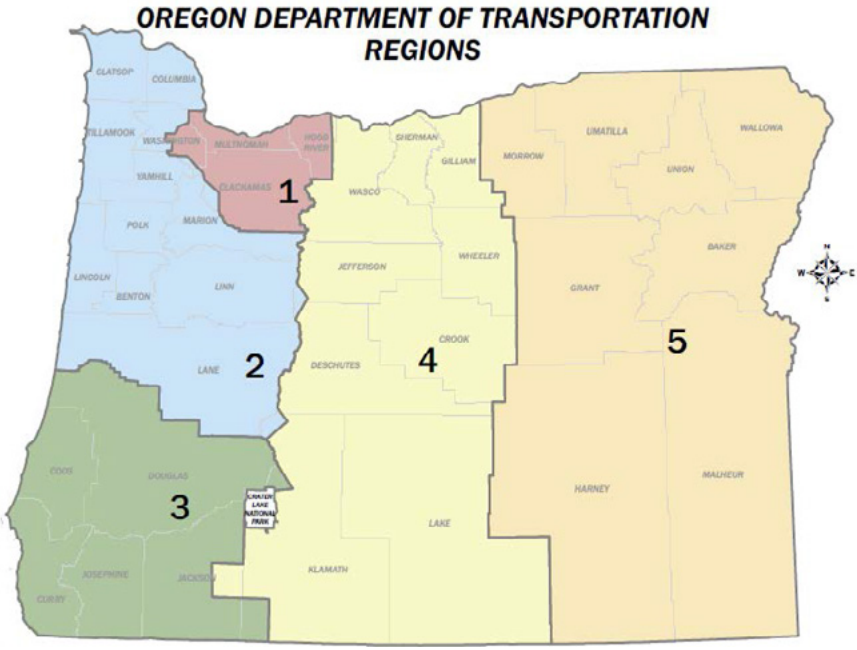
The contractor will provide a copy of the permit(s) to the Agency for review. Pay close attention to the Electrical Permitting Agencies requirements and timelines described in the required permits. Failure to comply with permits will add significant time and cost to the project.

This table below summarizes the minimum amount of supplemental inspections recommended/required for each contract.

	Type of Inspection	When to request inspection	Contact	Advance Notice
1	Pole & controller layout inspection	After curb (or EP) radii are laid out and pole and controller locations are staked	Region Traffic/Region Electricians	3 days
2	Conduit & backfill inspection 00960.42(e)	During conduit installation, but before backfill	Region Electricians	3 days
3	In-ground electrical inspection	After forms and conduits are in place, but before foundations are poured	Region Electricians	3 to 5 days
4	Loop layout inspection 00990.43(b)(3)	After crosswalks and loops are laid out, but before cutting begins	Region Traffic	3 days
5	Loop installation inspection 00990.43(b)(3)	At the beginning of loop installations	Region Electricians	3 to 5 days
6	Field inspection 00990.70(g)	At anticipated signal completion date	Region Electricians	1 to 2 weeks
7	Power Service Inspection 00960.70	At anticipated signal completion date	Electrical Permitting Agency	As per the permit
8	Pre-signal turn-on inspection	At anticipated signal completion date	Region Traffic/Region Electricians	1 to 2 weeks
9	Final Inspection 00150.90	After punch list items have been completed	Region Electricians/ Region Traffic	3 to 5 days

Contacts

ODOT Traffic Standards Unit (Statewide)		
Discipline	**Name**	**Phone**
All	**Doug Bish, P.E.** Traffic Standards Manager	503-986-3594
Traffic Signals	**Scott Cramer, P.E.** Traffic Signal Engineer	503-986-3596
	Joe Searcy, Electrician Traffic Signal Standards Specialist	503-986-3577
	Vacant Illum. & Traffic Signal Control System Specialist	503-986-3251
	Katie Johnson, P.E. Traffic Signal QC Engineer	503-986-3595
	Martin Klug, P.E. Traffic Design Engineer	503-986-3586
Traffic Structures	**Scott Jollo, P.E.** Traffic Structures Engineer	503-986-3069
	Andrew Wilkes Traffic Structures Specialist	503-986-3238
Illumination	**Ernest Kim, P.E.** Illumination Engineer	503-986-3587



Construction

ODOT Traffic Signal Timing & Electrical Contacts			
Region	**Discipline**	**Name**	**Phone**
Statewide	Electrical (TSSU)	Laura Wilson – Lead Signal Tech	503-378-2956
	Electrical (TSSU)	Fraser Groves – Lead Chamber Tech	503-378-2927
	Timing	Craig Black, P.E.	503-986-3576
1	Electrical	John Sapp - Manager	971-673-6201
		Tim Damm	971-673-6201
	Timing	Doug Anderson – Signals, West	503-731-8213
		Tiffany Slauter, P.E. – Signals, East	503-731-3014
		Phuong Nguyen – Ramp Meters	503-731-3004
2	Electrical	Rich Hinkle - Manager	503-986-2705
		David Dexheimer - North	503-932-1479
		Brian Parks - South	541-686-7700
	Timing	Julie Infante, P.E.	503-986-2826
3	Electrical	Terri Moxley – Manager	541-474-3149
		Terry Brock – North	541-957-3667
		Bret Leslie – Coastal	541-269-5217
		Curt Duncan – South	541-621-2329
	Timing	Ray Lapke, P.E. - North	541-957-3536
		Dan Dorrell, P.E. - South	541-774-6354
4	Electrical	Brad Stevens	541-388-6221
	Timing	David Hirsch, P.E.	541-388-6472
5	Electrical	Mark Herburger - North	541-969-6554
		Joe Gastanaga – South	541-889-4243
	Timing	Don Fine	541-963-1594

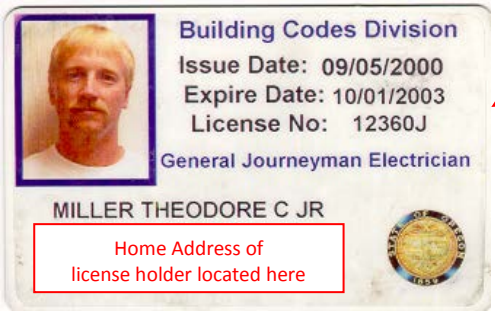
Labor Requirements

As per section 00960.30, every person engaged in the installation of electrical equipment and wiring systems shall possess a valid Oregon electrical license or registration:

- General Supervising License
- General Journeyman's License
- Electrical Apprentice Registration (must be working under the direct supervision of an individual with an electrical license)

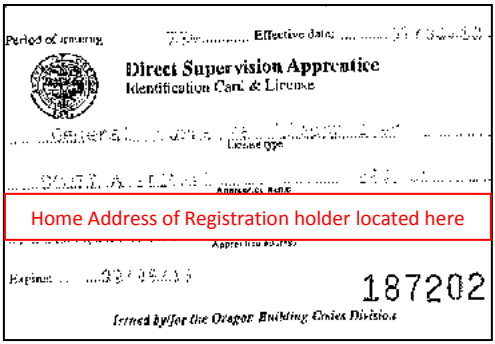
A copy of the electrical license or apprentice registration to the Engineer is required before performing any work (obtain at the pre-construction conference). In addition, OAR 918-030-0920 requires an individual's license to be visible when on the jobsite, unless it would create a safety issue. If a license or registration is not visible, it should always be immediately available upon request.

License Example:



Check the Expire Date!

Apprentice Registration Example (must be accompanied by photo ID):



The following Building Codes Division website has a license holder search tool: http://www.cbs.state.or.us/bcd/licensing.html

Work That Requires an Electrical License

These lists were developed in 1999 by the Oregon Building Codes Division as per Oregon Administrative Rule (OAR) 918-282-0120(1) due to a request for clarification of traffic signal work that requires an electrical license. Failure to follow these lists is a violation of Oregon Law and should be reported.

A license IS required to:

1. Install ground rods and grounding/bonding
2. Install conduit in a footing
3. Install luminaires on the pole
4. Install pedestrian pushbuttons
5. Install pedestrian signal heads
6. Install vehicle signal heads
7. Install interior illuminated signs on pole
8. Assemble and lay ALL conduit in a foundation or ditch
9. Assemble and handle conduit for boring operations
10. Install pull line in conduits
11. Pull wire and cable in ALL raceways (conduits, poles, arms)
12. Install ALL wire and making connections
13. Splice and solder loop wires to loop feeder cables
14. Install ALL cabinets (terminal, meter base, etc.)

A license is NOT required to:

1. Dig a hole for a footing in the ground
2. Tie rebar cages for the footings
3. Install anchor rods in a footing
4. Form the pole base
5. Unload the poles from a trailer
6. Unload the arms from the trailer
7. Unload light fixtures from trailer
8. Install arms on the poles
9. Install poles onto their bases
10. Uncrate pedestrian signal heads
11. Uncrate vehicle signal heads
12. Assemble ped heads into an assembly, on the ground
13. Assemble vehicle heads into an assembly, on the ground
14. Dig a ditch for conduit
15. Lay conduit alongside the ditch
16. Install poly warning tape in ditch above conduit
17. Backfill a ditch after conduit is assembled
18. Install gravel under junction boxes
19. Install concrete junction boxes
20. Install vehicle detector loops (saw, clean, place wire, seal)

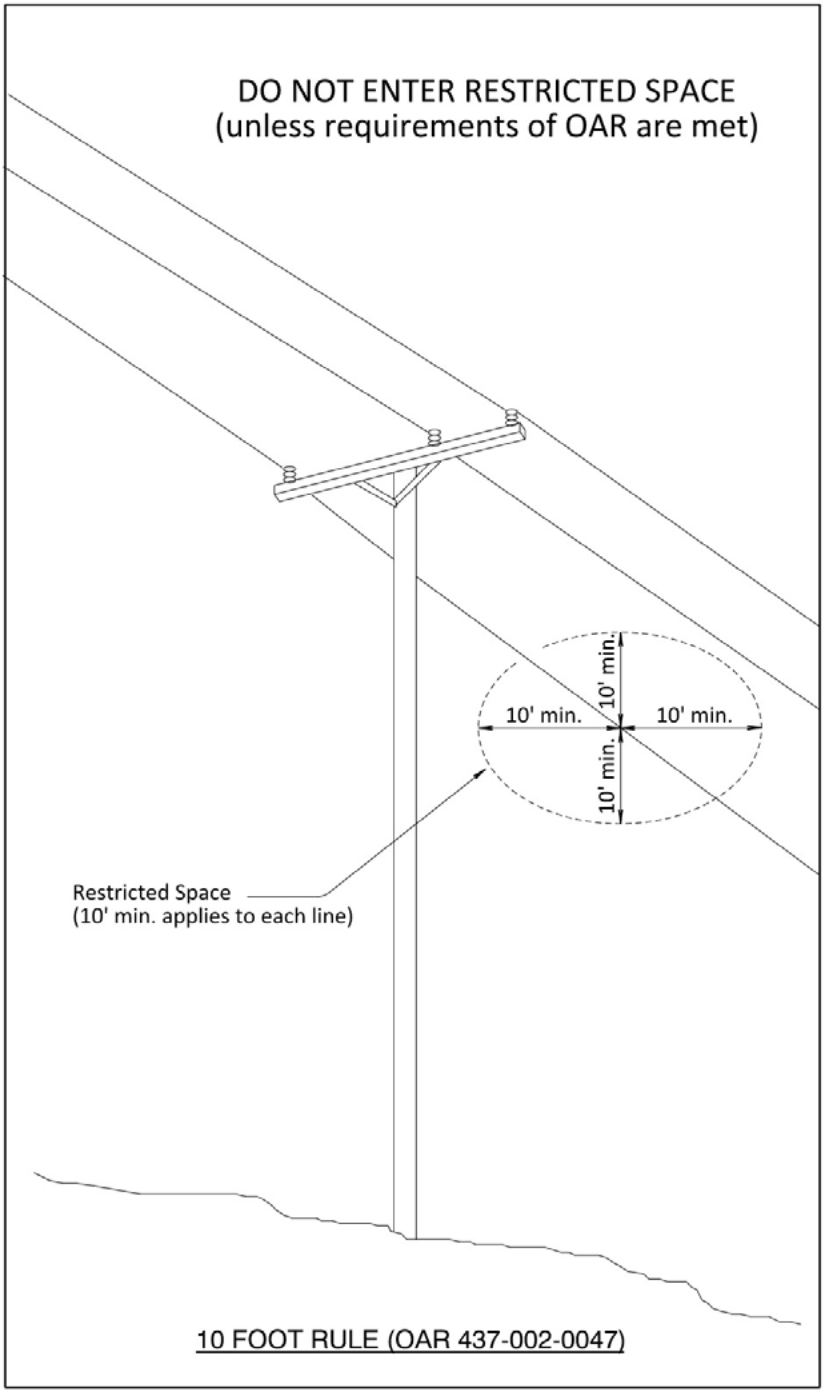
Working Near Overhead High Voltage Lines and Equipment

OAR 437-002-0047

- **Restricted space:**
  - For lines rated more than 600V to 50,000V, restricted space extends 10 feet in all directions from the surface of the line or equipment.
  - For line rated more than 50,000V, restricted space extends 10 feet plus 0.4 inch for each 1000V over 50,000V, or twice the length of the insulator (but never less than 10 feet) in all directions from the surface of the line or equipment.
- **Proper notification:**
  - The persons responsible for the planned activity must notify the owner/operator of the line or equipment at least 2 business days prior to the beginning of work.
- **General Requirement:** Do not enter, perform any function or activity within the restricted space surrounding an overhead high voltage line or equipment unless:
  - Proper notification is provided; and
    - The line and/or equipment is de-energized and visibly grounded by the owner of the high voltage system or their authorized agent; OR
    - Accidental contact is effectively prevented by use of insulating barriers or guards.
- **The Insulating barrier or guard must:**
  - Be erected or installed by the owner or the high voltage system or their authorized agent; and
  - Not be attached to, or be part of the lines, equipment or machinery
  - Prevent all possible contact with the lines or equipment
  - Insulate against the system's maximum voltage

- Overhead line covers are only for visual reference, and their use does NOT allow entry into restricted space.

- This standard does NOT mandate that the owner of the lines or equipment must agree to de-energize, move, barricade, guard or insulate lines or equipment, or take other action to allow entry into restricted space.



Construction

Temporary Staging & Work that Impacts Existing Traffic Signals

PRIOR TO STAGING CHANGES & OTHER CONTRACT WORK

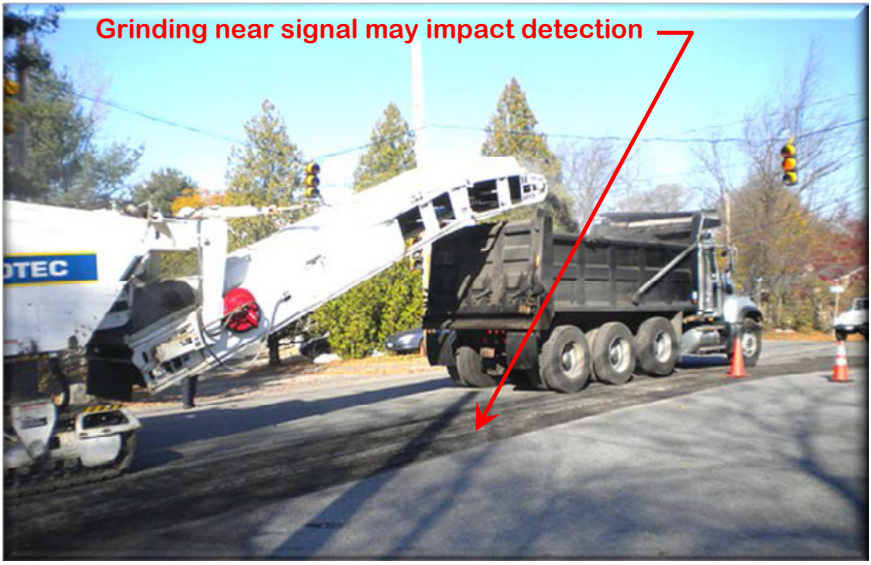
- Become familiar with the stage construction plans.
- Become familiar with the schedule of work
- Contact Region Traffic (or local agency providing maintenance/signal timing) **in advance** of any work that will impact the proper functioning of the traffic signal and may require adjustments to the signal timing, such as:
    - Removal of existing loop detection (i.e. grind/inlay)
    - Temporary lane use changes or closures near the signalized intersection
    - Temporary lane reductions near the signalized intersection.
    - Temporary Closure of crosswalks
    - Push buttons temporarily inaccessible

INSTALLATION

- Observe the traffic flow once the change is made.
- Notify Region Traffic or Agency Electricians (or local agency providing maintenance/signal timing) if you notice excessive congestion or the signal not cycling properly. Be as specific as you can in stating what you are observing.

CAUTION-POTENTIAL PROBLEMS

- The signal may skip phases or have green times that are either too short or too long if the detection is not working properly. This can result in disobedience of the traffic signal (potential crashes) and excessive congestion.



When work will affect signal timing, contact Region Traffic for temporary timing solutions!

Flagging at Signalized Intersections: Using the Police Panel

PRIOR TO FLAGGING THROUGH SIGNALIZED INTERSECTION

- Contact TSSU or Agency Electricians for permission to turn-off the signal.
- PM offices may already have internal procedures/agreements in place for who is allowed to access and use the "police panel" to turn off the signal. Review the procedures/agreements.

FLAGGING THROUGH SIGNALIZED INTERSECTION

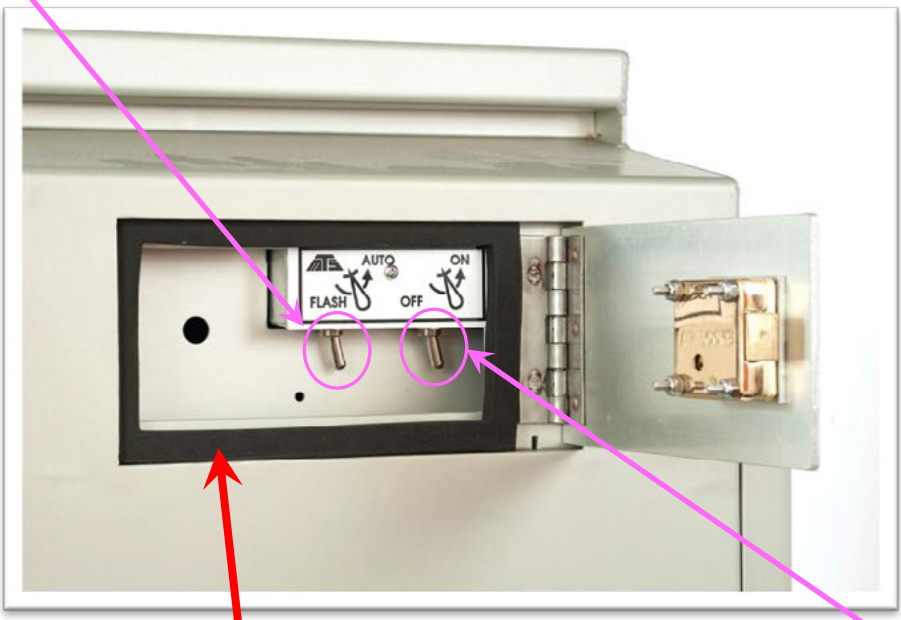
- The signal is turned off through the "police panel" located on the side of the signal controller cabinet (see next page for illustration).
- Signals MUST be turned off during flagging operations. Oregon Law ORS 811.265.

CAUTION-POTENTIAL PROBLEMS

- The police panel requires a key for access. Only trained personnel may be issued a key, as determined by TSSU.
- DO NOT USE THE POLICE PANEL TO TURN OFF SIGNAL INDICATIONS IF YOU HAVE NOT BEEN PROPERLY TRAINED!! Training is provided by TSSU or Agency Electricians.
- Proper communication and understanding between the person using the police panel and flaggers is critical.

This switch places the signal into flash.

- "AUTO" is for the signal to run in normal operation
- "FLASH" places the signal into flash mode



This switch turns the signal indications on or off.

- "ON" signal indications are on
- "OFF" signal indications are off

Police Panel

Construction

Temporary Signal (Standard)

PRIOR TO INSTALLATION

- Become familiar with the stage construction plans.
- The existing signal cannot be removed until the temporary signal or new signal is operational. 00950.40.
- Poles for temporary signals are non-standard wood poles. The contractor is responsible for providing design details to the agency for review and approval. 00225.15 & 00225.10.

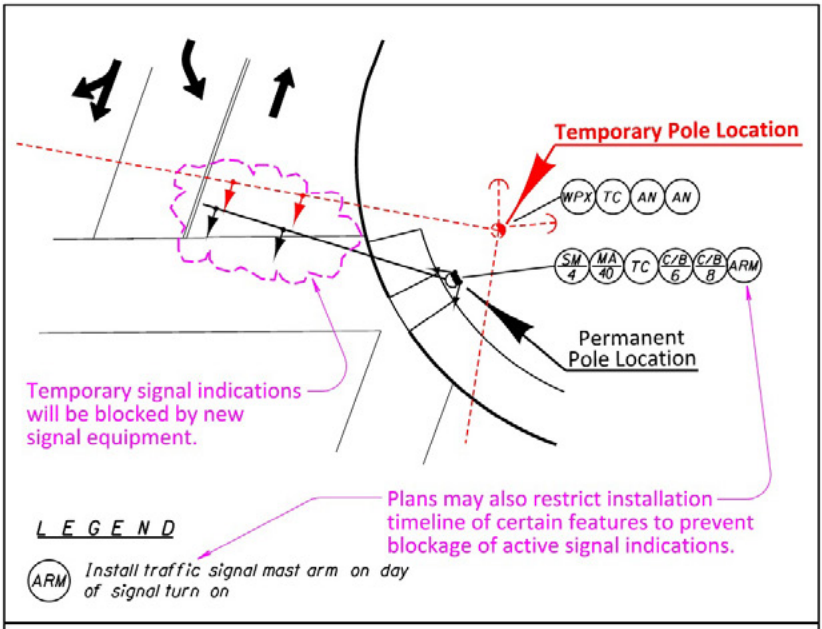
INSTALLATION

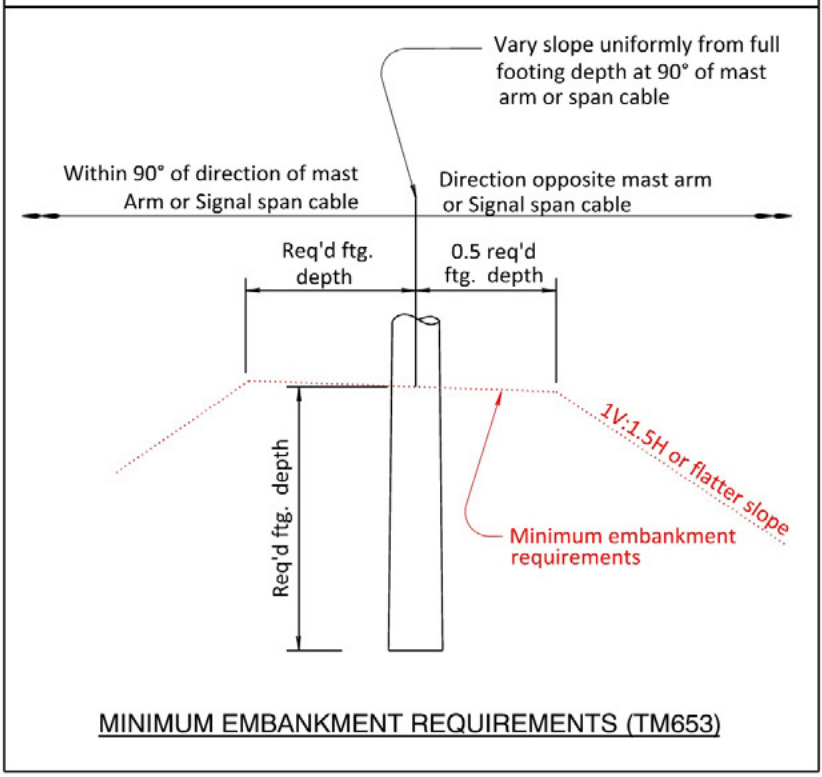
- Region Traffic (or local agency) is responsible for signal timing. 00225.15(a)(5).
- Equipment used for temporary signals shall be new or like new. 00225.15(a)(1)
- Do not use permanent signal equipment as part of the temporary installation 00225.15(a)(1)
- Verify that the minimum embankment requirements for the large temporary poles are met. The permanent requirements may be applied to temporary poles. TM653
- If the stage construction requires changes to lane use or lane alignment, the signal head types/location and/or the signal phase may need to be adjusted.

CAUTION-POTENTIAL PROBLEMS

- The contractor is responsible for maintenance and power costs of the temporary traffic signal. Agency Electricians may perform necessary maintenance at the contractor's expense. 00225.45(a)(2) & 00225.65(a).
- Mast arms may need to be installed the day of permanent signal turn-on to avoid blocking temporary signal indications. Plan Sheets.
- Pedestrian signal indications and push buttons may require re-location throughout construction to properly accommodate access (ADA max reach of 24" to the push button, 4' clear area). TM458.
- For each stage change that requires moving or changing temporary signal equipment, contact EOR, Region Traffic, TSSU, and Agency Electricians for field assistance (timing and turn-on inspection).

Typical Sources of Info:
Specs: 00225.15, 00225.45, 00225.65, 00225.85, 00225.95
Std. Dwg: TM452, TM455, TM870
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Various





MINIMUM EMBANKMENT REQUIREMENTS (TM653)

Construction

Portable Temporary Traffic Signal

PRIOR TO INSTALLATION

- Become familiar with the stage construction plans.
- Portable Temporary Traffic Signals (PTTS) require State Traffic Engineer Approval prior to use. Typically used for two-way, one lane operation. Contact Region Traffic for verification of State Traffic Engineer approval. TM870.
- PTTS are contained on the larger, ODOT Qualified Products List, NOT the Green Sheets. They are NOT required to be chamber tested by TSSU. 00225.15(b).

INSTALLATION

- Region Traffic is responsible for providing the contractor signal timing parameters. The contractor is responsible for installing and maintaining the signal timing. 00225.45(b)(3).
- The devices are hard wire connected. 00225.45(b)(1).
- Region Traffic, TSSU and/or Agency Electricians should be present during initial turn-on. 00225.45(b)(3).

CAUTION-POTENTIAL PROBLEMS

- The wiring connecting the devices should be protected from damage.
- The contractor is responsible for maintenance and power costs. 00225.45(b)(3) & 00225.46(c).
- The signal heads should line-up with the receiving lane. 00225.45(b)(1).
- Flaggers are to remain on stand-by for 2 hours after signal turn-on. 00225.45(b)(3).

Typical Sources of Info:
Specs: 00225.15(b), 00225.45(b), 00225.65(b), 00225.85(b), 00225.90
Std. Dwg: TM870
Plan Sheets: Typically YES (See Temporary Traffic Control Plan Sheets)
Blue Sheet/Green Sheet Info: Pg. 1 (from QPL)

AREA UNDER
VIDEO
SURVEILLANCE
NARROW
BRIDGE
STOP
HERE ON
RED

Signal Head Alignment and Pole Location

Head location must be established before pole layout can be finalized. The lane dimension head (in conjunction with the pole entrance chart) determines exactly where each piece of equipment on the mast arm or span wire must be located in relation to the lane lines. This in turn, determines where the pole should be located.

PRIOR TO INSTALLATION

- Lay out preliminary lane lines from typical sections.
- Lay out curbs and back of walk or edge of pavement.
- “Roughly" locate poles from plans.
- "Roughly" locate path of span or arm.
- Verify signal head alignments.

INSTALLATION

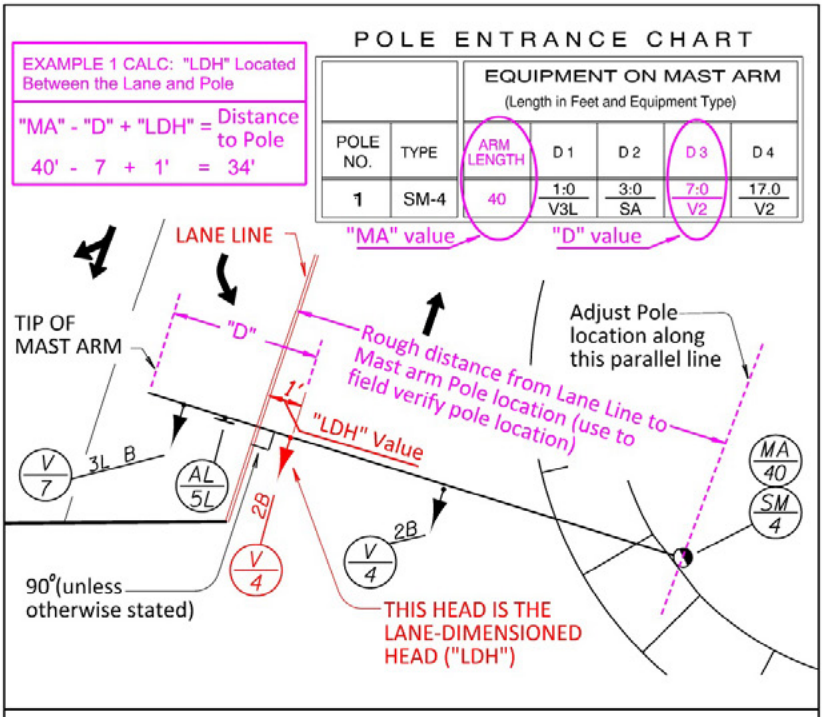
- Locate lane-dimensioned head (from plans), then measure back to the pole using the dimensions shown in the plan sheet.

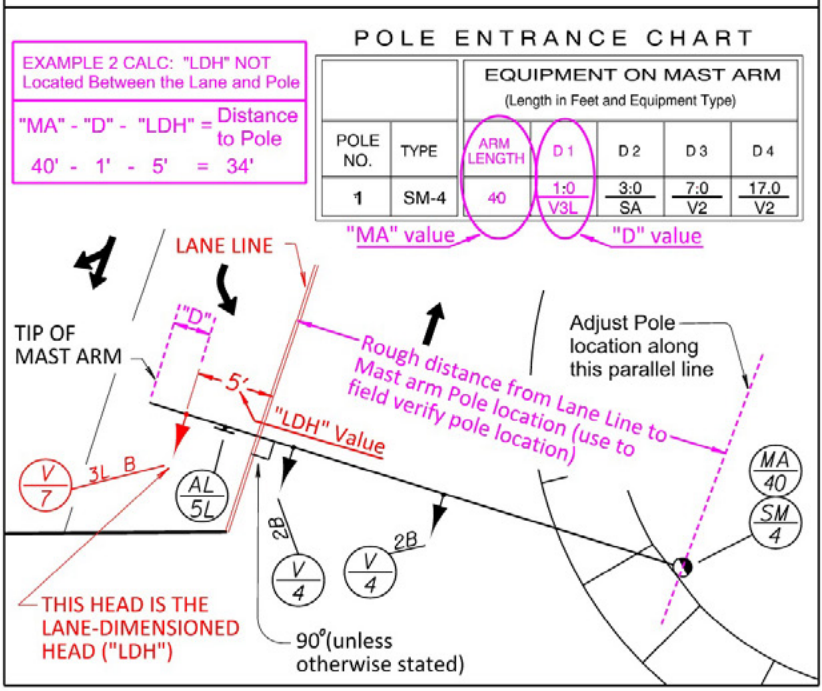
Calculation for Rough locate of pole:

1. Determine Mast Arm Length (“MA” value)
2. Find the Lane Dimension Head (only head that is dimensioned to a lane line) and the corresponding Lane Dimension Head distance (“LDH” value)
3. Determine distance from tip of mast arm to the Lane Dimension Head from the pole entrance chart (“D” value)
4. Determine if the location of the lane dimension head is between the pole and lane line (example 1 calc: **add** “LDH” value) or not (example 2 calc: **subtract** “LDH” value).
5. “MA” – “D” **(+ or -)** “LDH” = rough distance from lane line to mast arm pole location

CAUTION-POTENTIAL PROBLEMS

- If lane lines on road plan or striping plan do not match lanes on signal plans, contact Engineer of Record.
- If the rough locate of pole will be in conflict with other features (sidewalk, utilities, etc.), contact the Engineer of Record. A different design and/or pole size may be needed.





Construction

Pole & Pedestal Location

Pole and pedestal location must be field verified. Final pole location may need adjustment due to utility conflicts, radius changes, striping changes, ADA walk designs, etc.

PRIOR TO INSTALLATION

- Verify signal head alignment first (see page 104).
- Complete Field Verification Form. 00962.02
- Lay out curb or edge of pavement radius.
- Lay out back of sidewalk, including ADA ramp/bypass (if such).
- Lay out raised island (if such).
- Poles should be 5' min. from face of curb.
- Poles should be 6' min. from edge of pavement.
- Pole islands must be raised and have a minimum area of 75 square feet.
- Poles with pedestrian signals should be within crosswalk alignment projection.

INSTALLATION

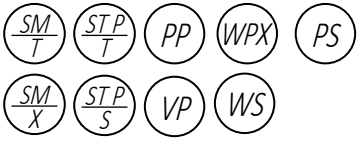
- N/A

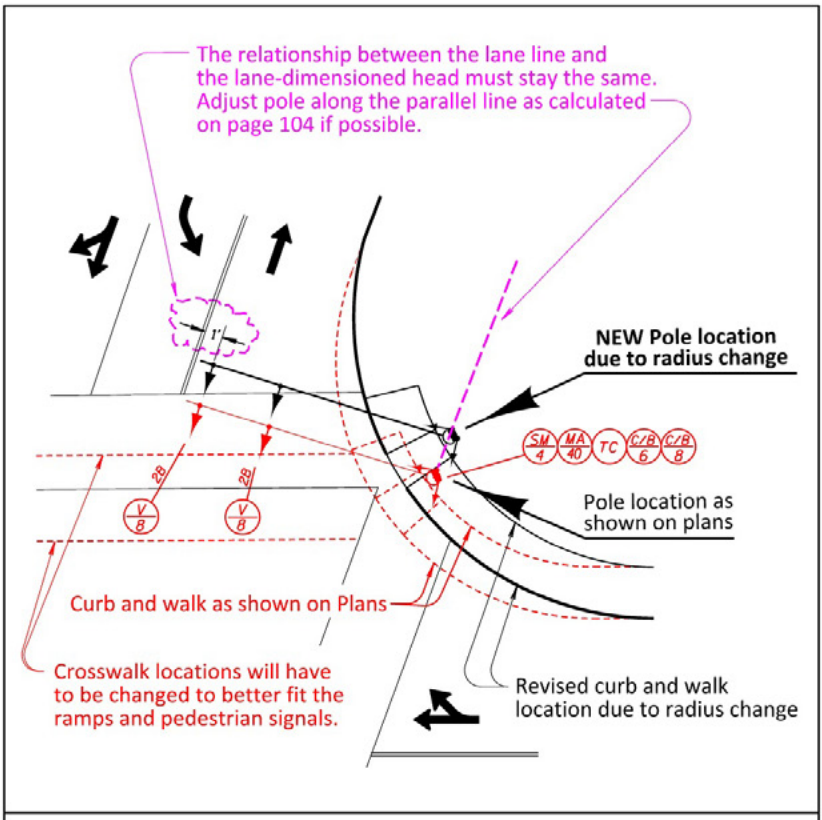
CAUTION-POTENTIAL PROBLEMS

- Changing pole location may require:
  - A longer or shorter mast arm, a different type of pole, and/or a different foundation.
  - a different type of strain or mast arm pole
  - auxiliary equipment (push-button posts, pedestrian pedestals, etc.)
  - illumination re-design.
- Mast arms come in 5' increments, thus relocations requiring different poles and arms will be in 5' increments. TM651
- Fit poles to ADA ramps, back of walk, out of the landing area. TM458.
- Update Field Verification Form when changes occur
- Supplemental Inspection Recommended, See page 88 for more info.

Construction

Typical Sources of Info:
Specs: NO
Std. Dwg: TM458
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO





Mast Arm Length (TM650)	Mast Arm Pole Type	Foundation Number (TM653)
15'	SM1	1
	SM1L	2
20' or 25'	SM2	2
	SM2L	3
30' or 35'	SM3	3
	SM3L	4
40' or 45'	SM4	4
	SM4L	5
50' or 55'	SM5	5
	SM5L	6

Strain Pole Type	Foundation Number (TM653)
STP1 & STP1L	3
STP2 & STP2L	4
STP3 & STP3L	5
STP4 & STP4L	6
STP5 & STP5L	7
STP6 & STP6L	8
STP7 & STP7L	9

Changing a pole location may require a different mast arm length, type of pole, and/or foundation. Always contact the Engineer of Record if poles location changes!!

Pole Foundations: Drilled Shaft Excavation

PRIOR TO INSTALLATION

- Verify location and finish grade before excavating using Field Verification Forms. 00962.02.
- Determine foundation number (1 thru 9) and corresponding foundation diameter (36” or 42”). Plan Sheets & TM653.
- Determine the shaft depth. Plan Sheets.
- Before the pre-construction conference, contractor shall provide personnel qualification requirements for those performing the drilled shaft installation. 00963.30
- At least 21 days before beginning drilled shaft construction, contractor shall submit a Drilled Shaft Installation Plan. DO NOT BEGIN WORK UNTIL ALL SUBMITTALS HAVE BEEN APPROVED. 00963.40(a)

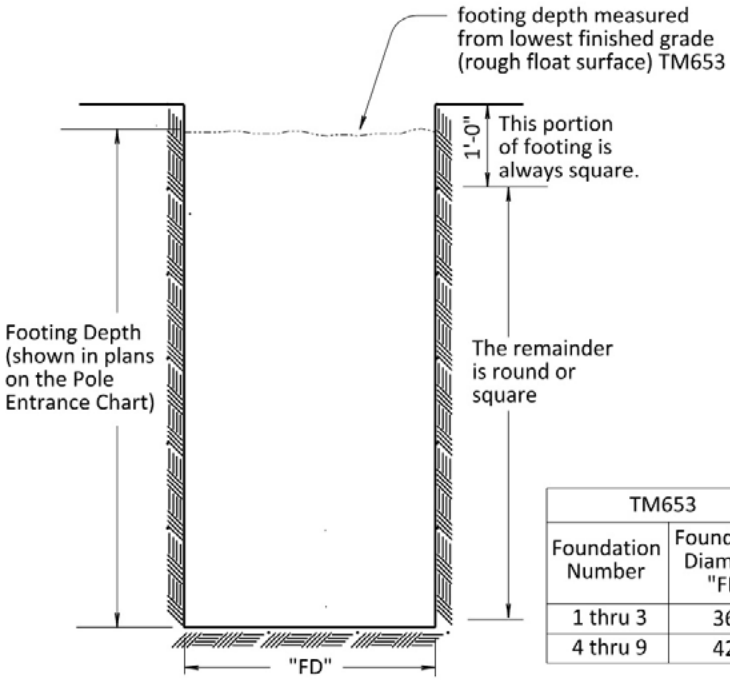
INSTALLATION

- Use a temporary casing according to the approved Drilled Shaft Installation Plan. 00963.43(c).
- Clean out the drilled shaft so that no more than 2” of loose or undisturbed material is at the bottom. 00963.43(f) to 00512.43(h).
- Measure the final shaft depth to determine if the shaft bottom meets contract requirements. 00963.43(f) to 00512.43(h) and TM653.
- The top foot of the foundation is always square. TM653.

CAUTION-POTENTIAL PROBLEMS

- If caving or other unstable conditions occur during any construction procedure 00963.43(a):
    - Stop further construction,
    - Notify the Engineer,
    - Stabilize the shaft excavation, and
    - Submit a revised Drilled Shaft Installation Plan for approval.
- Temporary casings used during construction must be removed. 00963.47(d).
- Do not leave partially completed shaft excavations open overnight unless they are cased full depth and are covered at the surface to protect the public. 00963.43(a).

Typical Sources of Info:
Specs: 00512, 00962.41, 00963
Std. Dwg: TM653
Plan Sheets: YES (pole entrance chart for foundation number & depth)
Blue Sheet/Green Sheet Info: NO



TM653	
Foundation Number	Foundation Diameter "FD"
1 thru 3	36"
4 thru 9	42"

TYPICAL FOUNDATION EXCAVATION FOR SIGNAL POLES (TM653)

Contractor required to submit a plan at least 21 days in advance of drilled shaft construction for approval.

FOLLOW THE APPROVED PLAN.

DRILLED SHAFT INSTALLATION PLAN (00963.40(a))

Pole Foundations: Reinforcing Steel

PRIOR TO INSTALLATION

- Do not place reinforcing steel into the shaft excavation until Engineer has approved the final elevation of the bottom of the shaft. 00963.45(a)
- Verify the cage for the correct number, size, spacing and clearance of vertical rebar, ties, and hoops. TM653.
- Verify anchor rod diameter, anchor plate diameter (out-to-out), and anchor rod alignment. Plan Sheets & TM652.

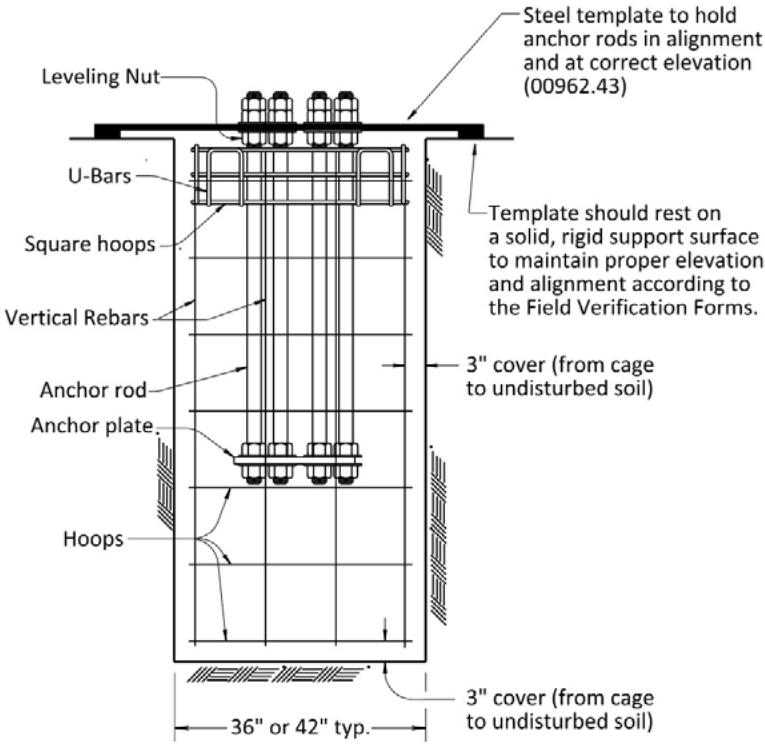
INSTALLATION

- Place the cage such that it extends 3" above the bottom of the shaft. The cage may be supported on the bottom of the shaft if approved. 00963.45(a).
- Rigidly brace the cage to retain its shape for lifting. Show any bracing on the submitted shop drawings. Remove bracing during placement. 00963.45(b).
- Maintain 3" cover (between cage and undisturbed soil) by placing spacers around the cage. TM653 & 00963.45(c).
- A steel template is used to hold the anchor rods plumb and in proper alignment. 00962.43.
- Verify foundation control point and tip of anchor rods are at the elevation shown on the Field Verification Forms. 00962.02.

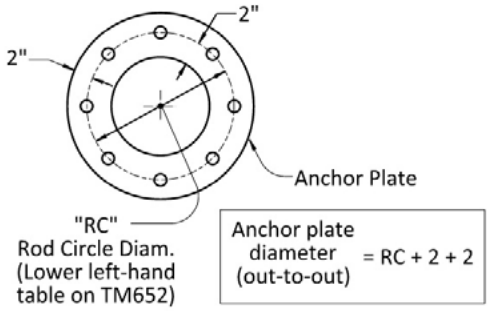
CAUTION-POTENTIAL PROBLEMS

- If concrete placement does not immediately follow cage placement, remove cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage. 00963.45(a).
- Carefully watch the lifting of the cage to ensure no distortion occurs.
- Anchor Rods (ASTM F 1554 Gr. 55) are NOT considered "high strength" and therefore DO NOT require lab check testing. TM651, note #7, 02560.30(a) & 02560.60(b).
- If a temporary casing is used, the steel template holding the anchor rods and conduit(s) are installed AFTER the casing is completely removed, at the end of the concrete pour.
- **Rebar Size Number: Each number equals 1/8". For example, a #5 bar is 5/8".** The QPL attachment A, shows examples of how to identify the rebar. Use AASHTO M31, Grade 60 (ASTM A615 or A706). TM653 note #16.

Typical Sources of Info:
Specs: 00962, 02560
Std. Dwg: TM651, TM652 & TM653
Plan Sheets: Typically NO (non-standard foundations will be shown in plans)
Blue Sheet/Green Sheet Info: pg. 1 (reinforcing steel on the QPL)



TYPICAL REINFORCING STEEL FOR SIGNAL POLES (TM652 & TM653)



ANCHOR PLATE DIMENSIONS (TM652)

Pole Foundations: Concrete & Conduit Installation

PRIOR TO INSTALLATION

- Ensure that the shaft is clean. 00963.43(f).
- Verify correct number and sizes of FIBERGLASS conduits are installed and bundled at top. Plan Sheets & 00960.42(d)
- Verify anchor rods are in proper alignment in the template. TM652
- Verify the foundation control point and the top of anchor rods are at the correct elevation according to the Field Verification Forms. 00962.02.
- Sample and test concrete with a certified QCT. 00962.10 to 00440.14(a).

INSTALLATION

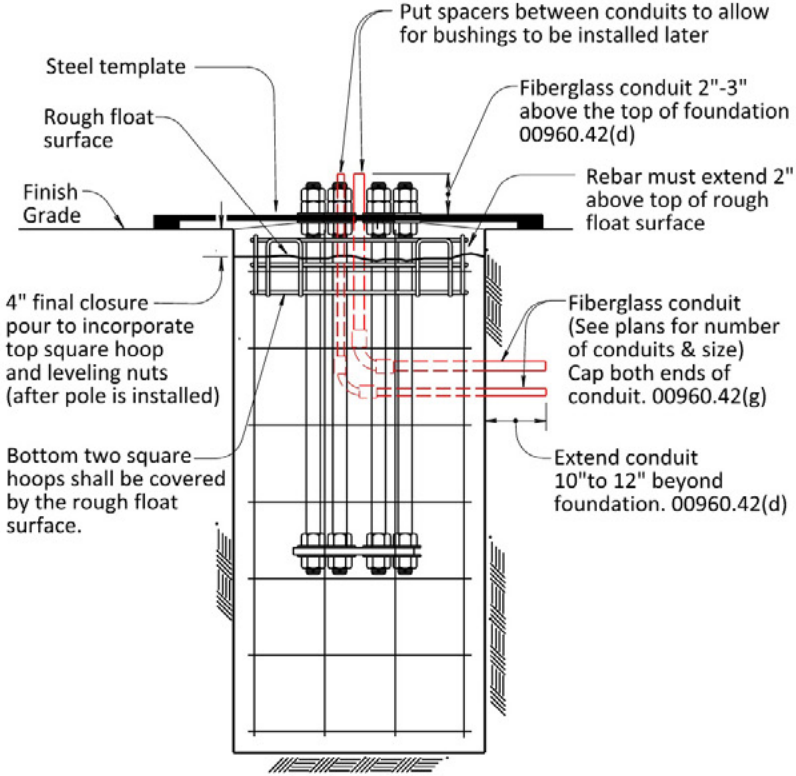
- Concrete shall meet requirements of 00440 except with an 8 inch slump (±1 ½"). 00963.10.
- Conduits are not to be spliced/coupled at foundation edge. They must extend 10" to 12" horizontally beyond edge or vertically below the edge of the foundation. 00960.42(d).
- Foundations are constructed with one continuous concrete pour, except for 4" pad at top (measured from foundation control point). 00962.43 & TM653.
- Ground rods are located outside of foundation in the nearest junction box. TM450 & TM452.
- Foundations are poured against undisturbed material. Some minor back-fill is allowed with well compacted materials. TM653.

CAUTION-POTENTIAL PROBLEMS

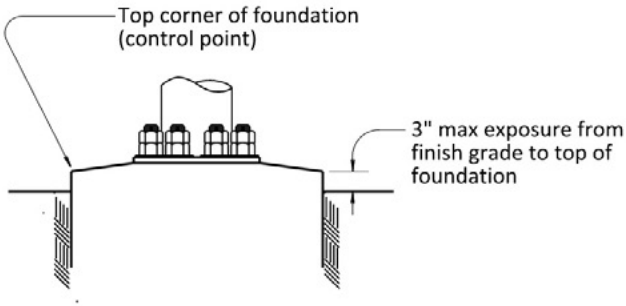
- Steel cage and template can be displaced by pour. Do not vibrate 8" slump.
- Improper anchor rod alignment, adjustment of anchor rods after concrete has set, or incorrect conduit within the foundation may be cause for rejection of the foundation. 00962.43.
- Temporary casings used during construction must be removed. 00963.47(d).
- All conduits in foundations must be FIBERGLASS. 00960.42(d).
- Put spacers between conduits when bundling to allow for bushings to be installed later.
- Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. See 00962.43, Table 00540-1, & TM651 note #15. Break concrete test cylinders to verify. 00440.
- Supplemental Inspection Recommended, See page 88 for more info.

Typical Sources of Info:

Specs: 00960.42(d), 00962.43, & 00963.47
Std. Dwg: TM450, TM452, TM650 thru TM653, TM660 &TM661
Plan Sheets: Typically NO (non-standard foundations will be shown in plans)
Blue Sheet/Green Sheet Info: pg. 12



TYPICAL CONCRETE & CONDUIT FOR SIGNAL POLES
(TM652 & TM653)



MAXIMUM EXPOSURE OF FOUNDATION
(TM653)

Pole Foundations: Installing the Pole

PRIOR TO INSTALLATION

- Check the pole tag for proper information. 00962.46(i).
- Check pole for deviation from straightness. 00962.46(f).
- Inspect factory welding (conduit hub). TM652 & 00962.46(g).
- Check for wire hanger hook ("J" hook) and grounding lug. TM450, TM452, TM661, & 00962.50(a).
- Check mast arm connection plate flatness.
- Repair galvanizing damage from handling. 00962.46(j)(1).

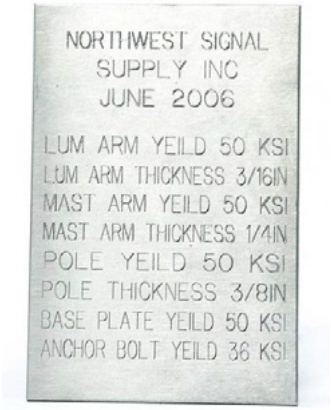
INSTALLATION

- Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. See 00962.43, Table 00540-1, & TM651 note #15. Break concrete test cylinders to verify. 00440.
- Lubricate anchor rods and nuts according to 02560.70. See 00962.46(j)(2).
- Install leveling nut & washer on anchor rods. TM652 & 00962.46(j)(2)(a).
- Install pole.
- Install top washer & nut, rake pole to counteract load using leveling nuts. 00962.46(j)(2)(a).
- Install final 4" concrete closure pour with ¾" pole drain (weep hole). TM653.

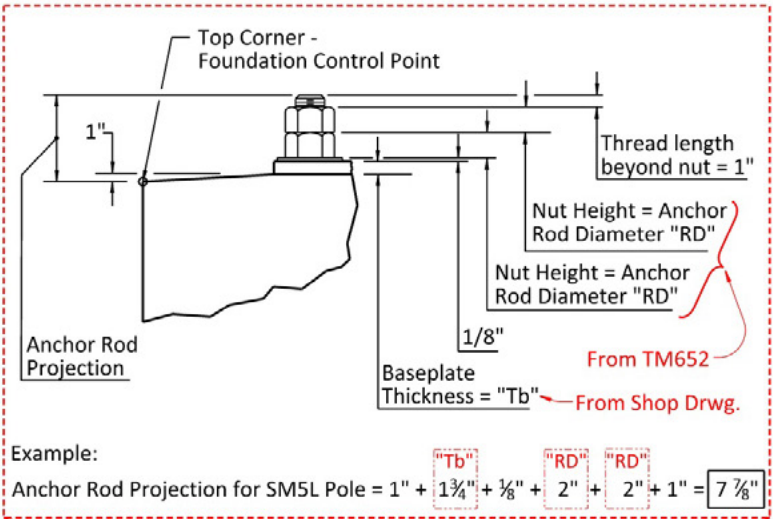
CAUTION-POTENTIAL PROBLEMS

- Tighten anchor rods according to 00962.46(j) and perform final tightening.
- Verify the anchor rod projection meets requirements. TM653.
- Poles and arms can be round or octagonal but two types shall not be mixed on project. TM651, Note #5.
- Reinstall handhole cover until wiring can be completed.

Typical Sources of Info:
Specs: 00962.46(j)
Std. Dwg: TM450, TM452, TM457, TM650 thru TM653, TM660 &TM661
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pgs. NO

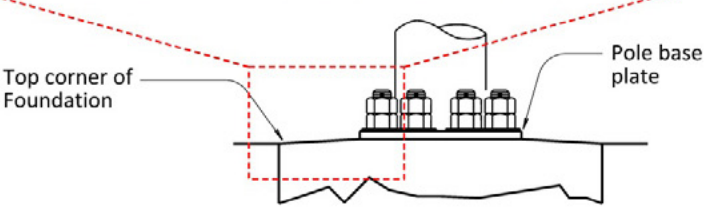


Verify pole tag for proper information (00962.46(i) & Shop Drawings)



Example:

Anchor Rod Projection for SM5L Pole = 1" + "Tb" 1¾" + ⅛" + "RD" 2" + "RD" 2" + 1" = 7 ⅞"



ANCHOR ROD PROJECTION
(TM653)

Construction

Pedestal Foundations

PRIOR TO INSTALLATION

- Verify location and finish grade before excavating. See page 106.
- Inspect poles for damage or defects. Verify anchor rod diameter. TM457.

INSTALLATION

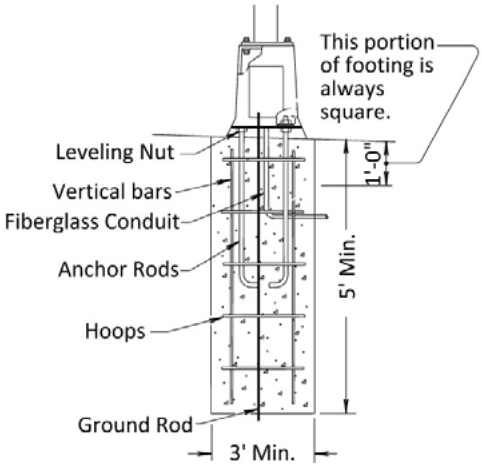
- Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. See 00962.43 then Table 00540-1 & TM651 note #15. Break concrete test cylinders to verify. 00440.
- For VEHICLE SIGNAL PEDESTALS ONLY - Verify cage for vertical bar size, ties, and clearance. TM457.
- Verify correct number and sizes of FIBERGLASS conduit bends are installed and bundled at top. Plan Sheets.
- Conduits are not to be spliced/coupled at foundation edge. 00960.42(d).
- Inspect anchor rods for diameter, length, and proper alignment in template. TM652.
- Pedestal foundations are constructed with one continuous concrete pour.
- Ground rods are located inside of foundation. TM457.
- Foundations are poured against undisturbed material. Some minor back-fill is allowed with well compacted materials. 00962.41(a).

CAUTION-POTENTIAL PROBLEMS

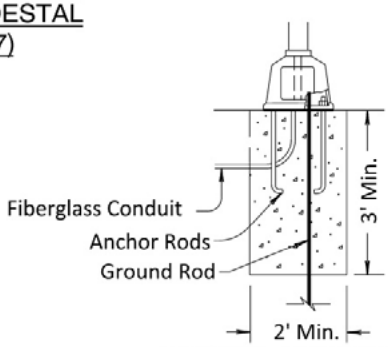
- Steel cage and template can be displaced by pour.
- Improper anchor rod alignment or adjustment of anchor rods after concrete has set may be cause for rejection of the foundation. 00962.43.
- All conduits in foundations must be FIBERGLASS. 00960.42(d).
- Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. See 00962.43, Table 00540-1, & TM651 note #15. Break concrete test cylinders to verify. 00440.

Rebar Size Number: Each number equals 1/8". For example, a #5 bar is 5/8"

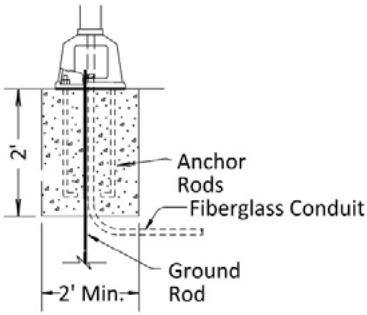
Typical Sources of Info:
Specs: 00962.43
Std. Dwg: TM457
Plan Sheets: Typically NO (only pedestal type shown on plans)
Blue Sheet/Green Sheet Info: pgs. 1 (reinforcing steel on QPL), 12, & 17



TYPICAL VEHICLE SIGNAL PEDESTAL (TM457)



TYPICAL PEDESTRIAN SIGNAL PEDESTAL (TM457)



PEDESTRIAN PUSH BUTTON PEDESTAL (TM457)

Construction

Wood Pole Installation

Wood poles are normally used for temporary signal installations. See page 100 for more info on temporary signal installations.

PRIOR TO INSTALLATION

- Inspect poles for splits or in-transit damage. 00225.15(a)(3)

INSTALLATION

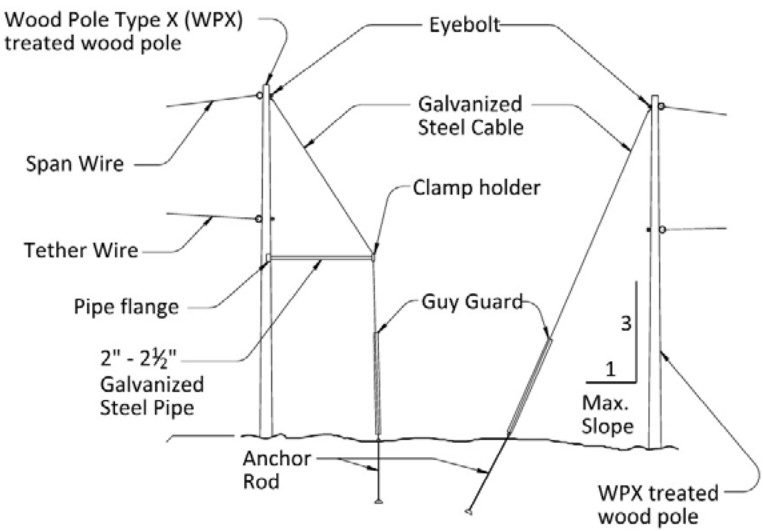
- Locate utilities before drilling holes.
- Verify setting depths.
- Rake pole away from the applied load.
- Install anchors as shown in the plans or contractor submittal.
- Backfill around pole with well compacted granular material.
- ALL wiring on pole shall be in a conduit. TM455.

CAUTION-POTENTIAL PROBLEMS

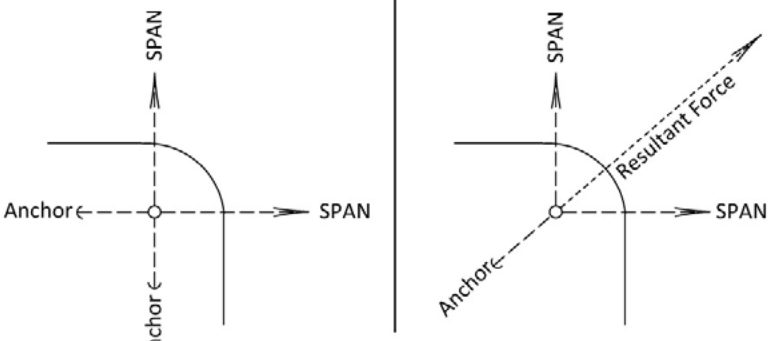
- Bond all equipment within 8’ of finish grade at each pole. TM455.
- Ensure that recommended embankment values will be present during all applicable stages of construction

Typical Sources of Info:
Specs: 00225.15, & 02120.10
Std. Dwg: TM455
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. NO

WS WPX AN



GUY ANCHOR
(TM455)



GUY ANCHOR LOAD SUPPORT
00225.45(a)(3)

Terminal Cabinet Installation

Terminal cabinets are mounted on poles. They are used as a splice point for the wiring from the signal controller cabinet and the wiring to the signal indications.

PRIOR TO INSTALLATION

- Check galvanizing and/or powder coating. 02925.40.
- Check for 3 lines of mounting brackets for single sectional terminal blocks (quantity & size as needed). 0990.41(a).
- Check pole for factory installed conduit hub and that lower mounting hole has been drilled and tapped. TM488.

INSTALLATION

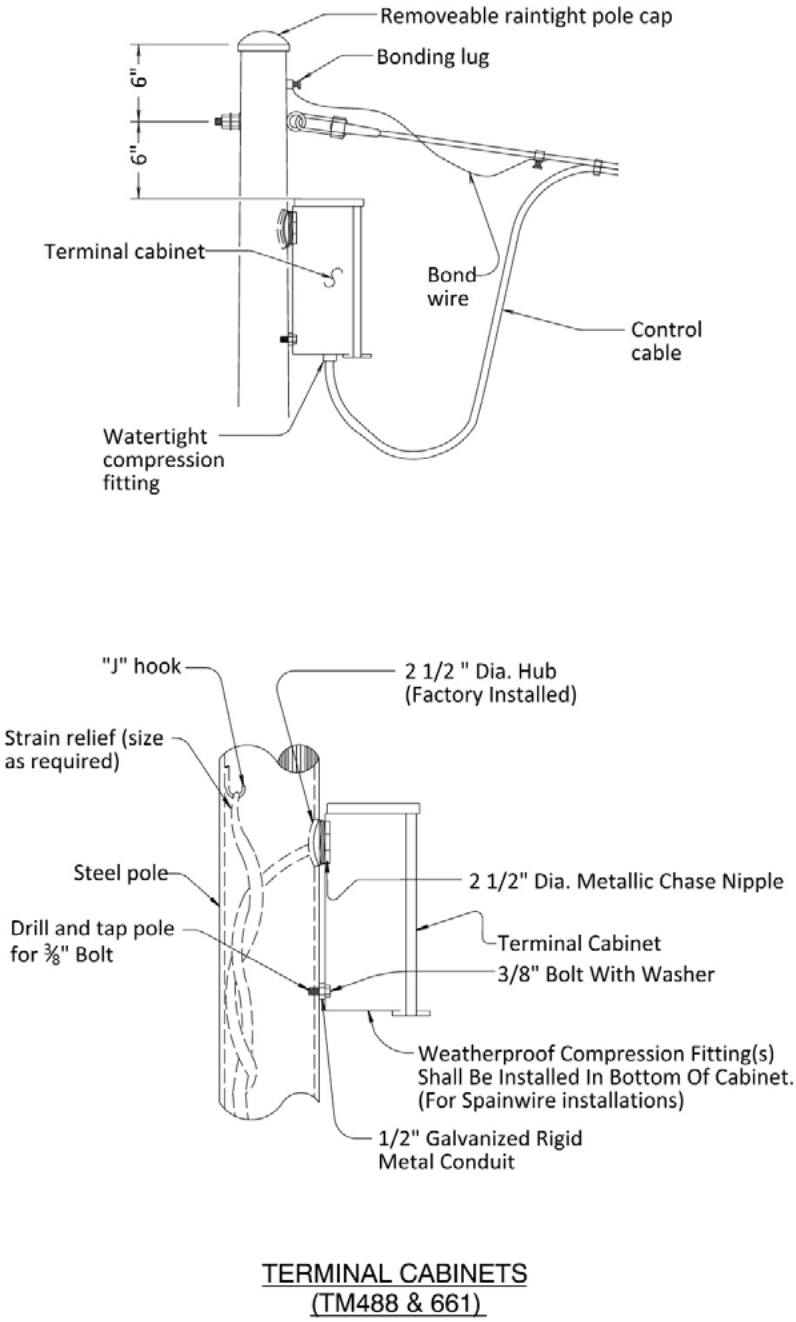
- Mount to pole with metallic chase nipple into factory installed conduit hub. Lower TC mount is 3/8" stainless steel bolt with ½" metal conduit spacer. TM488.
- Terminal cabinets for strain poles should have watertight compression fittings in bottom for control cable entrance.TM488 & 00990.41(a).
- Label all terminals with mechanically printed labels. 00990.41(a).

CAUTION-POTENTIAL PROBLEMS

- Required number of terminal blocks varies, but should be distributed equally amongst the three lines. 00990.41(a).
- 3 spare terminal blocks required in all terminal cabinets. 00990.41(a).
- Do not bring bond wire into TC. Bond messenger cable to pole. TM450 & TM452.
- Do not terminate Fire Pre-Emption or Illumination wiring in terminal cabinet. 00990.46.
- Plans may specify recessed terminal cabinets. Recessed terminal cabinets are contained within the pole on the pole shop drawing (they are not a blue sheet item).

Typical Sources of Info:
Specs: 00990.41(a) & 02925.40
Std. Dwg: TM488
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pg. 47

TC RTC



TERMINAL CABINETS
(TM488 & 661)

Trenching for Conduit

PRIOR TO INSTALLATION

- Utilities shown on plans are approximate. Always request a 'locate' before trenching. 00150.50(c).
- Lay out all poles, JB's and controller before trenching.

INSTALLATION

- Trenching for conduit shall be accomplished in the general pattern shown on the plans. Actual location of conduit runs may vary as necessary to avoid obstructions. Runs should be straight as possible. 00960.42(a).
- Trench adequate depth to provide minimum cover for conduit, as required in Section 00960.41(c):

	Minimum Cover (use permit depth if greater than these)	
Type of Conduit	**Roadway & Shoulders**	**Other Areas**
Metal	24”	18”
Rigid Non-Metallic	30”	18”

- Hold trench width to a practical minimum. 00960.41(d)(2)(a).
- Saw-cut pavement before trenching with an approved pavement saw. An “earth saw”, “conduit wheel”, etc. are not approved. 00960.41(a).

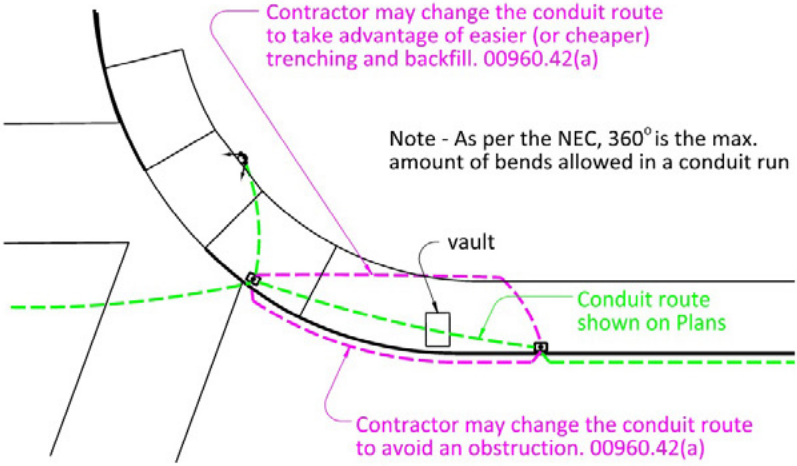
CAUTION-POTENTIAL PROBLEMS

- Un-located utilities are expensive and dangerous.
- Check permit to ensure that greater trench depths aren't required. 00960.41(c).
- 'Hand-trenching' may be necessary in landscape, irrigated areas, under curb lines or for utility conflicts. 00960.40(a).
- Plans sheets may specify horizontal directional drilling (HDD) only so as not to disturb the existing roadway and traffic.

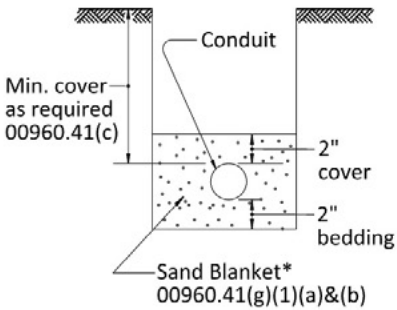
  Most trenching will be done with a backhoe. It also may be done with a trencher, but care must be taken to provide proper backfill of a narrow trench.

Typical Sources of Info:
Specs: 00960.41
Std. Dwg: NO
Plan Sheets: YES (for HDD requirements only)
Blue Sheet/Green Sheet Info: NO

HDD

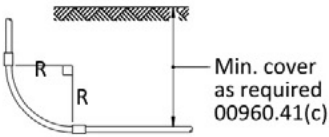


CONDUIT ROUTING



*Sand Blanket is NOT required in certain circumstances 00960.41(g)(1)(c) & 00960.41(g)(2)

Conduit Size Inside Diam. (inches)	R Minimum (inches)
1½	9
2	12
2½	15
3	18



Radius must be a minimum of 6 times the inside diameter of the conduit 00960.42(f)

FACTORS AFFECTING TRENCH DEPTH (MINIMUM COVER)

Conduit Installation

PRIOR TO INSTALLATION

- Conduits materials approved for use on signal projects are rigid non-metallic (PVC, HDPE, and Fiberglass) and galvanized rigid metallic conduit.
- Place 2” sand bedding in bottom of trench before laying PVC conduit (unless CLSM is to be used). 00960.41(g)(1).

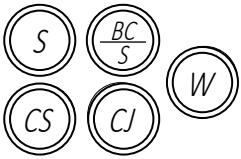
INSTALLATION

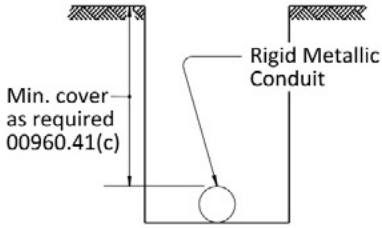
- Rigid metallic conduit must be reamed, threaded, free of burrs & joined with a coupling. Coat threads with rust preventative compound. 00960.42(g)(1).
- PVC conduit ends must be clean, dry, primed, and free of burrs before cementing. 00960.42(g).
- The contractor has the option to increase the conduit size for their convenience at no extra cost to the Agency. 00960.42(a).
- Conduit elbows must be FIBERGLASS. 00960.42(f).
- Risers in junction boxes must be PVC. 00960.42(g)(3).
- Conduit in Foundations must be FIBERGLASS. 00960.42(d).

CAUTION-POTENTIAL PROBLEMS

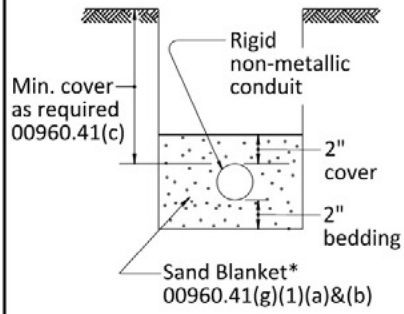
- In corrosive soils, metallic conduit must be coated or wrapped. (Also typically specified around high voltage electrical devices). 00960.42(a).
- Conduit for future use shall be installed with polyethylene pull line, and capped. 00960.42(g) & 00960.42(i).
- Install conduit plug after wires are pulled. 00960.42(g).
- Conduit installed under railroads requires a sleeve. 00960.41(e).
- Conduit installed on structures requires expansion fittings at all structure expansion joints. 00962.42(k).
- Must be installed by licensed Electrician.
- Conduit must be same size outlet-to-outlet (no reducers). 00960.42(a).
- Supplemental Inspection required by Agency Electrician 00960.42(e), See page 88 for more info.

Typical Sources of Info:
Specs: 00960.41, 00960.42, & 02920.10 thru 02920.12
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs.9, 11, 12, 13, 14, 15 &, 16



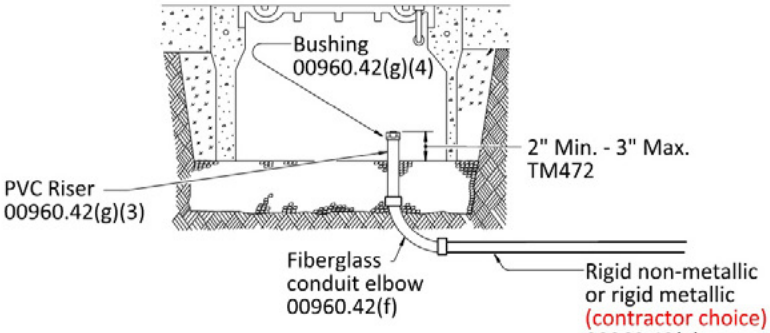


RIGID METALLIC CONDUIT
(WITHOUT A SAND BLANKET)

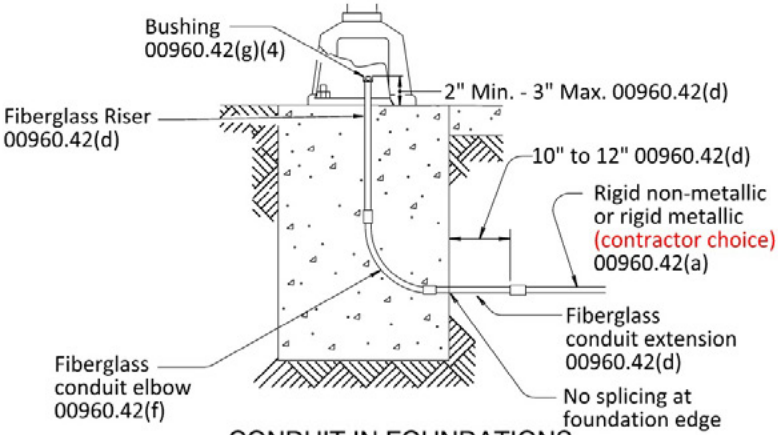


*Sand Blanket may be omitted in certain circumstances 00960.41(g)(1)(c)

RIGID NON-METALLIC CONDUIT
(WITH A SAND BLANKET)



CONDUIT IN JUNCTION BOXES



CONDUIT IN FOUNDATIONS

Construction

Conduit Trench Backfill

PRIOR TO INSTALLATION

- Verify the conduit material to be used (rigid non-metallic or rigid metallic). This will determine if a sand blanket is required (2” of sand bedding & cover).
- Determine the location of the conduit trench (“New Roadway and Shoulder”, “Existing Roadway and Shoulder”, or “Other Areas”). This will determine the correct backfill material and if a sand blanket is required.

INSTALLATION

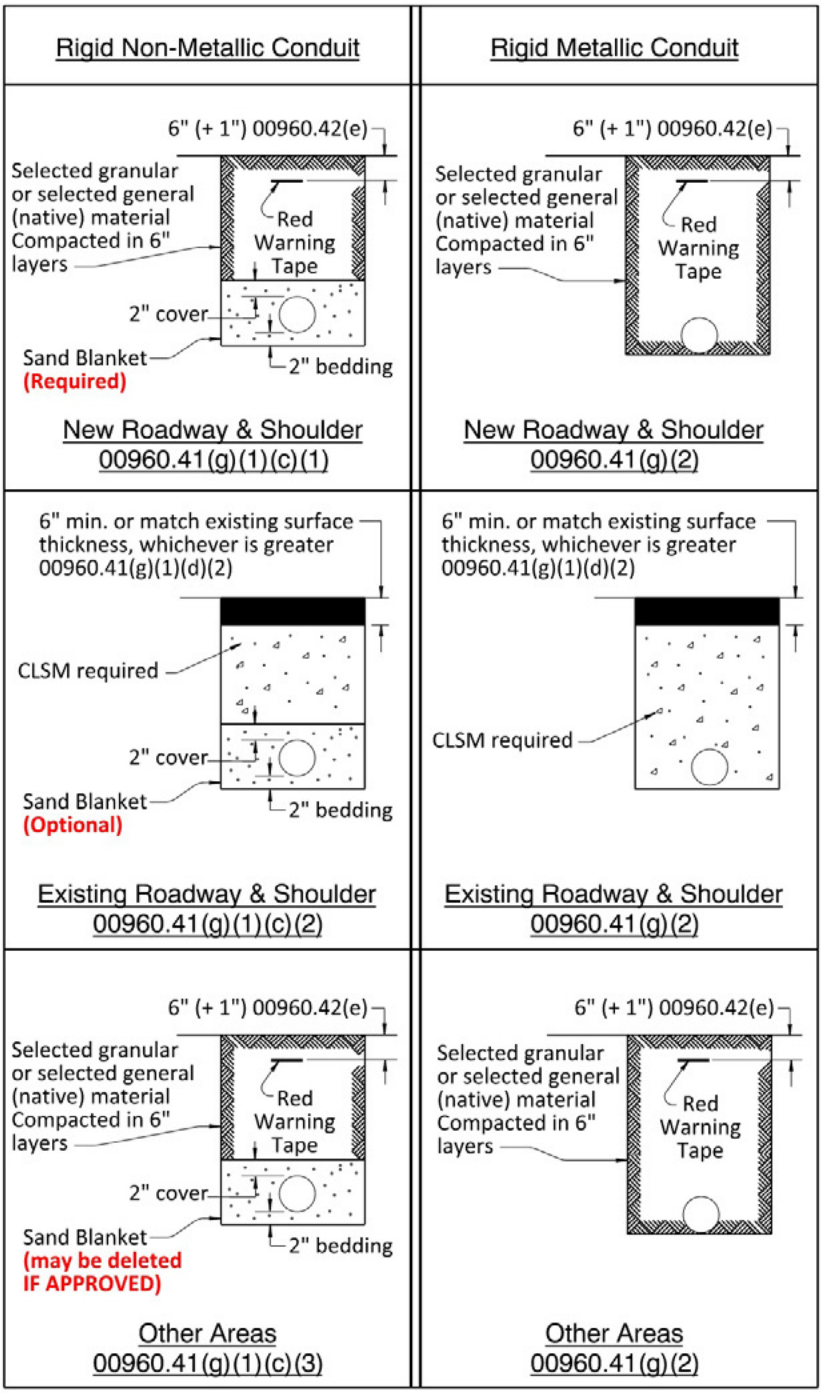
- Sand Blanket:
  - A sand blanket is typically required for rigid non-metallic conduit but may be omitted under certain circumstances. 00960.41(g)(1)(c)(1) thru (3).
  - A sand blanket is NOT required for rigid metal conduit. 00960.41(g)(2).
- Backfill Material:
  - Trenches located under “New Roadway and Shoulders” or “Other Areas” require selected granular backfill material in compacted in 6” layers. 00960.41(g)(1)(c)(1), 00960.41(g)(1)(c)(3), & 00960.41(g)(2).
  - Trenches located under “Existing Roadway and Shoulders” require CLSM backfill. 00960.41(g)(1)(c)(2) & 00960.41(g)(2).
- Place underground marking tape in all trenches NOT using CLSM for backfill. 00960.42(e).
- Finish final 6” to match surrounding surface for trenches located under “Existing Roadway and Shoulders”. 00960.41(g)(1)(d) & 00960.41(g)(2).

CAUTION-POTENTIAL PROBLEMS

- Contractor should be cautioned "Do not cover conduit runs until inspected" as required by 00960.42(e).
- Supplemental Inspection required by Agency Electrician 00960.42(e), See page 88 for more info.
- Make sure conduit doesn't 'float up' when using CLSM backfill.
- Plug all conduit ends during backfill operation, to keep debris from entering conduit. Keep plugged until wire is pulled. 00960.42(g).

CLSM = Controlled Low Strength Material. 00442.

Typical Sources of Info:
Specs: 00442 (for CLSM requirements), 00960.41, 00960.42
Std. Dwg: NO
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pg. 24


Rigid Non-Metallic Conduit
Rigid Metallic Conduit
6" (+ 1") 00960.42(e)
Selected granular or selected general (native) material Compacted in 6" layers
Red Warning Tape
2" cover
Sand Blanket (Required)
2" bedding
New Roadway & Shoulder 00960.41(g)(1)(c)(1)
6" (+ 1") 00960.42(e)
Selected granular or selected general (native) material Compacted in 6" layers
Red Warning Tape
New Roadway & Shoulder 00960.41(g)(2)
6" min. or match existing surface thickness, whichever is greater 00960.41(g)(1)(d)(2)
CLSM required
2" cover
Sand Blanket (Optional)
2" bedding
Existing Roadway & Shoulder 00960.41(g)(1)(c)(2)
6" min. or match existing surface thickness, whichever is greater 00960.41(g)(1)(d)(2)
CLSM required
Existing Roadway & Shoulder 00960.41(g)(2)
6" (+ 1") 00960.42(e)
Selected granular or selected general (native) material Compacted in 6" layers
Red Warning Tape
2" cover
Sand Blanket (may be deleted IF APPROVED)
2" bedding
Other Areas 00960.41(g)(1)(c)(3)
6" (+ 1") 00960.42(e)
Selected granular or selected general (native) material Compacted in 6" layers
Red Warning Tape
Other Areas 00960.41(g)(2)

Junction Box (JB) Locations

PRIOR TO INSTALLATION

- Layout curb radius, concrete walk, crosswalks and wheelchair ramps.
- Layout edge of pavement and pedestrian landings in non-curbed sections.
- Layout approximate location of detector loops.

INSTALLATION

- Stake JBs relative to locations on plans. Junction box locations are approximate; changes can be made to better fit site. 00960.44(a).
- JBs are to be no more than 300' apart; intermediate JBs may not be shown on plans, but 300' is the maximum, unless specified differently. 00960.44(a).
- Apron type junction boxes must be installed in gravel shoulders were incidental traffic may occur. 00960.44(a) & Plan Sheets.
- Only cast iron JBs are allowed in traffic areas (i.e. Concrete or AC roadway surface). Plan Sheets.
- Do not install cast iron junction boxes in non-paved areas or without p.c.c. envelope in paved areas. Plan Sheets.

CAUTION-POTENTIAL PROBLEMS

- Compare signal plans to Roadway plans (or existing facilities) for conflicts.
- Verify JB type and material. Plan Sheets.
- Concrete JBs in pedestrian landings should be located by pole, away from edge of pavement, or installed with a concrete apron behind walk within R/W.
- Do not install JBs in the slope of ramps or driveways.
- Concrete JB's in concrete walks may be subject to incidental traffic.

Construction

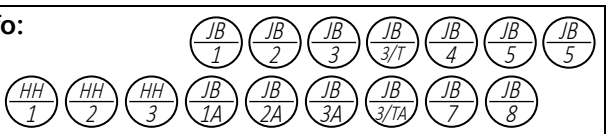
Typical Sources of Info:

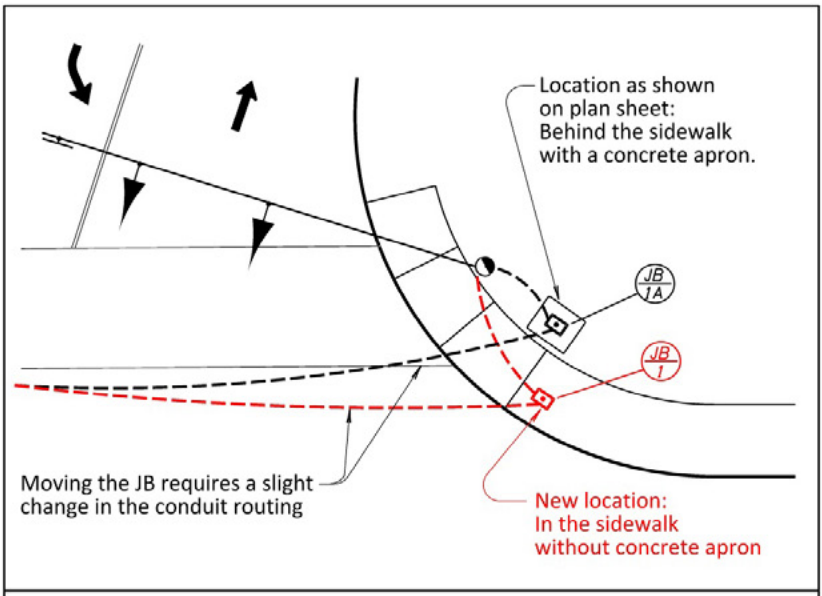
Specs: 00960.44

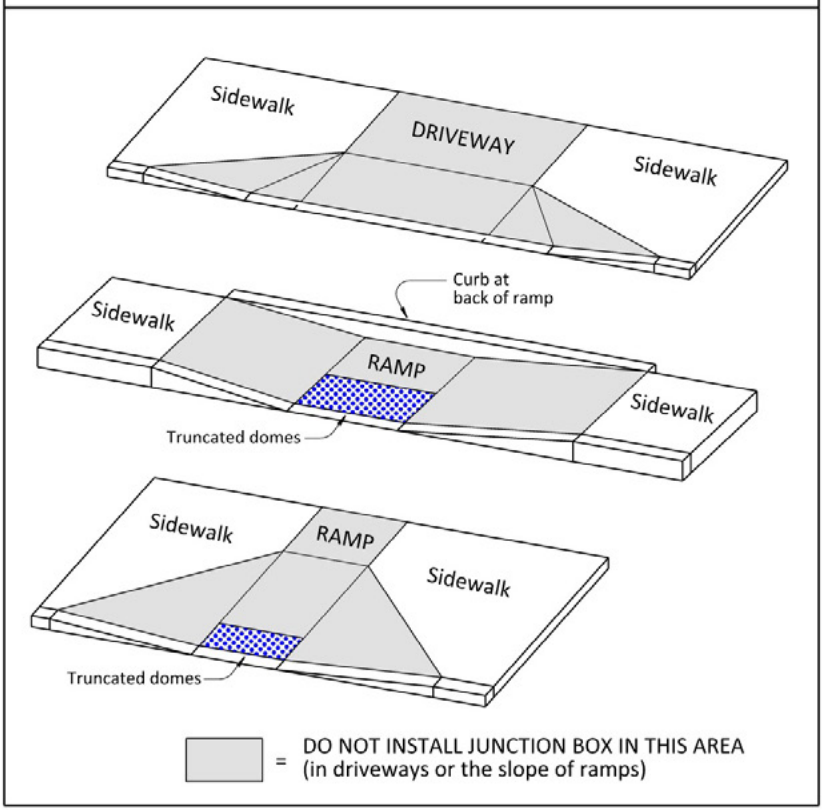
Std. Dwg: TM472

Plan Sheets: YES

Blue Sheet/Green Sheet Info: pgs. 18, 19, 20 & 21




Location as shown
on plan sheet:
Behind the sidewalk
with a concrete apron.
JB
1A
JB
1
Moving the JB requires a slight
change in the conduit routing
New location:
In the sidewalk
without concrete apron


Sidewalk
DRIVEWAY
Sidewalk
Curb at
back of ramp
Sidewalk
RAMP
Sidewalk
Truncated domes
Sidewalk
RAMP
Sidewalk
Truncated domes
=
DO NOT INSTALL JUNCTION BOX IN THIS AREA
(in driveways or the slope of ramps)

Concrete, Hybrid and Hand Hole JBs Installation

PRIOR TO INSTALLATION

- Determine finish grade for top of JB.
- Verify junction box size. Plan sheets.
- Verify excavation for JB is deep enough; box depth varies from 12” to 36” with an additional 12” (min.) depth needed for the ¾” – 0” gravel bedding. TM472.
- Verify the correct number and sizes of FIBERGLASS conduit elbows and PVC risers are installed. Plan sheets for size, 00960.42(f) & 00960.42(g)(3) for materials.
- Conduit must enter box from underneath (exception: hand holes) and be near the end walls. 00960.42(h)(1) & (h)(3).

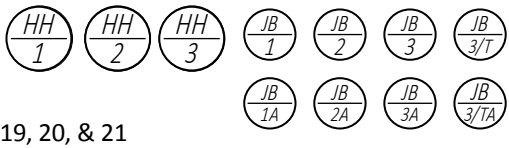
INSTALLATION

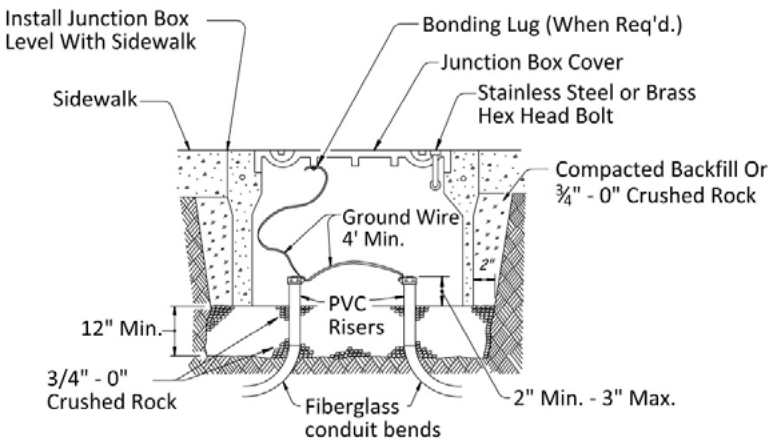
- Place box on bedding, backfill sides with well compacted material.
- Verify finish grade.
- Locate box 12” from back of curb and 12” from back of sidewalk. TM472.
- Do not install in traffic areas. TM472.
- Do not install in gravel shoulders without apron. 00960.44(a).
- Lids are held down with two stainless steel or brass hex head bolts. TM472.

CAUTION-POTENTIAL PROBLEMS

- Top of box shall be flush with the surrounding grade or top of curb. 00960.44(a).
- Be sure junction box is not resting on conduits.
- Tandem junction boxes are installed 4” apart. TM472.
- Mark JBs with a type 1 delineator in unsurfaced areas. 00960.44(b) & TM570.
- Lid should be marked with appropriate label (“Signals”, “Street Lighting”, etc.) TM472 & 02920.14(a)
- Must be fitted with a recessed lid rated for incidental traffic. Blue Sheets & 02920.14.
- Do not install in slopes of ramps or in driveways. TM472.

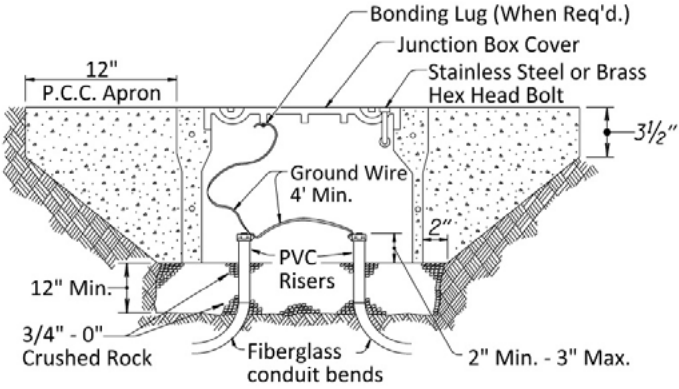
Typical Sources of Info:
Specs: 00960.44 & 002920.14
Std. Dwg: TM472
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 19, 20, & 21





INSTALLATION IN SIDEWALK OR AT BACK OF CURB
(TM472)

NOTE: For Incidental Travel Areas Only;
Gravel Shoulders, Behind Guardrail, Etc.



INSTALLATION WITH PORTLAND CEMENT CONCRETE APRON
(TM472)

Mast Arm Connection

PRIOR TO INSTALLATION

- Check pipe sleeve at mast arm mount for proper rounding. TM652.
- Rotational capacity tests for high strength fasteners (bolts used to connect the mast arm to the pole) is required to be performed by the manufacturer (not in the field). Provide 3 extra high strength bolt assemblies per size per lot for check testing. 00962.10 to 02560.20 to 02560.60.
- Determine the number of bolts required for each mast arm connection. Signal mast arm lengths of 15' to 35' require 4 bolts. Signal mast arm lengths of 40' to 55' require 8 bolts. TM652.
- Check mast arm plate straightness.

INSTALLATION

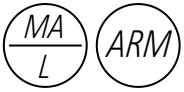
- Verify the mast arm connection bolt diameter, bolt circle, and bolt spacing requirements are met for each mast arm as per the table in the upper middle portion of TM652.
- 4-bolt arm connections: tighten bolts to a snug tight condition as defined in 00962.46(j)(2)(c).
- 8-bolt arm connections: tighten bolts using Direct Tension Indicator (DTI) washers. Verify the DTI is installed orientation is correct according to the detail shown on TM652. TM652 to TM651 note #22 to 00930.40(d).

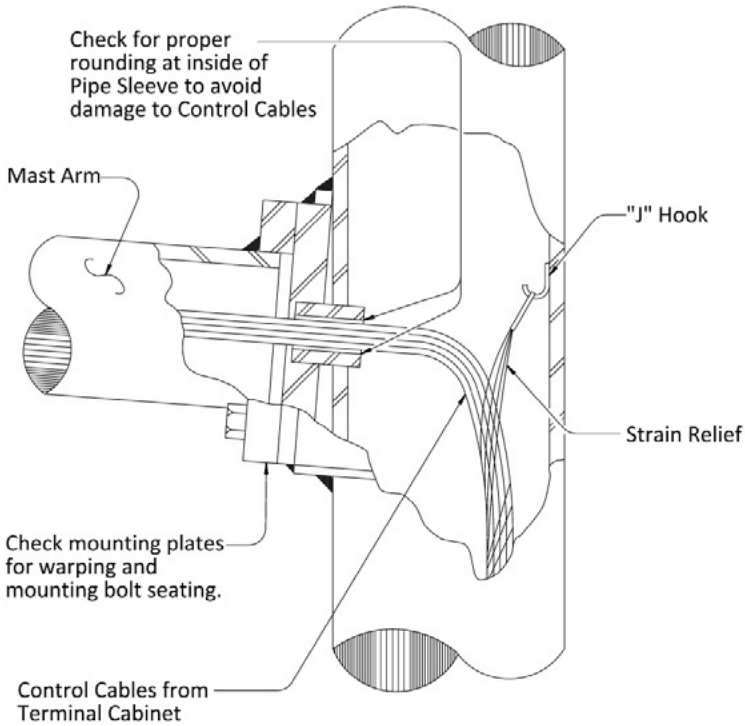
CAUTION-POTENTIAL PROBLEMS

- Check for mast arm mounting plate fit/bolting (warped plates or bolts not seating).
- Make sure mast arm won't block any active (temporary) signal indications. If the indications will be blocked, the mast arm will need to be removed and reinstalled on the day of the signal turn-on. Plans sheets may also indicate that the mast arm must be installed on day of turn-on.
- Field rotational capacity testing is NOT required for high strength fasteners. All inspections will be visual and no testing will be conducted. 00962.46(j)(3).
- Check the orientation of the DTI and check the gap on the DTI with a feeler gauge to verify the "nil gap" requirement (the feeler gauge shall be refused by at least ½ of all the openings between profusions, with a visible gap in at least one space). 00962.46(j)(2)(c) to 00930.40(d)(2)(a), and 00930.40(e)(2).

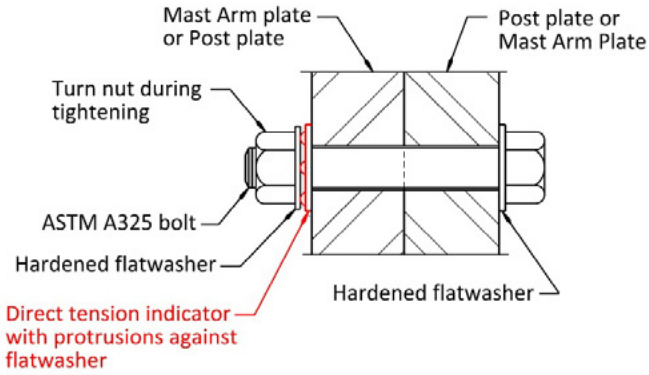
Typical Sources of Info:

Specs: 00962.46(j), 02560
Std. Dwg: TM450, TM452, & TM650 thru TM652
Plan Sheets: YES (mast arm length)
Blue Sheet/Green Sheet Info: pgs. NO





MAST ARM CONNECTION
(TM450 & 652)



8-BOLT ARM CONNECTION DTI DETAIL
(TM652)

Adjustable Bracket Installation

Adjustable brackets are typically used to suspend equipment from mast arms. They also provide a cable entrance into the equipment. This includes Type "B" mount for signs (aluminum sign mounting frame work) and the 4" side pole mount for mounting vehicle signals on pedestals.

PRIOR TO INSTALLATION

- Check dimensions for specified head-to-travel lane relationship. See pg. 104.

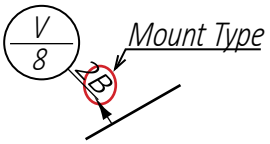
INSTALLATION

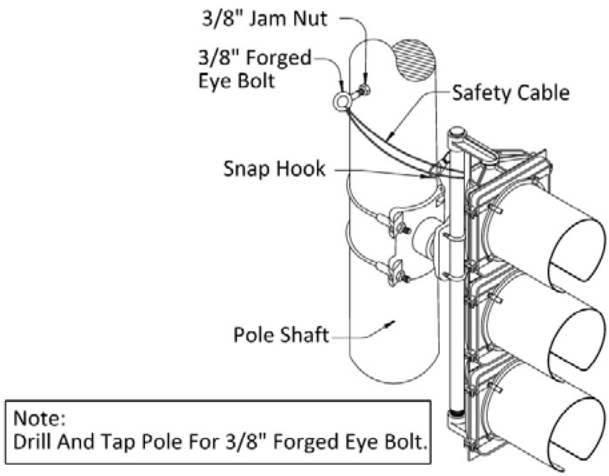
- Install hardware with anti-seize compound.
- Verify correct vertical clearance between the pavement and the bottom of the equipment on the mast arm is met, 18' minimum to 19' maximum. TM450.

CAUTION-POTENTIAL PROBLEMS

- Adjustable brackets require a safety cable. TM462 & 02925.62(d).
- Do not over tighten.
- Trim excess portion of gusseted tube above the top of the U-bolt (6" maximum allowed above top U-bolt). TM462.

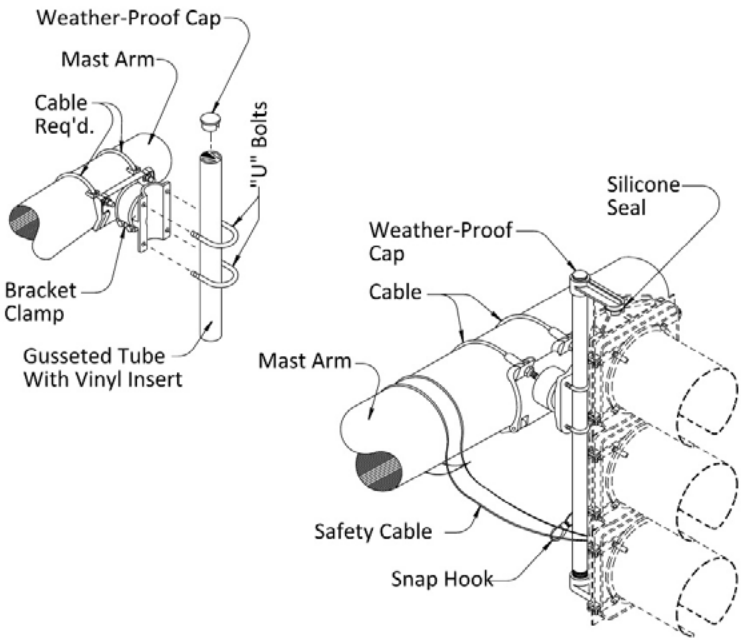
Typical Sources of Info:
Specs: 02925.62
Std. Dwg: TM462 & TM465
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 25 & 51





Note:
Drill And Tap Pole For 3/8" Forged Eye Bolt.

SIGNAL HEAD MOUNTING ON POLE SHAFT (TM462)



SIGNAL HEAD MOUNTING ON MAST ARM (TM462)

Construction

Messenger Cable Installation

Messenger cable is used to suspend equipment over the roadway in a span wire installation.

PRIOR TO INSTALLATION

- Install ¾” galvanized eyebolt as specified. TM452.
- Install strandvise bail onto eyebolt.
- Verify the number of cables attached to each messenger cable. Plan Sheets.

INSTALLATION

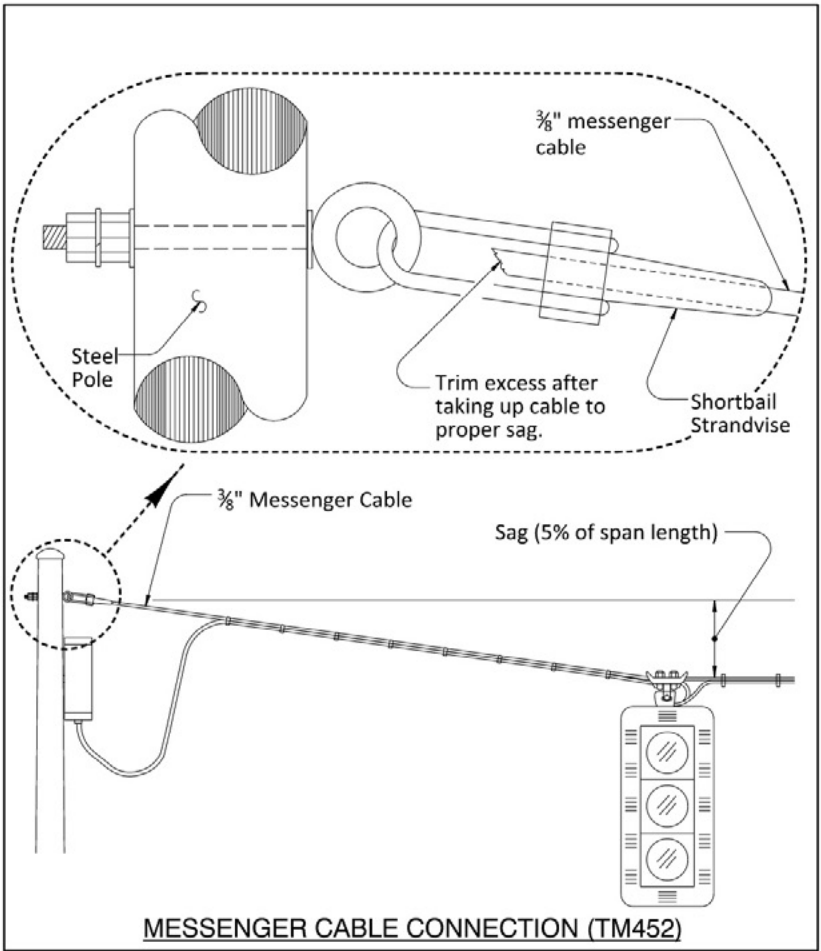
- Insert messenger cable into strandvise.
- Take up slack to minimum sag. Minimum sag is 5% of length of span (0.05 x length of span). TM452.
- Trim off excess cable.
- Only one messenger cable may be attached to an eye bolt. Multiple messenger cables attached to a single eyebolt is not allowed. TM452.

CAUTION-POTENTIAL PROBLEMS

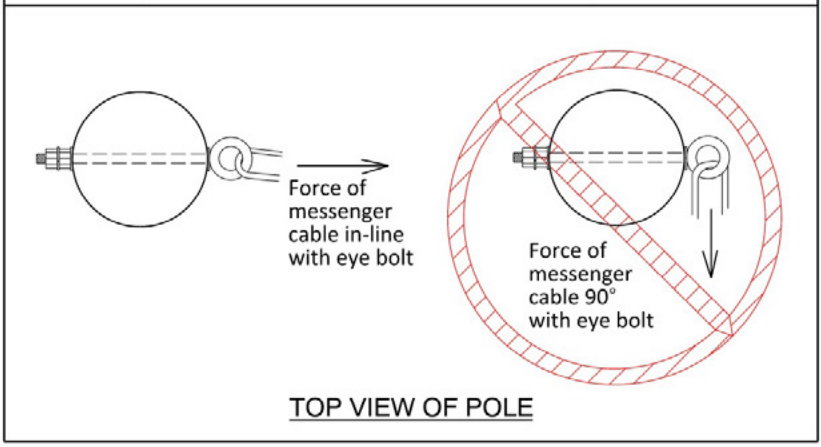
- Messenger cable does not use 'S' Hooks or turnbuckles. TM452.
- Bond messenger cable to pole. TM452.

Typical Sources of Info:
Specs: 02920.22
Std. Dwg: TM452
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 10, 27, 28 & 34

38 39



MESSENGER CABLE CONNECTION (TM452)



TOP VIEW OF POLE

Tether and Stabilizer Cable Installation

Tether and stabilizer cable are used to prevent movement of equipment suspended from messenger cable.

PRIOR TO INSTALLATION

- Install 1/2” - 3/4” galvanized eyebolt as specified. TM452.
- Install 'S' hook onto eyebolt, turnbuckle onto 'S' hook, strandvise bail onto turnbuckle. TM452.
- 'S' hooks are State furnished by TSSU call 503-378-2956. TM452 & 00990.40(d).

INSTALLATION

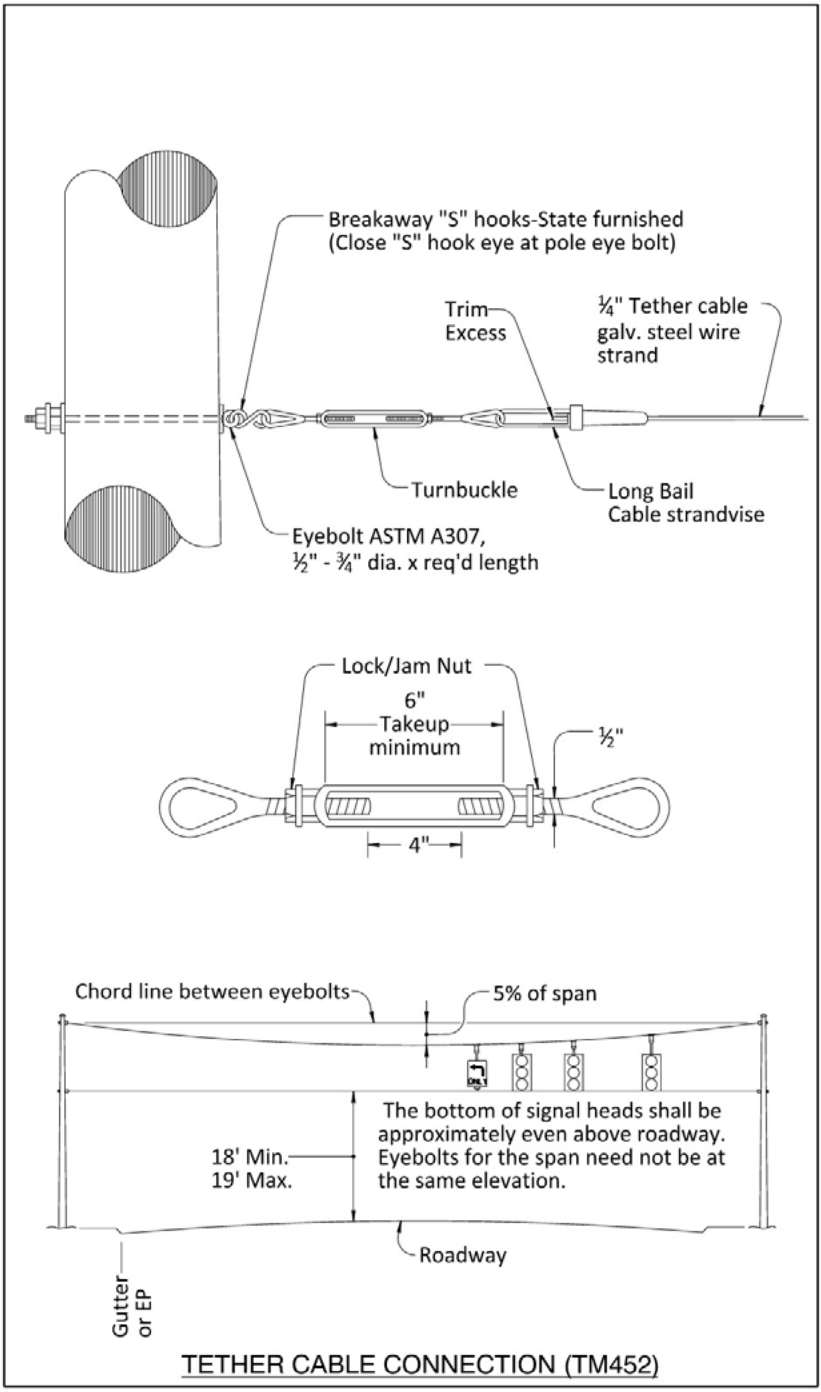
- Insert tether cable into strandvise and take up tension with turnbuckle.
- Trim excess cable.
- For stabilizer system see the signal plan sheets.
- Close “S” hook on eyebolt side (pole side only). TM452.
- Only one tether cable attached to an eye bolt. Multiple tether cables attached to a single eye bolt is not allowed. However, the stabilizer cable(if used) is typically attached to the same eyebolt as the tether cable.

CAUTION-POTENTIAL PROBLEMS

- Tether and stabilizer cable requires the use of 'S' hooks and turnbuckles on both ends. TM452.
- See TM463 for tether clamp details (cable is installed below lock bolts and is wrapped in sheet lead).
- Do not use high strength or larger cable. May not break when snagged.

Typical Sources of Info:
Specs: 02920.22
Std. Dwg: TM452
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 28, 48, & 49

38 41



TETHER CABLE CONNECTION (TM452)

Spanwire Hanger Installation

Spanwire hangers are used to suspend equipment from messenger cables. They also provide a cable entrance into the equipment. This includes the Type "A" mount for Aluminum Sign Mounting Framework.

PRIOR TO INSTALLATION

- Check dimensions for specified head-to-travel lane relationship. See page 104. Verify head/sign clearance for appropriate conduit length for spanwire hangers. TM452 & TM463.

INSTALLATION

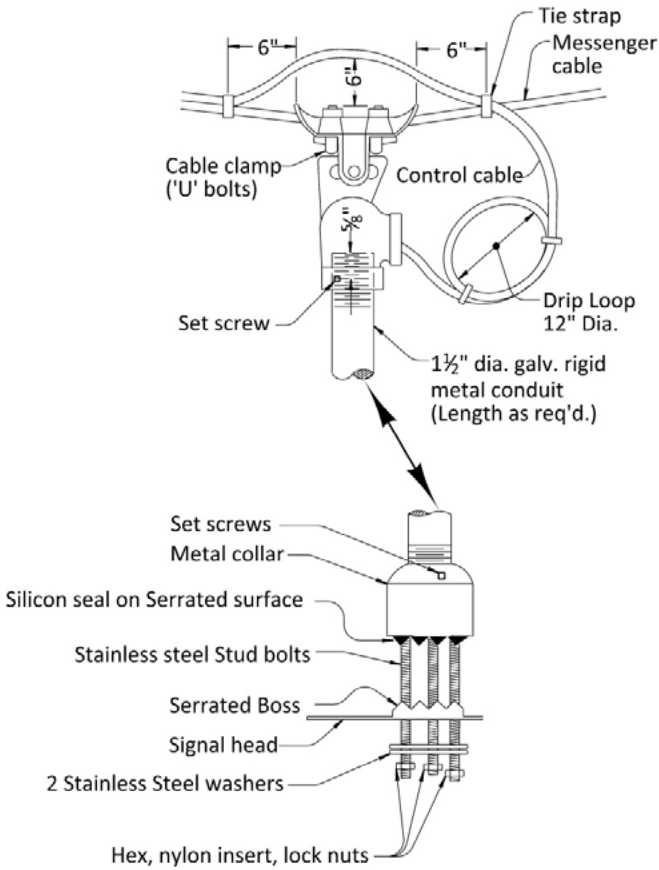
- Install hardware with anti-seize compound. TM463.
- Extension shall be 1 ½" galvanized rigid conduit drilled and tapped to accept set-screw on hanger. TM463.
- Mount signal head to tri-stud using lock-nuts (or lock washers and Hex nuts), form control cable into drip loop, thread through hanger into signal head. Terminate wire and install tether. TM463.
- All set-screws go through wall of conduit. With conduit extending 5/8" beyond set screw.
- Adjust length of conduit nipple to achieve proper mounting height.
- Verify correct vertical clearance between the pavement and the bottom of the equipment on the span wire is met, 18' minimum to 19' maximum. TM452.

CAUTION-POTENTIAL PROBLEMS

- Bind control cable into a drip loop that is lower than the throat of the hanger.
- Control cable must be arched over the span wire hangers to avoid damage. TM463.
- Span wire hangers use 'U' bolts for attachment, not 'J' or 'L' bolts. TM463.
- Always seal tri-stud adapters with silicon seal. TM463.

Typical Sources of Info:
Specs: 02925.62
Std. Dwg: TM463 & TM465
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pgs. 25, 46, & 50

MESSENGER CABLE ATTACHMENT (TM463)



TRI-STUD ADAPTER (TM463)

Construction

Electrical Service (Power Source)

PRIOR TO INSTALLATION

- The Project Manager coordinates with the Contractor for the electric service hook-up. 00960.70.
- Electrical service should be installed as shown on the project plans unless field conditions indicate otherwise.
- Verify power source in the field.
- If relocation is required, the Inspector should consider the locations of the utility company power source, the location of underground utilities, and the location of the signal controller, and then call the Engineer of Record for assistance.

INSTALLATION

- Utility companies should be notified at least two weeks in advance of the time power is needed at the site to allow them time to make adjustments or install equipment and wiring as necessary.

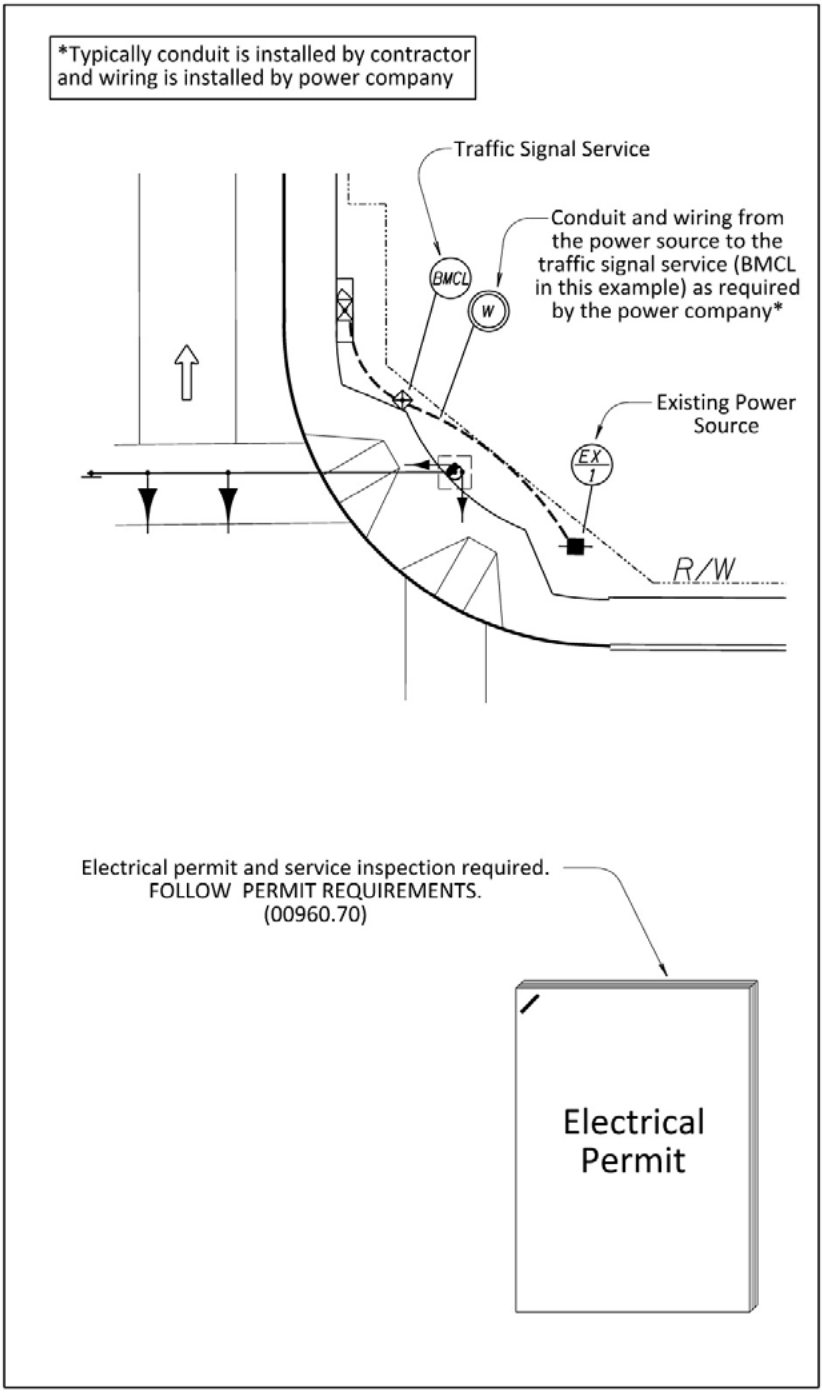
CAUTION-POTENTIAL PROBLEMS

- Considerable time and expense can be saved if the power source is agreed upon prior to construction. Changes made at this stage are the least expensive to incorporate into the construction plans.
- Conduit and wiring between the power source and signal service cabinet are specified by the electrical permit. See plan sheet.
- Supplemental Inspection by the Electrical Permitting Agency is required before a new traffic signal service cabinet can be energized. See page 88 for more info.

Typical Sources of Info:
Specs: 00960.49 & 00960.70
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO

W

EX
1


*Typically conduit is installed by contractor and wiring is installed by power company
Traffic Signal Service
Conduit and wiring from the power source to the traffic signal service (BMCL in this example) as required by the power company*
BMCL
W
Existing Power Source
EX 1
R/W
Electrical permit and service inspection required.
FOLLOW PERMIT REQUIREMENTS.
(00960.70)
Electrical Permit

Bonding and Grounding

PRIOR TO INSTALLATION

- Bonding and grounding is typically necessary for all conduits with AC conductors and for all signal poles, pedestals, controller cabinet and service cabinet.
- Identify which conduits will have AC circuits and which will have only DC circuits. DC circuits are used for pedestrian push buttons, loop detection systems, and fire preemption systems.
- Choose appropriate location for ground rods at all poles, pedestals, and cabinets. The ground rod may be located in an adjacent junction box. TM450, TM452, TM455, TM457, TM482, & TM485.

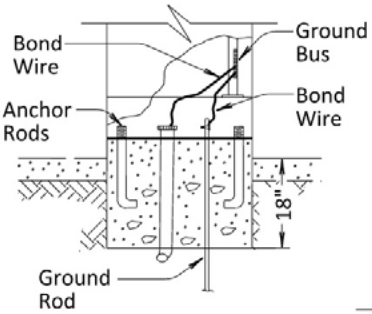
INSTALLATION

- Generally a bond wire is necessary in most conduits. 00960.50(f).
- Install bonded bushings on conduits where needed. 00960.42(g)(4).
- Drive ground rods, attach appropriate size grounding electrode conductor and grounding lug. Bond conduit to ground rod if needed. 00960.50.
- Bond metallic JB lids to conduit bonding lug (if AC power present) with 4' minimum length bond wire (to enable the removal of the cover). 00960.50(g) & TM472.

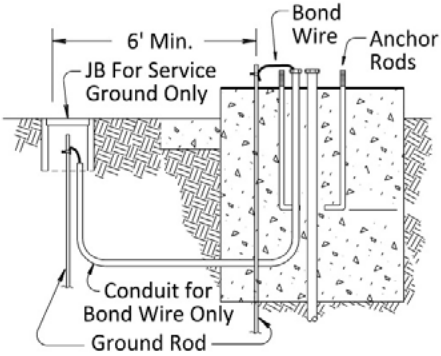
CAUTION-POTENTIAL PROBLEMS

- Bonding & Grounding can get rather complicated so this is one area where requesting assistance from Agency Electricians is STRONGLY suggested.
- Remember to connect bond wires to conduit bonding lugs when conductors are pulled.
- Ground rods must be installed in a minimum of a JB/1. On wood poles, all equipment less than 8' above ground shall be bonded at each pole as per std. Dwg. TM455.
- All ground and bond wires must be stranded conductors. 00960.50(a).
- Bonding to the JB is not required in a non-metallic junction box with non-metallic lid. (note: a grounding conductor may still be routed through the JB)
- Bonding is required in a metallic junction box or with metallic lids if there are any AC circuits in the box. 00960.50(g).

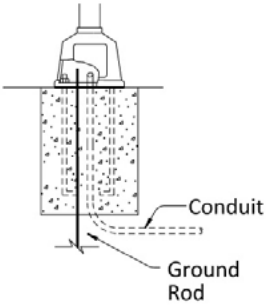
Typical Sources of Info:
Specs: 00960.50
Std. Dwg: TM450, TM452, TM455, TM457, TM472, & TM485
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pgs. 8, 9 & 17



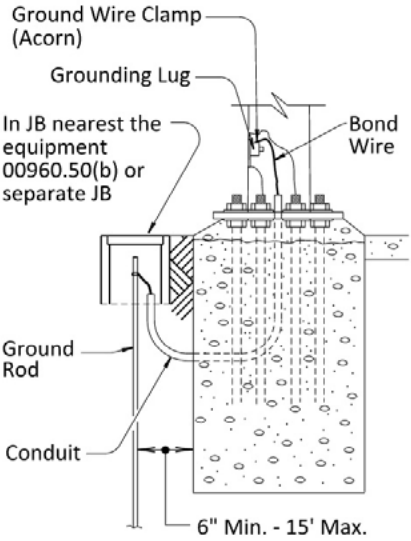
CONTROLLER CABINET (TM482)



BASE MOUNTED SERVICE CABINET (TM485)



PEDESTAL (TM457)



POLE (TM450 & 452)

Pulling Wires and Cables

PRIOR TO INSTALLATION

- Verify that all conduit bushings (with bonding lugs, if required) are installed before pulling wires. 00960.42(g)(4).
- Verify that bond wire is included with wire and cables (if required). 00960.50.
- Verify that all wiring used meets the color code requirements. TM470.

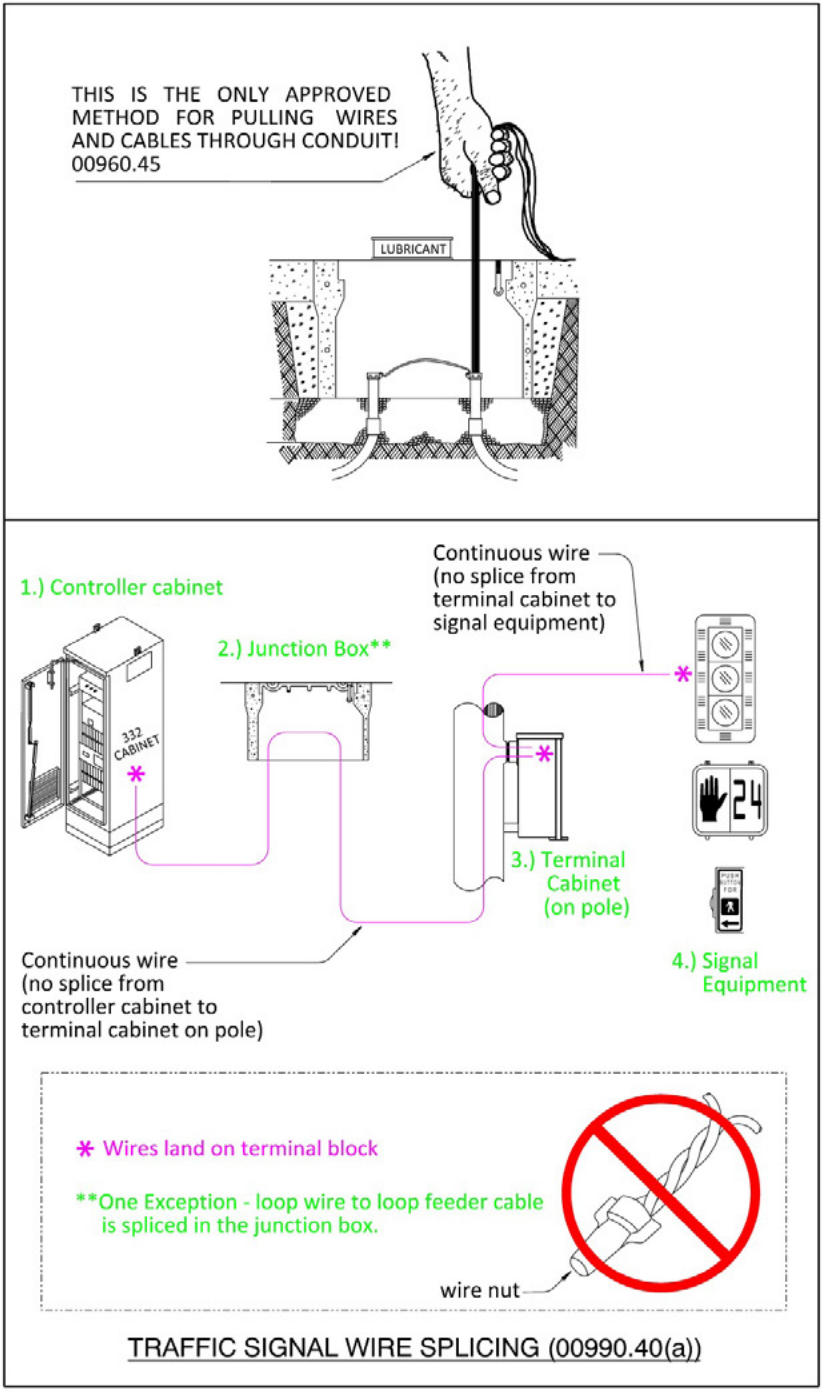
INSTALLATION

- Always pull wires and cables by hand in a straight line with the conduit opening, using a pulley device if necessary to achieve a straight line. 00960.45.
- Use approved lubricant to reduce pulling strain and prevent insulation damage. 00960.45.
- Typically requires one person pulling the wire and one person feeding the wire in the conduit.
- Install conduit plug after wires are pulled. 00960.42(g).

CAUTION-POTENTIAL PROBLEMS

- Be sure conduit is clean before pulling wires. Use a mandrel and compressed air (existing conduit and new conduit). 00960.45.
- Inspect pulled ends of conductors for insulation damage, replace if damage is discovered.
- No splicing is allowed outside of terminal cabinets (Splicing loop wire to feeder cable splices in junction boxes is the only exception). 00990.40(a).
- Do not use any mechanical means to apply or multiply pulling force.
- Do not tie or tape conductors or cables together inside conduit. 00960.45.
- Leave slack in each wire and cable as per 00990.40(a):
    - junction box nearest the controller (6 feet)
    - junction box (2 feet)
    - pole (2 feet)
    - controller cabinet (6 feet)

Typical Sources of Info:
Specs: 00960.45
Std. Dwg: TM470
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pgs. 8, 9, 13, 15, 23, 27, 29, & 31


THIS IS THE ONLY APPROVED METHOD FOR PULLING WIRES AND CABLES THROUGH CONDUIT! 00960.45
LUBRICANT
1.) Controller cabinet
332 CABINET
2.) Junction Box**
Continuous wire (no splice from terminal cabinet to signal equipment)
3.) Terminal Cabinet (on pole)
4.) Signal Equipment
Continuous wire (no splice from controller cabinet to terminal cabinet on pole)
* Wires land on terminal block
**One Exception - loop wire to loop feeder cable is spliced in the junction box.
wire nut
TRAFFIC SIGNAL WIRE SPLICING (00990.40(a))

Wiring Poles

Wiring poles consists of single conductors or control cable brought into terminal cabinets via underground conduit then distributed to various pieces of equipment.

PRIOR TO INSTALLATION

- Verify 'J' hooks above terminal cabinet entrance to strain pole and above mast arm connection on mast poles. TM450.
- Become familiar with the color code and wiring shown on plans. TM470.
- Signal heads normally use No. 14 AWG. Plan Sheets.
- Illumination on signal poles normally use No. 10 AWG. Plan Sheets.
- Signal conductors are stranded copper, THWN wire. Plan Sheets.
- Illumination and power conductors are stranded copper, XHHW wire. Plan Sheets.

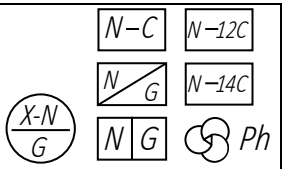
INSTALLATION

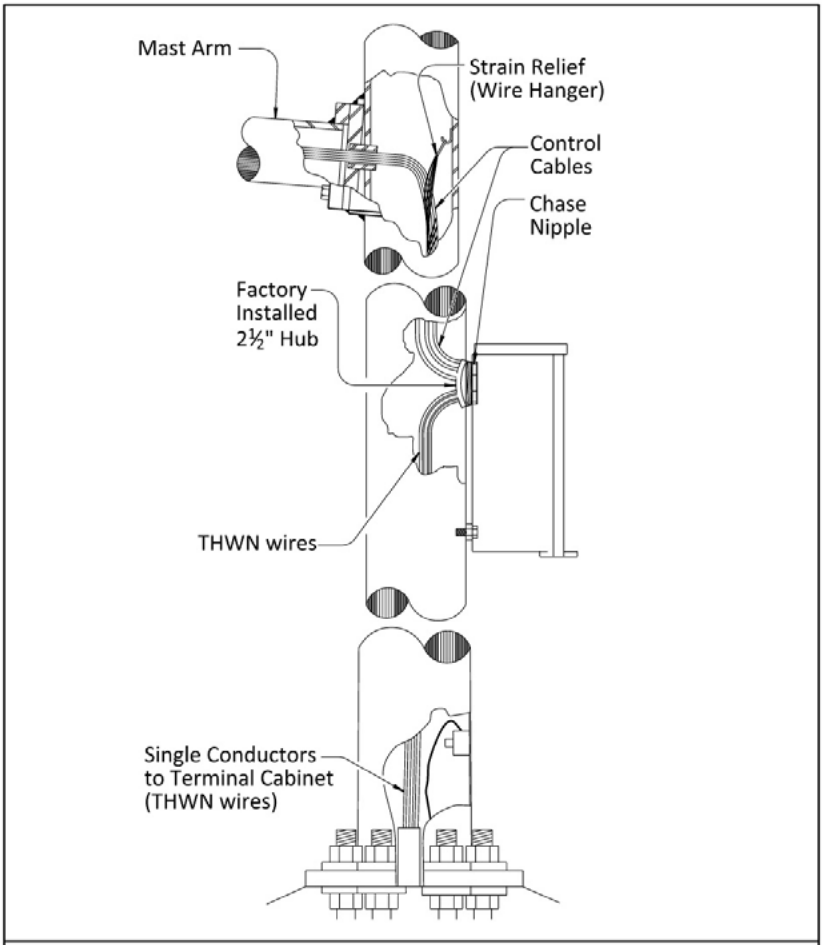
- Use cable Strain reliefs to support wires or cables at "J" hooks above terminal cabinets (strain pole) and above mast arm connections. TM450.
- Wire mast arms with control cables (One 7 conductor wire cable per vehicle head). 00990.40(a).
- Span-wire control cables exit bottom of terminal cabinet (using watertight compression fittings) and are attached to messenger cable with cable ties every 6”. TM452.

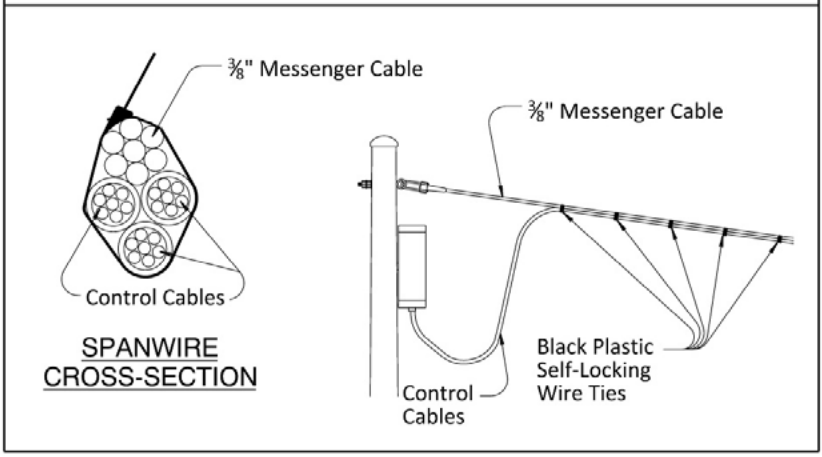
CAUTION-POTENTIAL PROBLEMS

- Observe the color code requirements. TM470.
- Install 3 spare conductors as shown in plan sheets.
- Cables on a span wire may bypass terminal the cabinet, for example fire preemption cable.
- Tape off ends of extra conductors. 00990.40(a).
- No splices are allowed outside of the terminal cabinets (except for loop wire to loop feeder cable in the junction box). 00990.40(a).
- Follow wire slack requirements. 00990.40(a).

Typical Sources of Info:
Specs: 00960.45, 00990.40, 02920.22, & 02920.23
Std. Dwg: TM450, TM470
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 8, 23, 27, & 56




Mast Arm
Strain Relief
(Wire Hanger)
Control
Cables
Chase
Nipple
Factory
Installed
2½" Hub
THWN wires
Single Conductors
to Terminal Cabinet
(THWN wires)


⅜" Messenger Cable
Control Cables
SPANWIRE
CROSS-SECTION
⅜" Messenger Cable
Black Plastic
Self-Locking
Wire Ties
Control
Cables

Pedestrian Signal Mount Installation

Hinged mounting brackets (clamshell mounts) are a two-piece, ready-to-use assembly into which the pedestrian signal is installed. TM467.

PRIOR TO INSTALLATION

- Drill pole for flange mount & ½" NF stainless steel, allen head, mounting bolts. TM467.

INSTALLATION

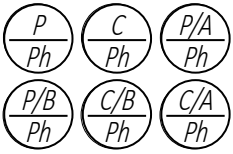
- Mount terminal compartment and assemble.

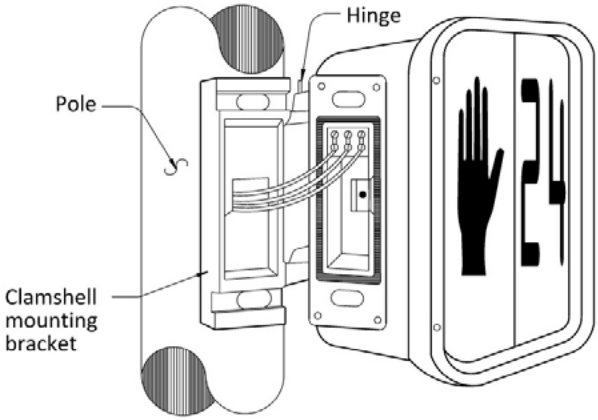
CAUTION-POTENTIAL PROBLEMS

- Check visibility from far end of crosswalk, adjust as necessary.
- PLUMBING PIPE AND FITTINGS are not permitted.
- Clamshells must be mounted with the hinge at the rear of the pedestrian signal housing but may need to be reversed to allow for the opening of the pedestrian signal. Make sure that the pedestrian signal can be opened for maintenance. TM467.
- Make sure crosswalk lines up with poles that have pedestrian indications.

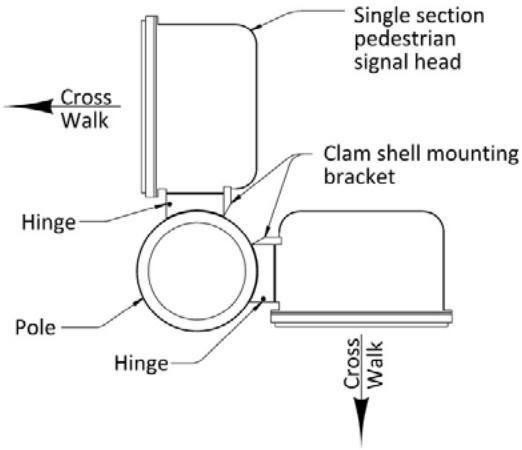
Construction

Typical Sources of Info:
Specs: 02925.65
Std. Dwg: TM467
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pg. 39





DETAIL VIEW CLAMSHELL MOUNT (TM467)



TOP VIEW CLAMSHELL MOUNT (TM467)

Pedestrian Signals & Push-Button Installation

PRIOR TO INSTALLATION

- Verify that pole has been drilled at proper location. See Pole Entrance Chart for mounting orientation.
- Verify direction of directional arrows on sign. TM467 & 00990.43(a).
- Housing, doors and visors shall be powder coated aluminum or polycarbonate. Blue Sheets & 02925.65(b) & (c).
- Pedestrian signal heads consist of a one-section housing and use LED hand/man or LED countdown hand/man modules. 02925.65(a) & (b).
- Push-buttons are installed in a one-piece assembly which includes the sign. 02925.66(c).

INSTALLATION

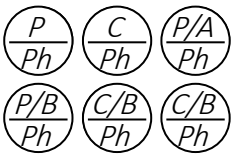
- Bolt the clamshell to the pole, draw wiring from pole & connect to contact terminals. TM467.
- Bolt the push button assembly to the pole, draw wiring from pole & connect to contact terminals. TM467.

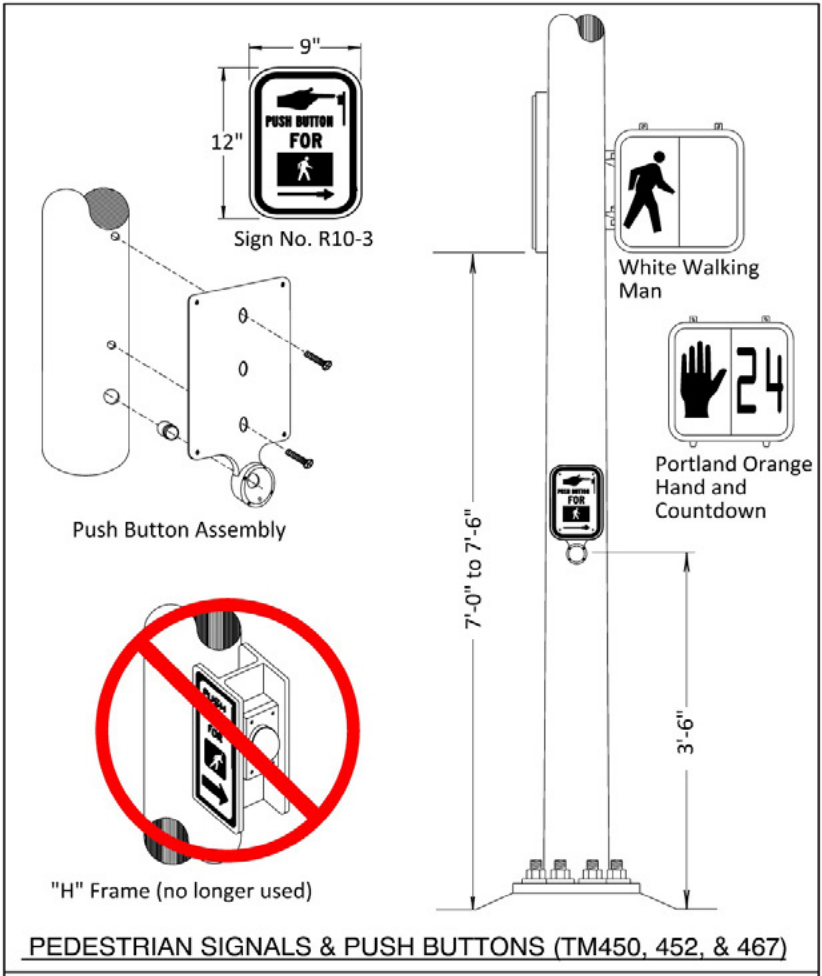
CAUTION-POTENTIAL PROBLEMS

- Use LED only for pedestrian signals. 02925.65(a).
- Push buttons shall be tamper-proof. 02925.66(d).
- Verify angle of crosswalk before mounting head & button.
- Verify that signal head covers are installed over the pedestrian signals until the signal is turned-on. 00990.42(g).
- Verify the mounting height of push button is 3’6” above the paved surface near the pole (measured from the center of the push button). TM450, TM452, & TM458.
- Verify that the A.D.A. Reach distance for the pushbutton (from the face of curb to face of pedestrian push button) is 24” or less. TM458.
- Verify the mounting height of the pedestrian signal is 7’ to 7’6” above the paved surface near the pole (measured from the bottom of the pedestrian signal). TM450 & TM452.

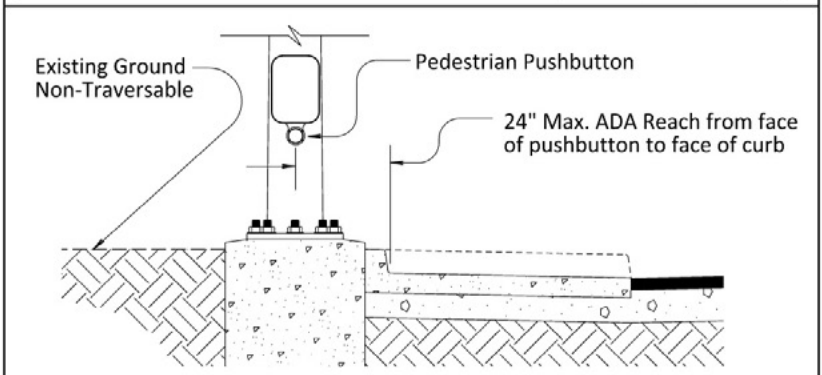
Construction

Typical Sources of Info:
Specs: 00990.42(d), 00990.43(a), & 002925.65
Std. Dwg: TM467
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 38 , 42, & 45





PEDESTRIAN SIGNALS & PUSH BUTTONS (TM450, 452, & 467)



MAX ADA REACH TO PUSHBUTTON (TM458)

Vehicle Signal Installation

Vehicle signals are comprised of individual signal face sections configured to serve any particular intersection. 02925.64.

PRIOR TO INSTALLATION

- Determine type of signal head to be installed. Plan Sheets & TM460.
- Install hardware onto span wire, or install hardware onto signal head for mast arm/pole mounts.
- Install tether clamp hardware to bottom of signal for span wire mount.
- Vehicle signal shall be aluminum powder coated 'flat black' or polycarbonate (head, visor, and backplate). 02925.64(d) & (e).
- Indications shall be LED with clear lenses. 02925.64(a).
- All hardware and fasteners shall be stainless steel. 02925.62(a).

INSTALLATION

- Suspended from span wires with a span wire hanger, conduit, and tri-stud adapter. See pg. 140.
- Mounted to mast arms and poles with an adjustable bracket. See pg. 134.
- Verify correct vertical clearance between the bottom of the equipment and the pavement is 18' minimum to 19' maximum. TM450 & TM452.

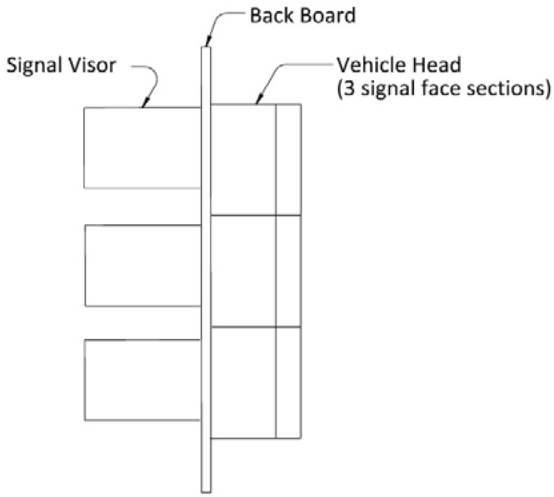
CAUTION-POTENTIAL PROBLEMS

- Install back plates on all signal heads. 00990.42(a).
- Cover signal heads until signal is activated. 00990.42(g).
- Install bottom hole plug and drill a ¼" drain hole in bottom plug. 02925.64.
- Verify that signal head covers are installed over the signal heads until the signal is turned-on. 00990.42(g).
- Material may be polycarbonate (standard or heavy duty). Special provisions.

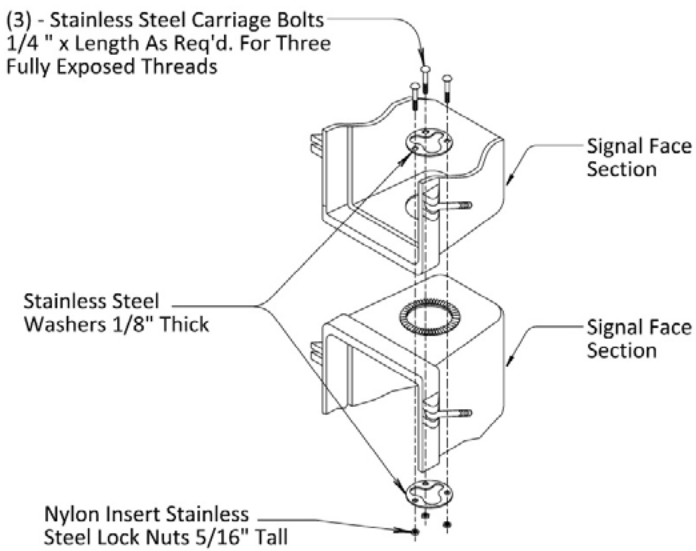
Construction

Typical Sources of Info:

Specs: 00990.42, 02920.51, 02925.51, & 02925.64
Std. Dwg: TM460 & TM462
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 26, 45, 52, & 53



COMPONENTS OF A VEHICLE SIGNAL



VEHICLE HEAD ASSEMBLY (TM462)

Louver Installation

Louvers are used within the signal visor and are designed to selectively limit the visibility zone of the signal indication. A common use is for intersections that are too close together (to restrict visibility to the other signal location).

PRIOR TO INSTALLATION

- Shim spanwire hanger so as to better restrict movement which could vary the visibility zone. TM463.

INSTALLATION

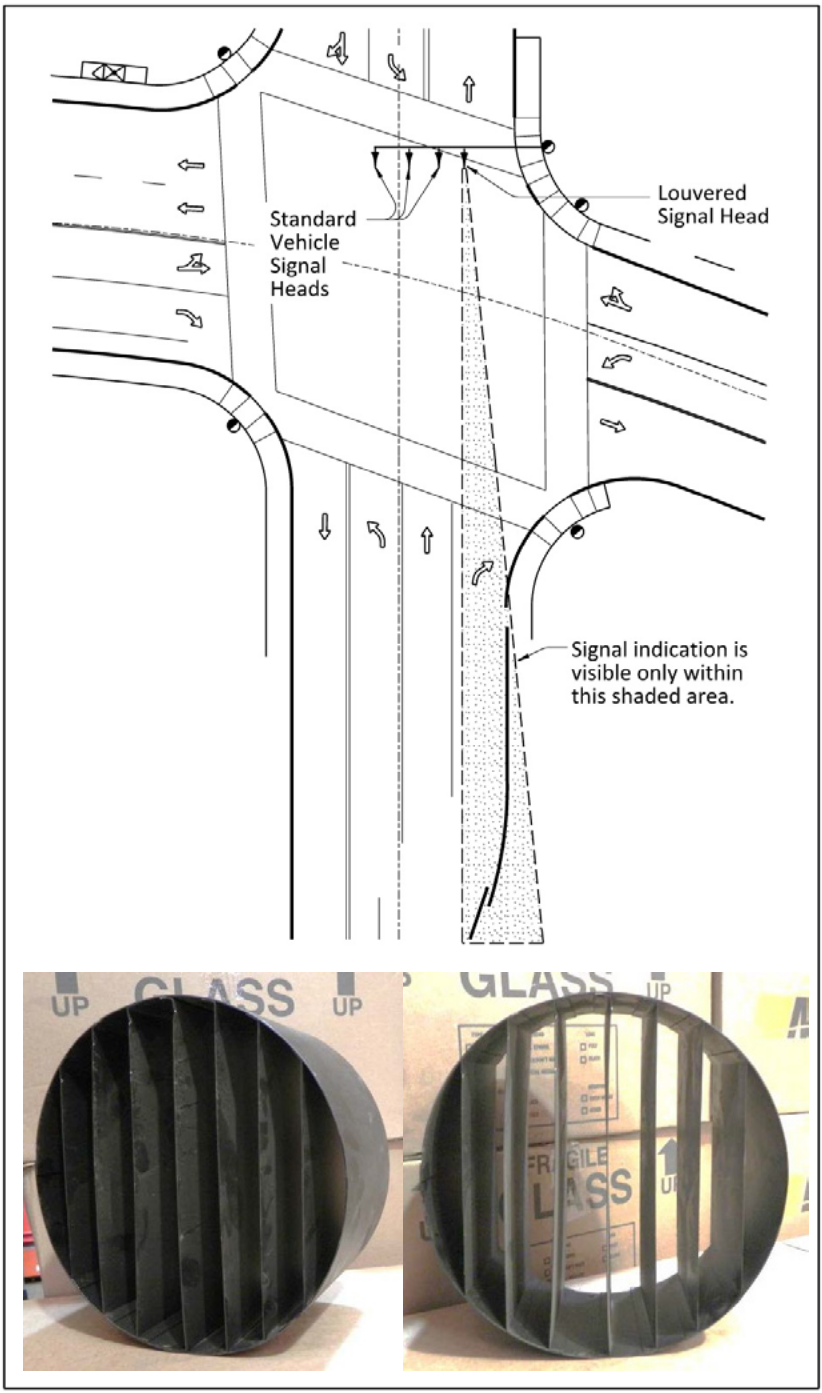
- Geometrically programmed louvers are used inside the visor of a standard signal head.

CAUTION-POTENTIAL PROBLEMS

- The louvers are checked for proper aiming during the signal turn-on by Region Traffic. Driving the approach containing the louvered signal head, in each lane, is advised to ensure proper aiming of the louver.

Typical Sources of Info:
Specs: 00990.42(c)
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO

GPL


Louvered
Signal Head
Standard
Vehicle
Signal
Heads
Signal indication is
visible only within
this shaded area.
UP
GLASS
UP
GLASS
UP
FRAGILE
GLASS

Sawcutting Detector Loops

Sawcutting detector loops provides a slot into which the DUCTED XHHW loop wires are installed.

PRIOR TO INSTALLATION

- Mark out loop locations and loop wire returns. 00990.43(b)(3) & Plan Sheets.
- Loop wire returns cannot be routed through adjacent loops.

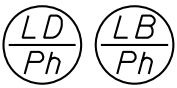
INSTALLATION

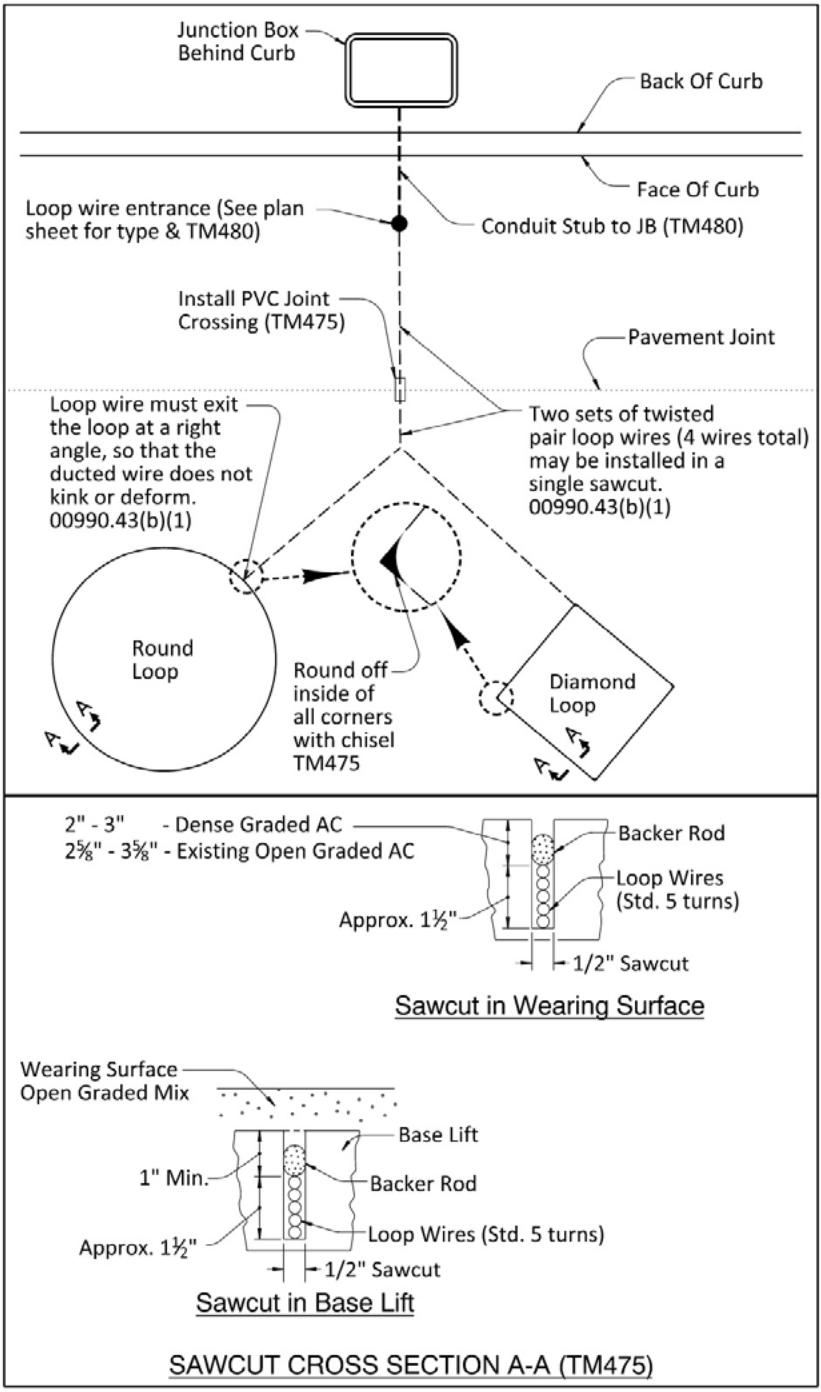
- Sawcuts shall be at least ½" wide. 00990.43(b)(1) .
- Sawcuts shall be deep enough to allow min. 2" cover over all wires placed in slot (Deeper for existing Open Graded Mix). TM475.
- Flush sawcut with high pressure water stream before cuttings dry, blow out water and debris with high pressure/volume air, check the entire slot for any foreign debris, dry slot thoroughly with air or use vacuum/extractor system. 00990.43(b)(1).

CAUTION-POTENTIAL PROBLEMS

- Detector loop installations are the most failure-prone portion of a signal. Careful construction according to specifications greatly reduces this failure rate.
- Round corners to prevent insulation damage.
- Check thoroughly for rock shards in bottom of sawcut.
- Install PVC sleeve pavement joint and crack crossings as per TM475.
- Pavement too thin to obtain cover, consult engineer of record for options.
- Do not sawcut and seal NEW open graded mix, install in base lift AC. 00990.43(b)(1) & TM475.
- For EXISTING open graded mix, see TM475.
- Avoid sharp corners for loop wire returns. Round off all corners, NO MORE THAN 90° AT ANY ANGLE POINT. TM475 & 00990.43(b)(1).
- Supplemental Inspection required by Agency Electrician 00990.43(b)(3), See page 88 for more info.

Typical Sources of Info:
Specs: 00990.43(b)
Std. Dwg: TM475
Plan Sheets: YES (location only)
Blue Sheet/Green Sheet Info: pg. NO




Junction Box
Behind Curb
Back Of Curb
Face Of Curb
Loop wire entrance (See plan sheet for type & TM480)
Conduit Stub to JB (TM480)
Install PVC Joint Crossing (TM475)
Pavement Joint
Loop wire must exit the loop at a right angle, so that the ducted wire does not kink or deform. 00990.43(b)(1)
Two sets of twisted pair loop wires (4 wires total) may be installed in a single sawcut. 00990.43(b)(1)
Round Loop
Round off inside of all corners with chisel TM475
Diamond Loop
A
A
A
A
2" - 3" - Dense Graded AC
2⅝" - 3⅝" - Existing Open Graded AC
Backer Rod
Loop Wires (Std. 5 turns)
Approx. 1½"
1/2" Sawcut
Sawcut in Wearing Surface
Wearing Surface
Open Graded Mix
Base Lift
1" Min.
Backer Rod
Loop Wires (Std. 5 turns)
Approx. 1½"
1/2" Sawcut
Sawcut in Base Lift
SAWCUT CROSS SECTION A-A (TM475)

Detector Loop Wire Installation

PRIOR TO INSTALLATION

- Recheck sawcut for adequate width & depth.
- Recheck sawcut for foreign debris.

INSTALLATION

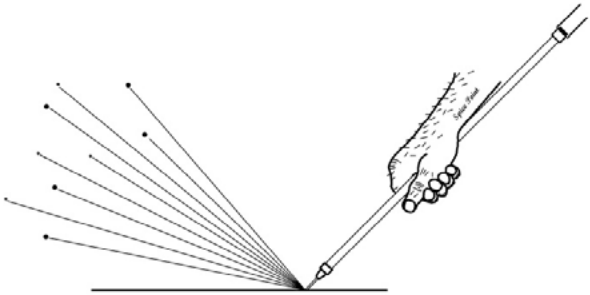
- Press loop wire into sawcut using a blunt, non-metallic tool. Do not force wire; The No. 14 AWG wire with duct should slip effortlessly into a ½" wide slot. If it doesn't, find out why, before duct or wire insulation is damaged. 00990.43(b)(3).
- If loops are to be installed in series, each pair of loop wires must return to the junction box before connecting loops in the series. TM475
- Wedge 1" lengths of backer rod into all sawcuts as loop wire hold-downs. Hold-downs should be placed no more than 12" apart and 6" from any corners. 00990.43(b)(3).
- Test each loop 1.) Before splicing and sealing 2.) Before splicing after sealing and 3.) After splicing and sealing. Contractor shall provide a report with data for each phase of testing. 00990.43(b)(5). Provide copies of report to TSSU.

CAUTION-POTENTIAL PROBLEMS

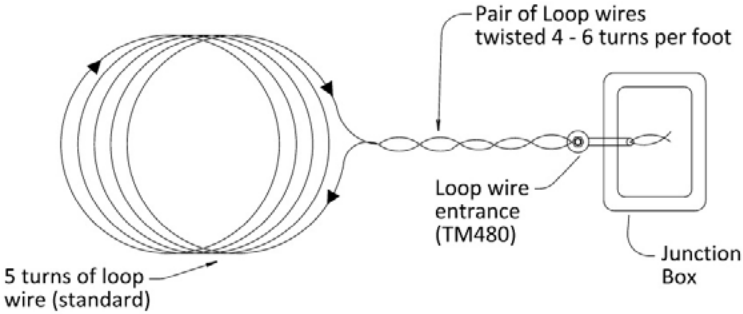
- Installing detector loop wires requires good practices and great care to avoid damage which is not readily apparent.
- Detector loops are failure-prone. Loops may function initially, then fail later when moisture intrudes through minor damage to the wire insulation.
- All loops are to be wound clockwise. Five turns of wire is standard (or as shown on plan sheets). TM475.
- Loops located more than 500 feet from the controller cabinet may require more than 5 turns of wire. Plan Sheets.
- Twisted pairs in a too-narrow slot can hang up requiring excess force to properly seat in bottom of sawcut.
- Avoid kinking or deforming ducted wire.
- Loop wire returns are twisted 4-6 turns per foot from loop to the splice in the junction box. 00990.43(b)(3) & TM475.
- Supplemental Inspection required by Agency Electricians 00990.43(b)(3), See page 88 for more info.

Typical Sources of Info:
Specs: 00990.43(b)
Std. Dwg: TM475
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 33 & 40

Flush sawcut with high pressure water before rock dust dries, then blow out water and debris with high pressure/volume air or use vacuum extractor system. Dry slot thoroughly. Check for sharp rock shards. 00990.43(b)(1)



PREPARING THE SAWCUT BEFORE INSTALLING LOOP WIRE



LOOP WIRE INSTALLATION

Construction

Loop Wire Entrance Installation

The Loop wire entrance provides loop wire access to junction box conduit stubs. In the event of a loop failure, the loop can be re-cut into these entrance points. There are two types of wire entrances:

1. PVC CONDUIT OPTION-6” PVC conduit sleeve with AC cold mix cap/seal.
2. SAND POCKET OPTION-6” max. opening cut into pavement, filled with sand and capped with AC cold mix.

PRIOR TO INSTALLATION

- Verify which option to install. Plan Sheets.
- Sand pocket option: sawcut 6”x6” maximum opening or 4” minimum diameter core drill opening. TM480.
- Take care not to damage conduit stub.

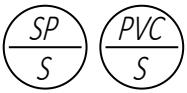
INSTALLATION

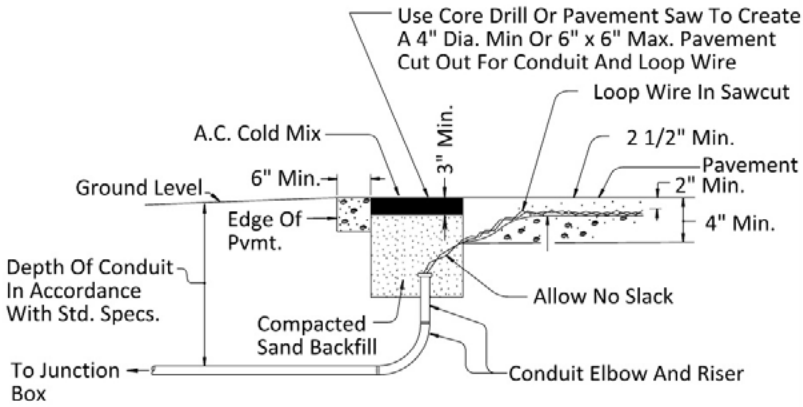
- PVC Option: center conduit sleeve in hole and fill around box or sleeve with hard, non-flexible epoxy (not loop sealant). TM480.
- PVC Option: After epoxy cures, sawcut loop wire slots through epoxy and PVC sleeve/box.
- After installing wires, seal conduit with approved sealer, fill with sand and cap with cold mix AC. TM480.

CAUTION-POTENTIAL PROBLEMS

- Improperly sealed sawcut into sleeve or pocket may allow loop sealant migration into the conduit.
- Cap loop wire entrances with cold mix AC, not loop sealant. TM480.

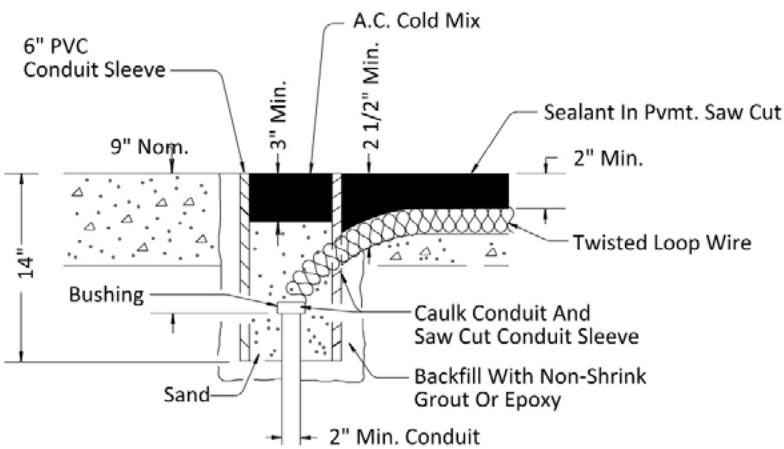
Typical Sources of Info:
Specs: NO
Std. Dwg: TM480
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 31, 32, 33, & 40





UNCURBED SECTION (On Monolithic Curbs, Locate Loop Entrance In Pavement At The Edge Of Concrete Gutter (All Other Notes Apply As Above)

SAND POCKET OPTION (TM480)



PVC CONDUIT OPTION (TM480)

Sealing Detector Loops

PRIOR TO INSTALLATION

- Be sure backer rods are in place. 00990.43(b)(3) & TM475.

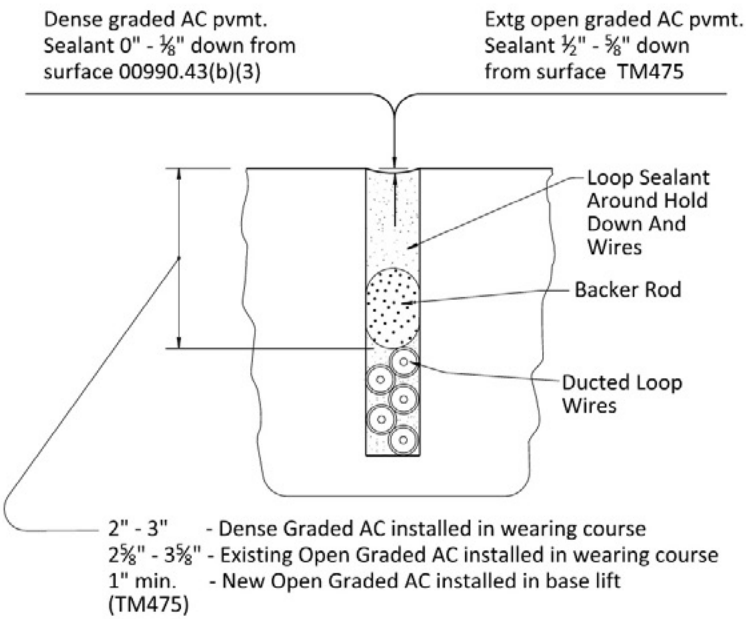
INSTALLATION

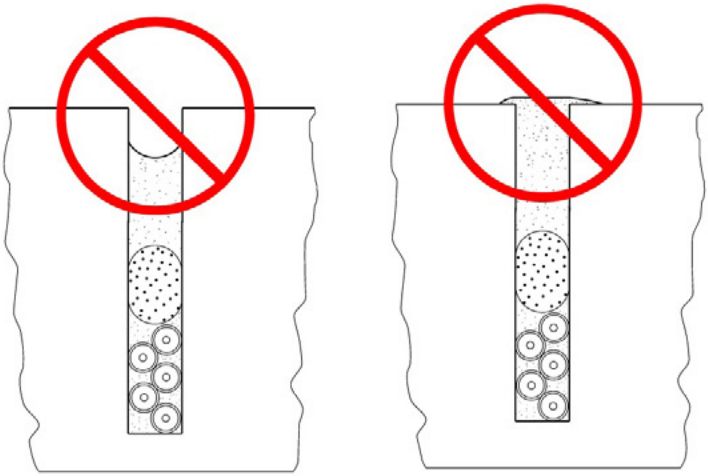
- Place sealant directly into sawcut, using manufacturer's recommendations. 00990.43(b)(3).
- High temperature sealants must be placed in lifts to avoid heat damage to insulation. 00990.43(b)(3).
- Surface of sealant should be within 1/8" of pavement surface without protruding. 00990.43(b)(3).
- Surface of sealant is installed ½" below existing Open Graded Mix AC. TM475.
- Test each loop 1.) Before splicing and sealing 2.) Before splicing after sealing and 3.) After splicing and sealing. Contractor shall provide a report with data for each phase of testing. 00990.43(b)(5). Provide copies of report to TSSU.

CAUTION-POTENTIAL PROBLEMS

- Use only QPL listed sealants. Loop sealants shall be proportioned, mixed, and installed in accordance with manufacturer recommendations. 00990.10.
- On sloped sections, duct tape can be used to contain sealant in sawcut. Remove tape after sealant is fully cured. 00990.43(b)(3).
- If sealant runs or puddles on pavement surface, discontinue operation until contractor corrects his placement method.
- DO NOT QUICK COOL SEALANT WITH WATER. 00990.43(b)(3).
- Maintain clean and DRY sawcut before sealing.
- DO NOT seal loops at temperatures below 40°F (as per manufacturer instructions).
- If sealant is NOT installed ½" below existing open graded pavement surface water dams may form causing puddles or ice patches.

Typical Sources of Info:
Specs: 00990.43(b)
Std. Dwg: TM475
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pg. 1 (Backer Rod and Sealant from QPL)





Construction

Preformed Detector Loop Installation

Preformed detector loops are typically used in thin pavement areas and concrete surfaces. They are sealed systems from loop to junction box.

PRIOR TO INSTALLATION

- Mark out loop locations and loop wire return to first junction box.

INSTALLATION

- Sawcut pavement for loop trench, clean trench bottom and sides as for standard loop slots. Place preformed loop and return in sawcut and bed with sand to bottom of adjacent surfacing.
- Repave sawcut with material matching adjacent surfacing.
- They may be installed during the paving operation in the base lift of AC.

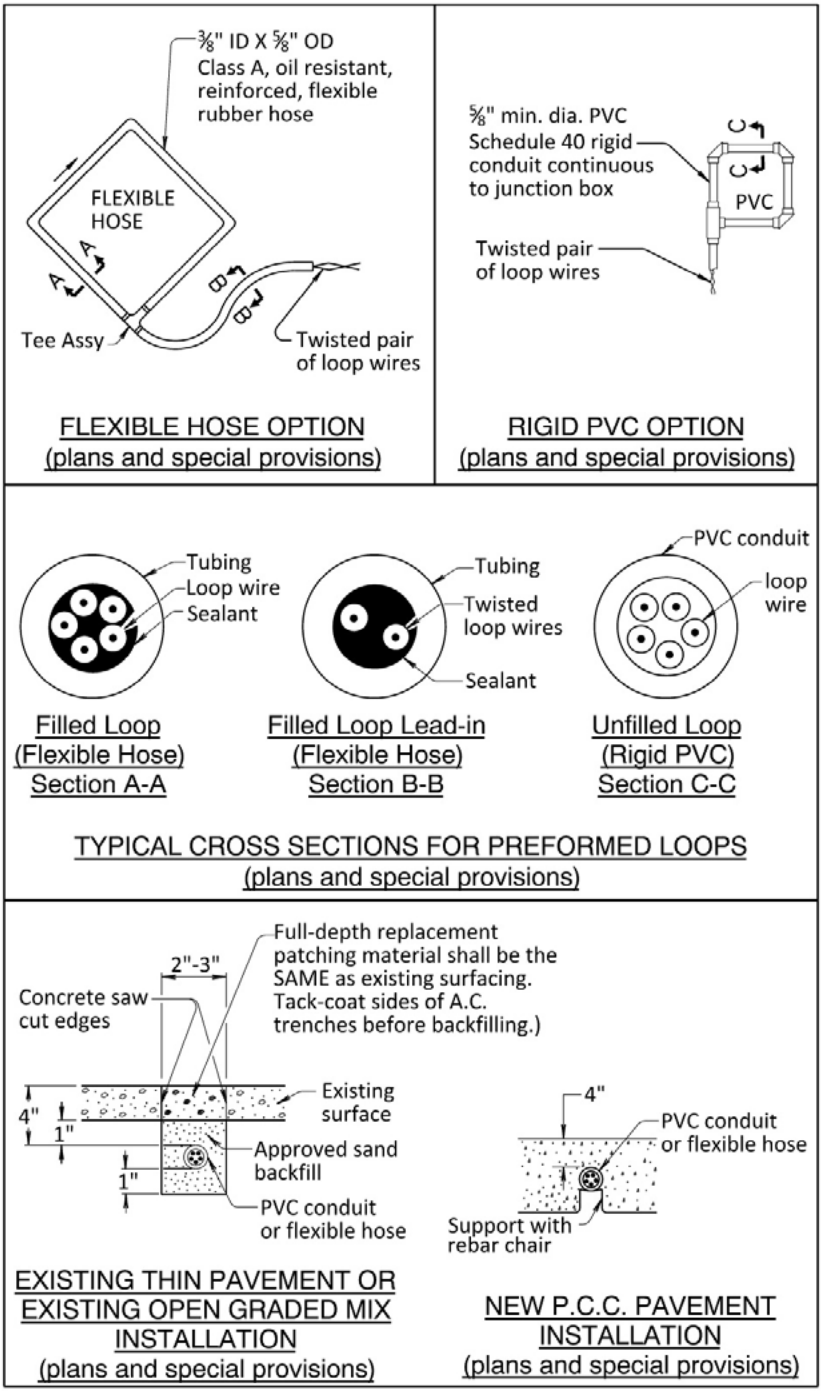
CAUTION-POTENTIAL PROBLEMS

- Preformed loops to be poured into bridge decks (or P.C.C. pavement) should be supported throughout at 2”-4” below finish grade (See Bridge plans for further details).
- Test loops before backfilling.
- ALL preformed loops should be marked for direction wire is wound and IN and OUT wires.
- We accept a number of systems; hydraulic hose, PVC conduit etc. See Plans and Special Provisions.

Construction

Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pg. 40

PL/Ph PD/Ph LE


⅜" ID X ⅝" OD
Class A, oil resistant, reinforced, flexible rubber hose
FLEXIBLE HOSE
A
A
B
B
Tee Assy
Twisted pair of loop wires
FLEXIBLE HOSE OPTION
(plans and special provisions)
⅝" min. dia. PVC Schedule 40 rigid conduit continuous to junction box
C
C
PVC
Twisted pair of loop wires
RIGID PVC OPTION
(plans and special provisions)
Tubing
Loop wire
Sealant
Filled Loop
(Flexible Hose)
Section A-A
Tubing
Twisted loop wires
Sealant
Filled Loop Lead-in
(Flexible Hose)
Section B-B
PVC conduit
loop wire
Unfilled Loop
(Rigid PVC)
Section C-C
TYPICAL CROSS SECTIONS FOR PREFORMED LOOPS
(plans and special provisions)
Full-depth replacement patching material shall be the SAME as existing surfacing. Tack-coat sides of A.C. trenches before backfilling.)
2"-3"
Concrete saw cut edges
4"
1"
1"
Existing surface
Approved sand backfill
PVC conduit or flexible hose
EXISTING THIN PAVEMENT OR EXISTING OPEN GRADED MIX INSTALLATION
(plans and special provisions)
4"
PVC conduit or flexible hose
Support with rebar chair
NEW P.C.C. PAVEMENT INSTALLATION
(plans and special provisions)

Loop Wire Splice Installation

Loop wire splices are made between pairs of loop wires (loops wired in series). They are also made between loop wires and loop feeder cable.

PRIOR TO INSTALLATION

- Remove outer jacket of loop feeder cable, cut & remove drain wire and woven shield to 4” to 6” back of intended splice. 00990.43(b)(4).

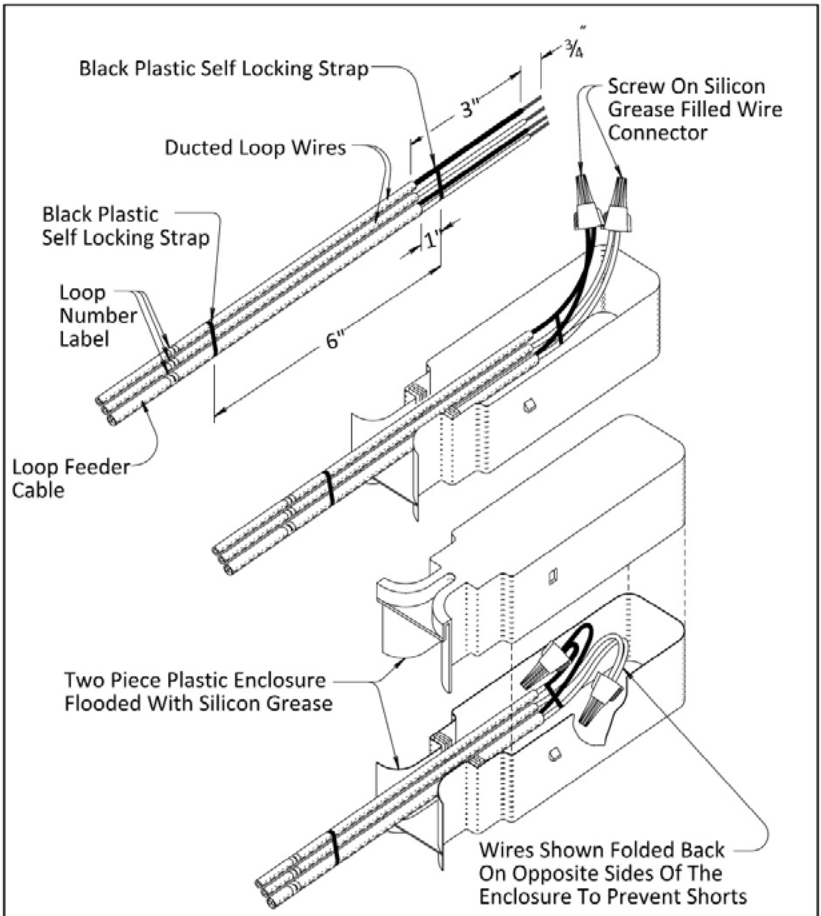
INSTALLATION

- Remove insulation from conductors, install screw on silicon grease filled wire connector, install black plastic self-locking straps, turn back wire connectors, insert into two piece plastic enclosure filled with silicon grease. TM475.
- Label both ends of loop feeder cable and loop wires with loop number. TM475.
- Test each loop 1.) Before splicing and sealing 2.) Before splicing after sealing and 3.) After splicing and sealing. Contractor shall provide a report with data for each phase of testing. 00990.43(b)(5). Provide copies of report to TSSU.

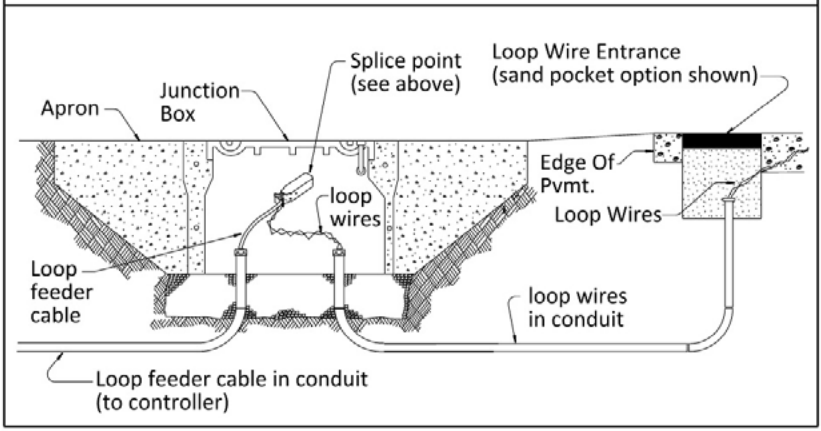
CAUTION-POTENTIAL PROBLEMS

- Do not ground the shield or drain wire in J.B.
- All splices for permanent installations must be made inside junction boxes not loop access. TM475.

Typical Sources of Info:
Specs: 00990.43
Std. Dwg: TM475
Plan Sheets: NO
Blue Sheet/Green Sheet Info: pgs. 31, 32 & 33



LOOP WIRE TO LOOP FEEDER SPLICE (TM475)



Construction

Fire Preemption System Installation

PRIOR TO INSTALLATION

- Examine physical layout of intersection to ensure proper placement of detectors. Determine the channel and traffic movements assigned to each preemption detector (field) unit. Plan Sheets.
- Determine the number of barrels for each preemption detector (field) unit (either 1 or 2). Plan Sheets.

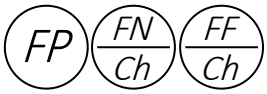
INSTALLATION

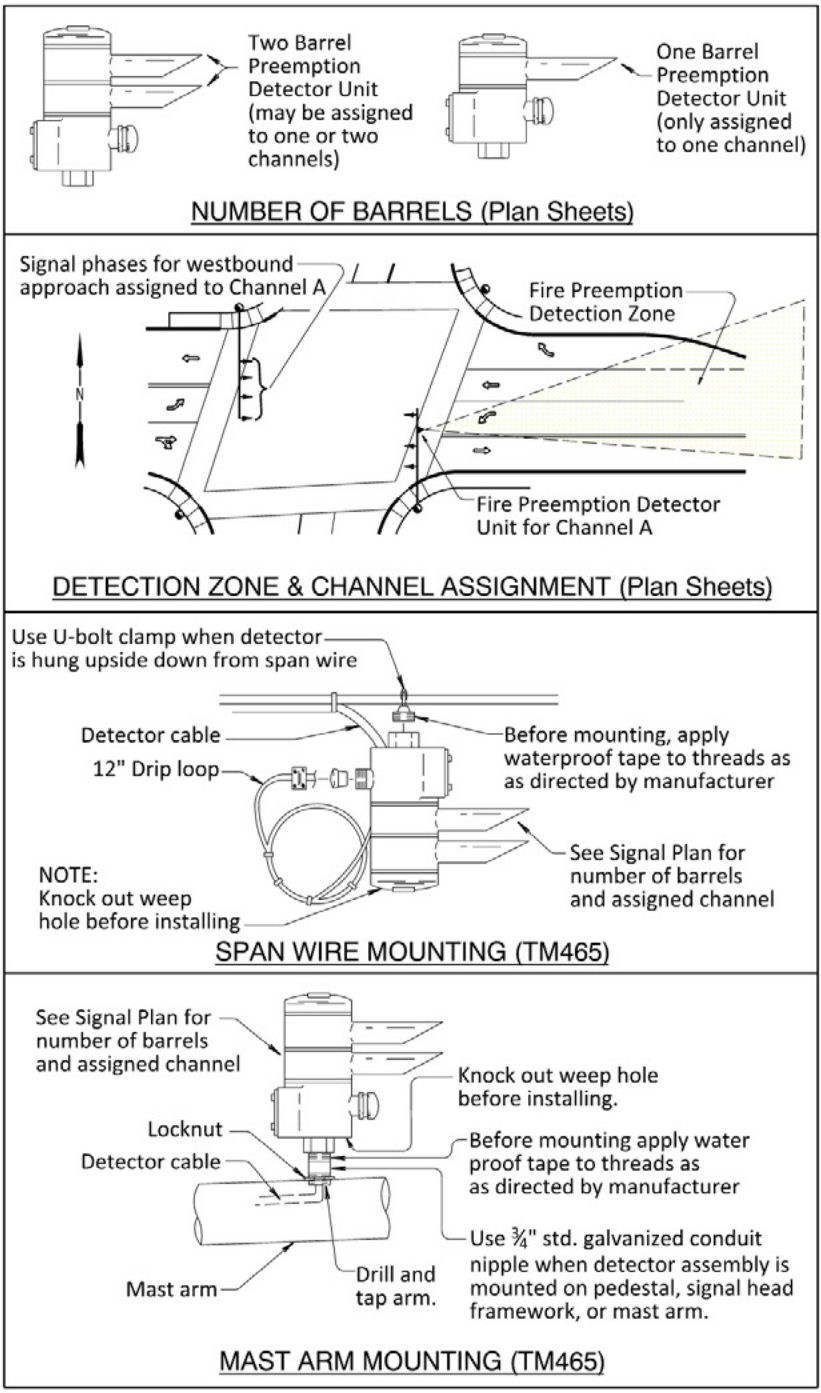
- Mount detector unit using appropriate method dependent upon placement (span wire or mast arm). Plan Sheets & TM465.
- Connect the preemption detector (field) unit to the preemption interface inside the controller cabinet with a single, unspliced length of preemption feeder cable. 00990.46.

CAUTION-POTENTIAL PROBLEMS

- Remember to knock out appropriate weep hole. TM465.
- Pole mounted detector units must be mounted at least 19' above roadway surface.
- One-channel detectors may have two barrels. Both barrels should be aimed towards the same approach (See manufacturer's recommendations).
- Two channel detectors require two barrels. Each barrel should be aimed at a different approach (See manufacturer's recommendations).
- Preemption feeder cable is never spliced and bypasses terminal cabinets. 00990.46.

Typical Sources of Info:
Specs: 00990.46
Std. Dwg: TM465
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 70 & 71




Two Barrel Preemption Detector Unit (may be assigned to one or two channels)
One Barrel Preemption Detector Unit (only assigned to one channel)
NUMBER OF BARRELS (Plan Sheets)
Signal phases for westbound approach assigned to Channel A
Fire Preemption Detection Zone
N
Fire Preemption Detector Unit for Channel A
DETECTION ZONE & CHANNEL ASSIGNMENT (Plan Sheets)
Use U-bolt clamp when detector is hung upside down from span wire
Detector cable
12" Drip loop
Before mounting, apply waterproof tape to threads as as directed by manufacturer
See Signal Plan for number of barrels and assigned channel
NOTE: Knock out weep hole before installing
SPAN WIRE MOUNTING (TM465)
See Signal Plan for number of barrels and assigned channel
Knock out weep hole before installing.
Locknut
Detector cable
Before mounting apply water proof tape to threads as as directed by manufacturer
Use ¾" std. galvanized conduit nipple when detector assembly is mounted on pedestal, signal head framework, or mast arm.
Mast arm
Drill and tap arm.
MAST ARM MOUNTING (TM465)

Luminaire Installation

PRIOR TO INSTALLATION

- Plans specify luminaire arm length and luminaire type, and wattage.
- Locate and verify pole position.
- Wiring for illumination is not routed through the controller cabinet. Plan Sheets.
- Service cabinets for signals with illumination normally include a test switch. TM485.
- Mount photo electric cell as per 00970.43. (20'-36' up pole).

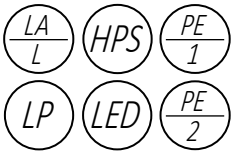
INSTALLATION

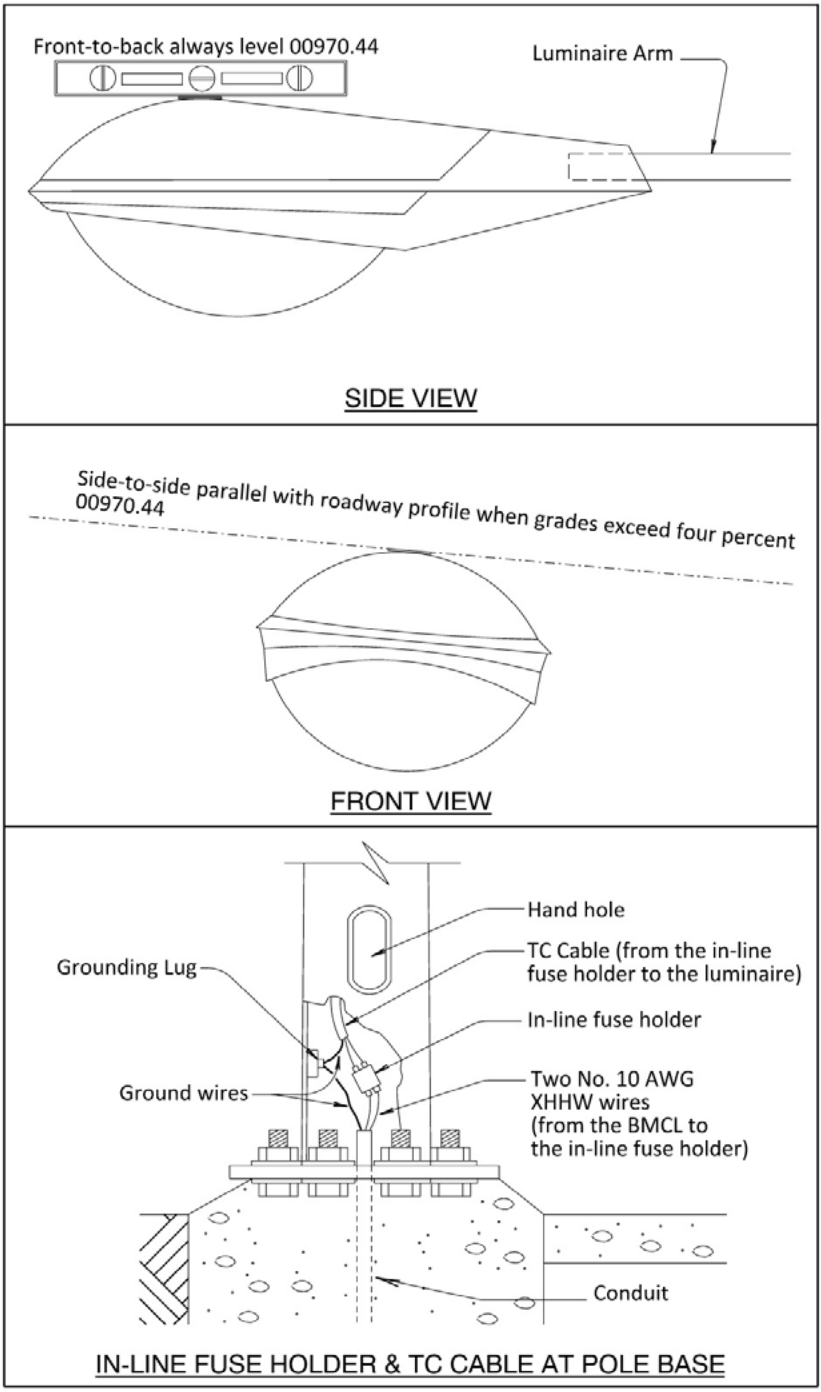
- Luminaires must be installed level. If roadway profile grade is greater than 4 percent, rotate luminaire on arm so side-to-side so position of leveling pad is parallel with roadway grade. 00970.44.
- Mark lamp base with month & year installed. 00970.44(b).
- Support conductors with strain relief at top of pole.
- Some local agencies use a photocell on each luminaire rather a system photocell.
- In-line fuse holder used in the base of the pole, connecting the TC cable (going from the luminaire to the in-line fuse holder) and the XHHW wires (going from the in-line fuse holder to the Service Cabinet)

CAUTION-POTENTIAL PROBLEMS

- If a pole location is changed more than 6' laterally or 3' perpendicular, consult ENGINEER OF RECORD. Luminaire or arm length may need to be changed.
- Luminaires attached to signal poles are shown on the signal plans. Stand-alone luminaires are shown on the Illumination Plan Sheets.

Typical Sources of Info:
Specs: 00970
Std. Dwg: TM650, TM660, & TM465
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 14, 54, 55, & 56




Front-to-back always level 00970.44
Luminaire Arm
SIDE VIEW
Side-to-side parallel with roadway profile when grades exceed four percent
00970.44
FRONT VIEW
Hand hole
TC Cable (from the in-line fuse holder to the luminaire)
Grounding Lug
In-line fuse holder
Ground wires
Two No. 10 AWG XHHW wires (from the BMCL to the in-line fuse holder)
Conduit
IN-LINE FUSE HOLDER & TC CABLE AT POLE BASE

Service Cabinet Installation

PRIOR TO INSTALLATION

- Verify the service is in a safe and protected area.
- Verify the BMC is located 10 feet or more from the controller cabinet. TM485.

INSTALLATION

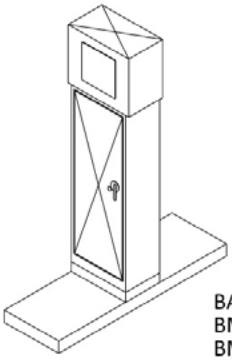
- Wire from the service cabinet to the controller cabinet is installed in a separate conduit. Wire typically consists of two No. 6 AWG XHHW wires and a bond wire. Plan Sheets.
- Do not route illumination circuit wiring through controller cabinet. Plan Sheets.
- Verify there are 2 ground rods a minimum of 6' apart, as per the NEC. Install PVC conduit between the junction box and service cabinet. TM485.

CAUTION-POTENTIAL PROBLEMS

- Contractor obtains the required permits and arranges for utility to inspect power service. 00960.70.
- Refer to section "Electrical Service (Power Source)" on page 142.
- NEVER mount service equipment on controller cabinets.
- Check the service cabinet for damage to galvanizing and/or powder coating, repair as needed. Note: the meter base is inclusive to the service cabinet in permanent installations.
- Check the stand-alone meter base for damage to powder coating, repair or replace cabinet if damaged coating cannot be repaired. Note: A stand-alone meter base and stand-alone service cabinet are used only for temporary signals.
- Supplemental Inspection required by Permitting Electrical Agency 00960.70, See page 88 for more info.

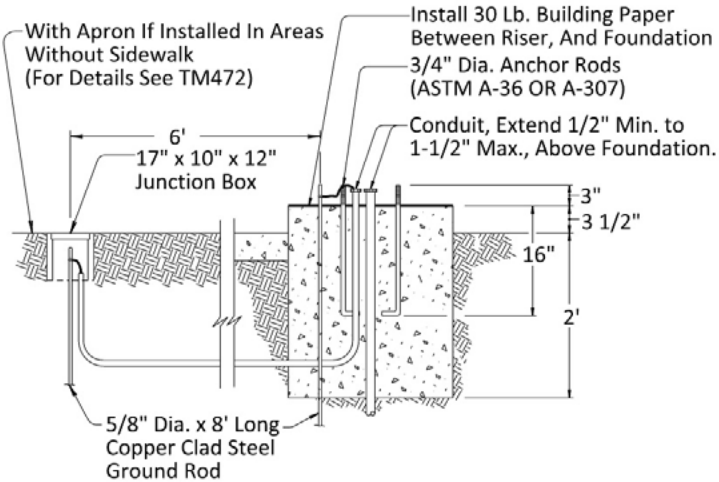
Typical Sources of Info:
Specs: 00960.49, 00990.41, & 02925.40
Std. Dwg: TM485
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pgs. 35 & 44

BMC BMCL BMCF
SC SCL MS



BASE MOUNTED SERVICE OPTIONS
BMC = service for signal system
BMCL = service for signal and illumination
BMCF = service for flashing beacon system
BMCFL = service for flashing beacon and illumination

BASE MOUNTED SERVICE (TM485)



BASE MOUNTED SERVICE & CONTROL CABINET FOUNDATION (TM485)

Model 332s Controller Cabinet Installation

Model 332s controller cabinets are specified for most signal installations.

PRIOR TO INSTALLATION

- Install the riser frame to new foundation. TM482.
- Verify that the ground rod is in place. TM482.
- Verify the controller cabinet is located 10 feet or more from the service cabinet. TM482.
- All traffic signal control equipment must be submitted for physical, functional, and environmental testing. 00990.70(a).
- After testing, the control cabinet will be released to the contractor for installation. 00990.70(e) & (f).
- The TSSU will deliver and install all internal control equipment at day of turn-on. 00990.70(f).

INSTALLATION

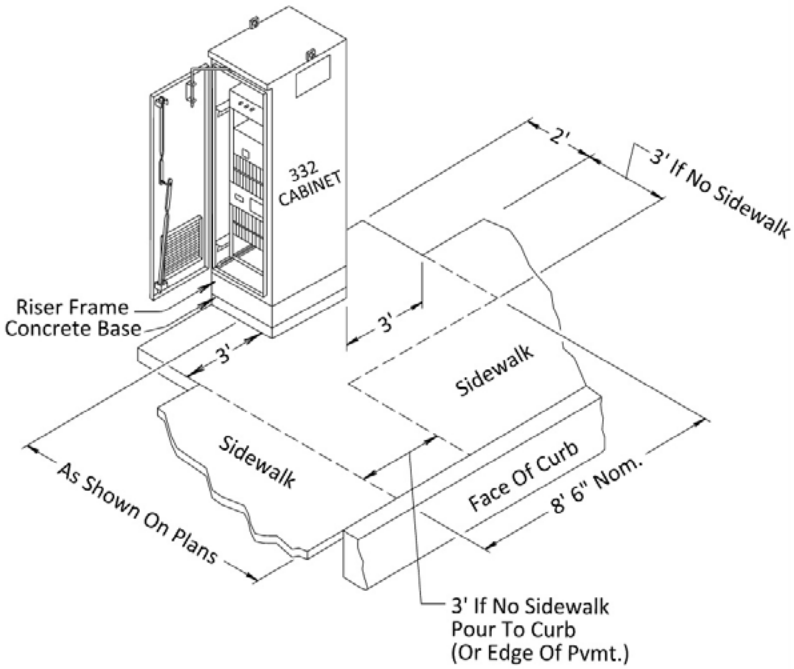
- Install building paper gasket between riser frame and foundation. Install non-hardening water-tight seal between riser frame and controller cabinet.TM482.

CAUTION-POTENTIAL PROBLEMS

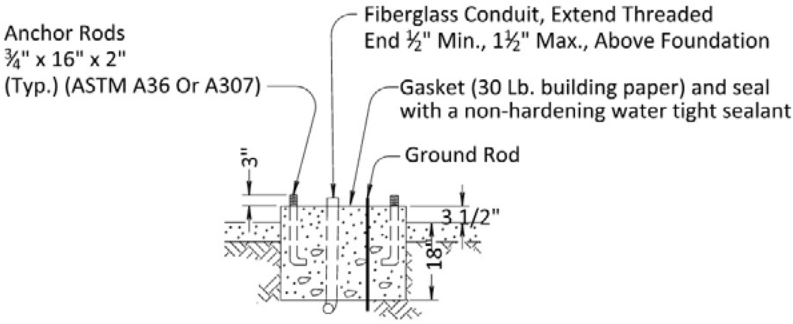
- Ground rod is installed inside controller cabinet in conduit area. TM482.
- Slack wire coiled neatly in riser frame at bottom of cabinet. 00990.40(a).
- Verify controller cabinet is in a protected area, behind pole and away from traffic.
- Metal pole bollards near the controller cabinet may be shown on plans (to protect the cabinet from low-speed vehicle strikes; i.e. Cabinet located near a parking lot).
- Supplemental Inspection recommended for layout and conduit in foundation, See page 88 for more info.

Typical Sources of Info:
Specs: 00990.70, & 02925.40
Std. Dwg: TM482
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pg. 60 (+ various components listed in the Green Sheets)

332S



WALKWAY REQUIREMENTS (TM482)



FOUNDATION SIDE VIEW (TM482)

Construction

Model 336s Controller Cabinet Installation

Model 336s controller cabinets are pole mounted cabinets typically used for temporary signal installations.

PRIOR TO INSTALLATION

- Check to see that cabinet bottom is attached.
- All traffic signal control equipment must be submitted for physical, functional and environmental testing. 00990.70(a).
- After testing, the control cabinet will be released to the contractor for installation. 00990.70(e) & (f).
- The TSSU will deliver and install all internal control equipment at day of turn-on. 00990.70(f).

INSTALLATION

- Mount cabinet onto pole with Nom. 1 ½" wide galvanized steel or stainless steel bands. TM455.

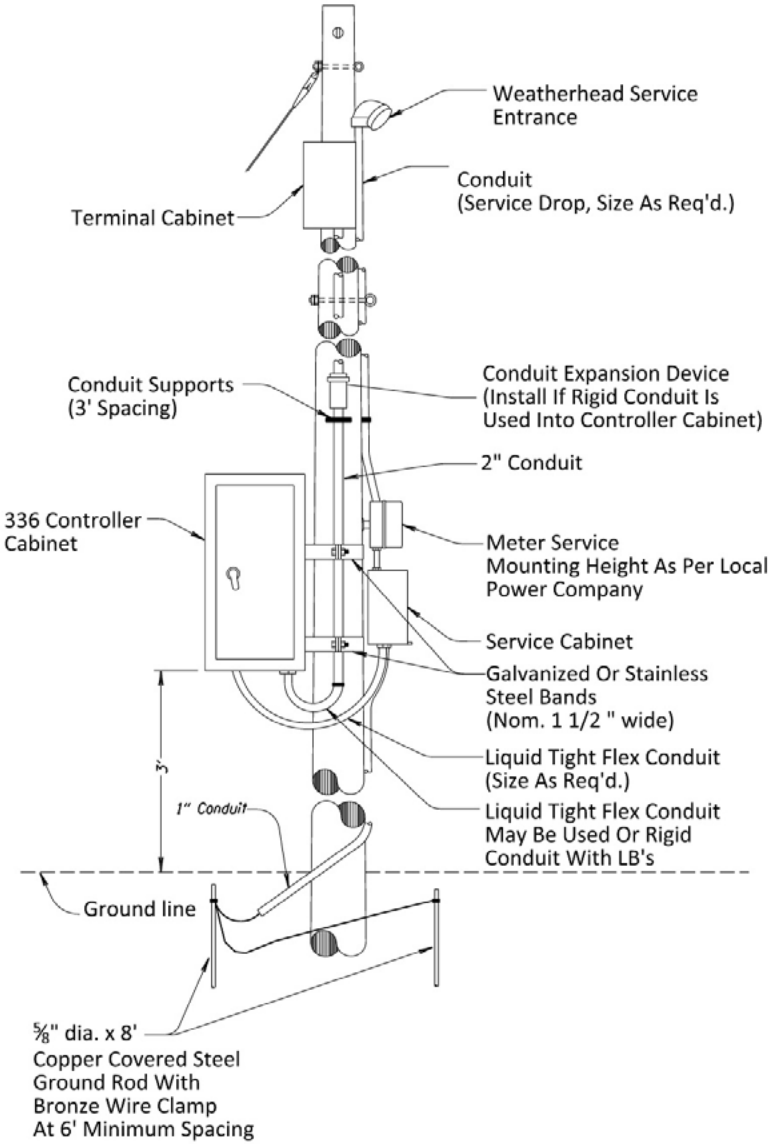
CAUTION-POTENTIAL PROBLEMS

- Intake vent must be screened and cooling fan operational for controller to function properly.
- Maintain access to cabinet when used at a temporary signal installation
- DO NOT locate controller cabinet in path of pedestrians. Locate on side of pole away from traffic. Pole Entrance Chart.
- Supplemental Inspection recommended for layout and conduit, See page 88 for more info.

Typical Sources of Info:

336s

Specs: 00990.70, & 02925.40
Std. Dwg: TM455
Plan Sheets: YES
Blue Sheet/Green Sheet Info: pg. 60 (+ various components listed in the Green Sheets)



CONTROLLER AND SERVICE ON WOOD POLE (TM455)

Field Inspection & Signal Turn-On

PRIOR TO TURN-ON

- Coordinate with Region Traffic, Agency Electricians, TSSU Signal techs, and the Contractor to establish the Field Inspection and Turn-on schedule.
- Supplemental Inspection required by Agency Electricians 00990.70(g) – Field Inspection, See page 88 for more info.
- Ensure the Contractor completes the "punch list" items provided by the Agency Electrician's Field Inspection.

DAY OF TURN-ON

- Contractor is required to be present during the signal turn-on to un-bag signal heads and correct any errors. 00990.70(h).
- Flaggers and associated TP&DT should be on-site and ready. Turning-on a new signal without flaggers may be possible, but turning-on a re-built signal always requires flaggers.
- Region Traffic (or the maintaining agency) provides the signal timing.
- Traffic Signal Services Unit will bring and install all of the components (that have been tested and approved) inside the controller cabinet. 00990.70(f).
- Note the date and time of signal turn-on. After traffic signals are turned on and operating as designed, the agency responsible for maintenance will assume operation and maintenance of the signal (see 00990.70(h)). The Contractor then starts the warranty period for their workmanship on the project (see 00990.75).

CAUTION-POTENTIAL PROBLEMS

- Signal turn-on's on a Friday or the day before a holiday are strongly discouraged.
- Turn-on does not constitute final approval. 00990.70(h).
- **Note the required advance notice timeframes. 00990.70(b), (g) & (h).**
- Ensure that all striping and signing (temporary or permanent) is in place, such as stop bars, crosswalks, lane lines, lane use arrows, "Signal Ahead" and "New Traffic Pattern Ahead" signs, lane use signs, etc. Striping may be installed up to two weeks prior to scheduled signal turn-on date.
- Ensure that any inappropriate/conflicting signing (STOP signs, "stop ahead" signs) or striping is promptly removed or covered up.

Typical Sources of Info:
Specs: 00990.70, & 00990.75
Std. Dwg: NO
Plan Sheets: NO
Blue Sheet/Green Sheet Info: NO

Final Clean-Up & Final Inspection

When the signals on the project have been successfully turned-on and all work (including punch list items) and clean-up has been satisfactorily completed, the project is ready for final inspection (see 00150.90). Supplemental Inspection recommended for final inspection, see page 88 for more info.

As-Constructed Drawings

Once the signal installation has been accepted, as-constructed (red line, not modified CADD) drawings will need to be made by the inspector and sent in with the semi-final records. ANY part of the installation of the traffic signal that differs from the original design needs to be noted so that others will have accurate information as to how it was built. Especially important to note are changes in:

- location of junction boxes
- vehicle signal heads
- conduit runs
- wiring
- pole locations
- Utilities

The changes noted on the drawings need to be detailed/complete enough to accurately amend the original plans. The as-constructed drawings you submit will be reviewed by the EOR and Traffic-Roadway Section. Final mylars will be produced to reflect the construction changes.

Traffic Roadway Section will archive the final mylars on the Filenet website. These mylars are important to Agency Electricians and designers; they rely on the drawings to be accurate for maintenance and future design purposes.

Link to Filenet: http://www.oregon.gov/ODOT/HWY/TS/pages/signals.aspx

Requesting Changes to Standard Drawings, Specifications or this Manual

If an error, omission, or need for clarification is discovered in the standard drawings, specifications or this manual please let us know so we can address the issue in a future update. If you have a great idea, we want to hear it. Feedback from the field is EXTREMELY important for producing and maintaining quality documents.

We review the Project Manager's Narrative & all Contract Change Orders that are uploaded to the Construction Section server on a monthly basis. Please make detailed comments and notes in these documents – we use this information to improve our design standards, construction standards & specifications, and internal ODOT processes related to traffic signals.

We want to hear from you!

To request changes to the Standard Drawings, use the following form:

http://www.odot.state.or.us/ffp/hwy/roadway/request-for-std-dwg-change.htm

To request changes to the Specifications, use the form on the following web site:

http://www.oregon.gov/ODOT/HWY/SPECS/pages/spec_change_request.aspx

To request changes to this Manual, contact the Traffic Signal Engineer:

503-986-3596

Reading Plan Sheets

Standard drafting symbology is used in signal design to represent common equipment, providing valuable information to the user without using any text. As such, the user should become familiar with the standard symbols and line styles.

Bubble notes are used in conjunction with the standard drafting symbology to provide the specific information about the installation. The bubble notes have been designed to be "intelligent", such that an experienced user will be able to read the signal plan sheets without much assistance from the bubble note legend text. For example:

Bubble notes use abbreviations for equipment that can be defined entirely by the bubble note legend text:

C / 2070 — *Install model 2070 controller in model 332 cabinet*

"C" abbreviation for "Controller" and 2070 indicates the model

Bubble notes use abbreviations **AND** variables **(shown in pink)** for equipment that must be further defined by where/how it is used:

SM / T — *Install (T=type) standard traffic signal mast arm pole (See, "Pole Entrance Chart")*

"SM" abbreviation for "Signal Mast arm pole" and "T" is the variable

"Variable always defined in text

Regardless of experience level, it is always advised to read the bubble note legend text at least once because changes in text may occur. For example:

LD / Ph — *Install phase (Ph=phase) 6' round or 4' diamond vehicle detector loop*

VS.

LD / Ph — *Install phase (Ph=phase) 6' round vehicle detector loop*

If there is conflict between symbology and the bubble note, contact the Engineer of Record for clarification.

BASIC DRAFTING SYMBOLOGY

CABINETS

336 controller cabinet (door shows orientation)

332 controller cabinet (door shows orientation)

Base Mounted Service Cabinet (BMC, BMCL, or BMCF)

POLES

Mast Arm Pole (15' to 55')

Steel Signal pole shaft (no foundation)

Steel Signal pole w/foundation

Wood pole

Pedestrian or vehicle pedestal w/foundation

Existing or proposed power supply pole

Pole Anchor

LUMINAIRES

Luminaire head

SIGNALS

Vehicle signal head (new)

Vehicle signal head (exiting)

Pedestrian signal head (new)

Pedestrian signal head (existing)

FIRE PREEMPTION

Fire preemption head (single channel, one or two barrels)

Fire preemption head (two channels, two barrels)

SIGNS

Aluminum sign (mast arm or signal pole mounted)

Interior illuminated sign (mast arm or signal pole mounted)

BASIC DRAFTING SYMBOLOGY

JUNCTION BOXES

Junction Box, Type JB/1, JB/2 and JB/3

Junction Box, Type JB1/A, JB2/A and JB3/A

DETECTION

6' round vehicle detector loop

6' diamond vehicle detector loop

2½' diamond bicycle detector loop

6' diamond pre-formed vehicle detector loop

Entrance for loop wires into junction box (Loop pocket)

Radar Detector

Video Detection Camera (new)

Video Detection Camera (existing)

MISCELLANEOUS

Crosswalk closure barricade

CONDUITS

Conduit (new)

Conduit (existing)

WIRES & CABLES

Loop Wire

Span Wire

READING PLAN SHEETS
(Pole & Signal Indications)

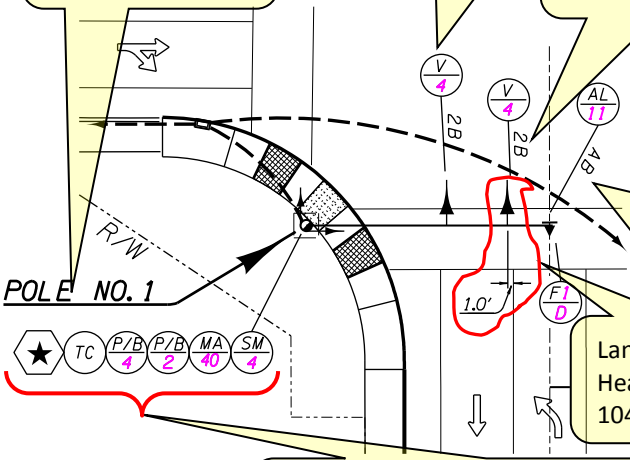
Poles are labeled consecutively for entire project

Install phase **4** vehicle signal

Signal head type (2) & mount type (B) info on leader-line

Sign mount type (AB) info on leader-line

Lane Dimension Head - See pg. 104



On this Type **4** signal pole: A **40'** mast arm, two pedestrian indications, two push buttons, one terminal cabinet, and one sign.

L E G E N D

- SM/T — Install (T=type) standard traffic signal mast arm pole (See. "Pole Entrance Chart")
- MA/L — Install (L=length) foot traffic signal mast arm
- TC — Install terminal cabinet
- V/Ph — Install phase (Ph=phase) vehicle signal
- P/B/Ph — Install phase (Ph=phase) pedestrian signal with clamshell mount and pushbutton with 'H' mount
- FN/Ch — Install channel (Ch=channel), (N=number) barrel fire preemption detector unit
- AL/11 — Install aluminum (30"x36", type "W7 mod") "LEFT TURN YIELD ON GREEN BALL" sign (R10-12)
- ★ — See signing plans for details on sign and attachment

F1/D

Replace variables in text when reading: "Install channel **(D)**, **(1)** barrel fire preemption

Detailed on other plan sheet: not paid under traffic signal bid

SIGNAL MOUNTING OPTIONS
B = Adjustable signal bracket assembly w/rain cap(s)
(Install 1" galvanized chase nipple)

SIGN MOUNTING OPTIONS
AB = Adjustable sign bracket assembly w/rain cap(s)

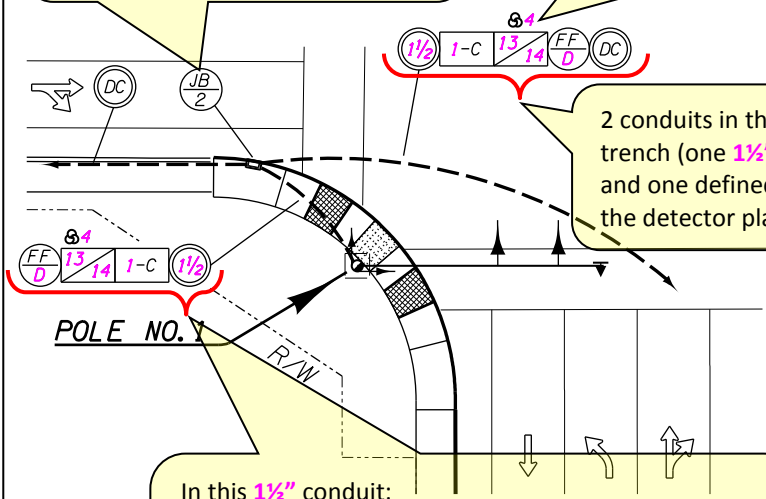
SIGNAL HEAD TYPES
2 = 12" R, 12" Y, 12" G

READING PLAN SHEETS
(Conduit & Wiring)

4 conduits enter this junction box:

- Two conduits defined on detector plan, and
- Two **1 ½"** conduit

3 spare wires for phase **4** are inclusive to the number of wires listed below (**13** No. **14** AWG)



2 conduits in this trench (one **1½"** and one defined on the detector plan)

In this **1½"** conduit:

- **1** No. 8 AWG THWN wire (common)
- **13** No. **14** AWG THWN wires (3 spare wires for phase **4** are inclusive to this wire count)
- one fire preemption detector feeder cable

L E G E N D

JB 2	Install 22"x12"x12" (min. dimension) precast concrete junction box
S	Install (S=size) inch conduit
DC	Detector conduit (See Detector Plan)
N-C	Install (N=number) No. 8 AWG THWN (Signal system common)
N/G	Install (N=number) No. (G=AWG wire size) THWN wires
FF Ch	Install channel (Ch=channel) fire preemption detector feeder cable

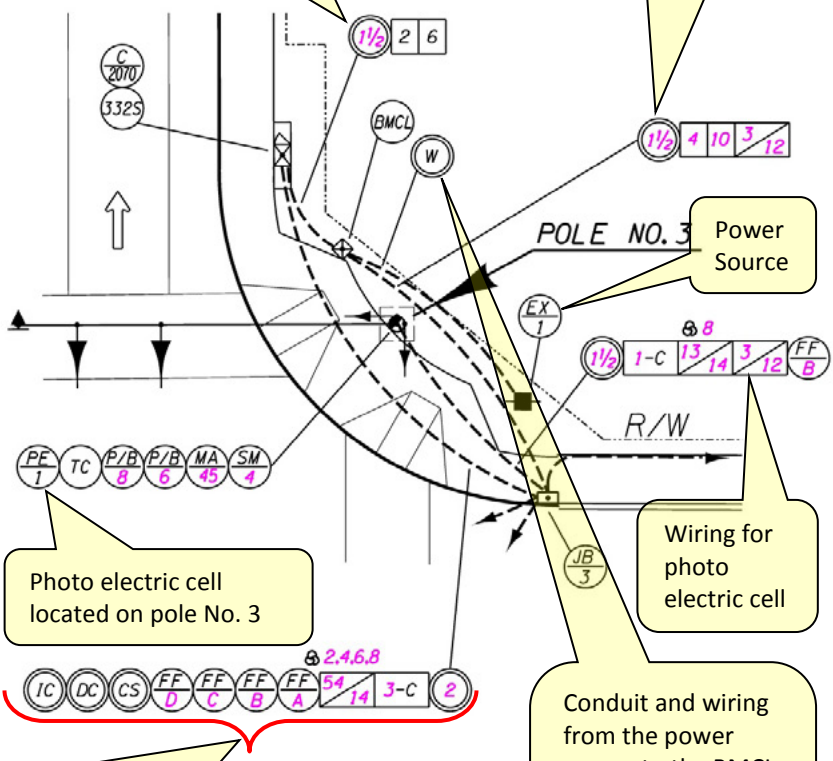
Ph Includes 3 spare wires for phase (Ph=phase) as per table

READING PLAN SHEETS
(Cabinets & Controllers)

In this 1½" conduit: 2 No. 6 AWG XHHW wires.
Typical wiring between the BMCL & controller cabinet.
(Bonding wire also required by specifications – not shown on plans)

In this 1½" conduit:
- 4 No. 10 AWG XHHW wires (for illumination fixtures)
- 3 No. 12 AWG THHN wires (for photo electric cell)

Illumination wiring ALWAYS bypasses the controller cabinet



Power Source

Photo electric cell located on pole No. 3

Wiring for photo electric cell

There are 4 conduits in this trench. three conduits carry all the wiring going directly into the controller cabinet. One conduit is for future use (CS).

Conduit and wiring from the power source to the BMCL is always according to the requirements of the power company (permit)

READING PLAN SHEETS
(Cabinets & Controllers)

Door orientation is shown on the plan sheet by the controller cabinet symbology

L E G E N D

332S	Install a model 332S cabinet & control equipment with riser frame, orient louvered door as shown
C / 2070	Install model 2070 controller in model 332S cabinet
BMCL	Install base mounted service cabinet, 120/240 volt metered, for signal and signal pole mounted illumination systems
EX / 1	Retain and protect existing power pole (Power source)
SM / T	Install (T=type) standard traffic signal mast arm pole (See, "Pole Entrance Chart")
MA / L	Install (L=length) foot traffic signal mast arm
P/B / Ph	Install phase (Ph=phase) pedestrian signal with clamshell mount and pushbutton with 'H' mount
TC	Install terminal cabinet
PE / 1	Install photo electronic control relay on pole, as per Std. Dwg. No. TM465
JB / 3	Install 30"x17"x12" (min. dimension) precast concrete junction box
S	Install (S=size) inch conduit
CS	Install 2" conduit stub (For future use, cap ends)
W	Install conduit and wire as required by power company
DC	Detector conduit (See Detector Plan)
IC	Interconnect conduit (See Interconnect Plan)
N-C	Install (N=number) No. 8 AWG THWN (Signal system common)
N / G	Install (N=number) No. (G=AWG wire size) THWN wires
N | G	Install (N=number) No. (G=AWG wire size) XHHW wires
FF / Ch	Install channel (Ch=channel) fire preemption detector feeder cable

Ph Includes 3 spare wires for phase (Ph=phase) as per table

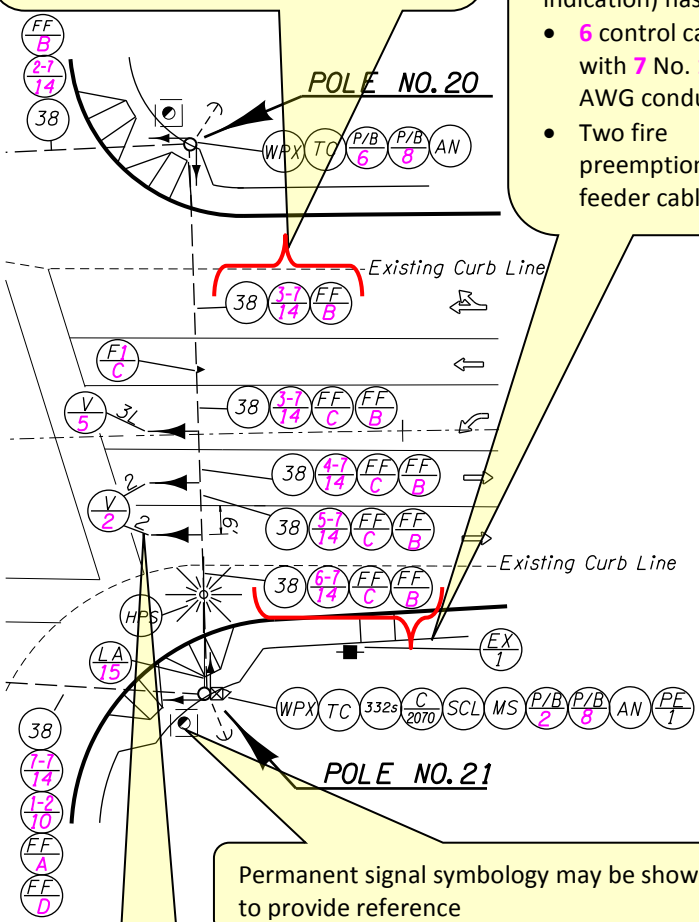
READING PLAN SHEETS
(Temporary Signal & Span Wire)

This portion of span wire (between the pole and the Fire Preemption unit) has:

- **3** control cables with **7** No. **14** AWG conductors
- one fire preemption feeder cable

This portion of span wire (between the pole and the signal indication) has:

- **6** control cables with **7** No. **14** AWG conductors
- Two fire preemption feeder cables



Permanent signal symbology may be shown to provide reference

The signal head type (2) is located on the leader-line.

Any changes to temporary lane use may require modification to the signal indications or phasing. ALWAYS contact EOR for options.

READING PLAN SHEETS
(Temporary Signal & Span Wire)

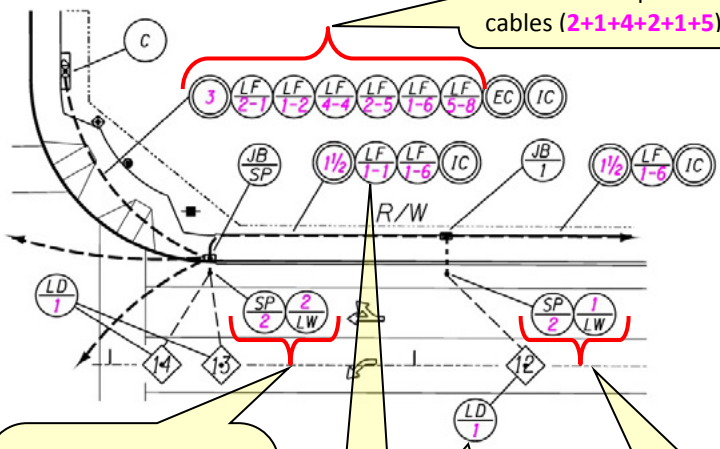
L E G E N D

336s	Install a model 336s pole mounted cabinet & control equipment
C / 2070	Install model 2070 controller in model 336s cabinet
EX / 1	Retain and protect existing power pole (Power source)
WPX	Install special (X=non-standard) treated wood pole (See, "Pole Entrance Chart")
AN	Install back guy and anchor(s)
LA / L	Install (L=length) foot luminaire arm
TC	Install terminal cabinet
SCL	Install service cabinet, 120/240 volt, for both signal and illumination circuits
MS	Install 120/240 volt meter base
V / Ph	Install phase (Ph=phase) vehicle signal
P/B / Ph	Install phase (Ph=phase) pedestrian signal with clamshell mount and pushbutton with 'H' mount
PE / 1	Install photo electronic control relay on pole, as per Std. Dwg. No. TM465
HPS	Install 250 watt high pressure sodium luminaire, type M-S-III, 120/240 dual voltage mag-regulator ballast. Bond luminaire to pole grounding terminal with No. 10 AWG THWN wire
38	Install galv. steel 3/8" messenger and 1/4" tether cables
X-N / G	Install (X=number of cables) control cable(s) with (N=number) (G= AWG wire size) AWG conductors
FF / Ch	Install channel (Ch=channel) fire preemption detector feeder cable
FN / Ch	Install channel (Ch=channel), (N=number) barrel fire preemption detector unit

Wood poles are non-standard. They are designed by the contractor and submitted to ODOT for review and approval.

READING PLAN SHEETS
(Loop Detection)

In the **3"** conduit there is a total of 15 loop feeder cables (**2+1+4+2+1+5**)



2 pairs of loop wires (one from loop no. 13 & one from loop No. 14) are entering the **2"** sand pocket block out.

Loop No. 12 for phase **1**

1 loop feeder cable for phase **1** (for loop no. 12)

1 pair of loop wires (from loop no. 12) is entering the **2"** sand pocket

L E G E N D

- C — Install Controller cabinet (See Signal Plan)
- JB/SP — Junction box (See Signal Plan)
- SP/S — Install 6" max. sand pocket block-out with (S=size) inch conduit to junction box
- S — Install (S=size) inch conduit
- EC — Electrical conduit (See Signal Plan)
- IC — Interconnect conduit (See Interconnect Plan)
- LF/X-Ph — Install (X=number of cables) phase (Ph=phase) loop feeder cables
- N/LW — Install (N=number) pair of loop wires
- LD/Ph — Install phase (Ph=phase) 6' round vehicle detector loop

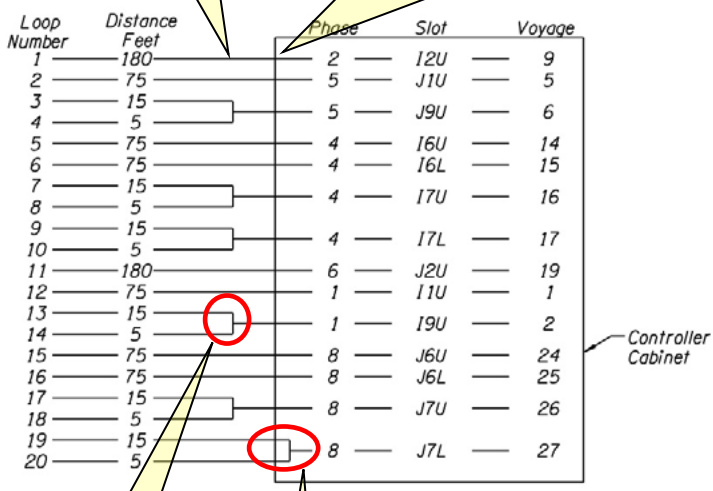
LF 2-1

Replace variables in text when reading: "Install **(2)** phase **(1)** loop feeder cables"

READING PLAN SHEETS
(Loop Detection)

Lines represent loop feeder cable

Total of 15 Loop feeder cables entering the controller cabinet (Count the number of lines crossing into the controller cabinet). For example there are 2 loop feeder cables for phase 5.



LOOP DETECTOR WIRING DIAGRAM

"Distance" is from Stop Line to center of loop in feet

Loops are wired in series. (Splice inside the junction box)

Loops are wired in series. (Splice inside the controller cabinet)

1

10 foot rule · 94

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