Oregon Department of Transportation

Inspector's Manual For Signal Construction

Traffic Engineering Section | Delivery & Operations Division

2025

The material contained in this manual 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.

NOTE: This is manual is updated every year in February

The most current version is available online, but hardcopies can always be purchased (see website links & QR scan codes provided starting on pg. 227).

Contents

Certified Traffic Signal Inspector

ODOT certified traffic signal inspector (CTSI) and re-certification training is part of the ODOT Inspector Certification Program*. This program provides training, resources, and certification for inspectors to ensure consistency and compliance with contract documents on ODOT construction projects.

All traffic signal and electrical construction on the state highway requires inspection by personnel certified as a CTSI. This includes:

- Construction inspectors working under the Engineer (00150.02)
- Traffic system services unit (TSSU)
- Agency electricians

The CTSI are in addition to and do not eliminate the need for electrical inspection required via the electrical permit issued by the permitting agency.

Other personnel involved in traffic signal construction such as region traffic, quality compliance control specialists (QCCS), contractors, etc. are not required to be a CTSI. However, certification is recommended to stay current and knowledgeable of construction processes and traffic signal standards.

Exam

The certification exam is taken online and contains 50 multiple choice questions, 2 points each. A score of at least 80% is required to pass.

Certification

If you pass, your certification and CTSI number is e-mailed to you within two weeks of passing the exam. Certification is valid for 3 years. If you do not pass, challenge exams are available.

Other Certifications/Training Needed to Inspect Traffic Signals

Certain parts of the traffic signal installation require other certifications or training in addition to the CTSI. Typically, different personnel holding these certifications will assist the CTSI as needed on the project:

- Quality control technician (QCT) and concrete strength testing technician (CSTT) certification to inspect furnishing, placing and finishing of commercial grade concrete (00440.30) for traffic signal pole, pedestal and cabinet foundations (00963.10 & 00960.43).
- Drilled shaft foundation inspector certification is not required but may be helpful when inspecting signal support drilled shafts (00963).
- Certified ADA inspector to inspect ramps and pushbuttons.
- Bucket truck/fall protection training to inspect the mast arm DTI installation.

* Website links & QR scan codes provided starting on Pg. 227

Materials: General

Blue, Green and Red Sheets

- The blue sheets* are described in detail, starting on page 5
- The green sheets* are described in detail, starting on page 67
- The red sheets* are described in detail, on page 3

Pre-qualified materials (QPL)

There are several items used for traffic signal installations that are specified from the standard qualified products list (QPL)*. Follow the procedure in the ODOT Construction Manual for approval of QPL items:

- Backer rod material (used in loop detector sawcut): 00990.10
- Hot-melt loop sealant: 00990.10
- Crosswalk closure support (i.e., Mailbox supports): 00902 & 01070
- Portable temporary traffic signal: 00227.13
- Qualified manufacturers for reinforcing steel (for pole and pedestal foundations): 00960.10, 00963.10, & 02510

Pole & Luminaire Submittals

The following materials require submittals:

- Mast arm poles & arms (drawings/calculations): 00962.02 & 00150.35
- Luminaire extensions & arms (drawings): 00962.02 & 00150.35
- Luminaires and lamps (sample and cut sheets): 00970.02 & 00970.03
- Wood poles (drawings and calculations): 00227.12

Pole shop drawings must be stamped by a professional engineer. Prequalified manufacturing shop drawings must be reviewed and accepted by the ODOT traffic structures engineer or engineer of record (EOR) prior to use on the project.

Non Field-Tested Materials Acceptance Guide

The Non Field-Tested Materials Acceptance Guide* contains information on the required acceptance documentation for non-field tested materials in accordance with the specifications. See 00165.10(b) for more information.

Intelligent Transportation Systems (ITS) Equipment

Upon request, the ITS unit will provide project specific information and training at the pre-construction meeting (highly recommended). Contact the ITS unit.

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.

* Website links & QR scan codes provided starting on Pg. 227

Red Sheet Materials

Pursuant to ORS 479.540 and OAR 918-261-0037 a list (known as the red sheets*) for all traffic management system components used by ODOT and other applicable public agencies that are exempt from UL or NRTL certification requirements was created. The red sheets just grant exemption from certification and are NOT used for construction qualification or approval of products during construction (00160.00(e)).

The electrical permitting agency's inspector (from the building codes division, city or county) needs to be aware of the red sheets to properly perform their electrical inspection, and typically they are. However, if there are any questions or issues about a lack of UL or NRTL certification for traffic signal equipment used on the project, refer to the red sheets.

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(1)
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

(1) Agency Code:
ODOT = Oregon Department of Transportation
COP = City of Portland

* Website links & QR scan codes provided starting on Pg.227

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Blue Sheet Materials

Prequalified products and submittals for qualification of electrical equipment and materials are known as the blue sheets (00160.00(c)). The contractor must electronically submit the blue sheets **within 30 calendar days after execution of the contract** (00960.02). Note: Documenting submittals and approvals in DocExpress removes the functionality of a "smart PDF". The blue sheets "smart PDF" must be attached as a supporting document at each documented milestone to remain usable throughout construction. Follow the instructions in DocExpress.

The current version of the blue sheets* is posted online and may be updated at any time. Always verify and use the most current version (00160.07).

The CTSI is responsible for:

- Reviewing the contractor's submittal and submitting any write-in materials to the state traffic signal engineer for approval prior to starting work.
- Obtaining the certificate of materials origin (CMO) or construction material certificate of material origin (CCMO) if required. The blue sheets will contain a "CMO/CCMO Required" box for all applicable materials. Note: The region assurance specialist will confirm this documentation.
- Inspecting and accepting all materials that are incorporated into the project. This is documented on the blue sheet's "CTSI Inspected & Accepted" box for each material.

Materials arriving at the project site should be accompanied by proper certifications. See the Non Field-Tested Materials Acceptance Guide* for requirements. No materials shall be installed until certifications are received and checked for compliance by the CTSI. Field verify that materials to be installed on the project are per plan/specification and match approved items listed in the blue sheets.

Cut Sheets for 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 cut sheet as required by the Blue Sheet Qualifications/Specification Information*. The cut sheet shall identify the specific product to be used; manufacturer's name, identifying info, and how the product meets the Blue Sheet Qualifications/Specification Information requirements. Note: Submit cut sheets as a separate PDF. Do not combine with the blue sheets "smart PDF" as it will remove the functionality of the "smart PDF". **E-mail all write-in materials and cut sheets to the STATE TRAFFIC SIGNAL ENGINEER (NOT the engineer of record) for initial approval of the material.**

Always read and follow the instructions included in the blue sheets

* Website links & QR scan codes provided starting on Pg.227

Lists all materials that are pre-approved and instructions for use

The contractor will check the box if the material is on the project. This will open a new page to allow inspection of material. See Pgs. 8 & 9 for example.

Items Used on Project

Initial Submittal

The Contractor will:

1.) Check off all approved items to be used on the contract ON THIS SHEET ONLY. ***Do NOT check off any products on the specific material page (this will be done by the CTSI Inspector during Construction)***
2.) If proposing any write-in items, check off the box under "Write-in items" and follow the instructions on the "write-in items" page.
3.) Electronically submit this form prior to starting work.

The CTSI Inspector will:

1.) Verify all items checked off ON THIS SHEET ONLY will be used on the contract. Work with contractor to correct any errors/omissions prior to starting work according to Specification 00960.02.
2.) If "write-in items" is checked, follow instructions on the "write-in items" page for initial approval from the State Traffic Signal Engineer.
3.) When this sheet only is verified as correct and write-in item initial approval is received (if applicable), notify the contractor the submittal is "approved".

Construction

The Contractor will:

1.) Install approved items and ***approved*** write-in items only.
2.) Required CMOs and/or CCMOs will be submitted prior to materials being installed.

The CTSI Inspector will:

1.) Verify and document installed materials match approved material(s) and are installed per plan and specification. ***Check off box for each product installed. Check off box and date received for CMOs and/or CCMOs (This field will only be visible for applicable items).***
2.) Document inspection/installation details as necessary on each specific materials page.
3.) When each specific material has been entirely inspected and accepted on the project, fill out the "CTSI Inspected & Accepted" info on the specific materials page.

TEMPORARY FEATURES
- ☐ Temporary Covers
- ☐ Temporary Meter Base Socket
- ☐ Temporary Service Cabinet
- ☐ Temporary Terminal Cabinet
- ☐ Temporary Pre-cast 332s Foundation

TEMPORARY SPAN WIRE EQUIPMENT
- ☐ Cable Ties
- ☐ Messenger, Tether, & Stabilizer Cable
- ☐ Eyebolt, Turnbuckle, Strandvise, S-Hook
- ☐ Span Wire Hanger
- ☐ Tether Clamps
- ☐ Tri-Stud Adapter

POLES AND PEDESTALS
- ☐ Chase Nipple
- ☐ Pipe Plugs
- ☐ Pedestal

CONDUIT & APPURTENANCES
- ☐ Conduit
- ☒ Conduit Bushings
- ☐ Conduit Plug
- ☐ Conduiet
- ☐ Conduit Hub
- ☐ Expansion Fitting
- ☐ Pull Line
- ☐ Underground Warning Tape

JUNCTION BOX
- ☐ Junction Boxes

CABLES, WIRES, GROUNDING/BONDING & APPURTENANCES
- ☐ Bond Wire
- ☐ Ground Rod & Clamp
- ☐ Control Cable
- ☐ Industrial Ethernet Cable
- ☐ Interconnect Cable
- ☐ TFFN, THWN & XHHW wire
- ☐ Strain Relief

MISC. MOUNTINGS
- ☐ Radio Mount
- ☐ Video Detection Mount

PEDESTRIAN EQUIPMENT
- ☐ Pedestrian Signal & Mount
- ☐ LED Module (Pedestrian Signal)
- ☐ Pushbutton & Mount

VEHICLE SIGNAL EQUIPMENT
- ☐ Vehicle Signal (housing, backboard, & visor)
- ☐ LED Module (Vehicle Signal)
- ☐ Vehicle Signal Bracket
- ☐ Louver
- ☐ Tattle-Tale Light

LOOP DETECTION
- ☐ Loop Feeder Cable
- ☐ Loop Wire
- ☐ Loop Splice

ILLUMINATION
- ☐ In-Line Fuse Holder
- ☐ TC Cable
- ☐ Photoelectric Cell

CABINETS & APPURTENANCES (SERVICE, TERMINAL, ETC.)
- ☐ Riser Frame
- ☐ Base Mounted Service Cabinet
- ☐ Terminal Blocks

SIGNS
- ☐ PTR Sign
- ☐ Sign Bracket

WRITE-IN ITEMS (Includes ITS items)
- ☐ See last page for information

If there are any write-in items, the contractor will check this box. See next page for example.

Blue Sheets
Revised Nov. 16, 2023

Page 2 of 3

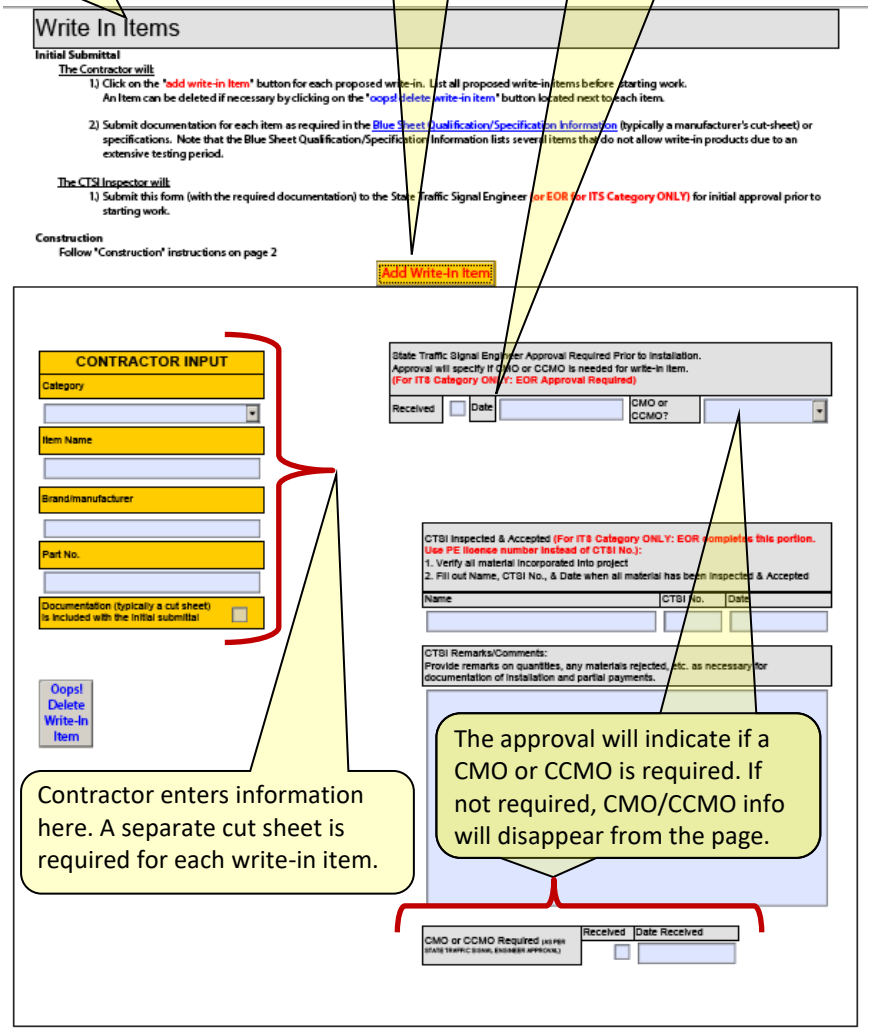
Contract No:

Always check the revision date - use the most current version

All write-in materials will be entered under this section

Click this button to create a new material page for **each** write-in item

State traffic signal engineer approval (via e-mail) is always required PRIOR TO INSTALLATION for all write-ins

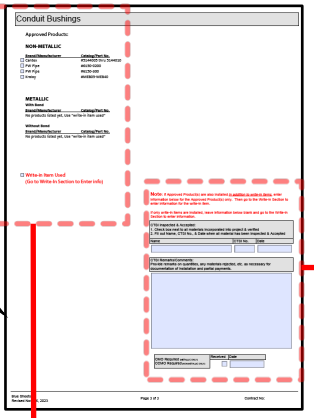


Contractor enters information here. A separate cut sheet is required for each write-in item.

The approval will indicate if a CMO or CCMO is required. If not required, CMO/CCMO info will disappear from the page.

Blue Sheet Example

MATERIAL SPECIFIC PAGE



Material specific page example

Next page

Each material is listed in the title

Conduit Bushings

Approved Products:

NON-METALLIC

Brand/Manufacturer	Catalog/Part No.
☐ Cantex	#5144005 thru 5144010
☐ PW Pipe	#6150-0200
☐ PW Pipe	#6150-300
☐ Kraloy	#MEB05-MEB40

METALLIC

With Bond

Brand/Manufacturer	Catalog/Part No.
No products listed yet, Use "write-in item used"	

Without Bond

Brand/Manufacturer	Catalog/Part No.
No products listed yet, Use "write-in item used"	

☐ Write-in Item Used
(Go to Write-In Section to Enter info)

All approved materials are listed here.

This material has 2 main categories:

- Non-metallic
- Metallic

With 2 sub-categories for metallic:

- With bond
- Without bond

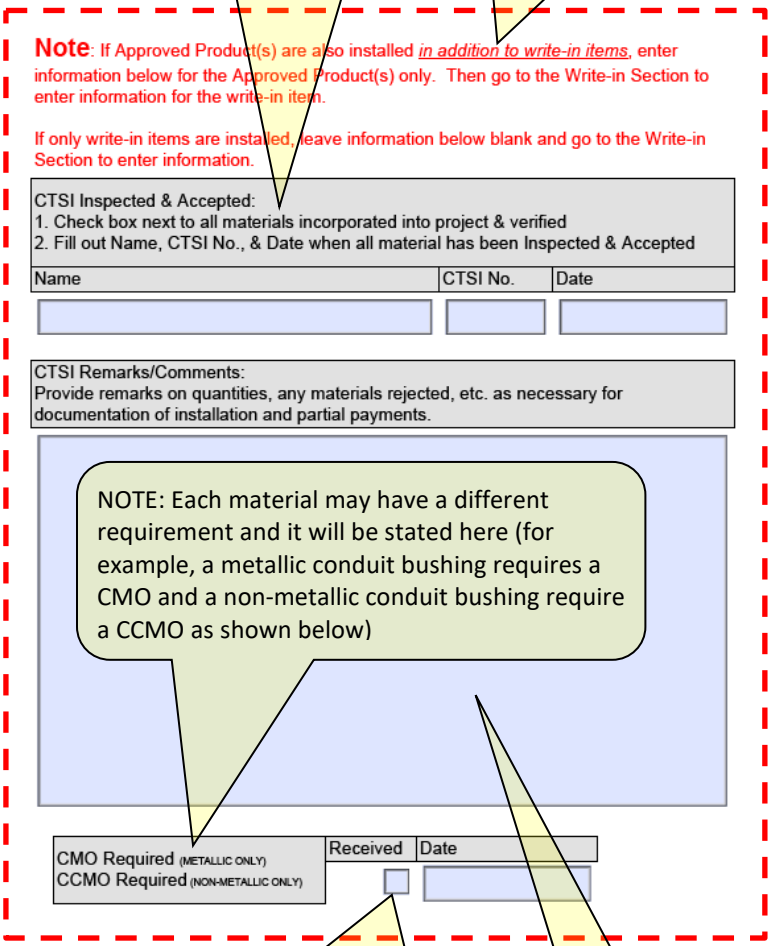
Not all materials will have main and sub-categories.

The CTSI **(NOT THE CONTRACTOR)** will check boxes for each product verified, inspected & accepted on the project during construction.

If a write-in item for this material is installed, the CTSI will check this box and fill out the “inspected & accepted” box in the write-in section.

CTSI to complete the "CTSI Inspected & Accepted" box when material has been installed for the entire project.

Follow RED instructions if write-in items were installed.



Note: If Approved Product(s) are also installed *in addition to write-in items*, enter information below for the Approved Product(s) only. Then go to the Write-in Section to enter information for the write-in item.

If only write-in items are installed, leave information below blank and go to the Write-in Section to enter information.

CTSI Inspected & Accepted:
1. Check box next to all materials incorporated into project & verified
2. Fill out Name, CTSI No., & Date when all material has been Inspected & Accepted

Name	CTSI No.	Date

CTSI Remarks/Comments:
Provide remarks on quantities, any materials rejected, etc. as necessary for documentation of installation and partial payments.

NOTE: Each material may have a different requirement and it will be stated here (for example, a metallic conduit bushing requires a CMO and a non-metallic conduit bushing require a CCMO as shown below)

	Received	Date
CMO Required (METALLIC ONLY) CCMO Required (NON-METALLIC ONLY)		

If CMO or CCMO is required for a material, this check box will appear on the page. The CTSI will check the "Received" box and date when CMO or CCMO form is received from contractor.

CTSI to use this area as needed to make remarks or comments about the installation.

Temporary Covers

DESCRIPTION

Yellow prefabricated nylon bag. Word Includes a fine mesh insert for testing pedestrian and vehicle signals. Integral elastic bands and clips to secure the covers.

USE

To cover vehicle and pedestrian signal heads until the signal is turned on and to cover pushbuttons that are inactive.

Cover for vehicle signals

Cover for pushbuttons

Cover for pedestrian signals

Typical Sources of Info:
Specs: 00990.50 & 00990.51
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: Pgs. 174, 178, & 180

Bubble Note(s) See pg. 213:

Not Applicable

Temporary Meter Base Socket

DESCRIPTION

Socket into which the power company's meter will be installed. Stainless steel or powder coated base. Will include a meter socket jumper cover (factory installed) if the plans specify flat rate billing.

USE

For power companies to meter power at temporary signals only. Mounted on a temporary wood signal pole, connected between the power source and service cabinet. Note: For permanent installations, the meter base is inclusive to the "Base Mounted Service Cabinet" (see Pg. 62 for more info).

Typical Sources of Info:
Specs: 00960.46 & 00960.60
Std. Dwg: TM454 & TM485
Plan Sheets: YES
Additional Installation Info: Pg. 166

Bubble Note(s) See pg. 213:

MS FR

Temporary Service Cabinet

DESCRIPTION

Stand-alone cabinet. Includes circuit breakers, contactors, test switches, neutral and ground bars. Stainless, powder coated aluminum, or galvanized steel cabinet.

USE

To provide fused electrical service for temporary signals only. Mounted on a temporary wood signal pole. Note: For permanent installations, the "Base Mounted Service Cabinet" is used (see Pg. 62 for more info).

Stand-alone service cabinet types (Housing stays the same, circuity inside changes as per TM485):

- **SC: Signal Only**
- **SCL: Signal & Illumination**

Typical Sources of Info:

Specs: 00960.45(d), 00960.46 & 00960.60
Std. Dwg: TM454 & TM485
Plan Sheets: YES
Additional Installation Info: Pg. 166

Bubble Note(s) See pg. 213:

SC SCL

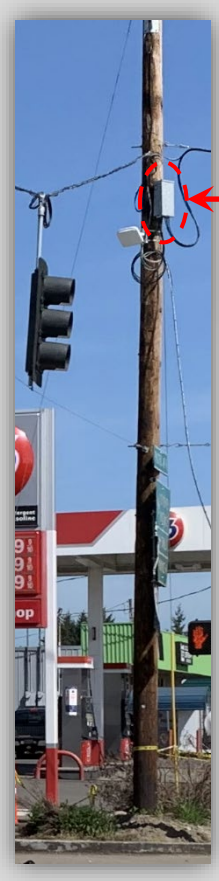
Temporary Terminal Cabinet (External)

DESCRIPTION

Constructed of 1/8 inch stainless, galvanized steel, or powder coated aluminum. Weatherproof fittings at the bottom for span wire installations.

USE

To house terminal blocks on poles for all signal circuits. Externally mounted on temporary wood poles. Note: For permanent installations a recessed terminal cabinet (RTC) is standard for new steel poles, which is part of the signal pole fabrication and not a blue sheet item.



External terminal cabinet

Recessed terminal cabinet is part of the pole shop drawing, not a blue sheet item

RTC

Typical Sources of Info:

Specs: NO
Std. Dwg: TM454
Plan Sheets: YES
Additional Installation Info: Pg. 126

Bubble Note(s) See pg. 213:

TC

Temporary Pre-Cast 332S Foundation

DESCRIPTION

Polymer pre-cast foundation.

USE

To provide a foundation for 332S controller cabinet for temporary installations.

Typical Sources of Info:

Specs: NO
Std. Dwg: TM454
Plan Sheets: YES
Additional Installation Info: Pg. 122

Bubble Note(s) See pg. 213:

TB

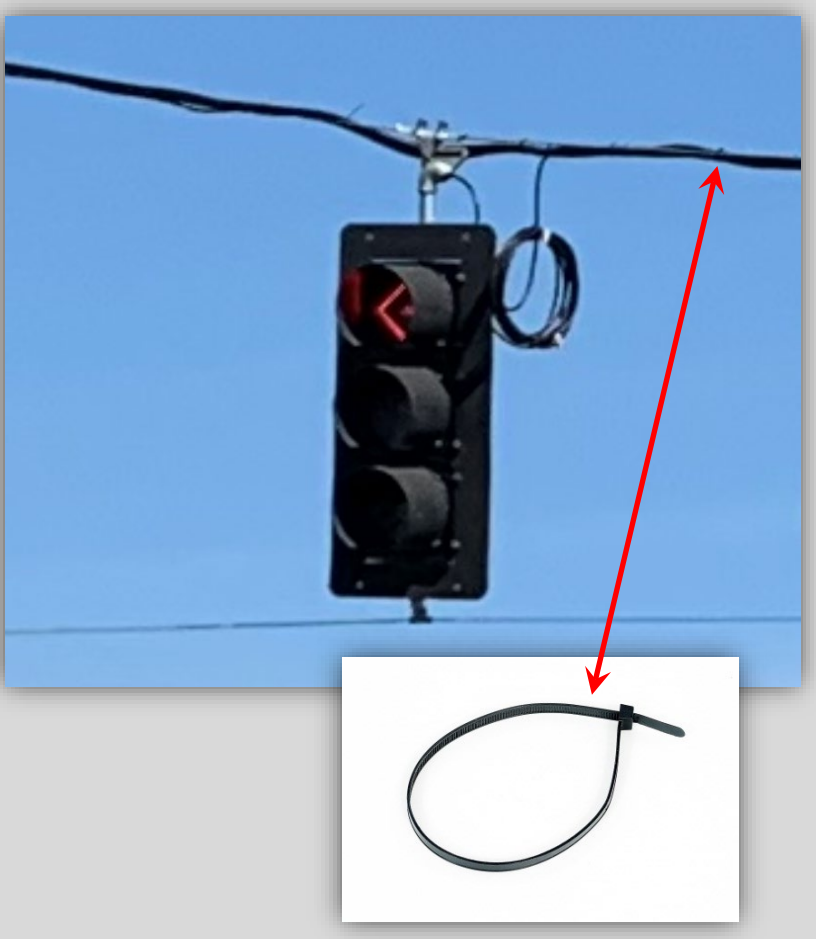
Cable Ties

DESCRIPTION

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

USE

To strap control cable/wire to messenger cable on spanwire installations. Installed at 6 inch spacing.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM452
Plan Sheets: NO
Additional Installation Info: Pg. 172

Bubble Note(s) See pg. 213:

Not Applicable

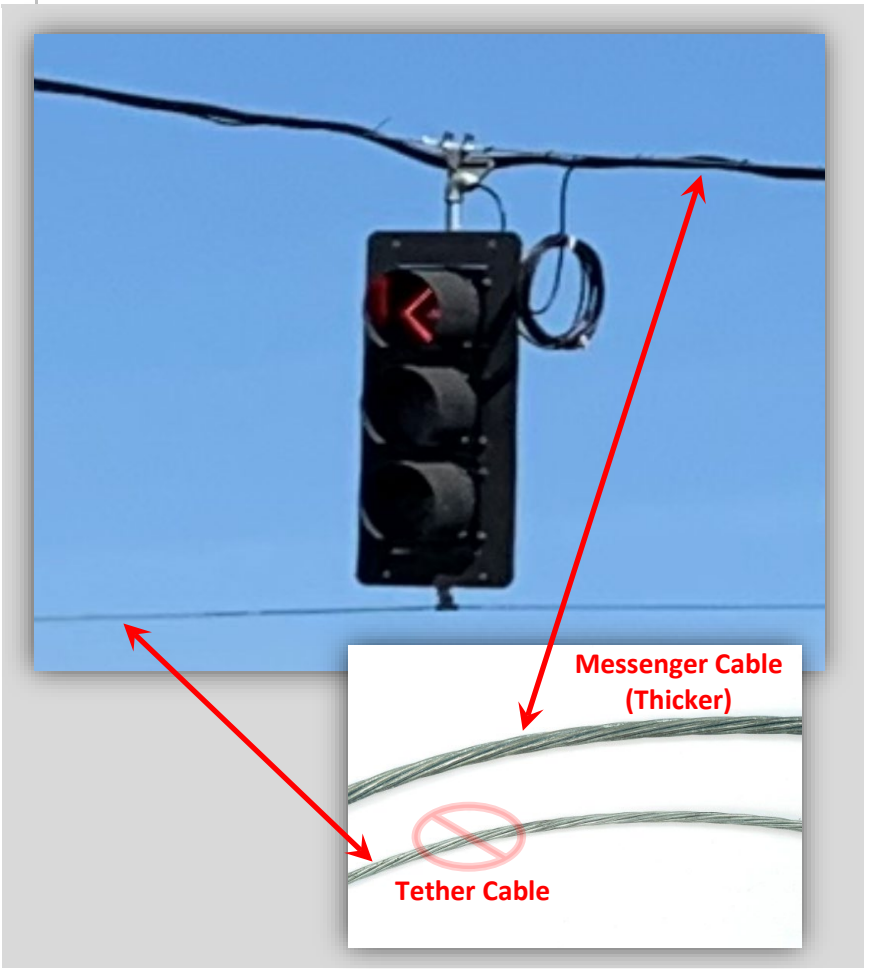
Messenger Cable

DESCRIPTION

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

USE

To structurally support control cables, signal heads and signs on a spanwire installation.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM452
Plan Sheets: YES
Additional Installation Info: Pg. 128

Bubble Note(s) See pg. 213:

38 39 42

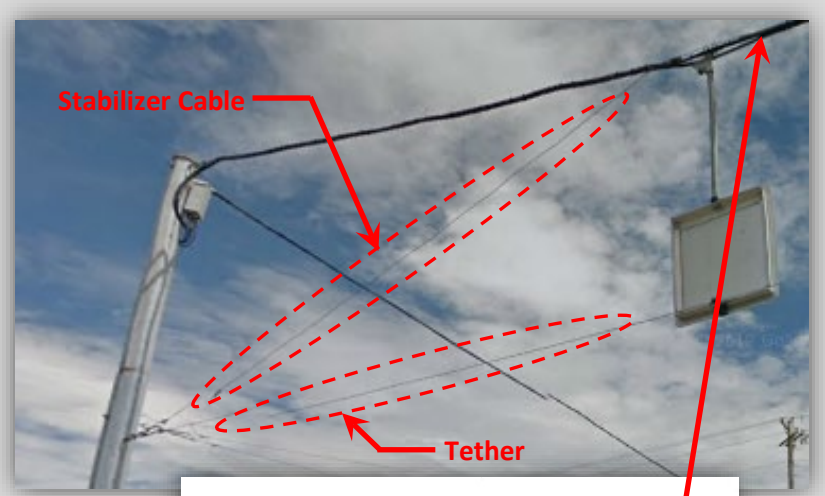
Tether & Stabilizer Cable

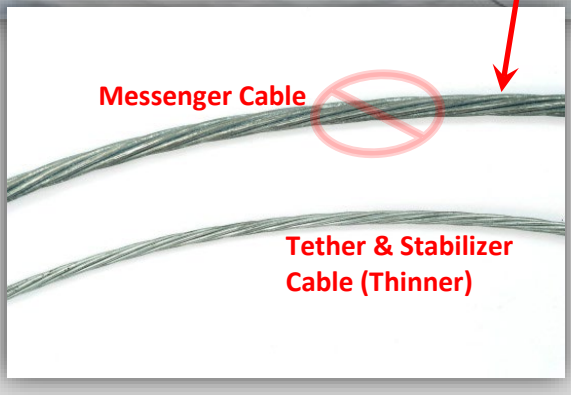
DESCRIPTION

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

USE

To stabilize and prevent wind movement of equipment mounted on a messenger cable. Also used as a messenger cable for applications that do not require the standard messenger cable size (e.g., to only hold cables between a large wood pole and a small wood pedestrian post).





Typical Sources of Info:

Specs: NO
Std. Dwg: TM452
Plan Sheets: YES
Additional Installation Info: Pg. 130

Bubble Note(s) See pg. 213:

38 41

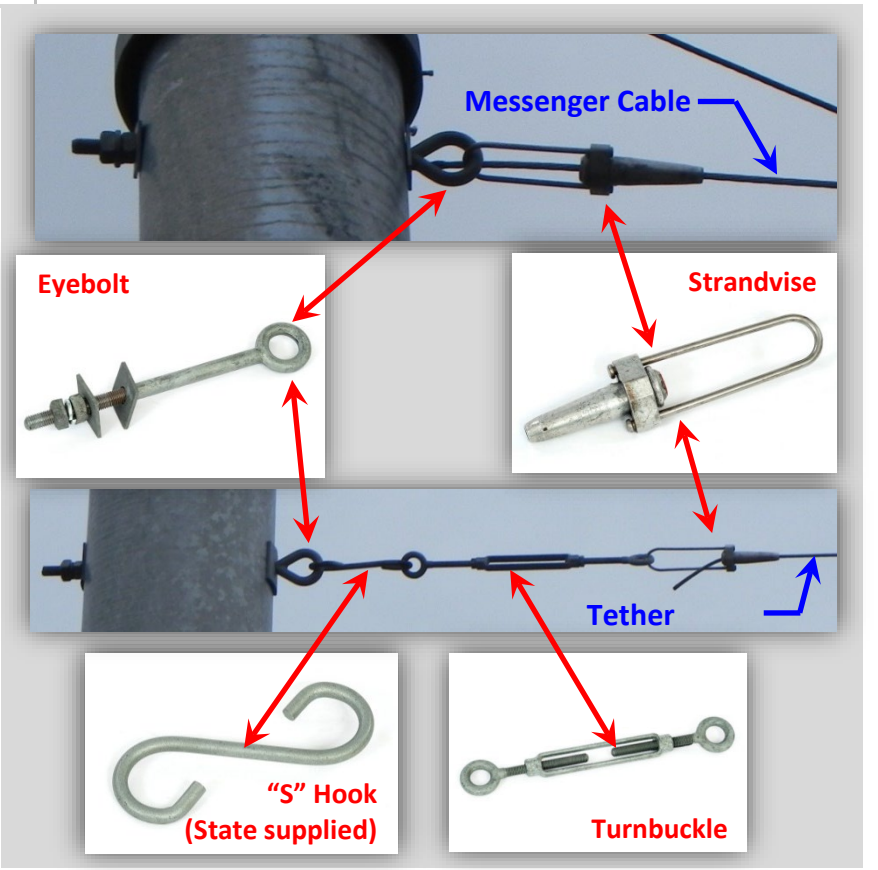
Eyebolt, Turnbuckle, Strandvise

DESCRIPTION

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

USE

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



Typical Sources of Info:

Specs: NO
Std. Dwg: TM452
Plan Sheets: NO
Additional Installation Info: Pgs. 128 & 130

Bubble Note(s) See pg. 213:

Not Applicable

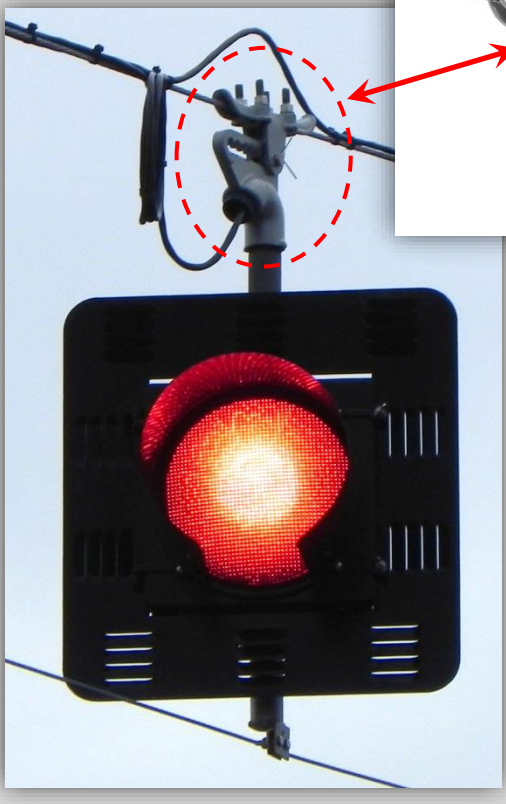
Spanwire Hanger

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 signals and signs on the messenger cable. Allows equipment to hang plumb and provides an entrance for the control cable into the vehicle signal.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM456
Plan Sheets: NO
Additional Installation Info: Pg. 132

Bubble Note(s) See pg. 213:

Not Applicable

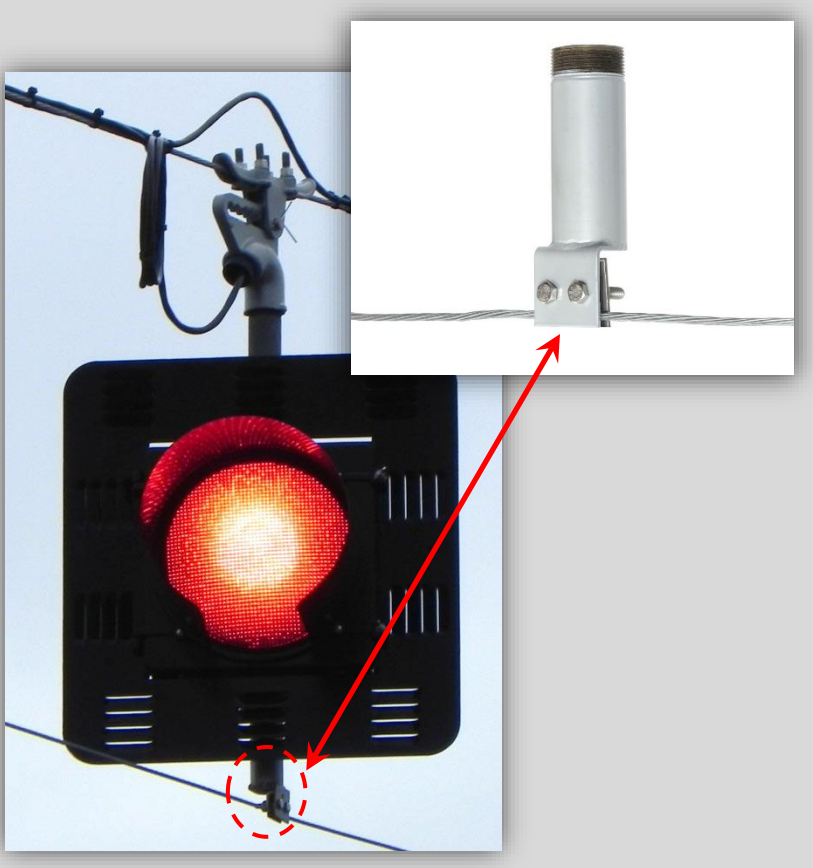
Tether Clamp

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 vehicle signals and signs to the tether cable.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM456
Plan Sheets: NO
Additional Installation Info: Pg. 130

Bubble Note(s) See pg. 213:

Not Applicable

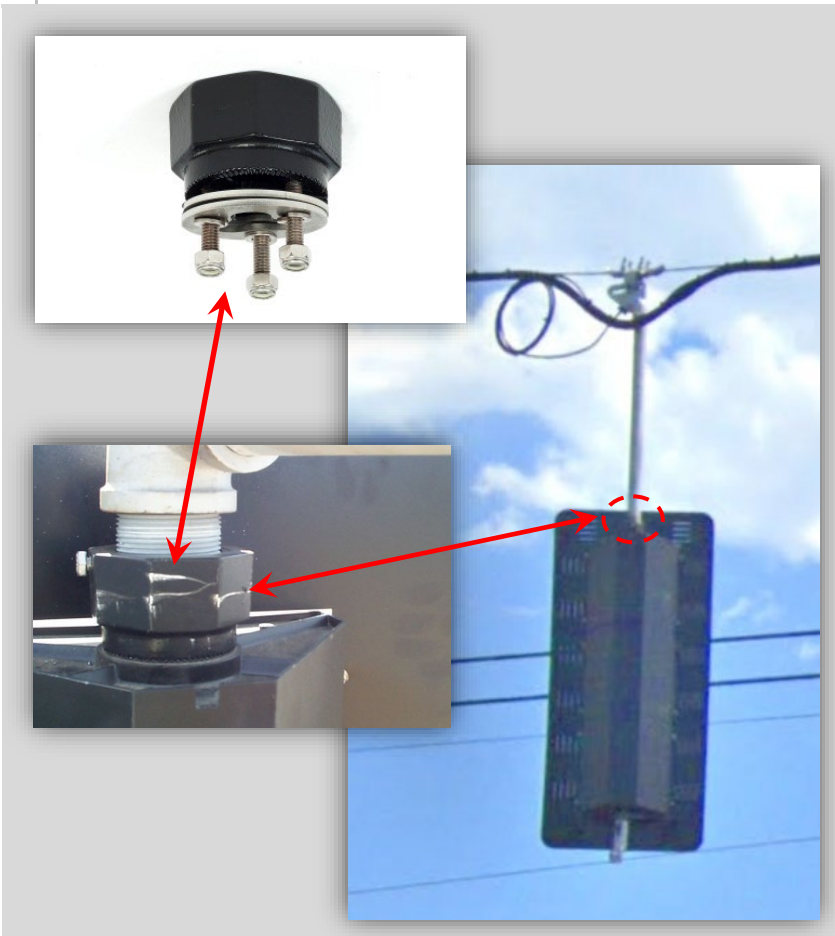
Tri-Stud Adapters

DESCRIPTION

Fitting of cast aluminum with steel insert, powder coated. Three bolts, split washers, and nylon insert lock-nuts, with 2 stainless steel backing washers.

USE

To attach vehicle signals and signs to a 1 ½ inch conduit riser which is then connected to a spanwire hanger.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM456
Plan Sheets: NO
Additional Installation Info: Pg. 132

Bubble Note(s) See pg. 213:

Not Applicable

Chase Nipple

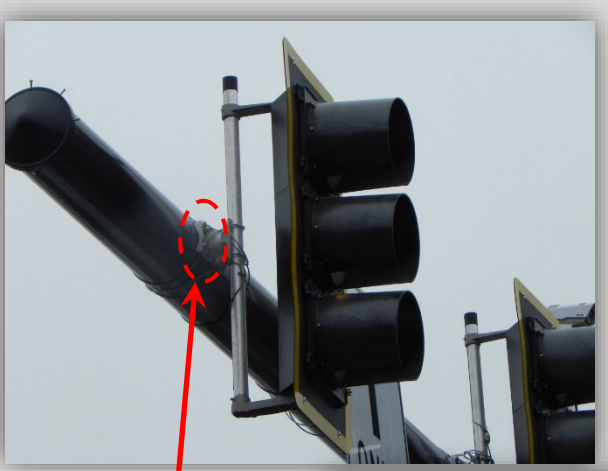
DESCRIPTION

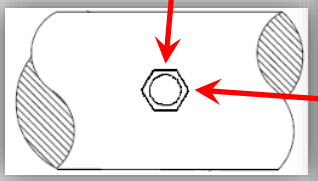
UL listed, galvanized steel electrical fitting threaded on one end with a formed, flat locknut affixed at the other end.

USE

To creates a path for wires (wire entrance) between attachments. Used from vehicle signal bracket into mast arm (1 inch diameter). See TM462.

Note: The chase nipple for the entrance from the pushbutton mount into the pole is part of the pushbutton mount assembly supplied by the manufacturer. See TM467.





Typical Sources of Info:

Specs: NO
Std. Dwg: TM462
Plan Sheets: NO
Additional Installation Info: Pg. 182

Bubble Note(s) See pg. 213:

Not Applicable

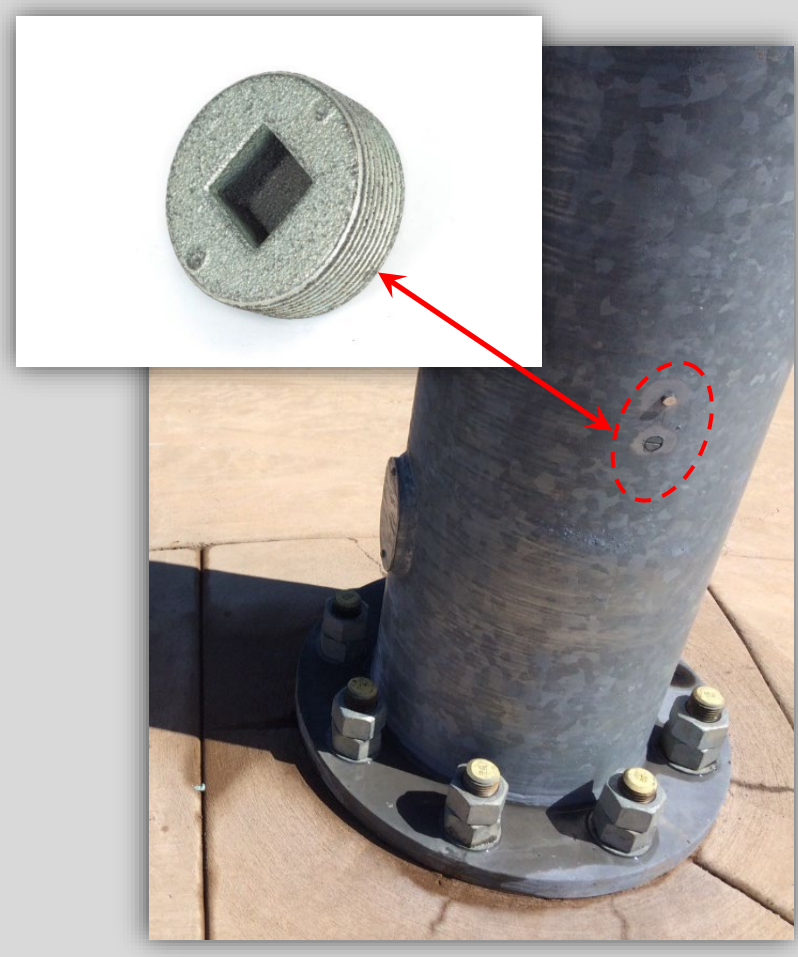
Pipe Plugs

DESCRIPTION

Stainless steel, hexagon, or square head with threaded end.

USE

To plug holes in steel poles and mast arms. Used when existing vehicle signals, pedestrian signals or pushbutton locations are modified.



Typical Sources of Info:

Specs: 00990.45
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pgs. 174, 178, & 180

Bubble Note(s) See pg. 213:

Not Applicable

Pedestal

DESCRIPTION

4 inch diameter galvanized steel pipe mounted on a cast aluminum or galvanized cast iron frangible base. Includes collar if required. See TM457.

USE

To mount various equipment required for traffic signals, ramp meters, RRFBs, and flashing beacon assemblies (e.g., vehicle signals, pedestrian signals, pushbuttons, RRFBs, signs, radar devices, etc.).

NOTE: vehicle pedestals are no longer used for new construction. See page 207 for info on vehicle pedestals.

Typical Sources of Info:

Specs: NO
Std. Dwg: TM457
Plan Sheets: YES
Additional Installation Info: Pgs. 134, 136, 148, 160, & 208

Bubble Note(s) See pg. 213:

PP/N PP/NS

DESCRIPTION

Non-Metallic:

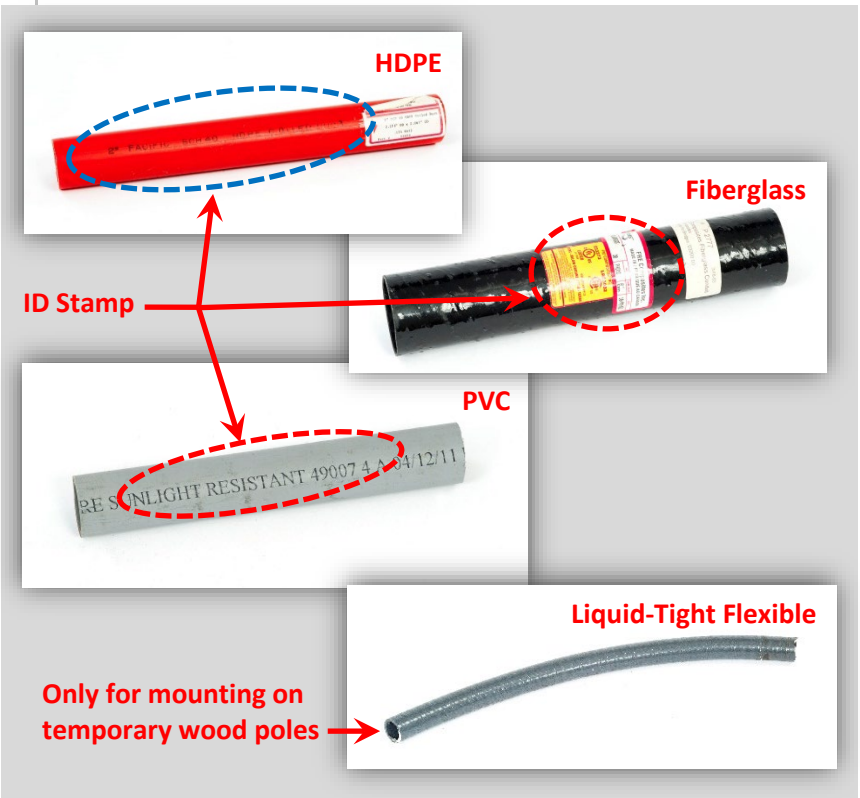
- High density polyethylene (HDPE), schedule 40 standard
- Fiberglass, schedule 40 standard
- PVC (marked for electrical use, typically grey), schedule 40 standard
- HDPE MicroDuct (ITS fiber optic installations)

Metallic:

- Rigid metal conduit (Typically only illumination and ITS work)
- Liquid-tight flexible metal conduit (Conduit mounted on wood poles)

USE

To house electrical conductors.



Typical Sources of Info:

Specs: 00960.41 & 00960.42
Std. Dwg: TM471
Plan Sheets: YES (size & location), Typically NO (material type)
Additional Installation Info: Pgs. 136, 150, 152, 154, & 210

Bubble Note(s) See pg. 213:

CS S W

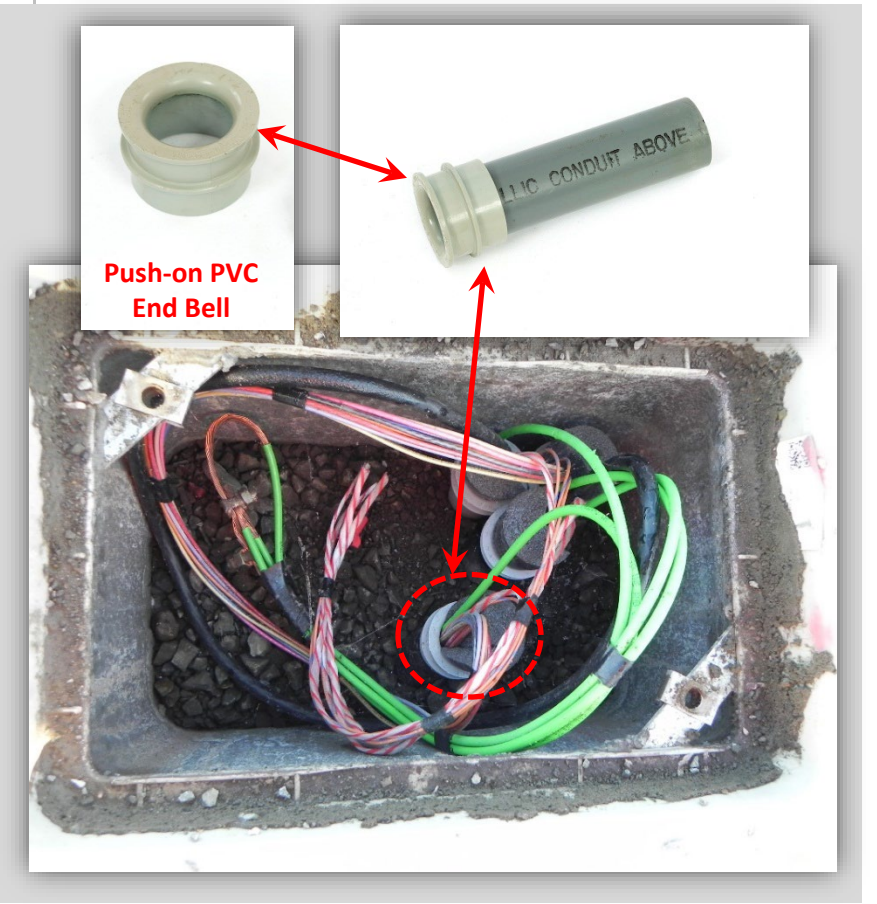
Conduit Bushings

DESCRIPTION

Non-metallic conduit bushings with insulated throat but no bonding lug. Note: ITS and illumination work may require metallic bushings (with or without bond)

USE

To protect wires/cables entering conduits. The smooth surface helps prevent damage to the wire/cable insulation. Installed onto the exposed end of conduits in foundations and junction boxes.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM471
Plan Sheets: NO
Additional Installation Info: Pgs. 152 & 170

Bubble Note(s) See pg. 213:

Not Applicable

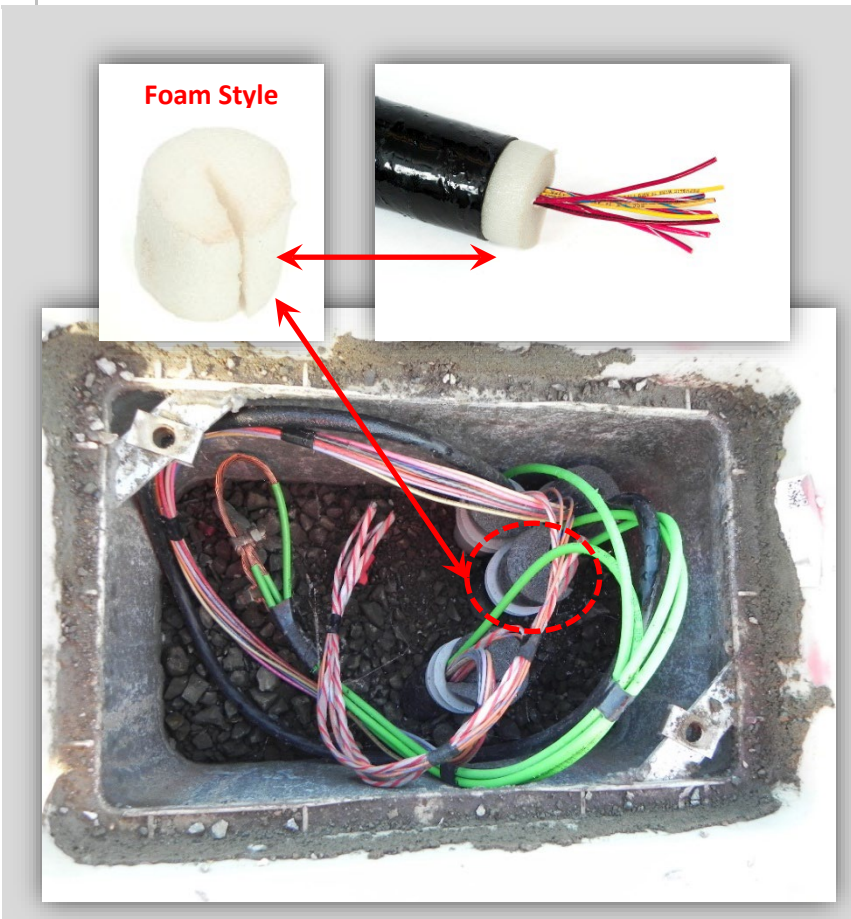
Conduit Plug

DESCRIPTION

Closed cell polyethylene foam style pre-formed for a specific conduit size. Spray foam not allowed. Cut to a supplier suggested length for conduit sizes.

USE

To keep debris out of the conduit. Inserted into the exposed end of conduits in foundations and junction boxes. Not watertight.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM471
Plan Sheets: NO
Additional Installation Info: Pgs. 152, 154, & 170

Bubble Note(s) See pg. 213:

Not Applicable

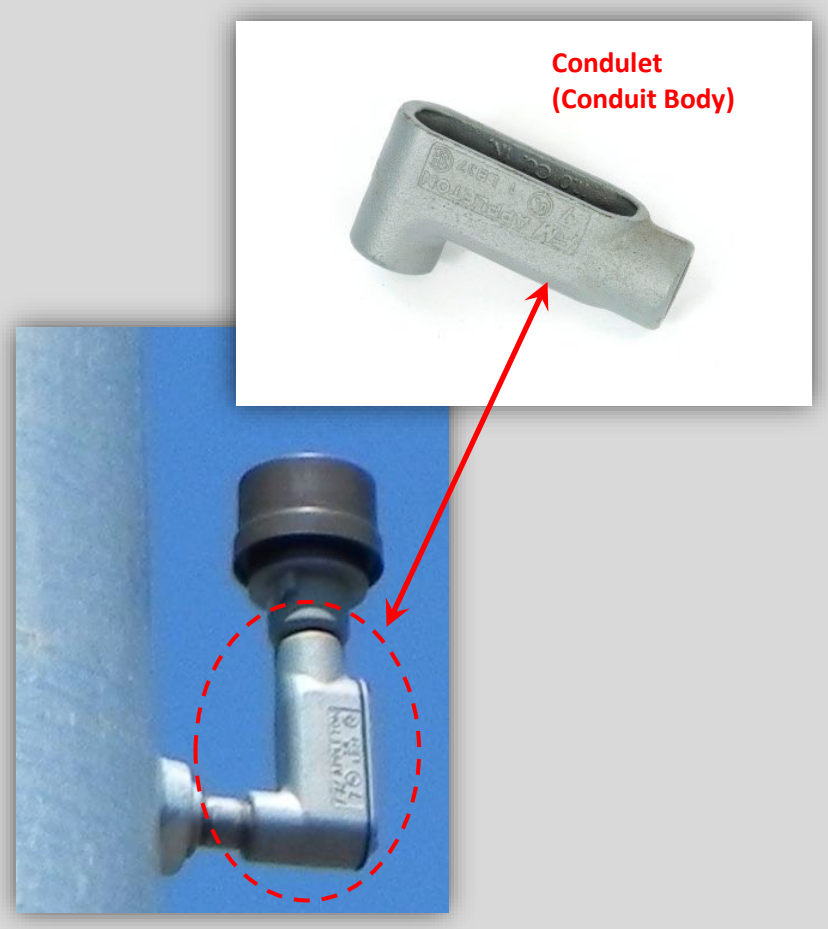
Condulet (Conduit Body)

DESCRIPTION

Malleable iron conduit body hot dip galvanized with cover and moisture-proof gasket.

USE

To provide a conduit transition/pull point. Typically used for installing a photoelectric cell.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM450
Plan Sheets: NO
Additional Installation Info: Pg. 198

Bubble Note(s) See pg. 213:

Not Applicable

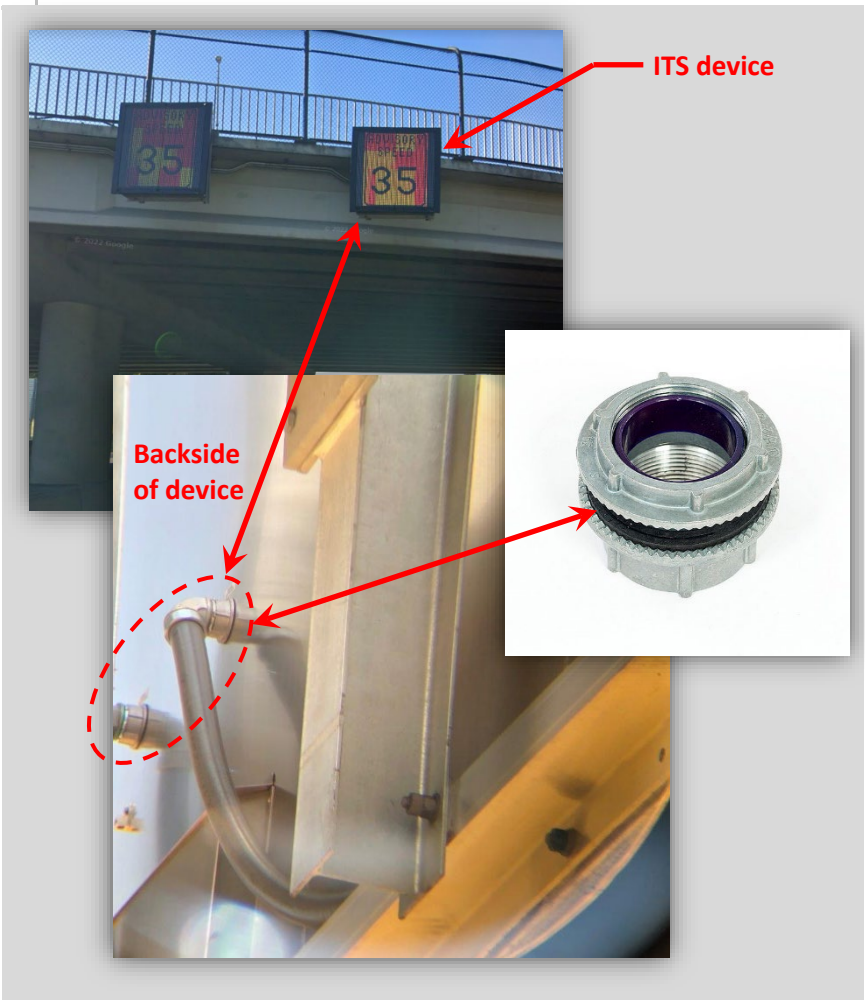
Conduit Hub

DESCRIPTION

Nylon insulated steel or malleable iron connector, with neoprene “O” ring.

USE

To provide a watertight connection for conduit entering cabinets. Typically only used for ITS devices.



Typical Sources of Info:

Specs: Typically YES
Std. Dwg: NO
Plan Sheets: Typically YES
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

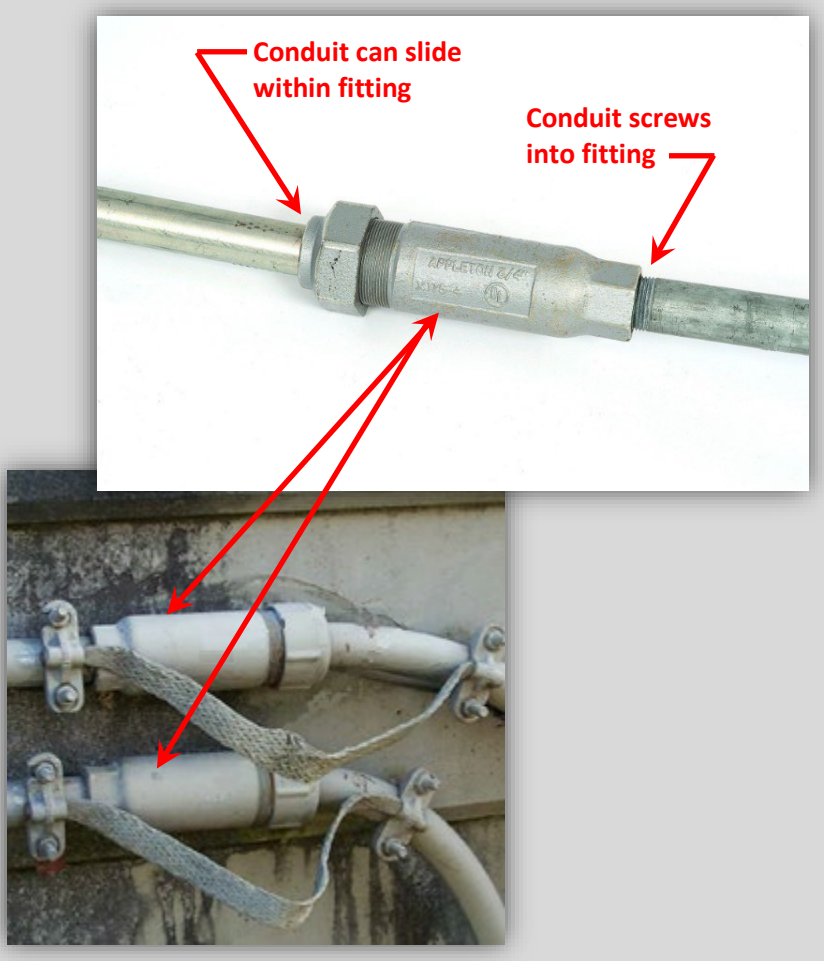
Expansion Fitting

DESCRIPTION

Fiberglass or weatherproof, malleable iron with a hot-dip galvanized finish.

USE

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



Typical Sources of Info:
Specs: 00960.42(f) to 00583.43
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: Pg. 152

Bubble Note(s) See pg. 213:

BC/S

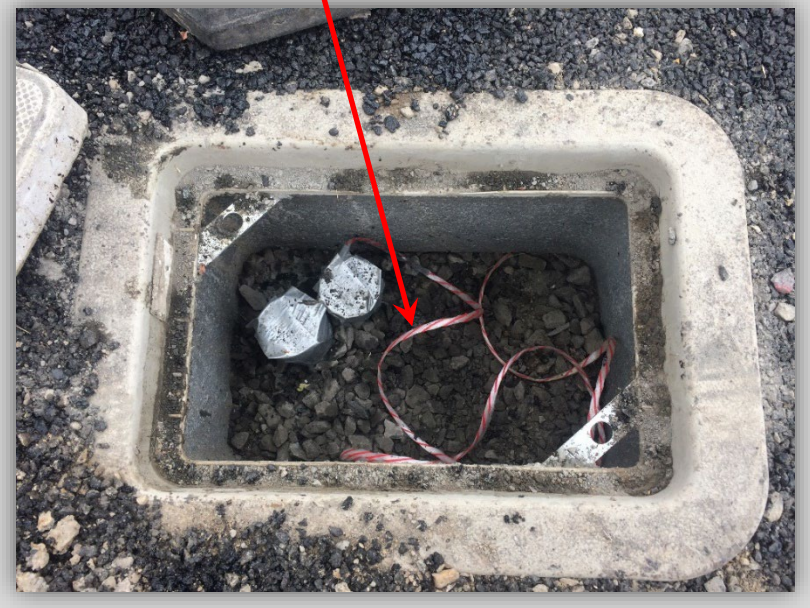
Pull Line

DESCRIPTION

Polyethylene or polypropylene rope with 1,200 pound break strength resistant to mildew and rot.

USE

To allow for easy installation of wire/cables in the future. Installed in spare conduits that are intended for future use.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM470
Plan Sheets: Typically YES
Additional Installation Info: Pgs. 152 & 170

Bubble Note(s) See pg. 213:

PL

Underground Warning Tape

DESCRIPTION

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

USE

To warn workers on future projects of buried electrical lines. Placed the full length of the conduit, 6 inch below the ground surface.

Typical Sources of Info:

Specs: NO
Std. Dwg: TM471
Plan Sheets: NO
Additional Installation Info: Pg. 154

Bubble Note(s) See pg. 213:

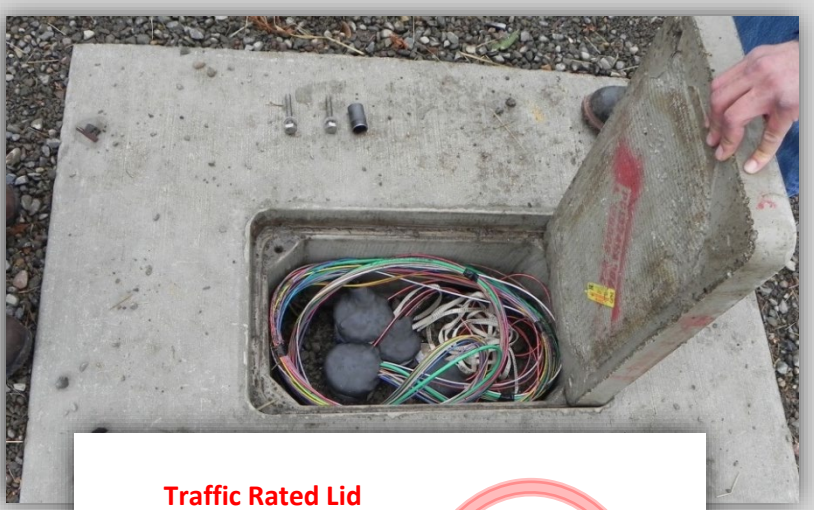
Not Applicable

DESCRIPTION

Open-bottom boxes of pre-cast concrete, polymer concrete, polymer or fiberglass with stainless steel fasteners. Three different sizes (see TM472).

USE

To provide an acceptable place in a run of conduit to facilitate the pulling in of wires/cables for traffic signals/illumination. Also provides a protected location for loop splices and ground rods. Conduit typically enters the junction box from the bottom (Note: ITS work may differ).



Typical Sources of Info:

Specs: NO
Std. Dwg: TM472
Plan Sheets: YES
Additional Installation Info: Pgs. 156 & 158

Bubble Note(s) See pg. 213:

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

Junction Boxes (Hand Hole)

DESCRIPTION

Open bottom boxes made of polymer, fiberglass, and/or polymer concrete. Three different sizes of hand holes (see TM472).

USE

To provide an acceptable place in a run of conduit to facilitate the pulling in of wires/cables for ITS installations (i.e. fiber optic cable). Conduit typically enters the hand hole from the sides.

Typical Sources of Info:

Specs: NO
Std. Dwg: TM472
Plan Sheets: YES
Additional Installation Info: Pgs. 156 & 158

Bubble Note(s) See pg. 213:

HH 1 HH 2 HH 3

DESCRIPTION

Mount that attaches to a pole and accepts a 1 ½ inch tube. Similar to a vehicle signal bracket, but without the arms.

USE

To mount radio equipment.

Typical Sources of Info:

Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Custom

Video Detection Mount

DESCRIPTION

Mount that attaches to a pole, mast arm or luminaire arm. One piece with 23 inch tube.

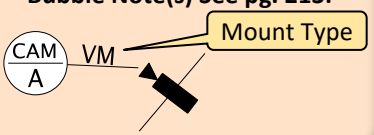
USE

To mount video detection camera.

Typical Sources of Info:

Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 194

Bubble Note(s) See pg. 213:



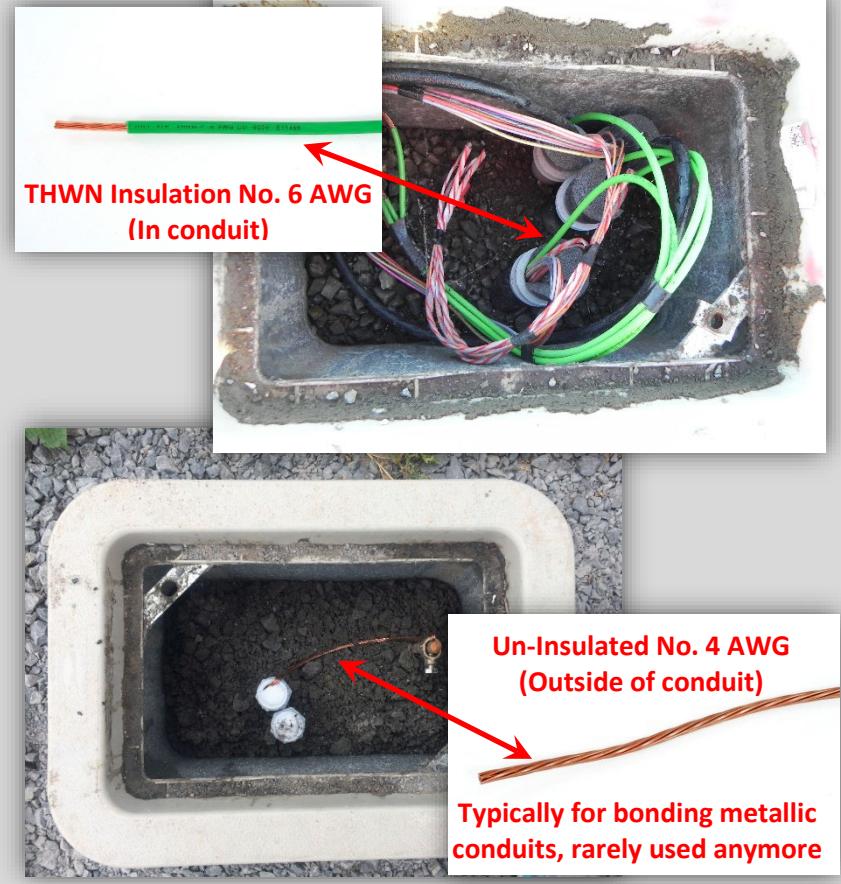
Bond Wire

DESCRIPTION

THWN No. 6 AWG, 7 Stranded copper wire (in conduit) or bare No.4 AWG, 7 Stranded copper wire (outside of conduit).

USE

To bond/ground 120V AC circuits.



Typical Sources of Info:

Specs: 00960.45(b)

Std. Dwg: TM450, TM452, TM453, TM454, TM482 & TM485

Plan Sheets: NO

Additional Installation Info: Pg. 168 & 170

Bubble Note(s) See pg. 213:

Not Applicable

Ground Rod & Clamp

DESCRIPTION

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

USE

To ground the electrical installation. All poles, pedestals/posts, service cabinets and controller cabinets are bonded to ground rods using full-contact clamps.

Typical Sources of Info:

Specs: 00960.45(c)

Std. Dwg: TM450, TM453, TM454, TM457, TM482, & TM492

Plan Sheets: NO

Additional Installation Info: Pgs. 148 & 168

Bubble Note(s) See pg. 213:

Not Applicable

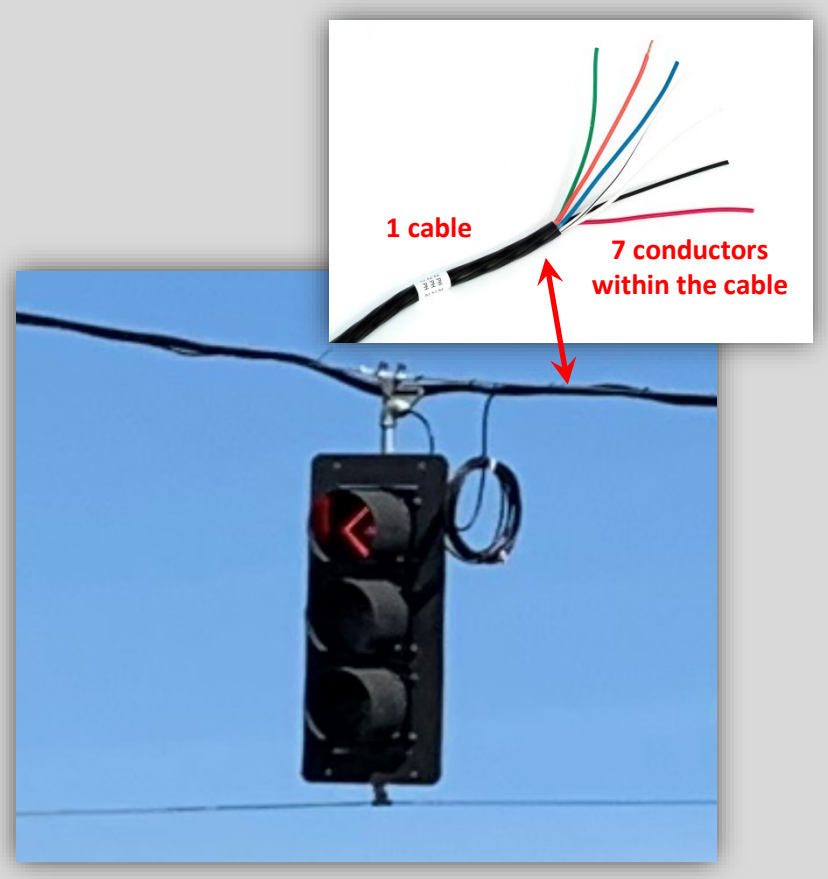
Control Cable

DESCRIPTION

Multi-conductor bundled cable with assorted stranded copper wires (typically No. 14 AWG, but may be other sizes). Must meet color code on standard drawings.

USE

To provide electrical energy to vehicle signals, pedestrian signals and pushbuttons. Used in conduit runs, mast arms, pedestals/poles and strapped to messenger cable (spanwire installations).



Typical Sources of Info:

Specs: NO
Std. Dwg: TM470
Plan Sheets: YES
Additional Installation Info: Pgs. 170, 172, & 210

Bubble Note(s) See pg. 213:

X–N
G

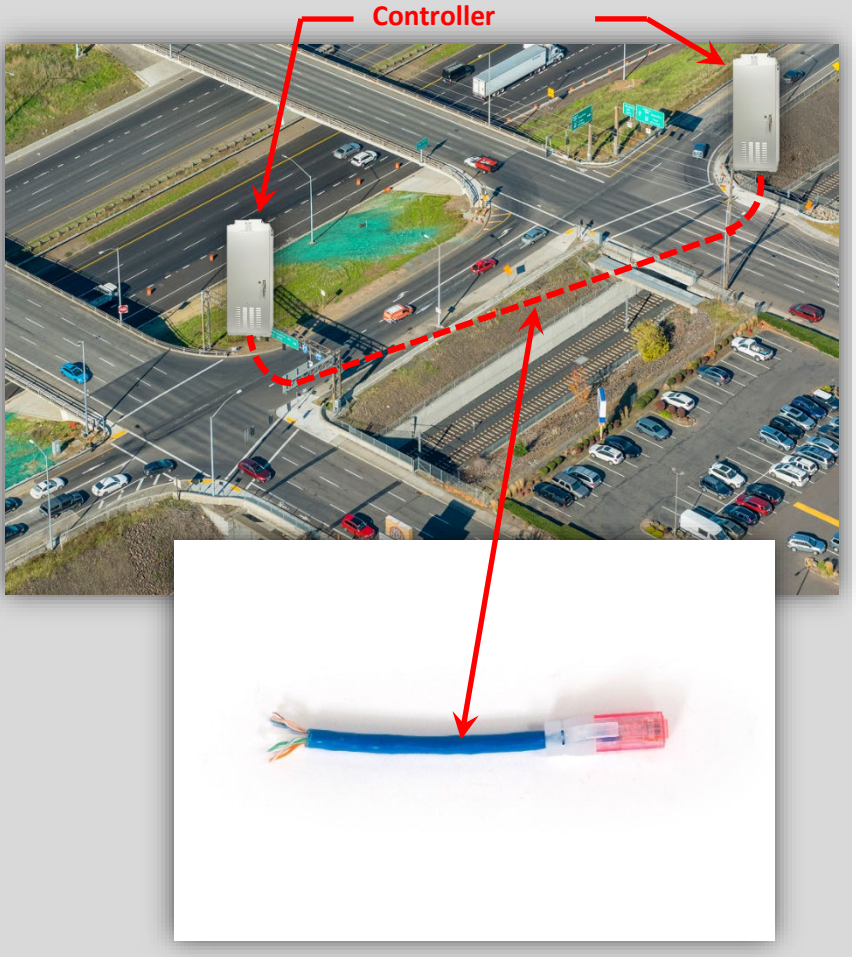
Industrial Ethernet Cable

DESCRIPTION

Waterblock/direct burial rated, shielded enhanced category 6 cable. No. 24 AWG solid bare copper conductors with PE inner jacket.

USE

To provide communication between devices.



Typical Sources of Info:

Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 170

Bubble Note(s) See pg. 213:

NET CAT6

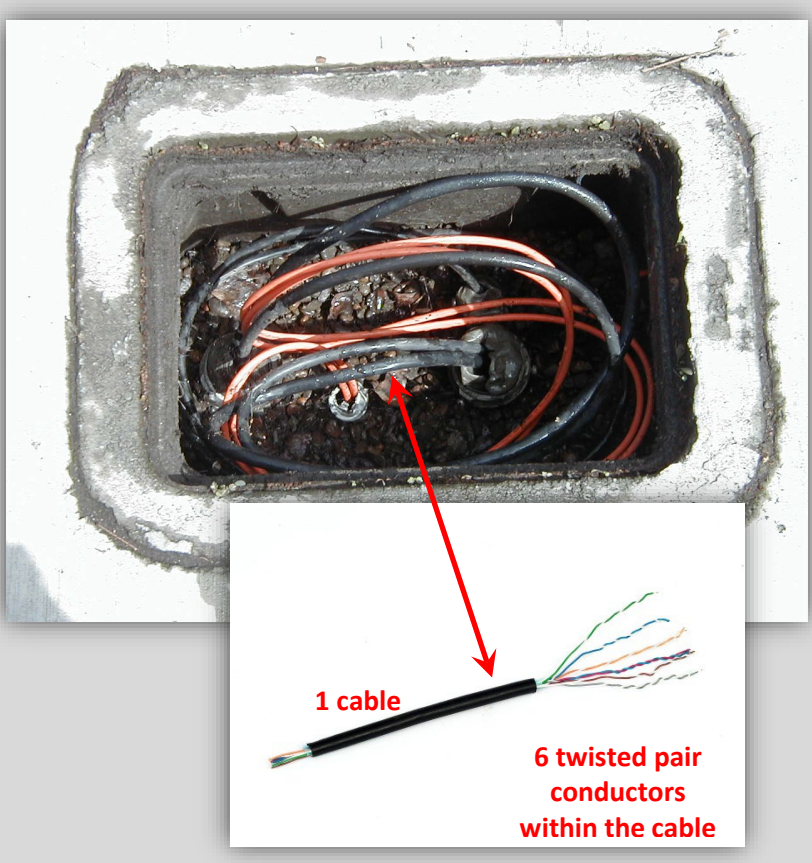
Interconnect Cable

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

To provide communication between traffic signal controllers. Installed with no splices between signal controllers. Note: this type of communication cable is rarely used in new construction.



Typical Sources of Info:
Specs: 00990.70(i)
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 170

Bubble Note(s) See pg. 213:

N/P

TFFN, THWN, & XHHW Wire

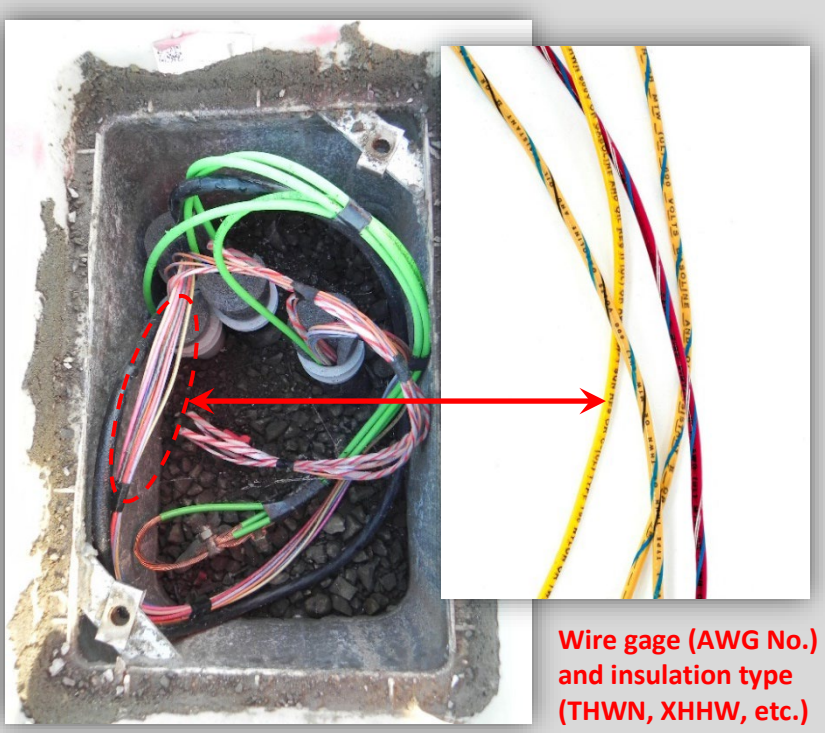
DESCRIPTION

Stranded copper conductor, color coded wire:

- **TFFN wire** has PVC insulation and nylon jacket. Very similar to THWN.
- **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 electrical energy. THWN is typically only used for retrofits and photoelectric cells. XHHW is typically used for illumination. TFFN wire is used exclusively as a tracer/locate wire.



Wire gage (AWG No.) and insulation type (THWN, XHHW, etc.) is labeled on the wire

Typical Sources of Info:

Specs: NO
Std. Dwg: TM470
Plan Sheets: YES (TFFN: NO)
Additional Installation Info: Pgs. 170 & 172

Bubble Note(s) See pg. 213:

N–C | N G | N–12C | N/G

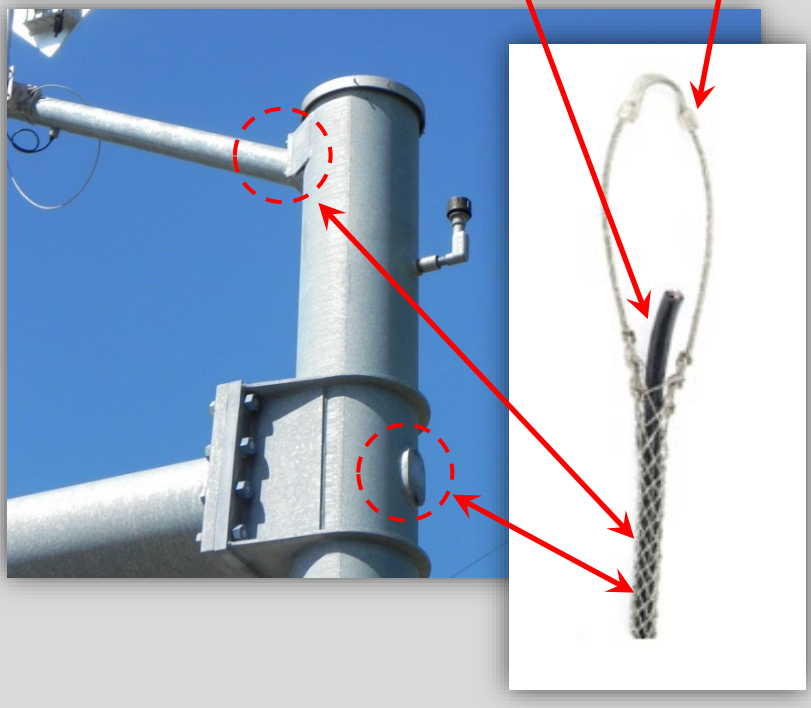
Strain Relief

DESCRIPTION

Single eye, tin coated bronze wire with a mesh grip.

USE

To provide slack and hold wires/cables at certain locations, protecting them from strain and damage. Typically used inside the signal pole at the point where the mast arm and luminaire arm connect to the pole.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM450
Plan Sheets: NO
Additional Installation Info: Pg. 172

Bubble Note(s) See pg. 213:

Not Applicable

Pedestrian Signal

DESCRIPTION

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

USE

To house the pedestrian signal LED module.

Typical Sources of Info:

Specs: NO
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: Pg. 174

Bubble Note(s) See pg. 213:

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

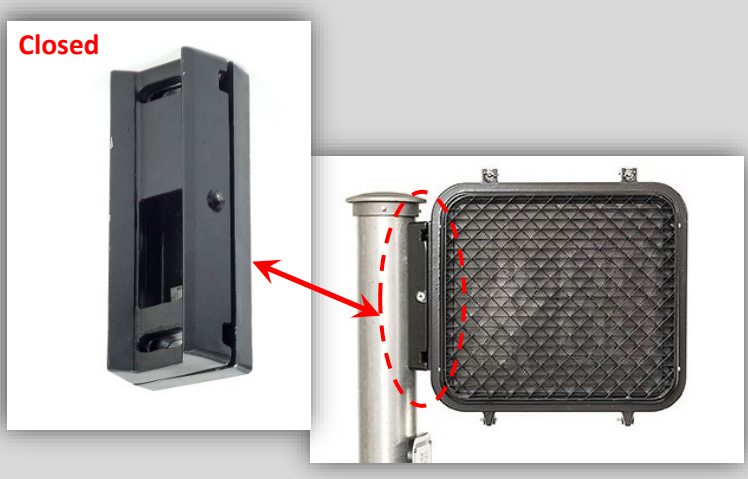
Pedestrian Signal Mount

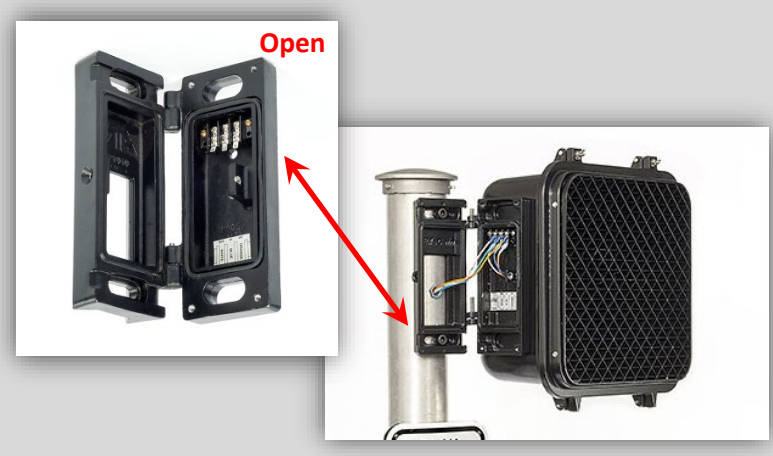
DESCRIPTION

Swing open clam shell compartment.

USE

To mount the pedestrian signal to pole/pedestal and provide a terminal block for wiring.





Typical Sources of Info:

Specs: NO
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: Pg. 174

Bubble Note(s) See pg. 213:

P / Ph P/B / Ph P/A / Ph

LED Modules (Pedestrian Signal)

DESCRIPTION

Light emitting diode (LED) unit for pedestrian signals. Flange mount type, clear lens. Countdown combo (hand/man on left, countdown on right).

USE

To display the pedestrian phases (WALK, FLASHING DON'T WALK, and DON'T WALK)

Typical Sources of Info:

Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 174

Bubble Note(s) See pg. 213:

P / Ph P/B / Ph P/A / Ph

Pushbutton & Mount

DESCRIPTION

Pushbutton with mount and sign. Note: Audible pedestrian signals are contained within the pushbutton mount and are a green sheet item (see Pg. 89).

USE

To provide a way for the pedestrian to be detected and request the WALK phase at a traffic signal or to activate the RRFB flashing beacons.

Typical Sources of Info:

Specs: NO
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: Pgs. 176, 178, & 208

Bubble Note(s) See pg. 213:

P/A Ph | A Ph | PAH
P/B Ph | B Ph | PBH

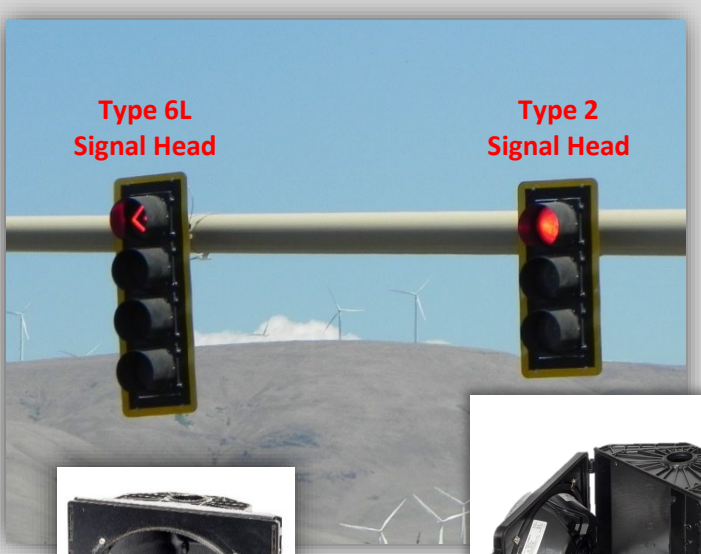
Vehicle Signal (Housing)

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

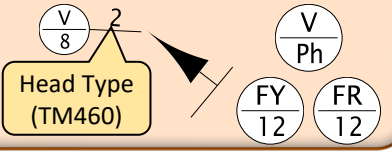
To house the vehicle signal LED modules.



Modular assembly:
Three individual signal faces connected together to create a type 2 signal head as shown

Typical Sources of Info:
Specs: NO
Std. Dwg: TM460
Plan Sheets: YES
Additional Installation Info: Pg. 180

Bubble Note(s) See pg. 213:



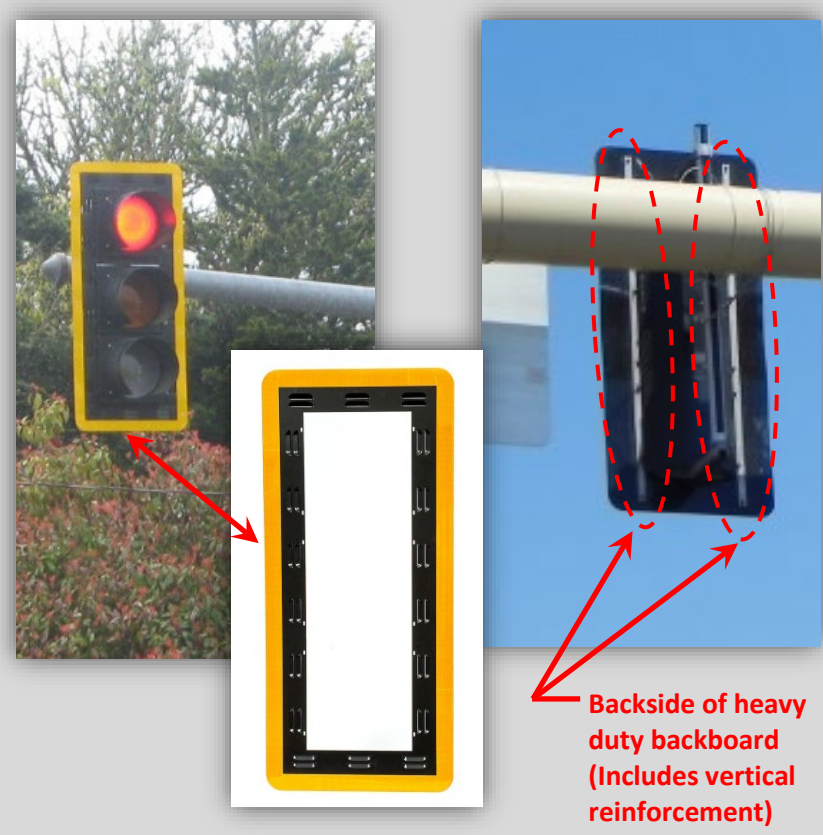
Vehicle Signal (Backboard)

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. Heavy duty option includes vertical reinforcement for added strength.

USE

To improve the vehicle signal visibility by increasing the size of the target, providing contrast to the background, and providing a retroreflective border.



Typical Sources of Info:
Specs: NO
Std. Dwg: TM460
Plan Sheets: YES
Additional Installation Info: Pg. 180

Bubble Note(s) See pg. 213:

V / Ph
FY / 12
FR / 12

Vehicle Signal (Visor)

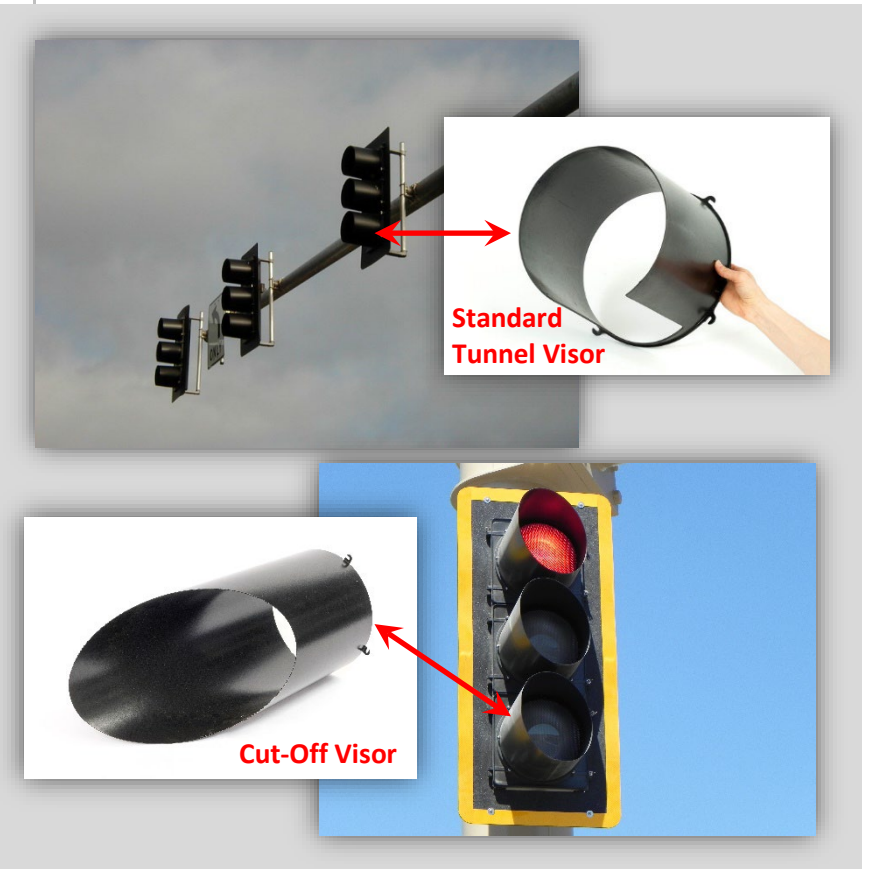
DESCRIPTION

Aluminum powder coated black or black polycarbonate. Visor must attach to signal heads with stainless steel screws.

- **Standard:** open at bottom standard (tunnel)
- **Cut-off:** longer, not open at bottom (used for special cases to selectively limit visibility of the indication)

USE

To direct the signal indication towards the driver and to increase visibility (especially in sunlight).



Typical Sources of Info:

Specs: NO
Std. Dwg: TM460
Plan Sheets: YES
Additional Installation Info: Pg. 180

Bubble Note(s) See pg. 213:

V / Ph | FY / 12 | FR / 12 | 45 / DEG

LED Modules (Vehicle Signal)

DESCRIPTION

Light Emitting Diode (LED) unit for vehicle signals. Flange mount type, clear lens. Twelve inch ball or arrow in red, yellow or green.

USE

To display the vehicle phases (RED, YELLOW, and GREEN).

Typical Sources of Info:

Specs: NO
Std. Dwg: TM460
Plan Sheets: YES
Additional Installation Info: Pgs. 180

Bubble Note(s) See pg. 213:

V / Ph
FY / 12
FR / 12

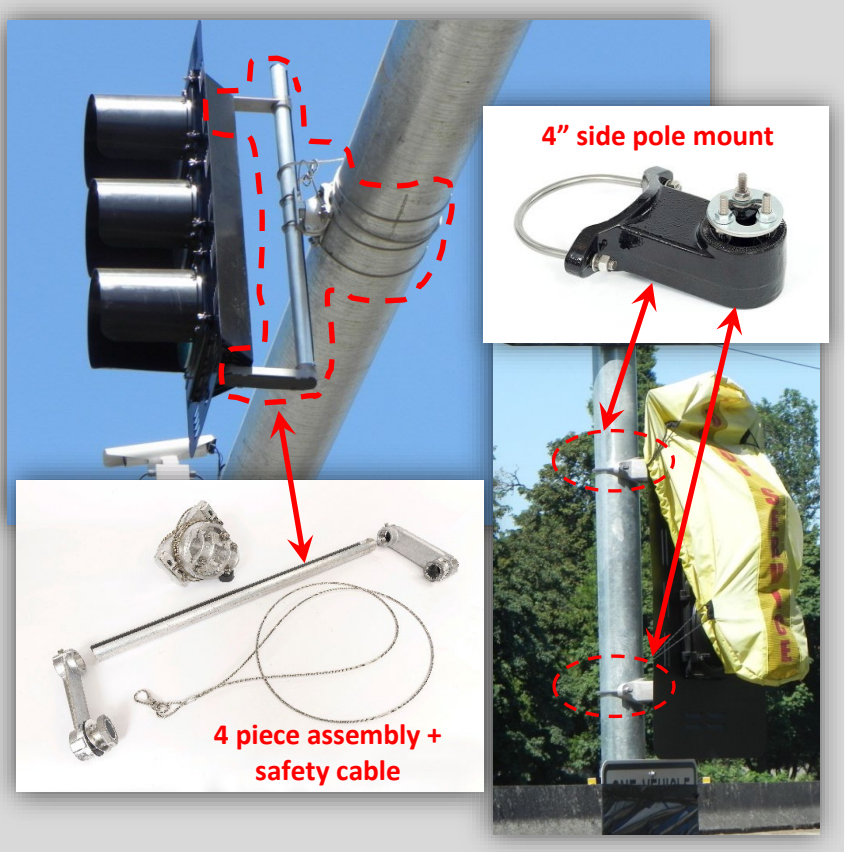
Vehicle Signal Bracket

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 on a mast arm or pole. Provides flexibility for horizontal and vertical alignment and full support of the vehicle signal sections. The 4 inch side pole mount is used to mount vehicle signals on pedestals.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM462
Plan Sheets: YES (pole entrance chart)
Additional Installation Info: Pg. 182

Bubble Note(s) See pg. 213:

Not Applicable

Louver

DESCRIPTION

Geometrically programmed louvers installed inside the visor.

USE

To selectively limit visibility of the signal indication in certain circumstances.

Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 180

Bubble Note(s) See pg. 213:

GPL

Tattletale Light

DESCRIPTION

Powder coated aluminum or polymer, 2 inch diameter, white LED indication.

USE

To help police enforce red light running violations. Mounted on the backside of the vehicle signal, hard-wired to the red indication.

Typical Sources of Info:

Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 180

Bubble Note(s) See pg. 213:

TTL

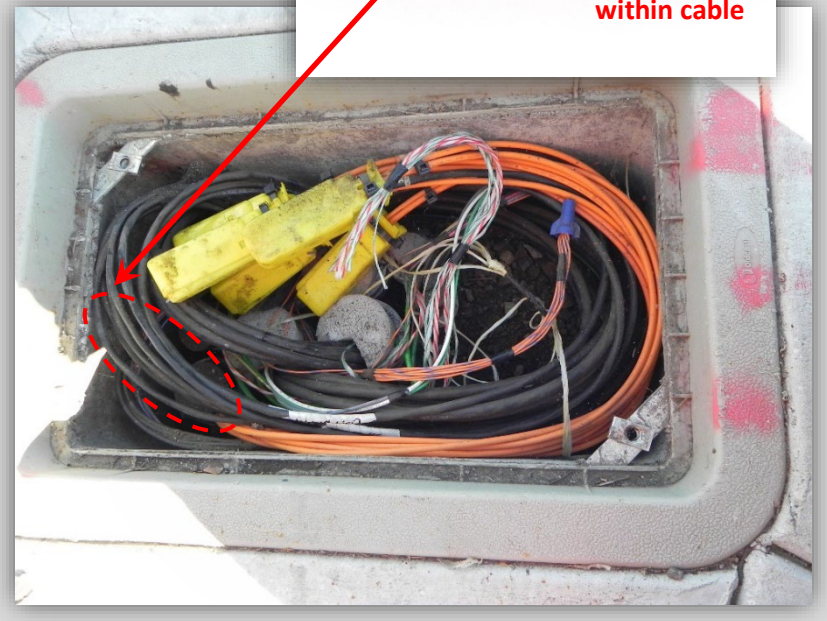
Loop Feeder Cable

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

To connect the loop detector in the pavement to the controller (loop wires are spliced to the loop feeder cable at the junction box nearest the loop).



Typical Sources of Info:

Specs: 00990.42(b)
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 170 & 192

Bubble Note(s) See pg. 213:

LF X-Ph | F18 X-Ph | LF X-F

Loop Wire

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

To make an inductive loop detector in the pavement that will detect vehicles. Loop wire is installed in a circle or diamond pattern.

Typical Sources of Info:

Specs: 00990.41
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pgs. 186, 188, & 192

Bubble Note(s) See pg. 213:

N
LW

Loop Splice

DESCRIPTION

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

USE

To connect the loop feeder cable and loop wire (splice point).

Typical Sources of Info:
Specs: 00990.41(d)
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: Pg. 192

Bubble Note(s) See pg. 213:

Not Applicable

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
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: Pg. 198

Bubble Note(s) See pg. 213:

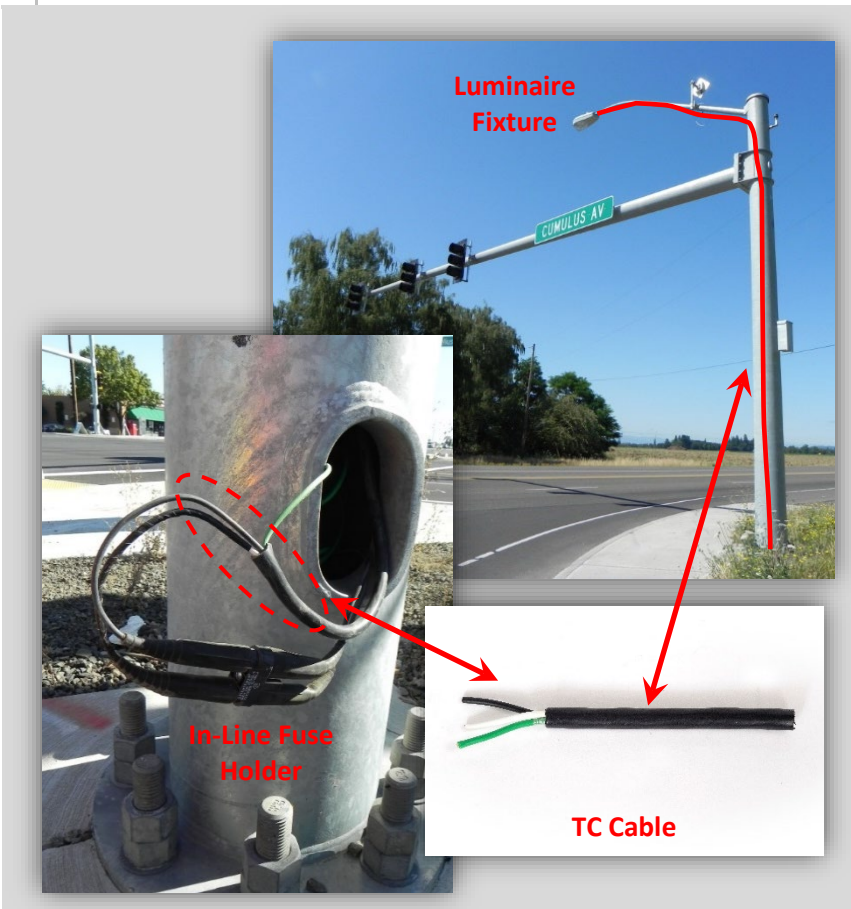
Not Applicable

DESCRIPTION

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

USE

To provide electrical energy to the luminaire fixture. TC cable is installed in the luminaire arm & signal mast arm pole between the luminaire fixture 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. 198

Bubble Note(s) See pg. 213:

Not Applicable

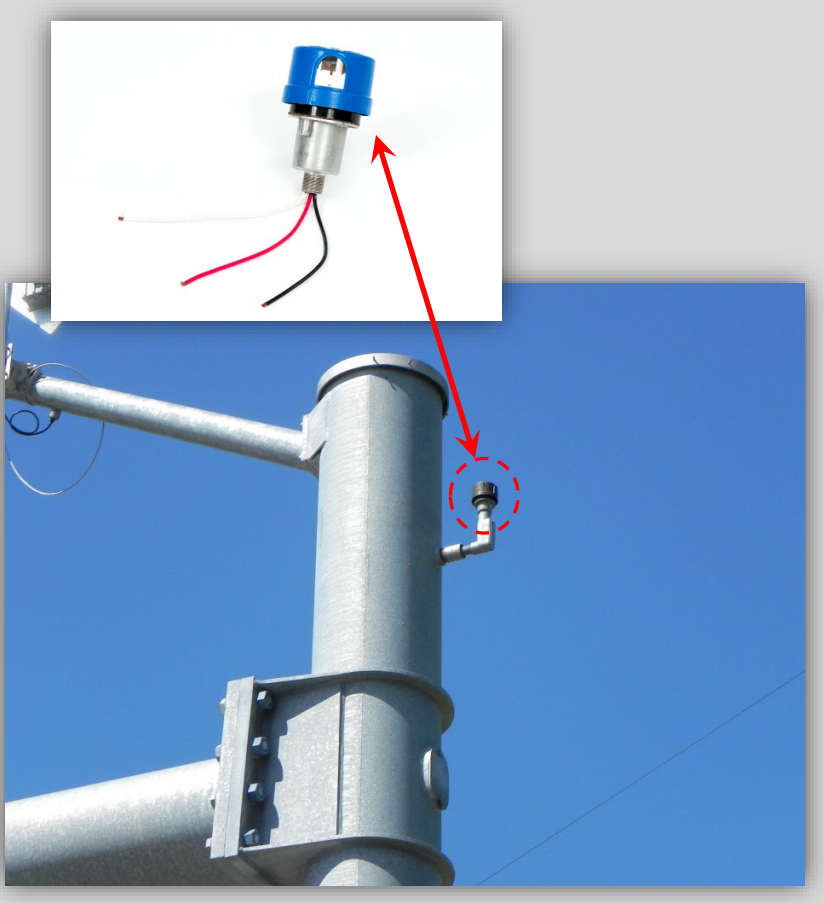
Photocontrol Electronic Relay

DESCRIPTION

A photo electronic device used for turning on illuminated signs or luminaires meeting specifications under 00970.

USE

To activate the all the luminaires at the traffic signal based on ambient lighting conditions (lights ON when dark, lights OFF when light).



Typical Sources of Info:

Specs: 00970.43 & 02926.41(e)
Std. Dwg: TM450
Plan Sheets: YES
Additional Installation Info: Pg. 198

Bubble Note(s) See pg. 213:

PE 1 PE 2

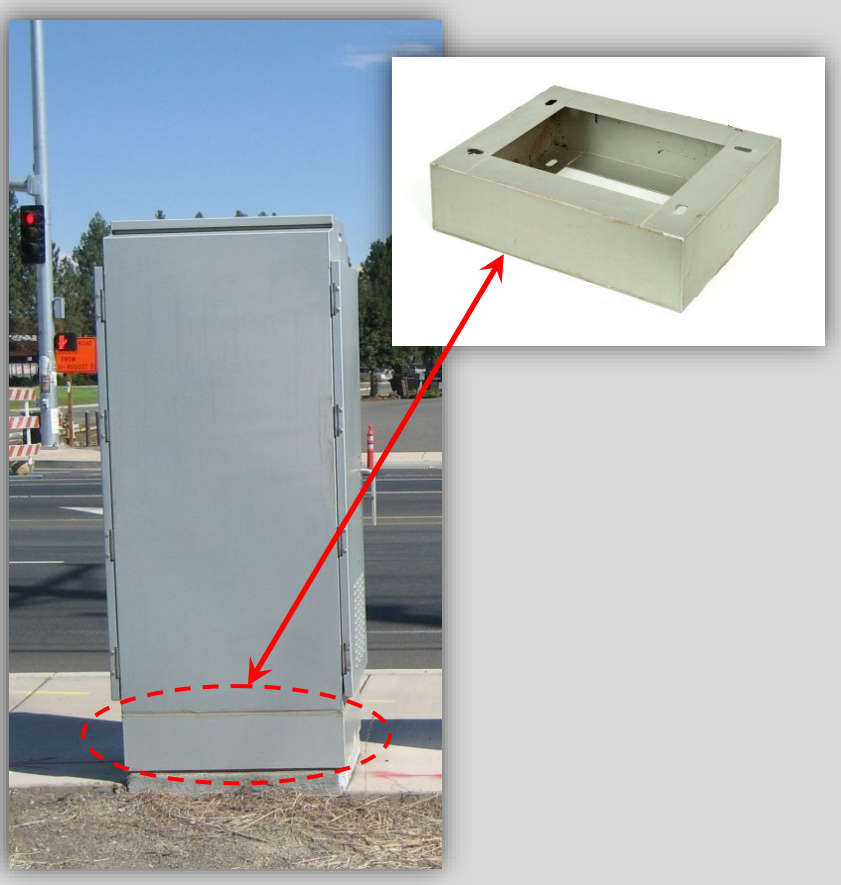
Riser Frames

DESCRIPTION

Aluminum framework of ¼ inch channel or 1/8 inch sheet stock. One piece welded construction for new 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 workspace under the cabinet.



Typical Sources of Info:

Specs: NO
Std. Dwg: TM482
Plan Sheets: YES
Additional Installation Info: Pg. 200

Bubble Note(s) See pg. 213:

332S 334 RF

Base Mounted Service Cabinet

DESCRIPTION

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. Will include a meter socket jumper cover (factory installed) if the plans specify flat rate billing.

Note: Temporary installations use a pole mounted, stand-alone service cabinet and stand-alone meter base. See Pages 11 & 12.

USE

To provide fused electrical service for permanent installations.

Base Mounted Service Cabinet Types (Housing stays the same, circuitry inside changes as per TM485):

- **BMC: Signal Only**
- **BMCL: Signal & Illumination**
- **BMCF: Signal & Flashing Beacon**
- **BMCFL: Signal, Flashing Beacon, & Illumination**
- **BMCX: Custom Service shown in plan sheets**

Typical Sources of Info:
Specs: 00960.45(d), 00960.46, & 00960.60
Std. Dwg: TM482 & TM485
Plan Sheets: YES
Additional Installation Info: Pg. 166

Bubble Note(s) See pg. 213:

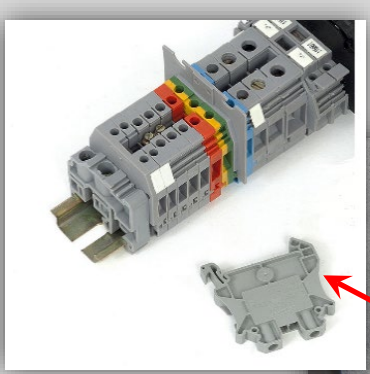
BMC | BMCF | BMCX | BMCL | BMC/FL | FR

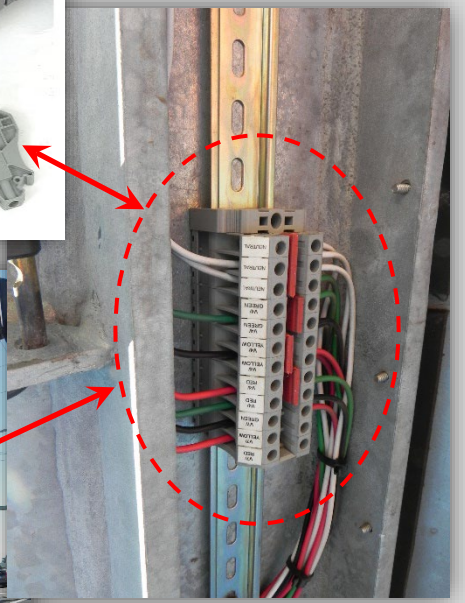
DESCRIPTION

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.





Type B terminal blocks used for recessed terminal cabinets

Typical Sources of Info:
Specs: NO
Std. Dwg: TM454 & TM470
Plan Sheets: NO
Additional Installation Info: Pgs. 126, 170, & 172

Bubble Note(s) See pg. 213:

Not Applicable

PTR (Part Time Restriction) Signs

DESCRIPTION

Flat black, painted, aluminum alloy case with legend when lit. LED illuminated legend. Also referred to as a "blank-out sign".

USE

To display restrictions that are only necessary under certain conditions (i.e., part time restrictions). Typically used to restrict turn movements at signals that have railroad preemption when the train occupies the rail crossing.

PTR sign OFF
(LED Message not visible)

PTR sign ON
(LED message visible)

NOTE: PTR signs are mounted with a vehicle signal bracket

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

Bubble Note(s) See pg. 213:

PR 6L PR 6R

DESCRIPTION

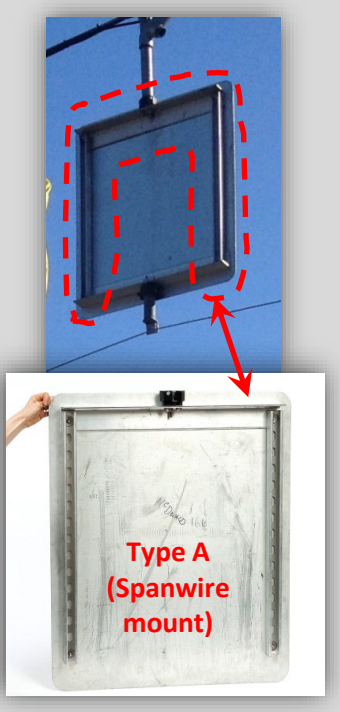
An aluminum assembly for mounting signs paid for under the traffic signal lump sum bid item (e.g., lane use signs, etc.) on a mast arm, pole or spanwire:

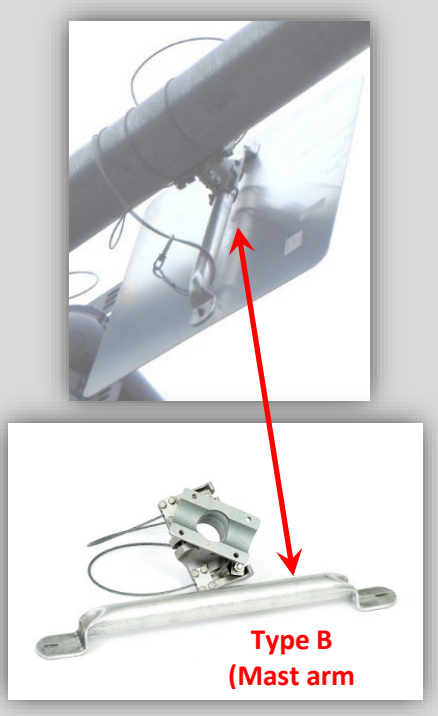
- Type A mount is used on temporary spanwire installations
- Type B mount is used on mast arm and pole installations

NOTE: for signs paid for under the signing bid items (e.g., street name signs mounted on the mast arm), see the sign plans and TM679 for the required mounting equipment (not a blue sheet item). See pg. 102 for more info on determining how signs installed on traffic signal poles, mast arms or spanwires are paid for.

USE

To attach signs to a mast arm, signal pole, or span wire.





Typical Sources of Info:

Specs: NO
Std. Dwg: TM456 (Type A) & TM462 (Type B)
Plan Sheets: YES (pole entrance chart)
Additional Installation Info: Pg. 132 (Type A)

Bubble Note(s) See pg. 213:

Not Applicable

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Green Sheet Materials

Conditionally prequalified products and submittals for conditional qualification of controller equipment are known as the green sheets (00160.00(d)). The contractor must electronically submit the green sheets **within 30 calendar days after execution of the contract** (00960.02). A cabinet print will also detail the required equipment, which is provided by the EOR as per 00990.70(a). Note: Documenting submittals and approvals in DocExpress removes the functionality of a "smart PDF". The green sheets "smart PDF" must be attached as a supporting document at each documented milestone to remain usable throughout construction. Follow the instructions in DocExpress.

The current version of the green sheets* is posted online and may be updated at any time. Always verify and use the most current version (00160.07).

The CTSI is responsible for:

- The initial conditional qualification of materials and submitting any write-in materials to the state traffic signal engineer for approval prior to starting work. This then allows the contractor to submit equipment to TSSU for testing.

Traffic systems services unit (TSSU) or agency electricians are responsible for:

- The initial chamber testing acceptance of materials BEFORE they are installed. This functional and environmental testing is a requirement for the majority of materials listed in the green sheets.
- Inspecting and accepting all of the materials installed on the project. This includes the successful field activation (turn-on).

Region traffic is responsible for:

- Inspecting and accepting all messages for audible pedestrian signals.

Real-time TSSU chamber testing status & scheduling* can be viewed online.

Cut Sheets for 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 cut sheet as required by the Green Sheet Qualifications/Specification Information*. The cut sheet shall identify the specific product intended to be used; manufacturer's name, identifying info, and how the product meets the Green Sheet Qualifications/Specification Information. Note: Submit cut sheets as a separate PDF. Do not combine with the green sheets "smart PDF" as it will remove the functionality of the "smart PDF". **E-mail all write-in materials and cut sheets to the STATE TRAFFIC SIGNAL ENGINEER (NOT the engineer of record) for initial conditional qualification of the material.**

Always read and follow the instructions included in the green sheets

*Website links & QR scan codes provided starting on Pg.227

Green Sheet Example
PAGE 2

Lists all materials that are pre-approved and instructions for use

The contractor will check box if the material is on the project. This will open a new material specific page See Pgs. 70 & 71 for example.

Items Used on Project

Initial Submittal

The Contractor will:

1.) Check off all approved items to be used on the contract on this page. This will create a specific material page listing all approved items. Check off all items on each specific material page to be used on the contract. DO NOT CHECK OFF MORE THAN ONE OPTION PER SUB-CATEGORY
2.) If proposing any write-in items or if plans/specifications call out a specific manufacturer part number that is NOT already an approved item, check off the box under "Write-in items" and follow the instructions on the "write-in items" page.
3.) Electronically submit this form prior to starting work.

The CTSI Inspector will:

1.) Verify all items checked off ON THIS SHEET AND THE SPECIFIC MATERIAL PAGE(S) will be used on the contract. Work with contractor to correct any errors/omissions prior to starting work according to Specification 00960.02.
2.) If "write-in items" is checked, follow instructions on the "write-in items" page for initial approval from the State Traffic Signal Engineer.
3.) When these sheets are verified as correct and write-in item initial approval is received (if applicable), notify the contractor the submittal is "approved".
4.) Return one copy of this form to contractor and one copy to TSSU (TSSU@ODOT.oregon.gov)

Construction

Materials delivered to TSSU shall be clearly marked as to brand and model/part description (verified materials), or shall be accompanied by supplier's certification as to brand and model/part description (copy attached).

The Contractor will:

1.) Install materials QUALIFIED by the inspector during INITIAL SUBMITTAL and APPROVED by TSSU .
2.) Install materials per plan and specification.

The CTSI Inspector will:

1.) Verify installed materials match the contractor's INITIAL SUBMITTAL.
2.) Coordinate with TSSU and Agency Electricians to INSPECT & ACCEPT materials installed.
3.) Coordinate with Region Traffic to approve audible pedestrian signal message.

TSSU or Agency Electricians will:

1.) Verify and document installed materials match the contractor's INITIAL SUBMITTAL and are installed per plan and specification.
2.) When each specific material has been entirely inspected and accepted on the project, fill out the "TSSU INITIAL CHAMBER TESTING" info and the "INSPECTED & ACCEPTED ON PROJECT" info for each specific material page.

Region Traffic will:

1.) If project specifies audible pedestrian signals, verify all messages are correct and fill out the "REGION TRAFFIC PE INSPECTED & ACCEPTED" info.

ITS Projects: The above instructions do not apply to ITS PROJECTS and the category "ITS Cabinet & Subassemblies". The initial submittal is reviewed and approved by the Engineer or Record. The inspection and acceptance is done by the Engineer of Record or ITS Tech. Write-in Items not allowed for ITS PROJECTS, follow 00960.02 instead.

CONTROLLER CABINET & EQUIPMENT (Chamber Tested)

- ☐ Controller Cabinet
- ☐ Controller
- ☐ Conflict Monitor
- ☐ Load Switch
- ☐ Flasher
- ☐ Detector Amplifer
- ☐ Isolator (DC & AC)
- ☐ Relay (FTR) Generic Model 430
- ☐ Preemption Interface
- ☐ Preemption Detector (Field Device)
- ☐ GPS Time Sync Module

CONTROLLER CABINET & EQUIPMENT (Non-Chamber Tested)

- ☐ Battery Backup Systems
- ☐ Communications Bracket
- ☐ Fiber Optic Connection Patch Panel

VIDEO/RADAR/HYBRID DETECTION SYSTEMS (Chamber Tested)

- ☐ Video Detection System
- ☐ Hybrid Video/Radar Detection System
- ☐ Radar Detection System

FIELD DEVICES (Non-Chamber Tested)

- ☒ Audible Pedestrian Signal

BEACON ASSEMBLIES (Non-Chamber Tested)

- ☐ 24/7 Flashing Beacon Assembly
- ☐ Actuated Flashing Beacon Assembly
- ☐ Rectangular Rapid Flashing Beacon (RRFB) Assembly
- ☐ Unintegrated Speed Feedback Assembly

ITS PROJECTS ONLY (Non-Chamber Tested)

- ☐ ITS Cabinet & Subassemblies

If there are any write-in items, the contractor will check this box. See next page for example.

WRITE-IN ITEMS (Includes ITS items)

☐ See last page for information

Green Sheets
Revised Dec 10, 2022

Page 2 of 3

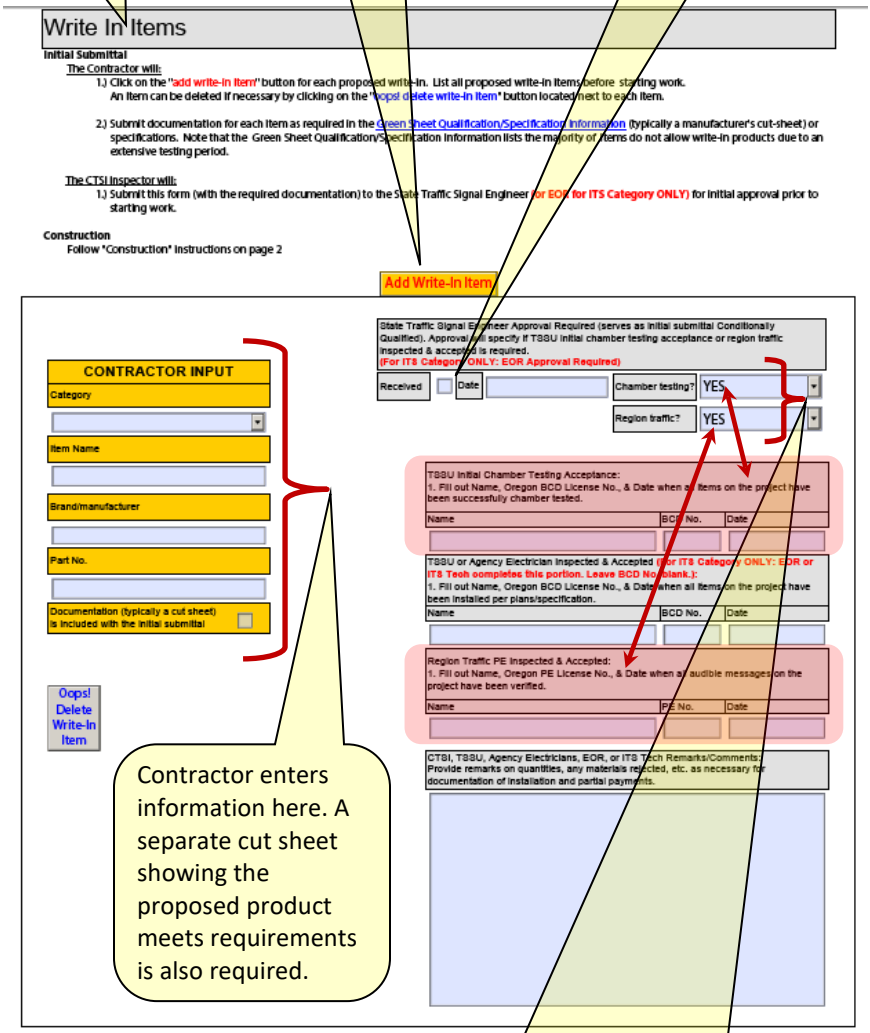
Contract No:

Always check the revision date - use the most current version

All write-in materials will be entered under this section.

Click this button to create a new material page for **each** write-in item.

State traffic signal engineer approval (via e-mail) is always required PRIOR TO INSTALLATION for all write-ins.



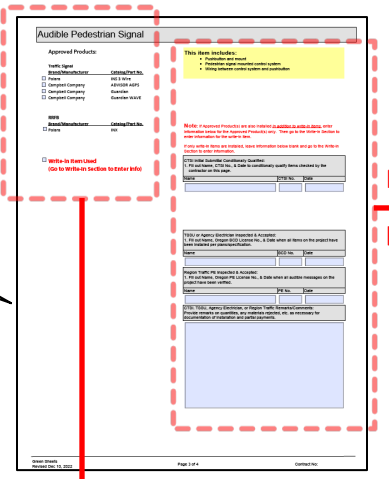
Contractor enters information here. A separate cut sheet showing the proposed product meets requirements is also required.

The approval will indicate if chamber testing is required and if region traffic approval is required. If not required, the associated acceptance boxes (shaded red in this example) will disappear from the page.

Green Sheet Example

MATERIAL SPECIFIC PAGE

Material specific page example



Each material is listed in the title block

Audible Pedestrian Signal

Approved Products:

Traffic Signal

Brand/Manufacturer	Catalog/Part No.
☐ Polara	INS 3 Wire
☐ Campbell Company	ADVISOR AGPS
☐ Campbell Company	Guardian
☐ Campbell Company	Guardian WAVE

RRFB

Brand/Manufacturer	Catalog/Part No.
☐ Polara	INX

☐ **Write-In Item Used**
(Go to Write-In Section to Enter Info)

All approved materials are listed for each sub-category (2 sub-categories shown: Traffic Signal and RRFB).

The contractor (NOT the CTSI) will check boxes for each product they intend to use on the project.

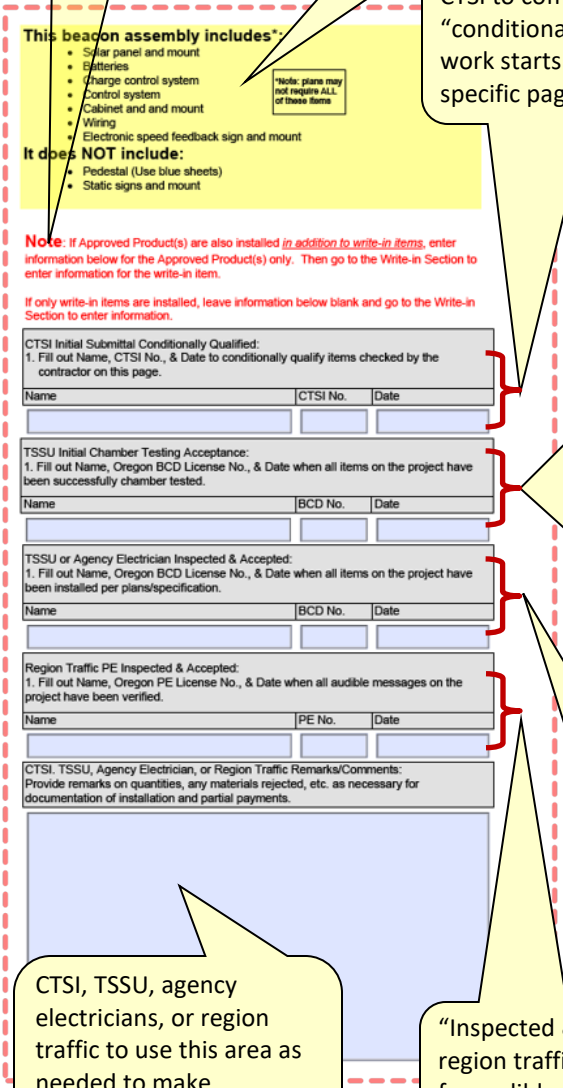
The CTSI will review this page. If it looks correct based on what is shown in the contract documents, fill out the "CTSI Initial Submittal Conditionally Qualified" box (See next page).

If a write-in item for this material is proposed, the contractor will check this box and follow instructions in the write-in section (See previous page).

Follow RED instructions for filling this info out if write-in items are installed.

If the material has additional components included, it will be listed in this yellow box.

CTSI to complete the "conditionally qualified" BEFORE work starts if the material specific page looks correct.



This beacon assembly includes*:

- Solar panel and mount
- Batteries
- Charge control system
- Control system
- Cabinet and and mount
- Wiring
- Electronic speed feedback sign and mount

*Note: plans may not require ALL of these items

It does NOT include:

- Pedestal (Use blue sheets)
- Static signs and mount

Note: If Approved Product(s) are also installed *in addition to write-in items*, enter information below for the Approved Product(s) only. Then go to the Write-in Section to enter information for the write-in item.

If only write-in items are installed, leave information below blank and go to the Write-in Section to enter information.

CTSI Initial Submittal Conditionally Qualified:
1. Fill out Name, CTSI No., & Date to conditionally qualify items checked by the contractor on this page.

Name	CTSI No.	Date

TSSU Initial Chamber Testing Acceptance:
1. Fill out Name, Oregon BCD License No., & Date when all items on the project have been successfully chamber tested.

Name	BCD No.	Date

TSSU or Agency Electrician Inspected & Accepted:
1. Fill out Name, Oregon BCD License No., & Date when all items on the project have been installed per plans/specification.

Name	BCD No.	Date

Region Traffic PE Inspected & Accepted:
1. Fill out Name, Oregon PE License No., & Date when all audible messages on the project have been verified.

Name	PE No.	Date

CTSI. TSSU, Agency Electrician, or Region Traffic Remarks/Comments:
Provide remarks on quantities, any materials rejected, etc. as necessary for documentation of installation and partial payments.

"Chamber Testing Acceptance" is completed by TSSU after the materials are tested and before they are installed. **NOTE: If this box is not visible for an item, then TSSU chamber testing as per 00990.70 (a) thru (e) is NOT required.**

"Inspected & Accepted" is completed by TSSU or the agency electrician after the materials are installed, tested and activated in the field.

CTSI, TSSU, agency electricians, or region traffic to use this area as needed to make remarks/comments about the material/installation.

"Inspected & Accepted" for region traffic is ONLY visible for audible pedestrian signals. See Pg. 89

Controller Cabinet

DESCRIPTION

332S (signals) and 334 (ramp meters) are the typically used models, ground mounted.

USE

To house the control equipment that runs the traffic signal.

Non-louvered door for back of cabinet

Note: Louvered door (Front of the cabinet) shall be oriented as per the plan sheets

Typical Sources of Info:

Specs: 00990.11, 00990.12, 00990.60 & 00990.70

Std. Dwg: TM482

Plan Sheets: YES

Additional Installation Info: Pg. 200

Bubble Note(s) See pg. 213:

332S 334

DESCRIPTION

Model ATC. It is typically agency supplied via an anticipated item.

USE

To coordinate the operation of the traffic signal (i.e., the brain/computer).

Typical Sources of Info:
Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pgs. 122 & 200

Bubble Note(s) See pg. 213:

C
ATC

Conflict Monitor

DESCRIPTION

Plug-in component with diode card for the controller cabinet.

USE

To monitor the green and flashing yellow arrow indications (vehicle) and walk indications (pedestrian) to ensure conflicting movements are not serviced at the same time. Also monitors voltages. Any faults detected will immediately transition the signal operation to flash mode.

Typical Sources of Info:
Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

Load Switch

DESCRIPTION

Plug-in component for the controller cabinet output file.

USE

To power the vehicle and pedestrian indications in the field during normal operation.

Typical Sources of Info:

Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

Flasher

DESCRIPTION

Plug-in component for the controller cabinet output file.

USE

To power the vehicle indications in the field during flash mode.

Typical Sources of Info:
Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

Detector Amplifier

DESCRIPTION

Plug-in component for the controller cabinet input file.

USE

To detect the change in inductance when a vehicle moves over a loop detector and provide an input to the controller for each vehicle detection.

Typical Sources of Info:

Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

Isolator (DC and AC)

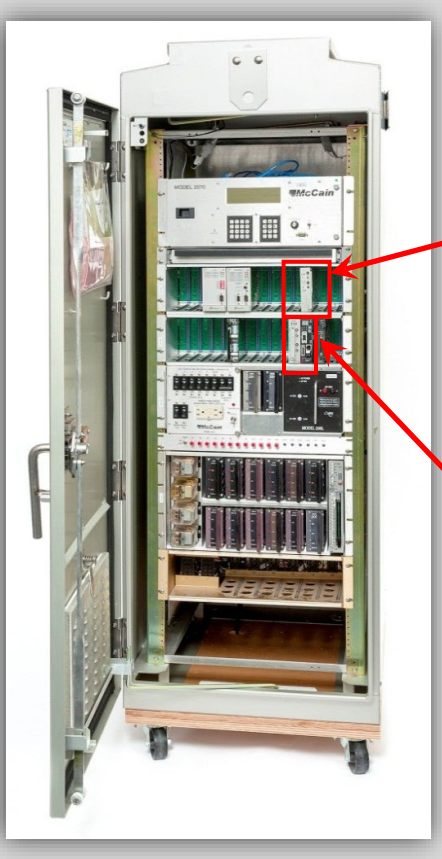
DESCRIPTION

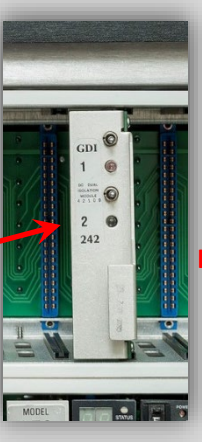
Plug-in components for the controller cabinet input file:

- Model 242 (24 VDC pedestrian push button)
- Model 252 (120 VAC railroad preemption, 332 cabinet only)
- Model 255 (120 VAC railroad preemption, 332S cabinet only).

USE

To detect when a pedestrian pushes a pushbutton or when a train is approaching and provides an input to the controller for each detection.





DC Isolator

AC Isolator

Typical Sources of Info:
Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

Relay (FTR)

DESCRIPTION

Plug-in component for the controller cabinet output file. FTR = flash transfer relay.

USE

To switch the power from the load switches (See Pg. 75) to the flashers (See Pg. 76).

Typical Sources of Info:
Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

Not Applicable

Preemption Interface (Cabinet)

DESCRIPTION

Plug-in component for the controller cabinet input file.

USE

To detect an emergency vehicle (that is using a preemption emitter in their vehicle) and provide an input to the controller for each detection.

Typical Sources of Info:

Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: Typically NO
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

FP

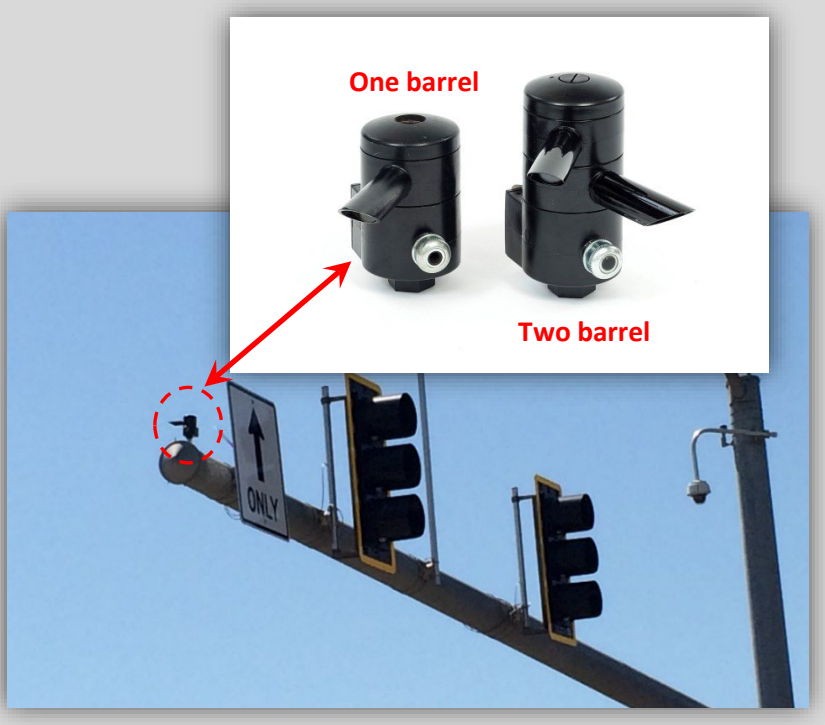
Preemption Detector (Field)

DESCRIPTION

Device that can detect an optical strobe pattern from an emergency vehicle (that is using a preemption emitter in their vehicle) plus additional system components. 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

To allow the appropriate traffic signal indications to change to green or remain green in response to an approaching emergency vehicle.



NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: NO
Std. Dwg: TM450 & TM456
Plan Sheets: YES
Additional Installation Info: Pg. 196

Bubble Note(s) See pg. 213:

FN Ch | FF Ch

GPS Time Sync Module

DESCRIPTION

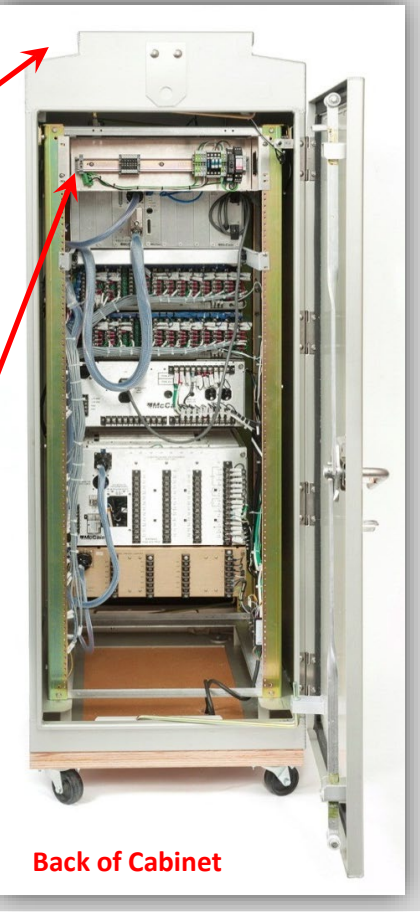
A device that provides a satellite-based time feed to the controller.

USE

To keep accurate time in the controller when the standard time feed (via frequency transmissions through powerlines) causes an unacceptable time drift. Accurate time is critical for data collection, performance measures, and coordinated signals.

Mounted outside:
On top of cabinet

Mounted inside:
In back of cabinet



Back of Cabinet

Typical Sources of Info:
Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

GPS

Battery Back-up System

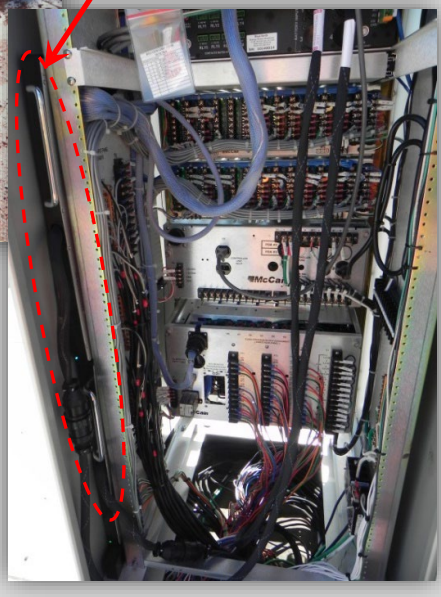
DESCRIPTION

A battery system either in a separate stand-alone cabinet or located entirely within the controller cabinet (fits between the controller cabinet shell and rack mount).

USE

To provide power to the traffic signal when commercial power is out.

Stand-alone system



332S Integrated system

Typical Sources of Info:
Specs: 00990.11 & 00990.12
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

BAT

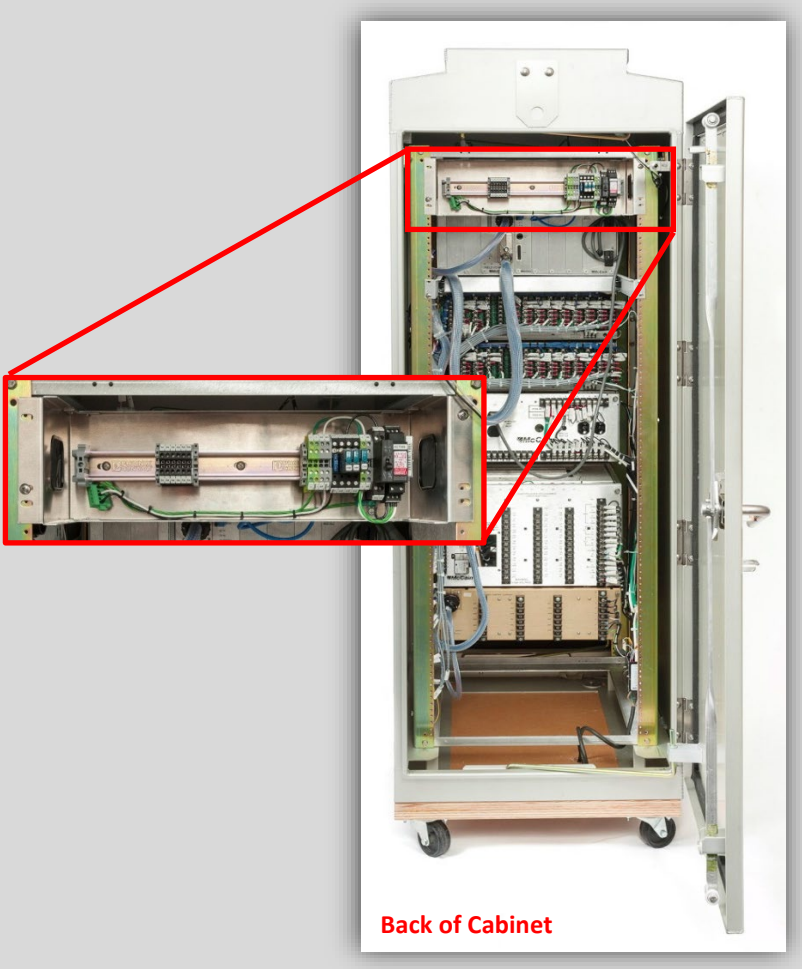
Communications Bracket

DESCRIPTION

Mounting assembly with a din rail.

USE

To mount communication equipment inside the controller cabinet.



Typical Sources of Info:

Specs: 00990.11, 00990.12 & 00990.70
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

DIN C DIN F

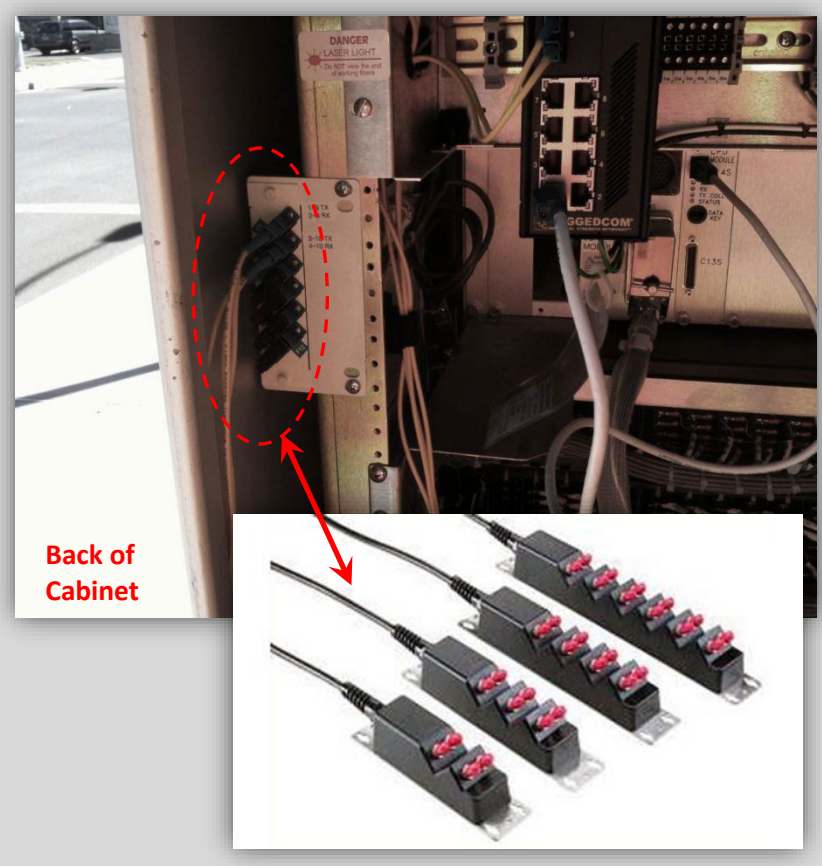
Fiber Optic Connection Patch Panel

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

Bubble Note(s) See pg. 213:

Not Applicable

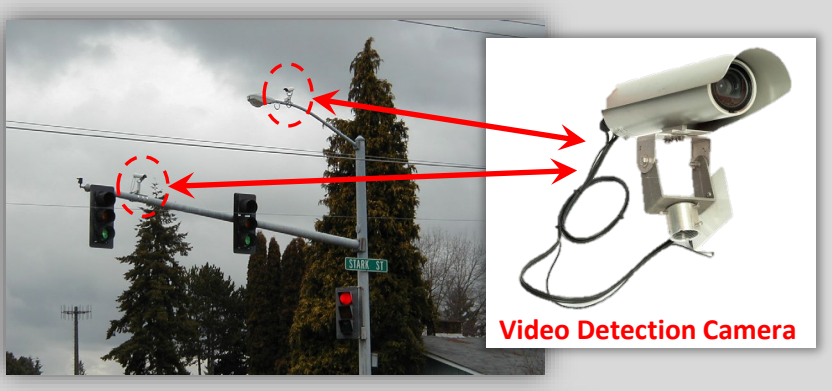
Video Detection System

DESCRIPTION

Camera mounted to mast arm or luminaire arm plus additional system components.

USE

To detect when a vehicle/ped/bike enters the user-defined detection zone and provide an input to the controller for each detection.



NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: 00990.30
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 194

Bubble Note(s) See pg. 213:

CAM T VDF T

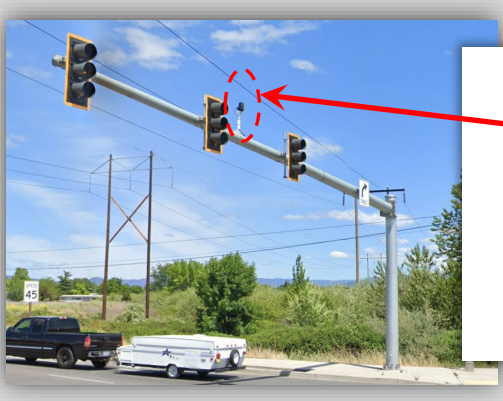
Hybrid Video/Radar Detection System

DESCRIPTION

Hybrid unit mounted to mast arm or luminaire arm plus additional system components.

USE

To detect when a vehicle/ped/bike enters the user-defined detection zone and provide an input to the controller for each detection.



Hybrid detector unit

Hybrid detector unit

NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: 00990.30
Std. Dwg: TM466
Plan Sheets: YES
Additional Installation Info: Pg. 194

Bubble Note(s) See pg. 213:

HVR / T VDF / T

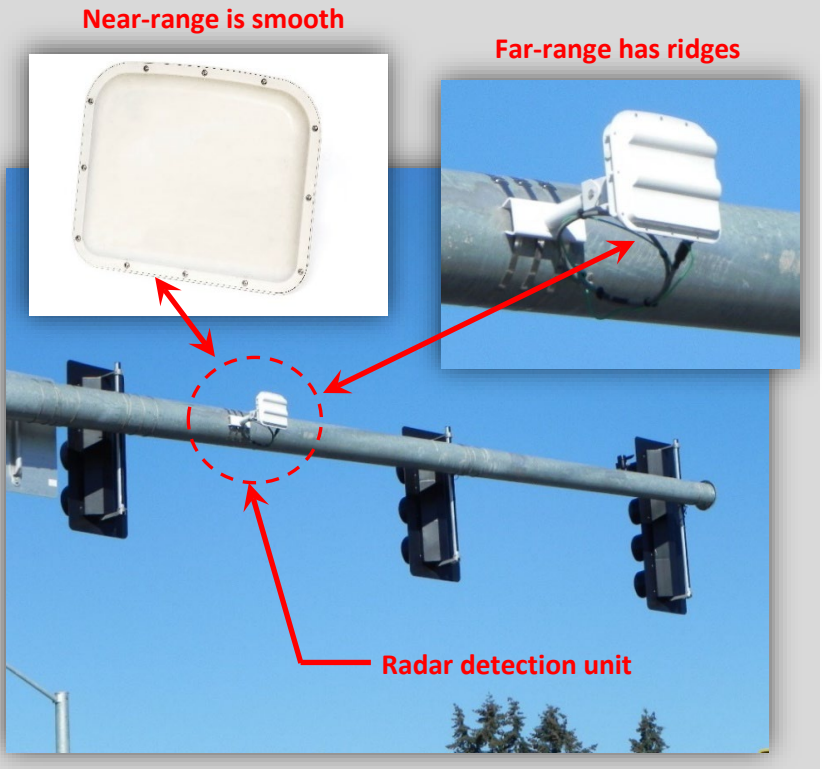
Radar Detection System

DESCRIPTION

Radar unit mounted to mast arm or luminaire arm plus additional system components.

USE

To detect when a vehicle/ped/bike enters the user-defined detection zone and provide an input to the controller for each detection.



NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: 00990.30
Std. Dwg: TM466
Plan Sheets: YES
Additional Installation Info: Pg. 194

Bubble Note(s) See pg. 213:

R–S / T | R–F / T | R–N / T | RCC / T

DESCRIPTION

Audio unit within pushbutton plus additional system components. **This item also has an additional installation approval required by region traffic (to verify the message used is correct).**

USE

To provide audible information about the pedestrian phase for sight impaired pedestrians.

Audible feature is contained within the pushbutton frame

Sign installs over the top:

- **Sign R10-3 is for traffic signals (shown below)**
- **Sign R10-25 is for RRFBs**

NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: NO
Std. Dwg: TM467
Plan Sheets: YES
Additional Installation Info: 176, 178, & 208

Bubble Note(s) See pg. 213:

P/A Ph | A Ph | PAH

24/7 Flashing Beacon Assembly

DESCRIPTION

Solar powered flashing beacon(s) mounted with a sign plus additional system components. Beacon(s) will flash continuously all day, every day. Sub-categories include:

- Red beacon (STOP sign application)
- Yellow beacon (warning sign application)
- Yellow beacon + speed feedback (curve warning sign application)

USE

To enhance the conspicuity of a sign.

NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 208

Bubble Note(s) See pg. 213:

FB R | FB Y | FB YF

Actuated Flashing Beacon Assembly

DESCRIPTION

Solar flashing beacon(s) mounted with a sign plus additional system components. Beacon(s) will flash only when actuated via detection or time-of-day/day-of-week programming. Sub-categories include:

- Bike/Ped (bridge application)
- School (school speed limit sign application)
- School + speed feedback (large and small sign applications)

USE

To indicate when a bike/ped is on the bridge or when the school speed limit is in effect.

Bike/Ped

School

School + speed feedback (Integrated)

NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:

Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 208

Bubble Note(s) See pg. 213:

AB P | AB SZ N | AB SZF N

Rectangular Rapid Flashing Beacon (RRFB) Assembly

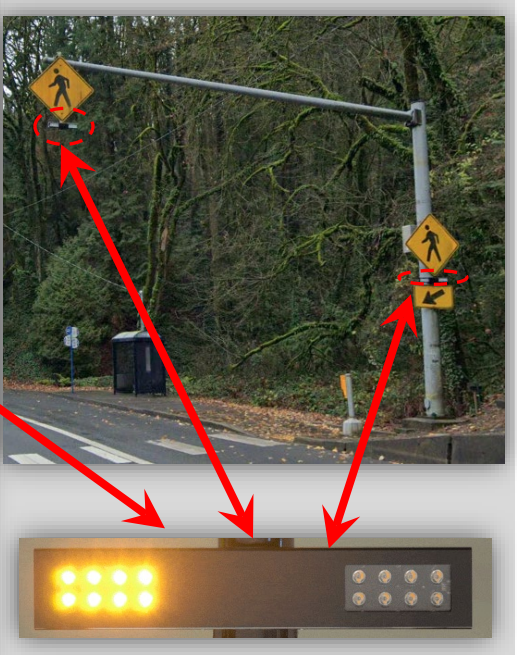
DESCRIPTION

Rectangular rapid flashing beacon mounted with a pedestrian/trail/school crossing sign plus additional system components. Beacon(s) will flash only when actuated via detection.

May be solar or commercial power (typically mounted on a pedestal or mast arm).

USE

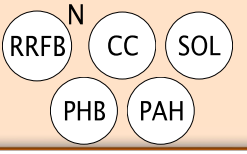
To indicate a pedestrian is in or wants to use the crosswalk.



NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: NO
Std. Dwg: TM493
Plan Sheets: YES
Additional Installation Info: Pg. 208

Bubble Note(s) See pg. 213:



Unintegrated Speed Feedback Assembly

DESCRIPTION

Stand-alone speed feedback installed below a speed limit sign or curve warning sign plus additional system components. Sub-categories include:

- Small (<45 mph application)
- Large (≥45 mph application)

Solar power only and mounted on a pedestal.

Note: speed feedback signs that also have a flashing beacon (See pgs. 90 and 91) are integrated and use one control system – they are NOT an unintegrated speed feedback assembly.

USE

To provide emphasis of the speed limit or curve warning sign plus information the driver can use to adjust their speed to the required or recommended speed.

NOTE: See the green sheets for all included components (cable, mounts, etc.)

Typical Sources of Info:
Specs: 00991
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: Pg. 208

Bubble Note(s) See pg. 213:

USF

ITS Cabinet & Subassemblies

DESCRIPTION

Controller cabinets used for ITS applications (Remote weather information stations (RWIS), variable message signs (VMS), weigh-in-motion, etc.). Sub-categories include:

- 340 ITS cabinet, 4 door, empty shell (ground mounted)
- 342 ITS cabinet, 2-door, empty shell (ground mounted)
- 346 ITS cabinet (pole mounted)

USE

To house the control equipment that runs the ITS device(s).

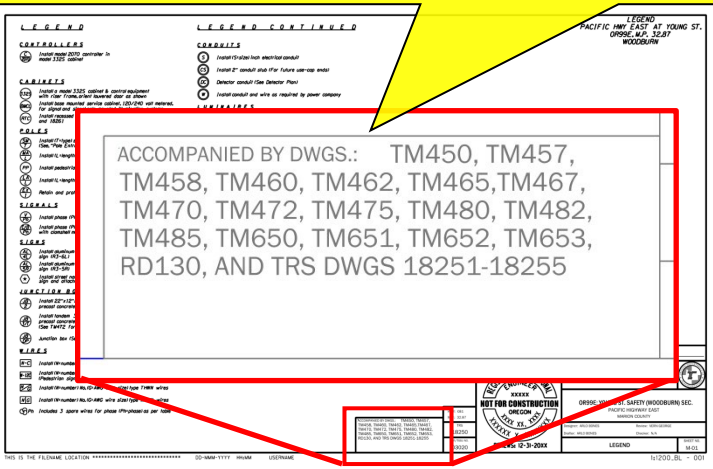
Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Additional Installation Info: NO

Bubble Note(s) See pg. 213:

340 342 346

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.



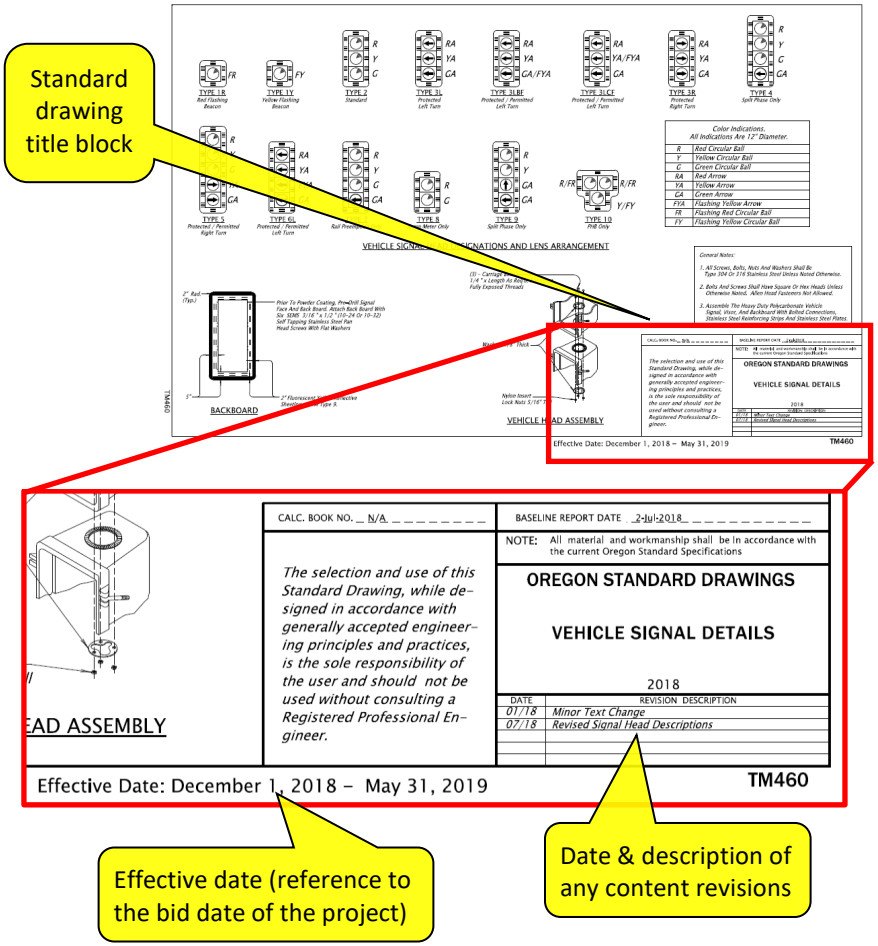
The applicable standard drawings are part of the contract plans, but they are also available online.

* Website links & QR scan codes provided starting on Pg. 227

Standard Drawing List (Traffic Signal Related)

TM200 SERIES - PERMANENT SIGNING	
TM240	Crosswalk Closure Detail
TM400 SERIES - SIGNALS	
TM450	Mast Arm Pole Details
TM452	Temporary Wood Strain Pole Details
TM453	Temporary Pedestrian Wood Post, Guy Wire/Anchor, & Luminaire Arm Details
TM454	Temporary Controller Cabinet, Service Cabinet, Meter Base, & Terminal Cabinet
TM456	Temporary Spanwire Mounting Details For Vehicle Signals, Signs & Fire Preemption
TM457	Pedestal Foundation and Traffic Signal Assembly
TM460	Vehicle Signal Details
TM462	Vehicle Signal Bracket & Sign Bracket (Type B) Details
TM466	Radar Mounting Details
TM467	Pedestrian Signal Mount and Pedestrian Pushbutton Details
TM470	Wire & Cable Installation
TM471	Trenching & Conduit Installation
TM472	Junction Boxes/Hand Holes
TM482	Controller Cabinet & Service Cabinet Foundation Details
TM485	Service Cabinet Wiring Details
TM492	Ramp Meter Assemblies
TM493	Rectangular Rapid Flashing Beacon (RRFB) Assemblies
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
TM654	Traffic Signal Recessed Terminal Cabinet
TM655	Traffic Signal 60’ through 75’ Mast Arm Supports General Details & Design Criteria
TM656	Traffic Signal 60’ through 75’ Mast Arm Supports Notes
TM657	Traffic Signal 60’ through 75’ Mast Arm Supports Steel Details (SH. 1)
TM658	Traffic Signal 60’ through 75’ Mast Arm Supports Steel Details (SH. 2)
TM800 SERIES - TEMPORARY TRAFFIC CONTROL	
TM870	Bridge Construction (Using signals, 1 lane, 2-way operation)

Standard drawings are updated twice a year, once in January and once in July. The effective date of the standard drawings 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 standard drawing report* (formally known as the baseline report) for each drawing provides detailed info on content and all content changes.



Always check the standard drawings for content changes prior to use

* Website links & QR scan codes provided starting on Pg. 227

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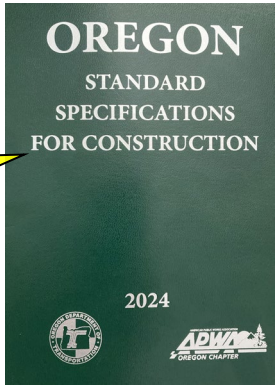
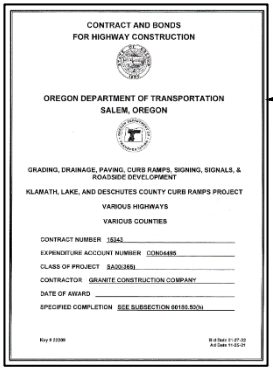
Specifications and Special Provisions

Standard specifications* are contained in a published book that is updated roughly every 3 to 10 years. Each edition of the standard specifications lists the year that it is produced for easy identification.



Current edition is 2024 (projects bid on or after Dec. 1, 2023). Previous edition is 2021.


CONTRACT AND BONDS
FOR HIGHWAY CONSTRUCTION

OREGON DEPARTMENT OF TRANSPORTATION
SALEM, OREGON

GRADING, DRAINAGE, PAVING, CURB RAMPS, SIGNING, SIGNALS, & ROADSIDE DEVELOPMENT
KLAMATH, LAKE, AND DESCHUTES COUNTY CURB RAMPS PROJECT
VARIOUS HIGHWAYS
VARIOUS COUNTIES

CONTRACT NUMBER 16343
EXPENDITURE ACCOUNT NUMBER CON04495
CLASS OF PROJECT SA(003455)
CONTRACTOR GRANITE CONSTRUCTION COMPANY
DATE OF AWARD
SPECIFIED COMPLETION SEE SUBSECTION 00150.50(h)

Key # 21006

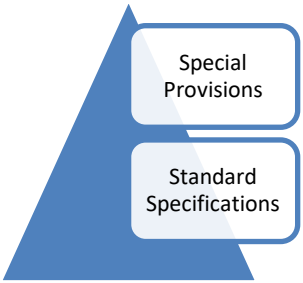
Bid Date 11-07-23
Aid Date 11-05-24

Project specific special provision

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 produces the special provisions for each project from special provision boiler plates*.

Special provisions are typically used to:

- Correct typos, errors, or omissions
- Add unique features to project (e.g., ornamental pole treatments)
- Delete information that is not relevant to the project
- Limit construction methods or materials that may be used
- Make a change in standards before the next standard specification publication



The order of precedence stated in 00150.10(a) lists a hierarchy of contract documents in the event that they conflict. 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.

Always carefully read the special provisions for your project

* Website links & QR scan codes provided starting on Pg. 227

Specification Sections (Traffic Signal Related)

The specifications are organized by sections. The main specification sections related to traffic signals are shown below.

These sections will reference other specification sections as necessary to complete certain components of the work. For example, 00960.43 requires installation of commercial grade concrete for pedestals, posts, and cabinets as per sections 00440 and 00540.48(a).

SPECIFICATION SECTION & TITLE	
00227	Temporary Traffic Signals and Illumination
00902	Crosswalk Closure Supports
00921	Major Sign Support Drilled Shafts (mast arm poles with mast arms 60'-75')
00950	Removal of Electrical Systems
00960	Common Provisions for Electrical Systems
00962	Metal Illumination & Traffic Signal Supports
00963	Signal Support Drilled Shafts (mast arm poles with mast arms 55' or less)
00970	Highway Illumination
00990	Traffic Signals
00991	Unintegrated Speed Feedback Assembly

Note: The ITS unit doesn't have standard specifications, but has several specific special provision sections: 00965, 00984, 00985, 00987, and 00989.

Specification Divisions

Each section of the specifications is further organized by divisions to make information retrieval easier. There are ten divisions:

SPECIFICATION DIVISION & DESCRIPTION		
XXXXX.00	Description	Work scope and definitions
XXXXX.10	Materials	Material properties and testing requirements
XXXXX.20	Equipment	Unique equipment requirements
XXXXX.30	Labor	Unique labor requirements/qualifications
XXXXX.40	Construction	Sequence of construction and end product requirements
XXXXX.50	Temporary	Unique temporary requirements
XXXXX.60	Maintenance	Maintenance and repair responsibilities
XXXXX.70	Finishing and Clean-up	Restoration responsibilities and warranties
XXXXX.80	Measurement	Measurement requirements for each bid item
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:

00440.12 Properties of Commercial Grade Concrete - Furnish a workable CGC mixture that is uniform in composition and consistency, and unless otherwise shown or specified, has the following characteristics:

- **Entrained Air** - 4.0 to 7.0 percent
- **Slump** - 5 inches or less
- **Compressive Strength** - Minimum 3,000 psi at 28 days
- **Temperature** - Minimum 50 F to maximum 90 F

+

Special Provision:

00440.12 Proportions of Commercial Grade Concrete - Replace the bullet that begins "Compressive strength…" with the following bullet:

- **Compressive Strength** - ASTV minimum of 3,000 psi at 28 days

=

Combining The Two = Complete & Useable Specification on Project:

00440.12 Properties of Commercial Grade Concrete - Furnish a workable CGC mixture that is uniform in composition and consistency, and unless otherwise shown or specified, has the following characteristics:

- **Entrained Air** - 4.0 to 7.0 percent
- **Slump** - 5 inches or less
- **Compressive Strength** – ASTV Minimum 3,000 psi at 28 days
- **Temperature** - Minimum 50 F to maximum 90 F

This special provision provides additional clarification for the compressive strength requirements:
ASTV = Actual Strength Test Value

Note: Specification numbers referenced in this manual may be located in the two documents as follows:

- ONLY in the standard specifications,
- ONLY in the special provisions, or
- In BOTH locations (00440.12 as shown above is an example of being located in both documents).

Because both documents are needed on a project and it is common for a specification number to be in both locations, this manual doesn't distinguish where a particular specification number may be located. **Always check both!**

Measurement and Payment

Read the specification divisions XXXXX.80 and XXXXX.90 to determine what IS and ISN'T included in the bid item to ensure proper payment.

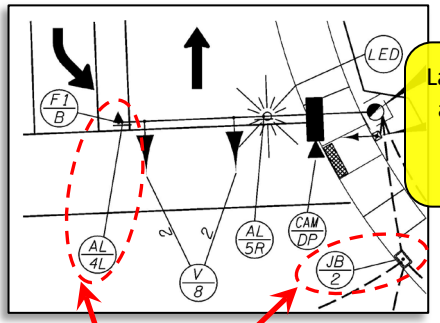
Bid Item	Spec. No.	Measurement (XXXXX.80)	Payment (XXXXX.90)
Temporary Traffic Signal	00227	None	Lump Sum (per specific intersection)
Portable Temporary Traffic Signal	00227	Unit	Each
Temporary Flashing Beacons	00227	None	Lump Sum (per specific intersection)
Crosswalk Closure Supports	00902	Unit	Each
54" Diameter Sign Support Drilled Shaft Foundation *(only for poles with mast arms 60'-75')*	00921	Length	Foot
Removal of Electrical Systems (method "A")	00950	None	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)
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)
Unintegrated Speed Feedback Assembly	00991	Unit	Each

The plan sheets will also **detail** or **reference** certain items to clarify which bid item they belong to. For example, if a signal plan sheet details an item, that item is included in the traffic signal lump sum bid item. If a signal plan sheet only references an item, that item is NOT included in the traffic signal lump sum bid item. See illustration on next page for examples.

Anticipated items are also commonly used for traffic signal work. Typical anticipated items include the electrical power hook-up and agency furnished items (e.g., ATC controllers, and ITS/communication equipment).

DETAILED

All info necessary to fabricate and install the item is included



Lane use signs are typically detailed on signal plans

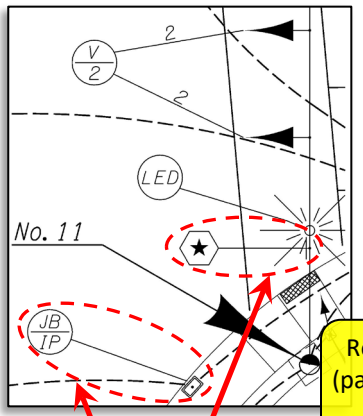
Detailed items (both paid under traffic signal lump sum bid

JB 2 — *Install 22"x12"x12" (min. dimension) precast concrete or hybrid junction box*

AL 4L — *Install aluminum (30"x36") left and through arrow sign (R3-6L) ASTM type IX sheeting*

REFERENCED

Details for fabrication or installation are only referenced



Street name sign are typically referenced on signal plans

Referenced item (paid under signing bid items)

Referenced item (paid under interconnect system lump sum bid item)

★ — *See signing plans for details on sign and attachment*

JB IP — *Junction box (See Interconnect Plan)*

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Construction & Installation

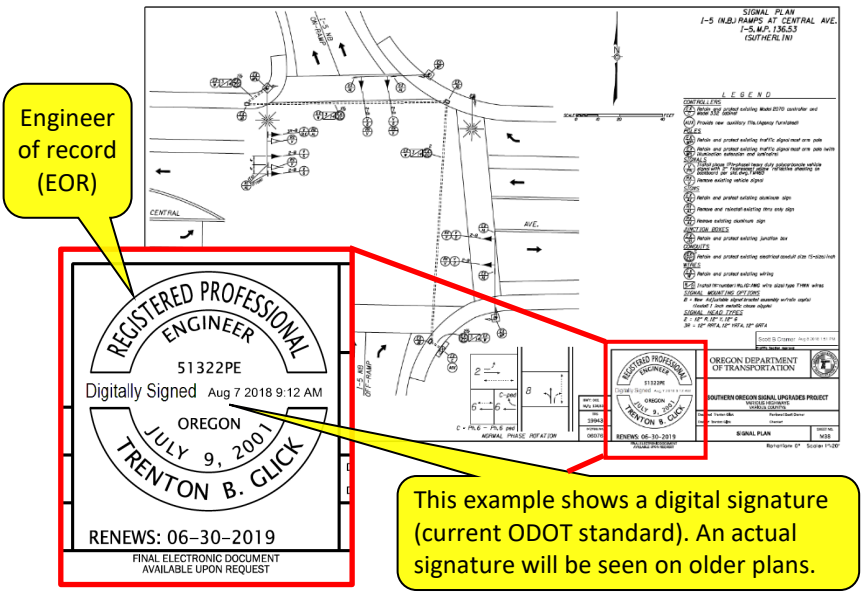
This section highlights fundamental information of a traffic signal installation. The information is grouped by type of work and presented in the order of a typical traffic signal construction sequence (see pg. 108).

Use this section in conjunction with the contract documents for your project (e.g., standard specifications, special provisions, project specific plan sheets, and standard drawings). It is intended to help to familiarize, refresh knowledge, and prepare for field inspection duties by using a uniform, user-friendly format with comprehensive contract document cross-referencing. The format is structured as follows:

- Key Enforceable Items
- Tips and Tricks (extra info for more context, potential pitfalls, and/or guidance for a successful, hassle-free installation)
- Inspector Action
- Typical Sources of Info
- Illustrations

Changes to the Plans and Specifications

Any changes made in the field are subject to the approval of the **ENGINEER OF RECORD (EOR)**. The CTSI should note any changes as they occur, as it will make processing the as-constructed drawings easier and more accurate (see pg. 204).



Coordination & Supplemental Inspection

The CTSI will coordinate supplemental inspections and key milestones, as shown in the table on the next page, with the appropriate personnel:

ODOT Region Traffic*	•Responsible for the signal timing and operation of the traffic signal •See pg. 111 for contact information
ODOT Agency Electricians*	•Responsible for the power cost and maintenance of the traffic signal •See pg. 111 for contact information
ODOT Traffic Systems Services Unit (TSSU)*	•Responsible for the initial chamber testing of the controller cabinet (and components) and installation of the components during signal turn-on •See pg. 110 for contact information
Electrical Permitting Agencies (Building Codes Division, City, or County)	•Responsible for permitting and inspecting electrical work •See pg. 112 for more information

*** The Local Agency** (city or county) may provide these services via an inter-governmental agreement (IGA). Verify who is responsible for the maintenance and signal timing with the appropriate region traffic contact.

During the pre-construction conference determine which supplemental inspections apply to your specific project based on the work shown and if additional coordination or supplemental inspections are desired by region traffic or agency electricians.

Supplemental Inspections & Key Milestones		When to Request Coordination	Contact (See pgs. 110 & 111)	Advance Notice	More Info
1	Temporary Stage Adjustments **00227.62**	At anticipated stage change	Agency Electricians & TSSU	1 to 2 weeks	Pgs. 116 & 122
2	Pole & Controller Layout Inspection	After radii are laid out and pole and controller locations are staked	Region Traffic & Agency Electricians	3 days	Pg. 134
3	Conduit in Foundation Inspection	After forms and conduits are in place, but before foundations are poured	Agency Electricians	3 to 5 days	Pg. 136
4	Conduit & Backfill Inspection **TM471**	During conduit installation, but before backfill	Agency Electricians	3 days	Pgs. 152 & 154
5	Power Service Inspection **00960.46**	After service cabinet has been installed	Electrical Permitting Agency	As per the permit	Pg. 166
6	Loop Layout Inspection **00990.41(a)**	After crosswalks and loops are laid out, but before sawcutting begins	Region Traffic	3 days	Pg. 184
7	Loop Installation Inspection **00990.41(a)**	After sawcutting, but before loop wire is installed	Agency Electricians	3 to 5 days	Pg. 184 & 186
8	Video/Radar On-Site Set Up **00990.30**	At anticipated signal completion date	Agency Electricians	1 week	Pg. 194
9	**Field Testing Inspection 00990.70(g)**	**At anticipated signal completion date**	**Agency Electricians & TSSU**	**1 to 2 weeks**	**Pg. 202 & 208**
10	Pre-Signal Turn-On Inspection	At anticipated signal completion date	Region Traffic	1 to 2 weeks	Pg. 202
11	**Signal Turn-On (new signal) 00990.70(h) -or- Activating New Equipment (existing signal modification) 00990.40**	**At anticipated signal completion date (Note: contingent on completion of corrections identified during the field testing inspection)**	**Region Traffic, Agency Electricians & TSSU**	**1 week**	**Pg. 202 & 208**
12	**Final Inspection 00150.90**	**After punch list items have been completed**	**Region Traffic & Agency Electricians**	**3 to 5 days**	**Pg. 204**

Yellow = Required by the contract documents
Bold Red = Apply to ALL projects, regardless of scope of work
White = Recommended. May vary according to region specific procedures

General Sequence for Constructing a Traffic Signal

The basic activities and sequence for installing a traffic signal is detailed below and on the next page to help the CTSI prepare and plan ahead for coordination. **Bold red items correspond to the supplemental inspections shown on the previous page**. A linear progression is shown, but some items could be constructed at the same time. Always refer to the contractor's schedule and prepare to inspect accordingly.

PRIOR TO CONSTRUCTION

- Attend pre-construction conference
- Obtain contractor's schedule
- Prepare field inspection forms for poles
- Review blue and green sheets – obtain initial approval if write-in items are proposed
- Submit pole shop drawings for structural review (ordering poles typically requires 3 to 6 month lead time)
- Obtain labor certifications (electricians)
- Obtain electrical permit
- Request utility locates

INSTALLATION OF TRAFFIC SIGNAL:
LOCATES, FOUNDATIONS, CONDUITS, & JUNCTION BOXES

- Submit initially approved green sheet items to TSSU for chamber testing (6 weeks minimum for testing)
- 2 • **Locate foundations (poles, pedestals, service and controller cabinet foundation)**
- Rough locate junction boxes and conduit trenches
- Excavate for foundations
- Install re-enforcing steel cage and anchor rod assembly (typically fabricated off-site)
- 3 • **Install conduits and ground rods that will be inside of the foundation**
- Pour concrete for foundations
- 4 • **Excavate conduit trenches, install conduit, & backfill conduit trenches**

Next Page

INSTALLATION OF TRAFFIC SIGNAL: EQUIPMENT INSTALL, WIRING, POWER SERVICE

- Install poles on foundations
- Install mast arm or messenger cable on pole: equipment on arm or span may already be installed off-site
- Install equipment on poles/mast arms/span wire and install tether cable
- Install service cabinet and controller cabinet
- 5 **Electrical inspection/approval for power**
- Coordinate power hook-up with power company
- Install junction boxes, except junction boxes with loop wire entrances
- Install wiring in poles/pedestals/cabinets/junction boxes and conduits

INSTALLATION OF TRAFFIC SIGNAL: DETECTION SYSTEM

LOOPS

- 6 **Locate loop detection on pavement**
- Install loop wire entrance and junction box
- 7 **Sawcut for loop detection**
- Install loop wire and test
- Seal loop wire and test
- Splice loop wire to loop feeder cable and test

VIDEO/RADAR

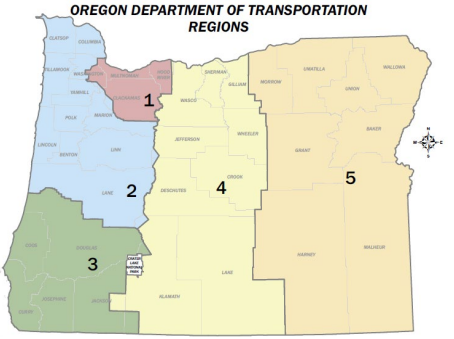
- 8 **Coordinate video/radar set-up**

INSTALLATION OF TRAFFIC SIGNAL: FINISHING TOUCHES, SIGNAL TURN ON

- 9/10 **Coordinate with others for scheduling signal turn-on**
- **Agency electricians perform field testing inspection**
- Address all punch list items from the field testing inspection
- 11 **Signal turn–on**
- Approve and process QA/QC documents (blue/green sheets, FIR, etc.)
- 12 **Final inspection**

Contacts

ODOT Statewide Contacts		
Discipline	**Name**	**Phone**
Traffic Standards	Kevin Haas, P.E. Traffic Standards Manager	(503) 986-3583
Traffic Signal Standards	Scott Cramer, P.E. State Traffic Signal Engineer	(503) 476-7849
	Barby Golden, Electrician Traffic Signal Standards Specialist	(503) 932-1483
	Sarah McCrea, P.E. Traffic Control System Engineer	(971) 375-0049
	Katie Johnson, P.E. Traffic Signal QC Engineer	(503) 302-7853
Traffic Structures	Scott Jollo, P.E. Traffic Structures Engineer	(503) 510-2204
Illumination	Ernest Kim, P.E. Illumination Engineer	(503) 476-7941
Signal Timing	Chris Primm, P.E. State Traffic Operations Engineer	(503) 400-4293
TSSU (electrical)	Laura Wilson Signal Unit Manager	(503) 383-8082
	Reggie Holcomb Lead Technician	(971) 345-1839
	Janelle Woodring TSSU Project Manager	(971) 374-3809
	Maegan Allenby Office Coordinator	(503) 378-2913
ATR sites	Paul Tiller Automatic Traffic Recorder Specialist	(541) 388-6119
ITS Unit	Doug Spencer, P.E. ITS Standards Engineer	(503) 856-6528
ODOT Rail	John Brown FRA Certified Rail Inspector	(503) 949-9582
	Bryon Alger FRA Certified Rail Inspector	(541) 213-1624



ODOT Region Contacts			
Region	**Discipline**	**Name**	**Phone**
1 **Dispatch:** **(503) 283-5859**	Agency Electricians	Terry Carlson – Manager	(503) 572-1826
		Lisa DeMers – Signals & Ramp Meters	(503) 969-1024
		Eric Richardson - Illumination	(503) 969-1027
	Region Traffic	Mark Rahman – Signals, Central	(971) 284-9767
		Aiman Mahmoud – Signals, East	(503) 798-8316
		Brian Sloane – Signals, West	(503) 302-0476
		Phuong Nguyen – Ramp Meters	(503) 731-3004
2 **Dispatch:** **(503) 362-0457**	Agency Electricians	Billy Kelso - Manager	(503) 602-2897
		Martin Lemas – District 1 (Astoria)	(503) 302-4636
		Scott Carriger– District 3 (Salem)	(503) 932-1481
		Jarrett Clark– District 4 (Albany)	(971) 707-0331
		Brian Parks – District 5 (Eugene)	(541) 953-6967
	Region Traffic	Jamie Schmidt, P.E. – Ops. Engr.	(971) 208-4095
		Darren Lawrence – District 4	(971) 599-9419
		Nick Schlotthauer – Districts 1 & 5	(503) 779-7667
		Derek Gustafson – District 3	(971) 707-2726
3 **Dispatch:** **(541) 858-3103**	Agency Electricians	Chris Emerson – Manager	(541) 294-8031
		Brian Henry - Roseburg	(541) 580-8532
		Bret Leslie - Coos Bay	(541) 290-0404
		Curt Duncan- Grants Pass	(541) 471-3800
		Ty Sonnen – Central Point	(541) 324-0913
	Region Traffic	William Fitzgerald, P.E.	(541) 315-8997
4 **Dispatch:** **(541) 383-0121**	Agency Electricians	Brad Stevens	(541) 480-4328
		David Beanland – Klamath Falls	(541) 887-9293
	Region Traffic	Jason Briedis, P.E.	(541) 215-9517
		Ben Fuller	(541) 224-3994
5	Agency Electricians	Mark Herburger - North	(541) 969-6554
		Kevin Daughdrill – South	(541) 881-6390
	Region Traffic	Tyson Tinnes	(541) 805-6167

Electrical Permits

Electrical permits are required for **ANY TYPE** of traffic signal work as per 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 exception 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 inspections as required by state law. Inspection is required before a new service cabinet can be energized. **Inspection protocol may vary based on the type of electrical work – all requirements will be clearly stated in the permit.**

The contractor must provide a copy of the permit(s) to the agency prior to installation (00960.03). Pay close attention to the electrical permitting agencies' requirements and timelines. Failure to comply with permits will add significant time and cost to the project.

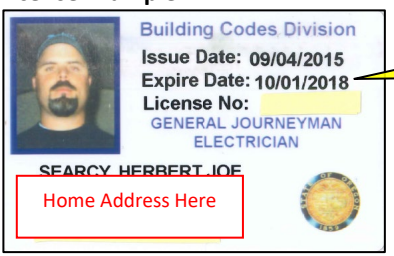
Labor Requirements

Every person engaged in the installation of electrical equipment/wiring shall possess a valid Oregon electrical license or registration (00960.30):

- General Supervising License. Will have an “S” at the end of the license no.
- General Journeyman’s License. Will have a “J” at the end of the license no.
- Electrical Apprentice Registration (must be working under the direct supervision of an individual with an electrical license)

Obtain a copy of the electrical license or apprentice registration at the pre-construction conference before any work is performed. 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. You can also search/look up electrical licenses online.*

License Example:



* Website links & QR scan codes provided starting on Pg. 227

Work That Requires an Electrical License

The following 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 signals
6. Install vehicle signals
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 trailer
6. Unload the arms from trailer
7. Unload light fixtures from trailer
8. Install arms on the poles
9. Install poles onto their bases
10. Uncrate pedestrian signals
11. Uncrate vehicle signals
12. Assemble pedestrian signals into an assembly, on the ground
13. Assemble vehicle signals 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

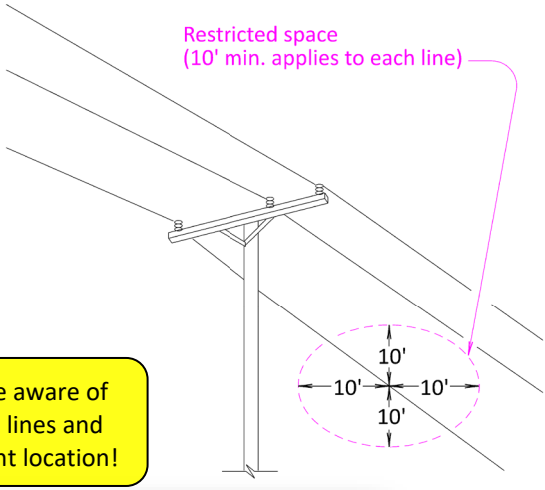
OAR 437-002-0047 (also known as "the 10 foot rule")

- **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. See illustration on next page.
  - 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.

DO NOT ENTER RESTRICTED SPACE
(unless requirements of OAR "10 foot rule" are met)



Always be aware of overhead lines and equipment location!

Temporary Staging & Work Impacting Existing Traffic Signals

Key Enforceable Items	
The existing signal cannot be removed until the temporary signal or new signal is operational.	00950.40
Existing signal equipment is removed or abandoned as shown on the plan sheets and as stated in the special provisions.	Plan Sheets & 00950.41

Tips and Tricks

Become familiar with the stage construction plans and the schedule of work so you can plan ahead and coordinate with others in a timely manner.

The signal may skip phases or have unreasonably long or short green times if the detection is not working properly. This can result in disobedience of the traffic signal and excessive congestion.

Long-term lane or road closures at a signal will typically require certain signal indications to be "bagged" (via temporary covers). 00221.40 requires any unnecessary or conflicting traffic control device be turned, covered, or removed.

Do not use temporary covers for vehicle or pedestrian signals that are active. The indication can still be seen with the cover on and has the potential to confuse users. Contact agency electricians or TSSU for assistance in disconnecting power to the indications prior to covering. See illustration on this page.

Inspector Action

Contact region traffic **in advance** of any work that may impact the proper functioning of the traffic signal. Common examples include (See illustrations on next page):

- 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 or opening of crosswalks
- Pushbuttons that will be temporarily inaccessible

Observe the traffic flow once the change is made.

Contact region traffic or agency electricians if you notice congestion or the signal not operating properly.

Coordinate a supplemental inspection (required) prior to temporary staging changes.	00227.62 & Page 107
Verify if any existing signal equipment is to be salvaged.	00950.42

When work will affect signal timing, contact region traffic for temporary timing solutions

Flagging at Signalized Intersections: Using the Police Panel

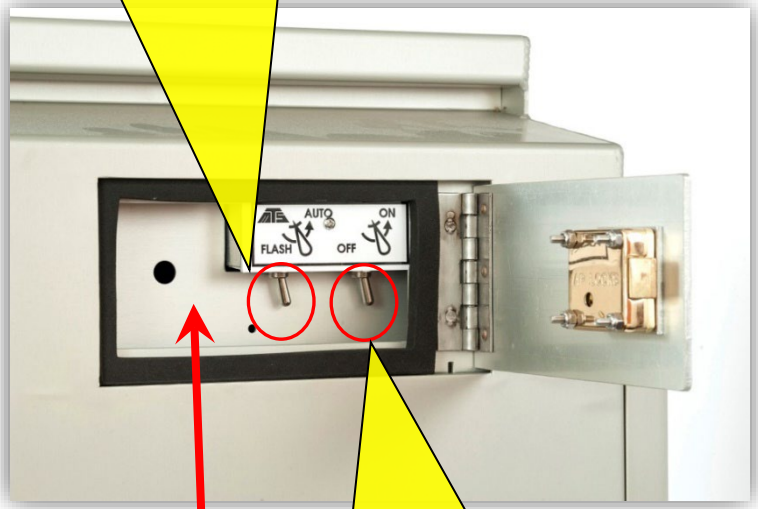
Key Enforceable Items	
Signals MUST be turned off during flagging operations.	Oregon Law: ORS 811.265 & 00221.01(c) via the OTTCH manual

Tips and Tricks
OTTCH = Oregon Temporary Traffic Control Handbook (for operations of three days or less)
The signal is turned off/on through the police panel located on the side of the controller cabinet. See illustration on next page.
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/ON SIGNAL INDICATIONS IF YOU HAVE NOT BEEN PROPERLY TRAINED!
ODOT resident engineer offices may already have internal procedures/agreements in place for who is allowed to access and use the police panel to turn off/on the signal.
Flaggers must understand the sequence for turning the signal off/on. Good communication between the person using the police panel and flaggers is critical.

Inspector Action	
Review and follow internal ODOT resident engineer office procedure (if one exists) for turning off a signal.	Internal Procedure
Contact TSSU or agency electricians for permission to turn-off/on the signal if there is no procedure exists.	Internal Procedure
Contact TSSU or agency electricians for training in using the police panel and obtaining a police panel key.	Internal Procedure
Review OTTCH requirements for "flagging through intersections" and "flagging principles"	Internal Procedure
If the traffic signal will be turned off for an extended duration (longer than 24 hrs.), contact TSSU or agency electricians to properly turn the signal back on. Note: If the traffic signal has rail interconnection, see pg. 210 for additional information and requirements.	Internal Procedure

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

Portable Temporary Traffic Signal (PTTS)

Key Enforceable Items	
PTTS are contained on the larger ODOT Qualified Products List, NOT the green sheets. They are NOT required to be chamber tested by TSSU. See illustration on next page.	00227.13
Region traffic is responsible for providing the contractor signal timing parameters. The contractor is responsible for installing and maintaining the signal timing.	00227.43(c)
Region traffic and/or agency electricians should be present during initial turn-on.	00227.43(c)
The contractor is responsible for maintenance and power costs.	00227.42(b) & 00227.63
Flaggers are to remain on stand-by for 2 hours after signal turn-on.	00227.43(c)
Tips and Tricks	
Typically only used for simple, short duration, two-way, one lane operation.	
Become familiar with the stage construction plans.	
Inspector Action	
Contact region traffic if a PTTS is NOT shown in the contract plans and the contractor proposes to use one. Using a PTTS requires state traffic roadway engineer approval.	Plan Sheets (EOR will create plan sheet using DET4703)
Coordinate with region traffic, agency electricians, and the contractor to establish the signal turn-on date and time.	00227.43(c)
Verify the vehicle signals line-up with the receiving lane.	00227.43(a)
Verify appropriate temporary signing and striping is in place (stop lines, “Signal Ahead” signs, etc.).	Plan Sheets

Typical Sources of Info:
Specs: 00227.13, 00227.43 & 00227.63
Std. Dwg: TM870
Plan Sheets: Typically YES (See Temporary Traffic Control Plan Sheets)
Blue Sheet/Green Sheet Info: Pg. 2 (from QPL)

Bubble Note(s) See pg. 213:
Not Applicable

PTTS are from the ODOT QPL List (not the blue/green sheets)
They do NOT require TSSU chamber testing

OREGON DEPARTMENT OF TRANSPORTATION
CONSTRUCTION SECTION

QUALIFIED PRODUCTS LIST

PUBLISHING DATE: JANUARY 2016

Oregon Department of Transportation

This list is published every six months and is available only from the Internet.
Please notify the Product Evaluation Coordinator, in the Construction Section at the ODOT Materials Laboratory, of any changes in Standard Drawings, Special Provisions, or Specifications, etc., which would require additions to, deletions from, or changes to this listing.

Temporary Signal General

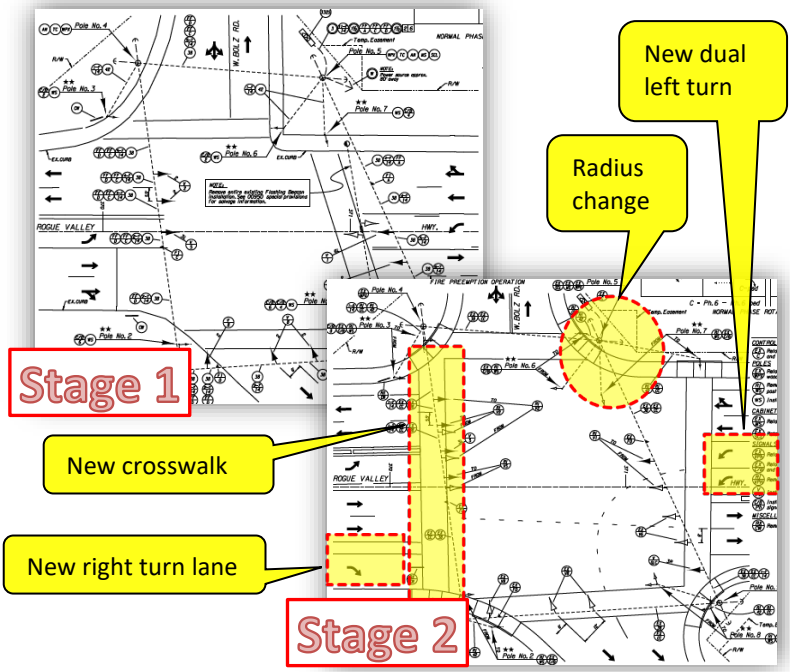
Key Enforceable Items	
The existing signal shall not be removed until the temporary signal or new signal is operational.	00950.40
Poles for temporary signals are non-standard wood poles. The contractor must submit design details to the agency for review and approval.	00227.12
Region traffic (or local agency) is responsible for signal timing.	00227.62
Do not use permanent signal equipment as part of the temporary installation.	00227.12(a)
The contractor is responsible for maintenance (except inside the controller cabinet) and power costs of the temporary traffic signal. Agency electricians may perform necessary maintenance at the contractor's expense.	00227.42(b) & 00225.62
Return all agency furnished materials (e.g., communication gear and ATC controller, etc.) to TSSU when the temporary signal is removed. Full payment for the temporary traffic signal bid item will not be made until all agency furnished materials are returned.	00227.42(a) & 00227.90
Install controller cabinet on a temporary pre-cast foundation. Maintain access to controller cabinet for all construction stages.	TM454
Tips and Tricks	
Become familiar with the stage construction plans. See illustration on next page.	
Mast arms may need to be installed the day of permanent signal turn-on to avoid blocking temporary signal indications. Plan sheets may indicate this. See illustration on next page.	
When stage construction requires changes to lane use or lane alignment, changes to vehicle signal heads are often required (e.g., adjusting location, addition, or removal/covering) as well modifications to the control equipment in the controller cabinet. This requires a field testing inspection as per 00227.62. See page 202.	
Inspector Action	
Verify equipment used for temporary signals is new or like new.	00227.12(a)
Verify controller cabinet has permanent certification tags by TSSU	00227.42(e)
Verify **(during each stage of construction)** the pedestrian signals are visible and pushbuttons are accessible (ADA max reach of 10" to the pushbutton with the correct sized clear space).	Pgs. 174, 176, & 178
Coordinate a supplemental inspection by agency electricians (required) at each stage that requires moving or changing temporary signal equipment. See illustration on next page.	00227.62 & Page 107

Typical Sources of Info:
Specs: 00227
Std. Dwgs: TM452, TM453, TM454, TM456 & TM870
Plan Sheets: YES
Blue Sheet/Green Sheet: Various

Bubble Note(s) See pg. 213:

Various. Temp equipment also uses many of the same notes as permanent.

Mast arms may need to be installed the day of the signal turn-on to avoid blocking the working signal indications as shown in this example.



Become familiar with stage plans. Changes between stages as shown above require adjustment of the signal equipment & timing.

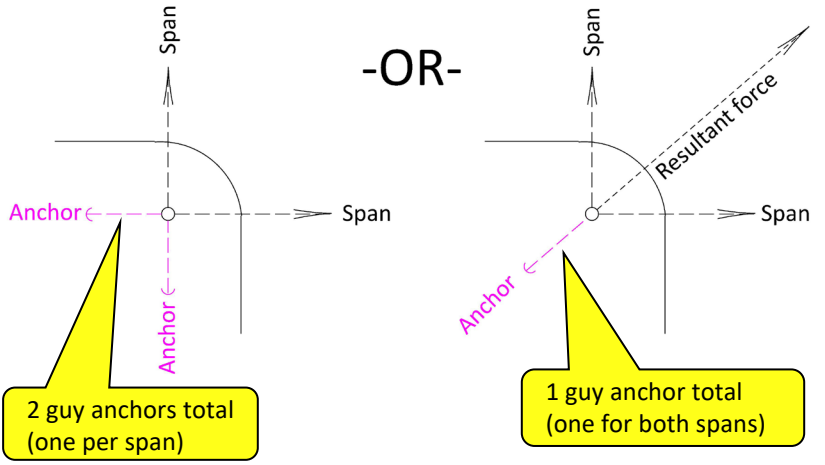
Temporary Wood Pole

Key Enforceable Items	
Contractor must submit stamped working drawings, details and calculations for wood pole design to the engineer for review and approval.	00227.12
ALL wiring on pole shall be in a conduit.	TM452, TM453 & TM454
Bond all equipment within 10’ of finish grade at each pole.	00227.42(c)
Tips and Tricks	
Wood poles are normally only used for temporary signal installations.	
Wood poles are ALWAYS defined as non-standard poles. Therefore, design calculations and drawings are required for each wood pole.	
Rake pole away from the applied load.	
Locate utilities before drilling holes.	
As per the calculations, 1 or 2 guy anchors per pole may be required. See illustration on next page.	
Inspector Action	
Check poles for splits or in-transit damage.	00227.12(c)
Verify setting depths.	Pole Submittal
Verify that minimum embankment requirements will be met during all applicable stages of construction. The permanent requirements may be applied to temporary poles.	TM653
Verify guy anchors are installed at 1:3 slope.	TM453
Verify guy anchors are not an obstruction to pedestrian walking paths. Use the galvanized steel pipe detail as needed to maintain a clear walking path. See illustration on next page.	TM453

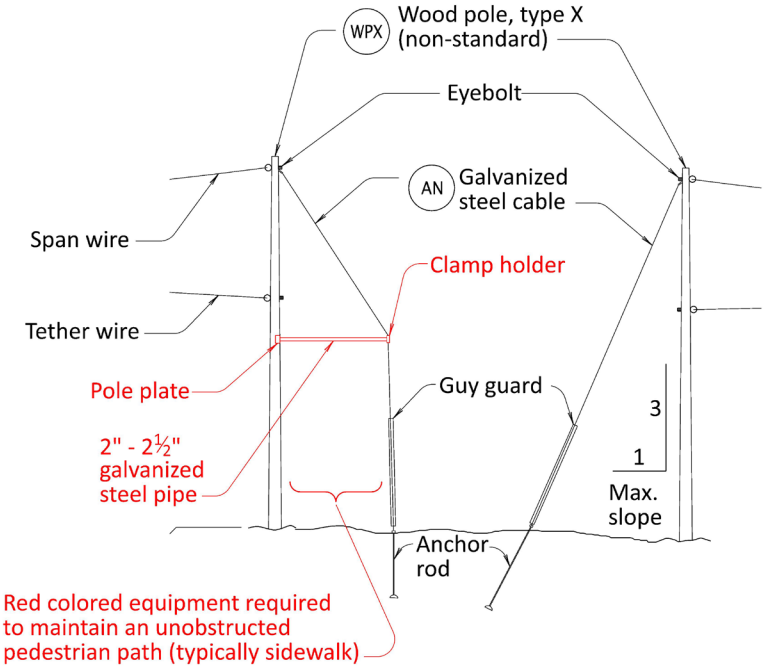
Typical Sources of Info:
Specs: 00227
Std. Dwg: TM452, TM453 & TM454
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO

Bubble Note(s) See pg. 213:

WPX WS AN



GUY ANCHOR LOAD SUPPORT (00227.42(c))



GUY ANCHOR (TM453)

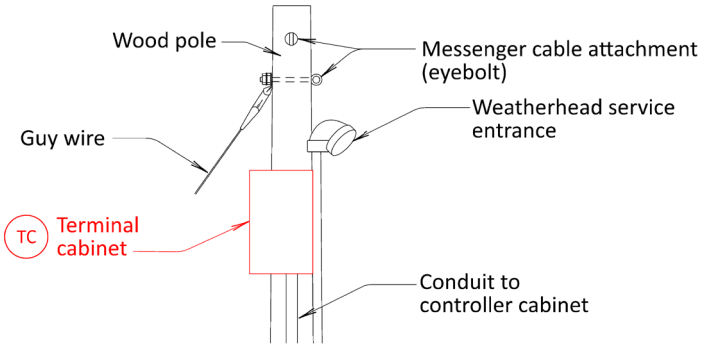
Temporary Terminal Cabinet

Key Enforceable Items	
Terminal cabinets should have watertight compression fittings in bottom for control cable entrance. See illustration on next page.	TM452 & TM454
Label all terminals with mechanically printed labels.	TM454
Required number of terminal blocks varies but should be distributed equally amongst the three lines.	TM454
Tips and Tricks	
Temporary terminal cabinets are externally mounted on temporary wood poles. They are used as a splice point for the wiring from the controller cabinet and the wiring to the signal indications.	
Mast arm poles will have ***recessed*** terminal cabinets (RTC). See TM470 and TM654 for details. Recessed terminal cabinets are contained within the pole on the pole shop drawing (they are not a blue sheet item).	
Inspector Action	
Verify terminal cabinet is installed at the proper orientation.	Plan Sheets (Pole Entrance Chart)

Typical Sources of Info:
Specs: NO
Std. Dwgs: TM452 & TM454
Plan Sheets: YES
Blue Sheet/Green Sheet: Pgs. 13 & 63

Bubble Note(s) See pg. 213:

TC



TERMINAL CABINETS FOR WOOD POLES (TM454)

Temporary Messenger Cable

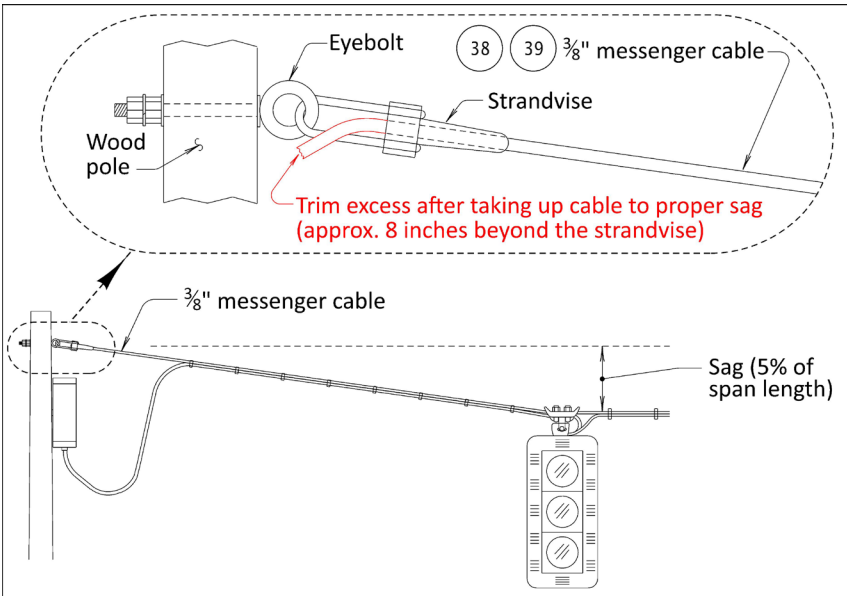
Key Enforceable Items	
Take up slack in the messenger cable to meet the sag requirement: 5% of length of span (0.05 x length of span).	TM452
Only one messenger cable may be attached to an eyebolt. Multiple messenger cables attached to a single eyebolt is NOT allowed.	TM452
Multiple messenger cables attached to the same pole are spaced 6 inches apart.	TM452
The messenger cable connection on the pole only includes an eyebolt and a strandvise. It does not include "S" hooks or turnbuckles.	TM452
Bond messenger cable to pole.	TM452

Tips and Tricks
Messenger cable is used to suspend equipment over the roadway in a span wire installation.
Too little slack in the messenger cable will result in extra loading on poles. Too much slack in the messenger cable will result in extra movement of the signal heads. The 5% sag requirement results in the Goldilocks "just right" zone. See illustration on next page.
The sag length can be visually estimated by using the signal head indications (which are 12 inches in diameter), or by using the entire type 2 signal head configuration (which is approximately 4 feet including the backboard). See illustration on next page.
Eyebolts are designed to be in tension, not sheer. The force of the messenger cable should always be in-line with the messenger cable. See illustration on next page.
Don't overlook workmanship details such as trimming off excess cable sticking out of the strandvise. See illustration on next page.

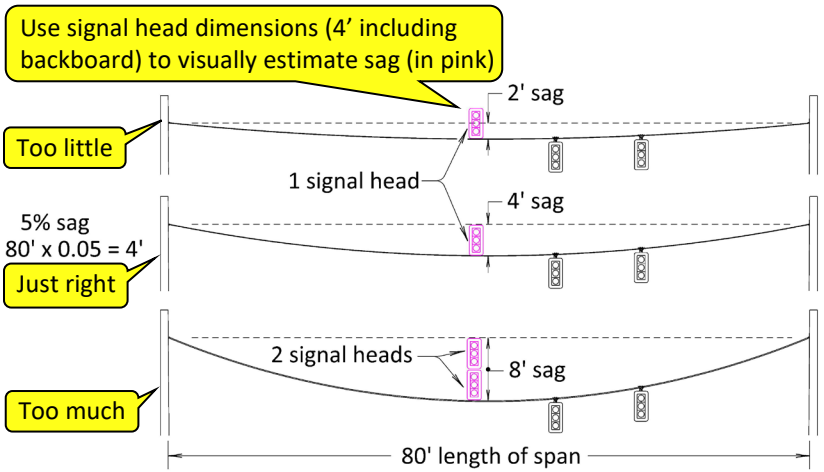
Inspector Action	
Verify the messenger cable meets sag requirement of 5%.	TM452
Verify the messenger cable connection to the pole (eyebolt and strandvise) is properly installed.	TM452

Typical Sources of Info:
Specs: NO
Std. Dwg: TM452
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 16 & 18

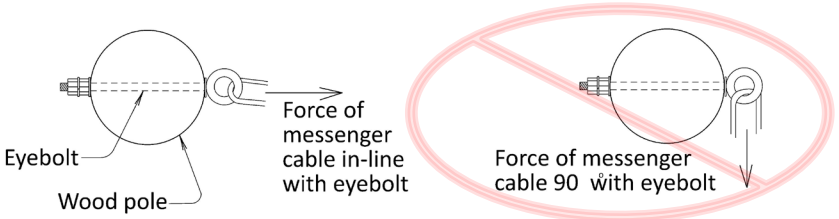
Bubble Note(s) See pg. 213:
38 39 42



MESSENGER CABLE CONNECTION (TM452)



MESSENGER CABLE SAG VISUAL INSPECTION (TM452)



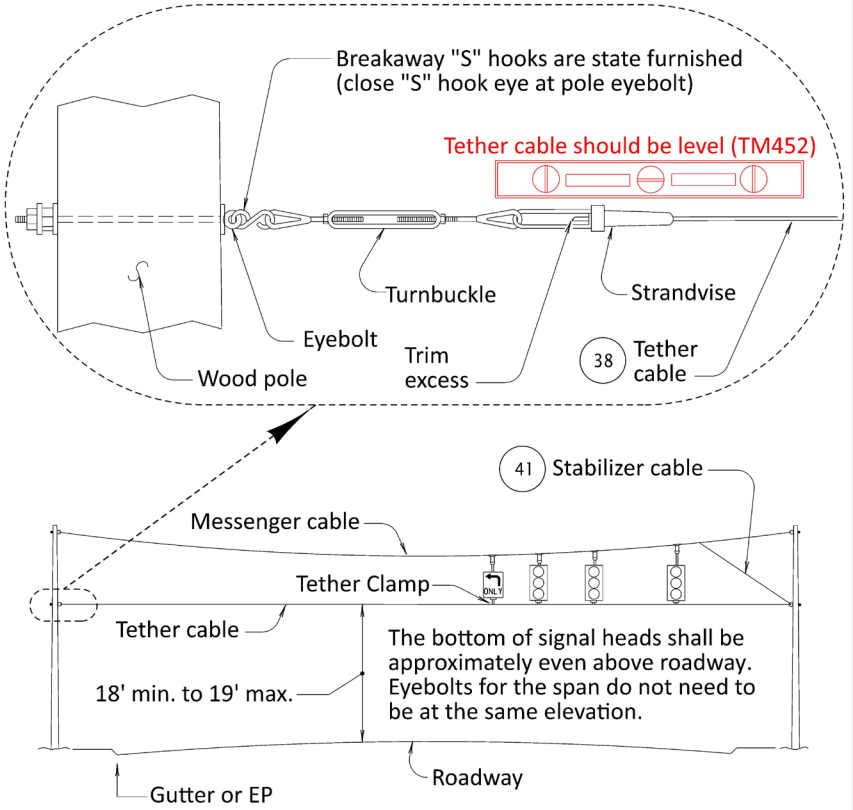
MESSENGER CABLE ALIGNMENT - TOP VIEW OF POLE

Temporary Tether, Stabilizer Cable, and Tether Clamp

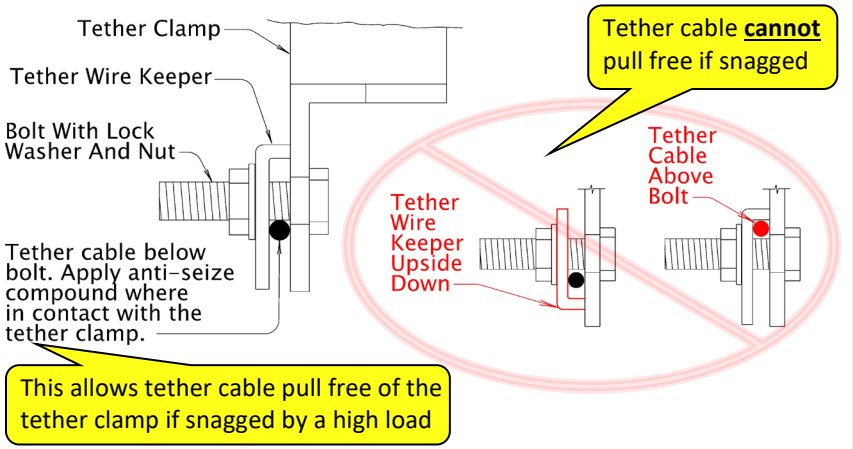
Key Enforcement Items	
The tether and stabilizer cable connections on the pole each include an eyebolt, an "S" hook, a turnbuckle, and a strandvise.	TM452
"S" hooks are state furnished by TSSU. Call 503-378-2645 or send e-mail to TSSU@odot.oregon.gov	TM452
Close "S" hook on eyebolt side (pole side only).	TM452
When attaching the tether clamp to the tether cable, the tether cable fits below the bolt that attaches the tether wire keeper and is coated in anti-seize compound. See illustration on next page.	TM456
Tips and Tricks	
Tether and stabilizer cable are used to prevent movement of equipment suspended from messenger cable.	
The tether cable is inserted into the strandvise. The turnbuckle takes up the tension.	
Stabilizer cable is typically only used in high wind areas. Stabilizer system will be shown in the signal plan sheets (not standard drawings).	
Only one tether cable may be attached to an eyebolt. Multiple tether cables attached to a single eyebolt is NOT allowed. However, the stabilizer cable (if used) is typically attached to the same eyebolt as the tether cable.	
Tether cable and tether clamps are designed to yield if snagged by a high load so that the strain poles, messenger cable, and equipment mounted on the messenger cable does not sustain major damage and become a falling hazard.	
Do not use high strength or larger cable as it may not break when snagged.	
Inspector Action	
Verify the tether cable connection to the pole (eyebolt, "S" hook, turnbuckle, and strandvise) is properly installed. See illustration on next page.	TM452
Verify the "S" hook is closed on the eyebolt side only. See illustration on next page.	TM452
Verify the tether cable is 18 feet minimum to 19 feet maximum above the roadway. See illustration on next page.	TM452
Verify the tether cable is level. See illustration on next page.	TM452

Typical Sources of Info:
Specs: NO
Std. Dwg: TM452 & TM456
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 17, 18, & 20

Bubble Note(s) See pg. 213:
38 41



TETHER CABLE CONNECTION (TM452)



TETHER CABLE NSTALLATION IN TETHER CLAMP - SIDE VIEW (TM456)

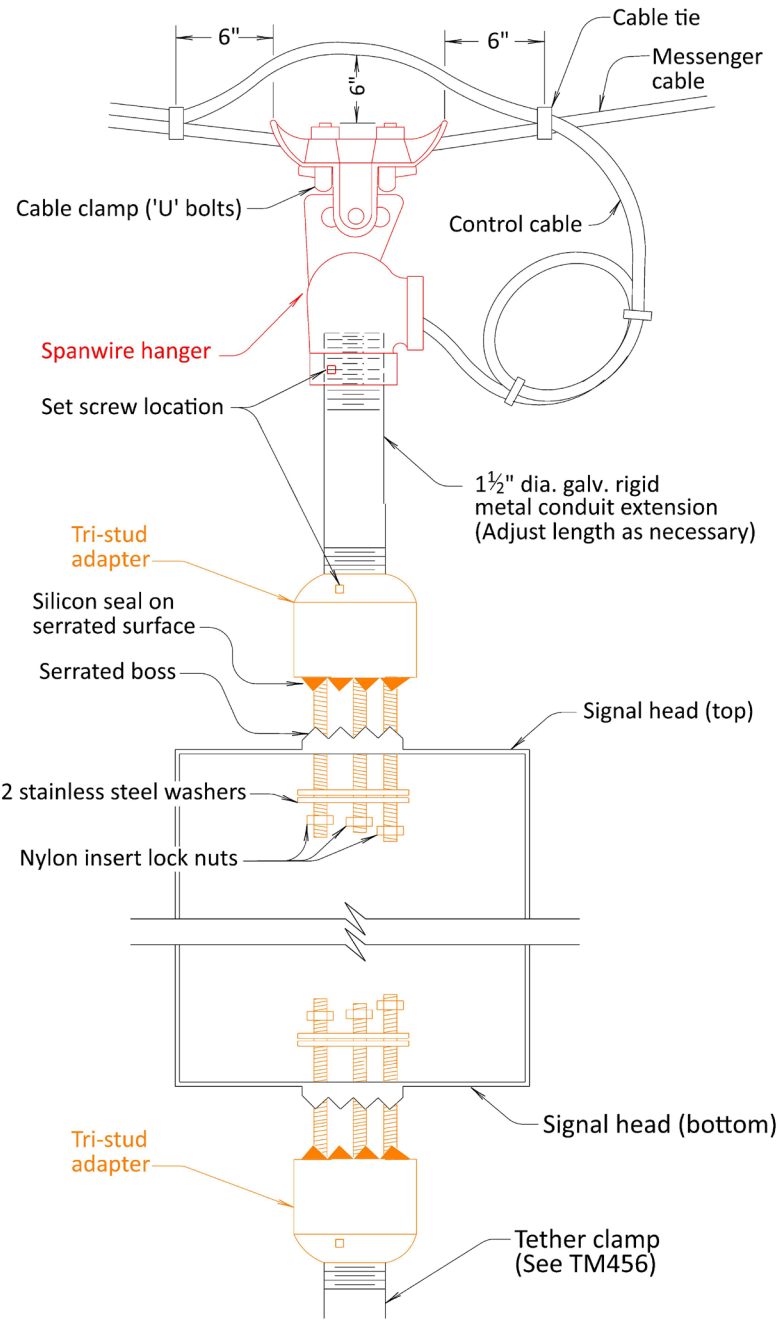
Temporary Spanwire Hanger

Key Enforceable Items	
Install hardware with anti-seize compound.	TM456
The extension is a 1 ½ inch galvanized rigid conduit.	TM456
The conduit extension is drilled and tapped for a set-screw to attach to the spanwire hanger.	TM456
Mount signal head to tri-stud adapter using lock-nuts (or lock washers and hex nuts), form control cable into drip loop, thread through hanger into signal head.	TM456
All set-screws go through the conduit wall, extending 5/8" maximum inside of conduit.	TM456
Span wire hangers use 'U' bolts for attachment, not 'J' or 'L' bolts.	TM456
Always seal tri-stud adapters with silicon seal.	TM456
Tips and Tricks	
Spanwire hangers are used to suspend equipment from messenger cables and provide a cable entrance into the equipment.	
The spanwire hanger is used with the type "A" sign bracket (see TM456).	
Adjust the length of the conduit extension (between the spanwire hanger and the tri-stud adaptor) to achieve proper mounting height of equipment. See illustration on next page.	
Bind control cable into a drip loop that is lower than the throat of the hanger.	
Control cable must be arched over the spanwire hangers to avoid damage.	
Inspector Action	
Check spacing of equipment mounted on the spanwire.	Plan Sheets (Pole Entrance Chart)
Verify the vertical clearance between the pavement and the tether cable is 18 feet minimum to 19 feet maximum.	TM452

Typical Sources of Info:
Specs: NO
Std. Dwg: TM452 & TM456
Plan Sheets: NO
Blue Sheet/Green Sheet Info: Pgs. 19, 21, & 65

Bubble Note(s) See pg. 213:

Not Applicable



MESSENGER CABLE ATTACHMENT & TRI-STUD ADAPTER (TM456)

Foundations (All):Location

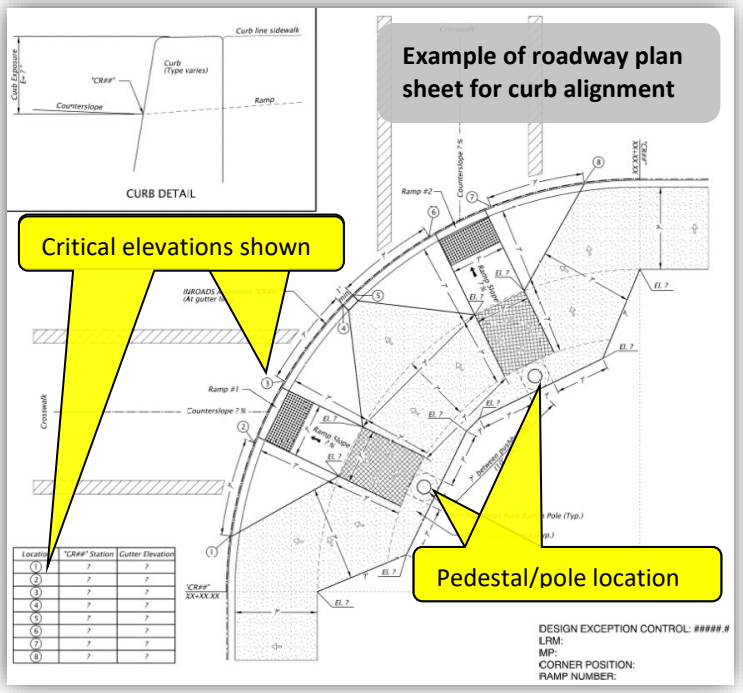
Key Enforceable Items	
Field verification forms are required for each pole prior to installation (NOT required for pedestals). See pages 138 and 140 for more info.	00962.02
Plan sheets will state the exact location of all signal poles and pedestals. See illustration on next page.	Plan Sheets
Plan sheets will show the general location of the controller cabinet and service cabinet: • If there is sidewalk, install flush against back of sidewalk. • If there is no sidewalk, install 3 foot wide walkway to cabinet.	Plan Sheets & TM482
Service cabinet and controller cabinet must be at least 10 feet apart.	TM482
Pole and pedestal foundations located in or adjacent to sidewalks require a preformed expansion joint filler between the sidewalk and foundation. The foundation shall be flush with the sidewalk grade (less than ¼" vertical difference).	TM457 & TM653

Tips and Tricks
All plans require a roadway plan sheet that establishes a survey alignment line for each intersection corner at the gutter line. Critical elevations/coordinates for the ramp, signal poles, and pedestals will also be provided. See illustration on next page.
Changing a pole location may result in significant changes and re-design, such as a longer or shorter mast arm, a different type of pole, and/or a different foundation. See illustration on next page.
Ramp design and pole location are critical to meeting ADA requirements due to the tight tolerances. See pgs. 176 and 178 for more info.

Inspector Action	
Verify the location of all foundations: Pole(s), pedestal(s), controller cabinet, and service cabinet.	Plan Sheets & TM482
Verify layout of curb, back of sidewalk, ADA ramps, raised island pedestrian cut-through paths, and/or other features near foundation.	Roadway Plan Sheets
Notify the EOR of any field conditions that may be in conflict with the foundation location (i.e., overhead/underground utilities, off right-of-way, etc.). **The EOR is responsible for providing a new location.**	Internal Procedure
Verify the location of the power source (commercial power). If it is different than as shown on the plans, notify the EOR.	TM485
Coordinate a supplemental inspection (recommended).	Page 107
Verify foundation location does not present an obstruction to the pedestrian path (5' desirable, 4' minimum if approved).	RD720

Typical Sources of Info:
Specs: 00960.43 (Pedestals & Cabinets) & 00962.43 & 00963 (Poles)
Std. Dwg: TM457, TM482, & TM653
Plan Sheets: YES (Location)
Blue Sheet/Green Sheet Info: NO

Bubble Note(s) See pg. 213:
Not Applicable



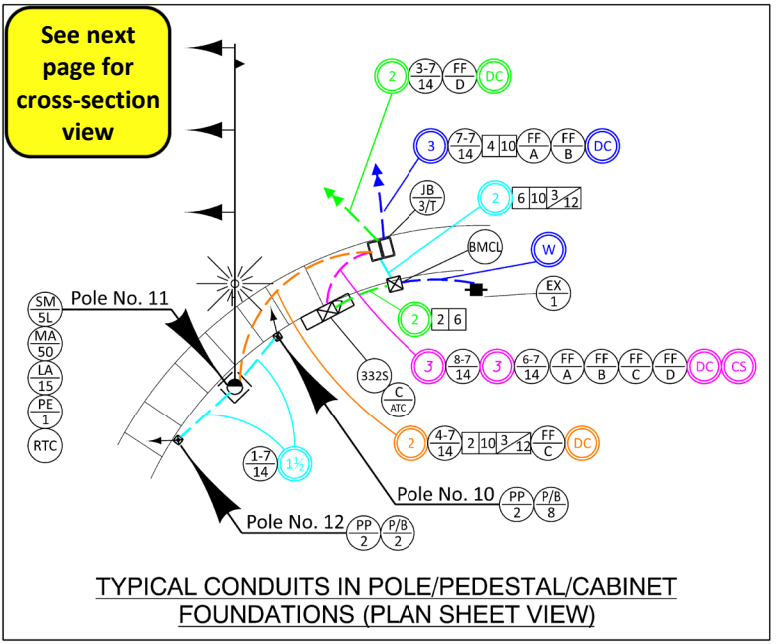
Changing a pole location may require a different mast arm length, type of pole, and/or foundation. Always contact the engineer of record if the pole location changes!!

Mast Arm Length		Mast Arm Pole Type	Foundation Number	
TM650	15’	SM1	1	TM653
		SM1L	2	
	20’ or 25’	SM2		
		SM2L	3	
	30’ or 35’	SM3		
		SM3L	4	
	40’ or 45’	SM4		
		SM4L	5	
	50’ or 55’	SM5		
		SM5L	6	
TM655	60’ or 65’	SM6L	Design No. 6	TM655 to TM628
	70’ or 75’	SM7L		

Note: SM6L and SM7L have unique requirements

Foundation Installation (All):Conduit in Foundations

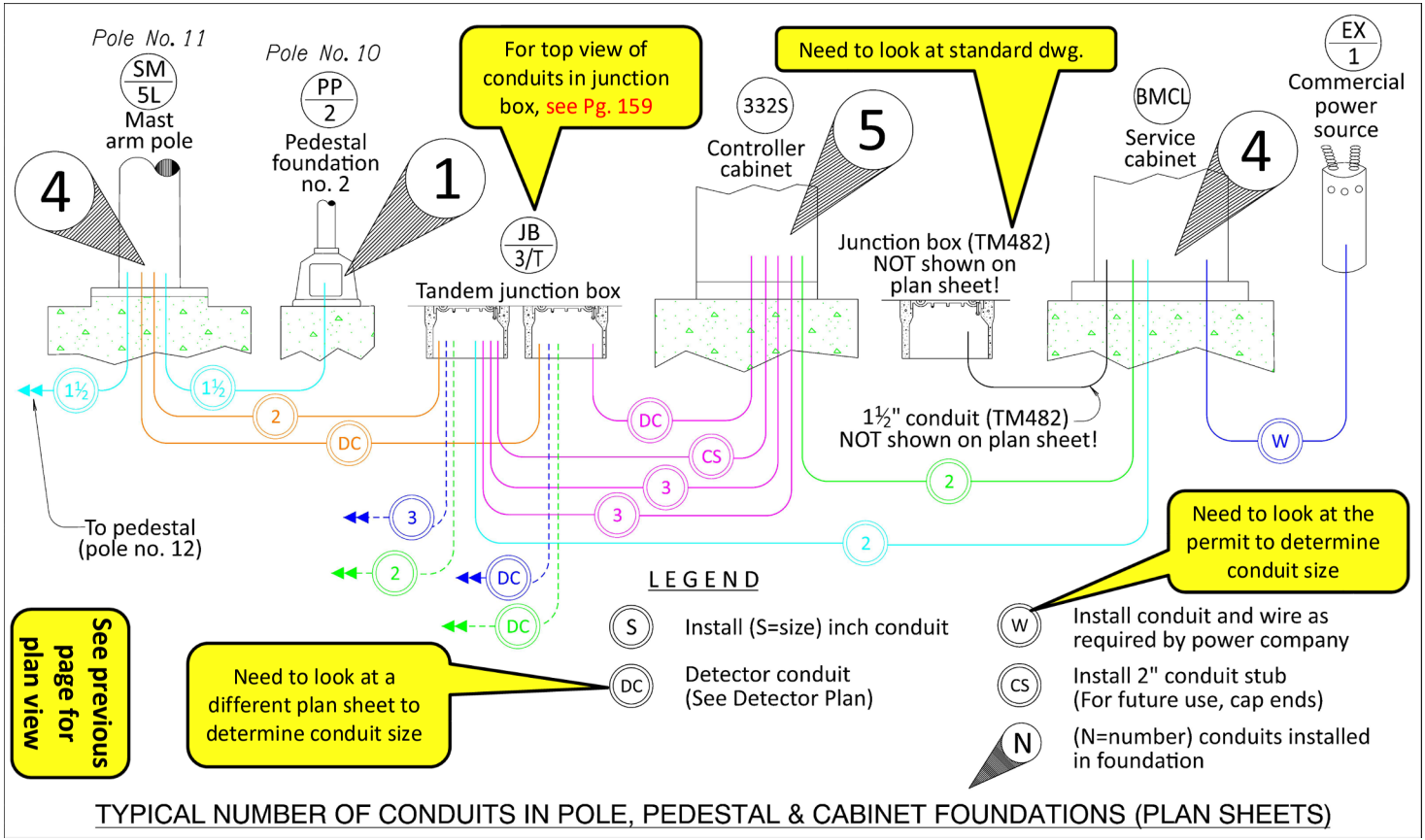
Key Enforceable Items	
Conduits are not to be spliced/coupled at foundation edge. They must extend 10" to 12" beyond edge of the foundation.	TM471
Conduits must extend 2" minimum to 3" maximum above foundation and be installed plumb.	TM471
Temporarily cap all conduit ends at all times to keep debris out.	TM471
All conduits in foundations must be FIBERGLASS.	TM471
Tips and Tricks	
Put spacers between conduits when bundling to allow bushings to be installed later.	
Inspector Action	
Verify correct number & sizes of FIBERGLASS conduits are installed and grouped together in the foundation. Note: The service cabinet has a conduit only shown on TM482. See illustration on this page & next page.	Plan Sheets, TM471, & TM482
Verify conduits are in proper alignment.	TM471
Coordinate a supplemental inspection (recommended).	Page 107



TYPICAL CONDUITS IN POLE/PEDESTAL/CABINET FOUNDATIONS (PLAN SHEET VIEW)

Typical Sources of Info:
Specs: NO
Std. Dwg: TM471 & TM482
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pg. 25

Bubble Note(s) See pg. 213:
Not Applicable

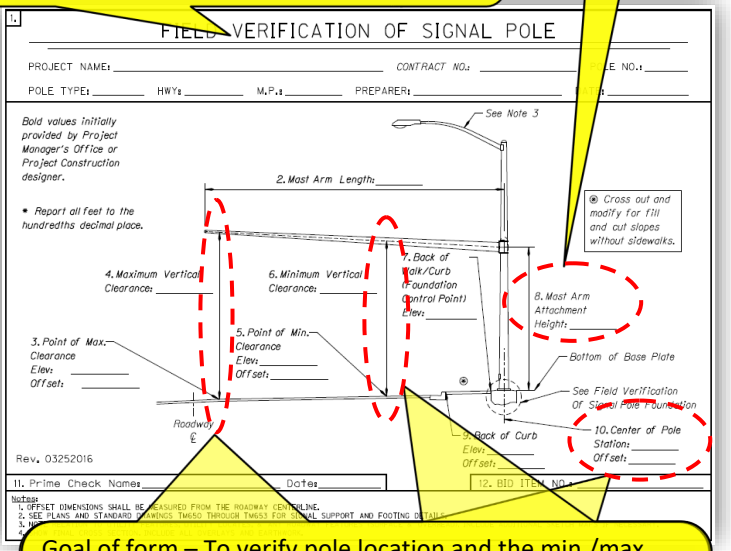


TYPICAL NUMBER OF CONDUITS IN POLE, PEDESTAL & CABINET FOUNDATIONS (PLAN SHEETS)

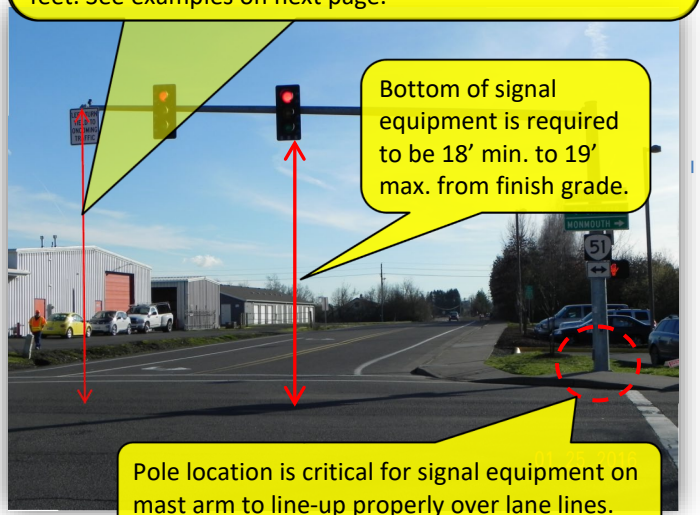
Foundations (Poles Only): Field Verification Form – Signal Pole

Download PDF form* and follow instructions. Contact EOR for assistance with cross sections and elevation measurements.

From shop drawing

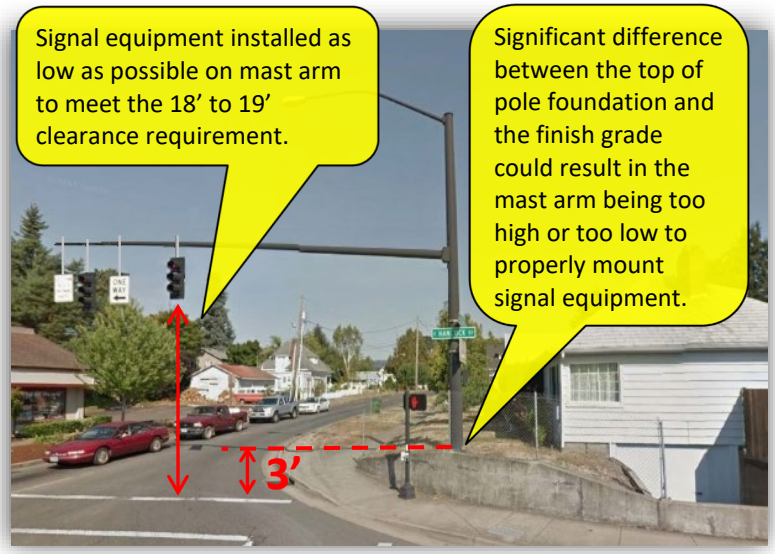


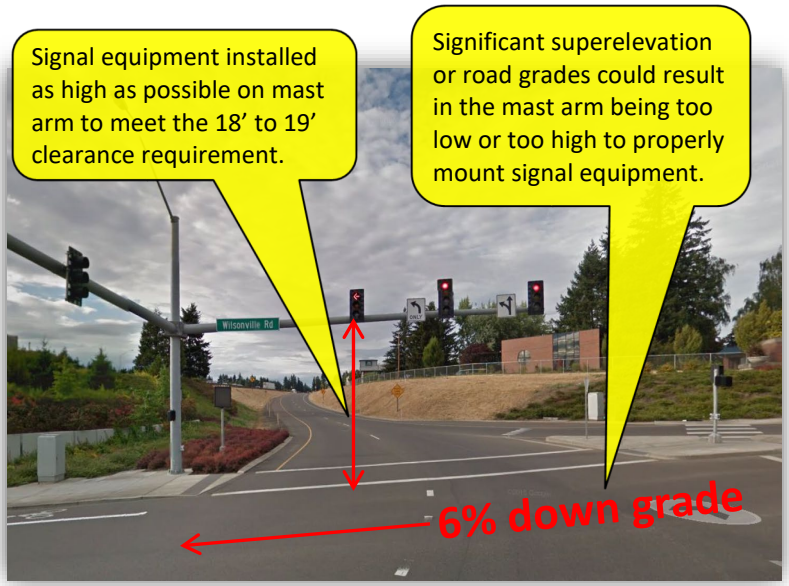
Goal of form – To verify pole location and the min./max. measurements from finished grade to centerline of mast arm to ensure proper mounting of signal equipment. The recommended min./max. measurement range is 20 to 24 feet. See examples on next page.



*Website links & QR scan codes provided starting on Pg. 227

If the min. and max. measurements from the centerline of the mast arm to finish grade are between 20 and 24 feet, signal equipment should be able to be installed properly. Contact the EOR for solutions if the values are outside of this range. Generally, values outside this range will only occur with significant grade issues, as illustrated by the examples on this page.

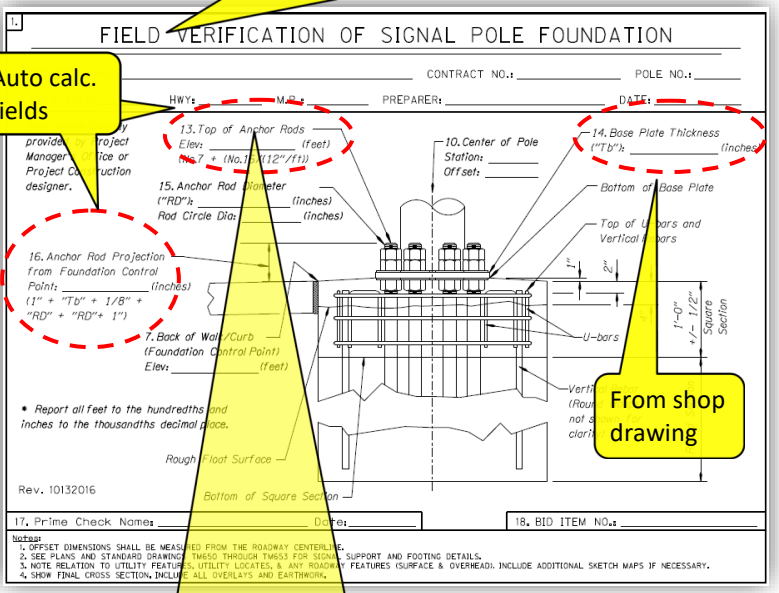




Foundations (Poles Only): Field Verification Form - Foundation

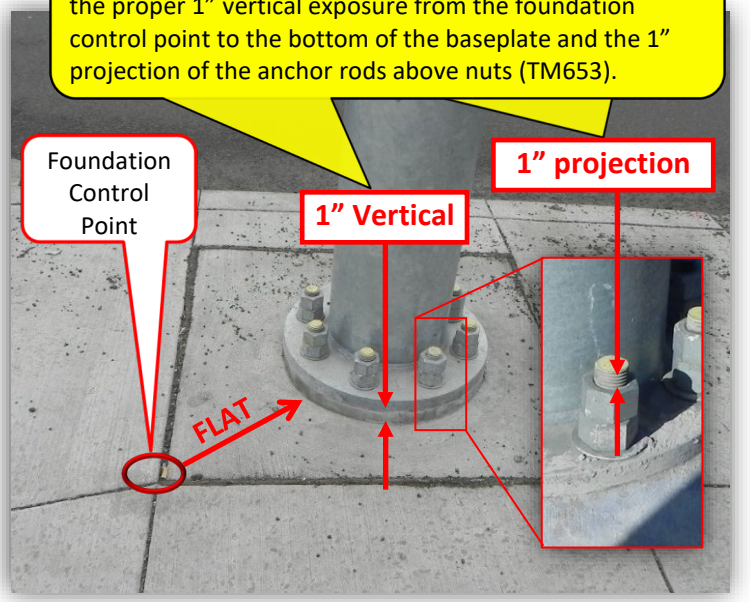
Download PDF form* and follow instructions.

Auto calc. fields

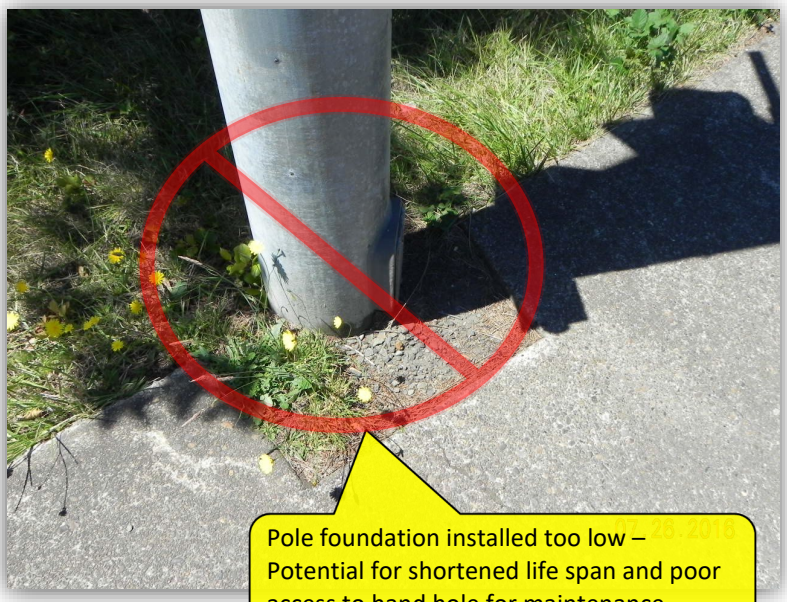


From shop drawing

Goal of form – To verify anchor rod elevation to achieve the proper 1" vertical exposure from the foundation control point to the bottom of the baseplate and the 1" projection of the anchor rods above nuts (TM653).



*Website links & QR scan codes provided starting on Pg. 227


Pole foundation installed too low –
Potential for shortened life span and poor
access to hand hole for maintenance.

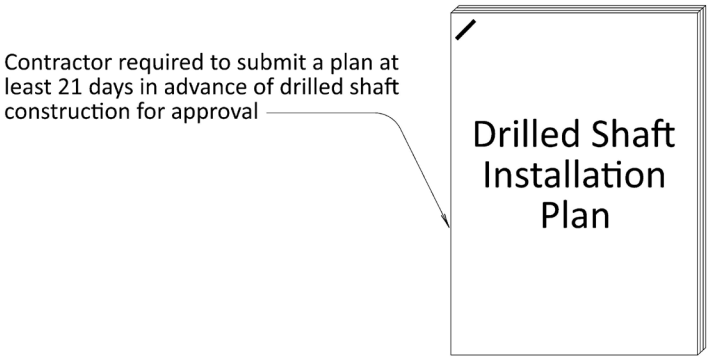

Pole foundation installed too high –
Potential for reduced structural capacity.

Foundations (Poles Only): Drilled Shaft Excavation

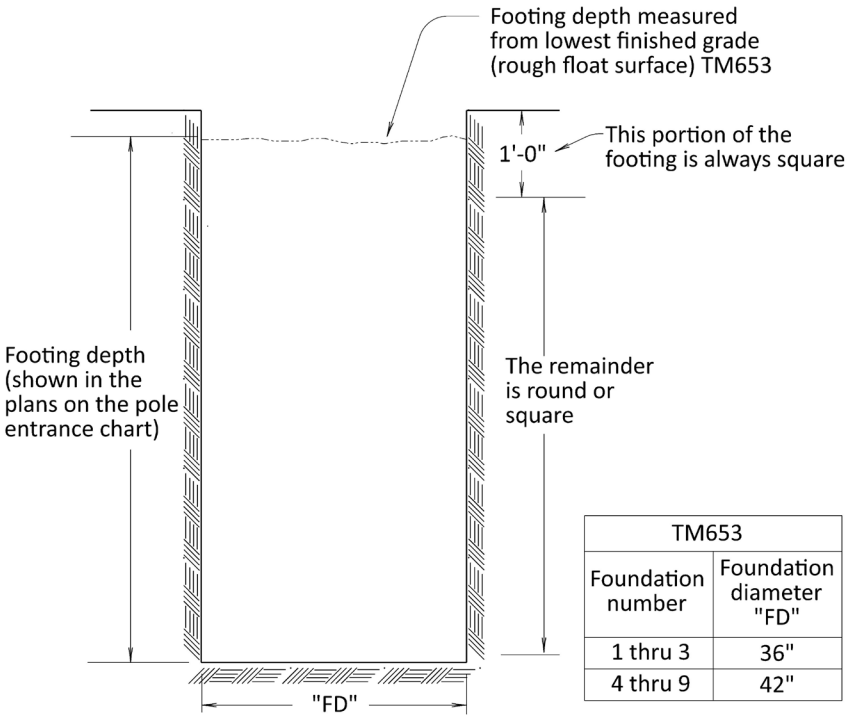
Key Enforceable Items	
Before the pre-construction conference, contractor shall provide personnel qualification requirements for those performing the drilled shaft installation.	00963.30
At least 21 days before beginning drilled shaft construction, contractor shall submit a drilled shaft installation plan. DO NOT BEGIN WORK UNTIL ALL SUBMITTALS HAVE BEEN APPROVED. See illustration on next page.	00963.40(a)
Temporary casings used during construction must be removed.	00963.47(d)
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)
The top foot of the foundation is always square.	TM653
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)
Tips and Tricks	
SM6L and SM7L mast arm poles have unique requirements. See TM655 thru TM658 and project plans for more info.	
Inspector Action	
Verify the foundation depth in the pole entrance chart.	Plan Sheets
Verify the foundation number (1 thru 9) and corresponding foundation diameter (36" or 42").	Plan Sheets & TM653
Verify the location (station/offset) of the center of the pole and finish grade using the field verification forms & the roadway plan sheets. Document updates to the field verification form when changes occur.	00962.02 & Plan Sheets & pgs. 138 & 140
Measure the final foundation depth and foundation diameter. See illustration on next page.	00963.43(f) to 00512.43(h) & TM653
Ensure the temporary casing is used according to the approved drilled shaft installation plan.	00963.43(c)
If caving or other unstable conditions occur during any construction procedure, stop further construction and notify the Engineer.	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

Bubble Note(s) See pg. 213:
Not Applicable



DRILLED SHAFT INSTALLATION PLAN (00963.40(a))



TM653	
Foundation number	Foundation diameter "FD"
1 thru 3	36"
4 thru 9	42"

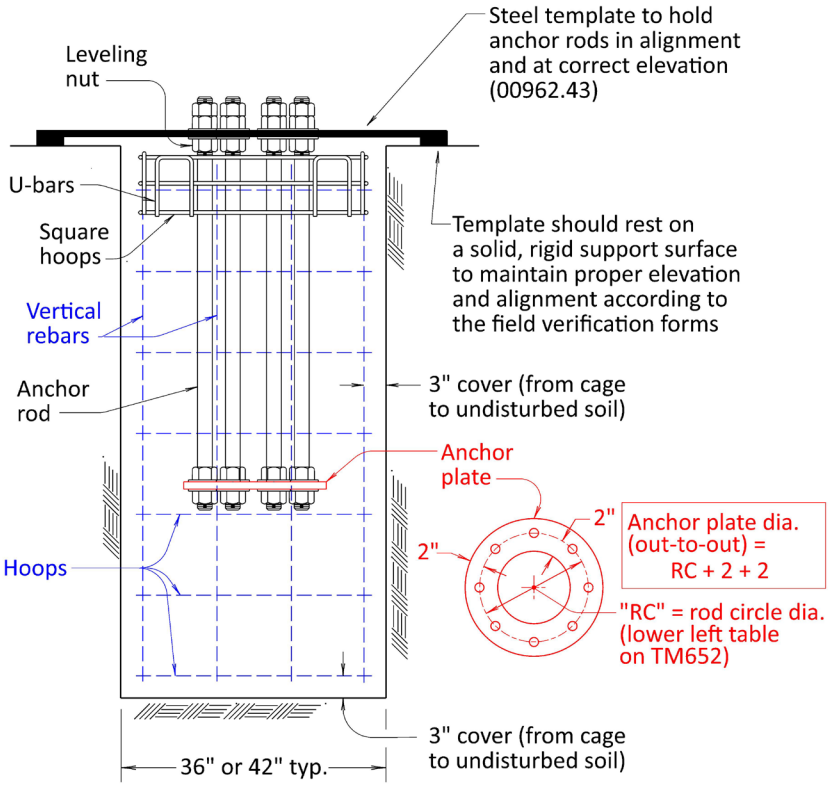
TYPICAL FOUNDATION EXCAVATION FOR SIGNAL POLES (TM653)

Foundation Installation (Poles Only): Reinforcing Steel

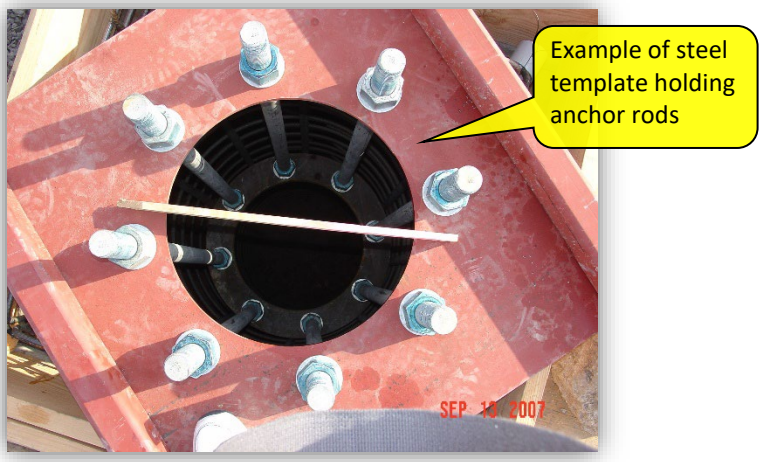
Key Enforceable Items	
Anchor rods (ASTM F 1554 Gr. 55) are NOT considered "high strength" and therefore DO NOT require lab check testing.	TM651, Note #7, 02560.30(a), & 02560.60(b)
Do not place reinforcing steel into the shaft excavation until the engineer has approved the elevation of the bottom of the shaft.	00963.45(a)
Place the cage such that it extends 3" above the bottom of the shaft. The cage may be supported on the bottom if approved.	00963.45(a)
Rigidly brace the cage to retain its shape for lifting. Bracing is shown on the 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. See illustration on next page.	00962.43
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)
Tips and Tricks	
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). TM651 note #16.	
SM6L and SM7L mast arm poles have unique requirements. See TM655 thru TM658 and project plans for more info.	
Inspector Action	
Verify the cage for the correct number, size, spacing & clearance of vertical rebar, ties, & hoops. See illustration on next page.	TM653
Verify anchor rod diameter, anchor plate diameter (out-to-out), and anchor rod alignment. See illustration on next page.	Plan Sheets & TM652
Verify top of anchor rods are at the elevation shown on the field verification forms.	00962.02 & pgs. 138 & 140
Witness the lifting of the cage to ensure no distortion occurs.	00963.45(b)

Typical Sources of Info:
Specs: 00962, 00963.45 & 02560
Std. Dwg: TM651, TM652, & TM653
Plan Sheets: Typically NO (Non-standard foundations will be shown in plans)
Blue Sheet/Green Sheet Info: Pg. 2 (Reinforcing steel on the QPL)

Bubble Note(s) See pg. 213:
Not Applicable



TYPICAL REINFORCING STEEL FOR SIGNAL POLES
(TM652 & TM653)



Foundation Installation (Poles Only): Concrete

Key Enforceable Items	
Concrete according to 00440 except with an 8" slump (±1 ½").	00963.10
Foundations are constructed with one continuous concrete pour, except for the 4" pad at the top (measured from the foundation control point). The top square hoop should be exposed. See illustration on next page.	00962.43 & TM653
Ground rods are located outside of foundation in the nearest junction box.	TM450
Foundations are poured against undisturbed material. Some minor back-fill is allowed with well compacted materials.	TM653
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)
Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. Break concrete test cylinders to verify.	00962.43, 00440, Table 00540-1, & TM651 Note #15

Tips and Tricks
Caution: steel cage and template can be displaced by pour. Do not vibrate 8" slump.
The bottom two square hoops will be covered by the initial concrete pour (leaving 4" for closure pour). The top square hoop will be exposed and covered by the closure pour. See illustration on next page.
SM6L and SM7L mast arm poles have unique requirements. See TM655 thru TM658 and project plans for more info.

Inspector Action	
Verify that the shaft is clean.	00963.43(f)
Verify correct number and sizes of FIBERGLASS conduits are installed and grouped together at top before concrete is poured.	Plan Sheets & Page 136
Verify anchor rods are in proper alignment in the template.	TM652
Verify the top of anchor rods are at the correct elevation according to the field verification forms prior to concrete pour.	00962.02 & pgs. 138 & 140
Witness concrete testing done by a certified QCT and verify concrete meets contract requirements.	00962.10 to 00440.14(a)

Typical Sources of Info:

Specs: 00962.10, 00962.43, 00963.10, & 00963.47

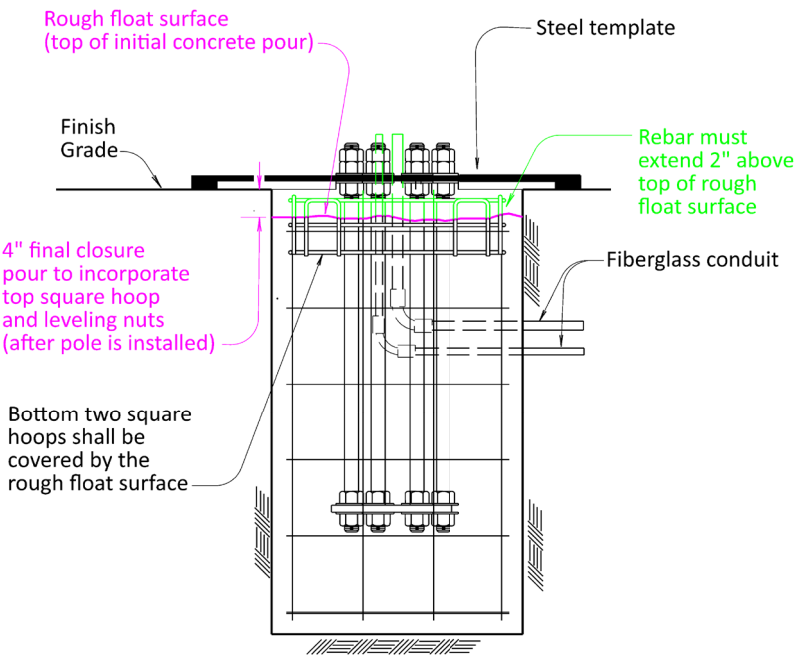
Std. Dwg: TM650 thru TM653

Plan Sheets: Typically NO (Non-standard foundations will be shown in plans)

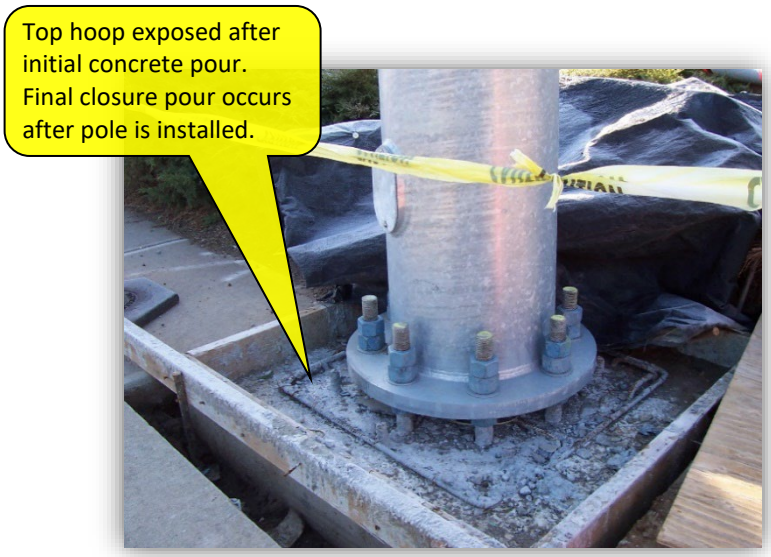
Blue Sheet/Green Sheet Info: NO

Bubble Note(s) See pg. 213:

Not Applicable



TYPICAL CONCRETE INSTALLATION FOR SIGNAL POLES
(TM652 & TM653)



Foundations (Pedestals & Cabinets): Excavation & Concrete

Key Enforceable Items	
Foundations are poured against undisturbed material. Some minor back-fill is allowed with well compacted materials.	00960.43
Foundations are constructed with one initial continuous concrete pour, except for pedestals which have a 4" pad at the top. See illustration on next page.	00960.43 & TM457
Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. Break concrete test cylinders to verify.	00960.43 to Table 00540-1, & 00440
One ground rod is located inside the foundation. Note: The service cabinet also has a second ground rod located a minimum of 6 feet away in a separate junction box.	TM457 & TM482
Service cabinet foundation extends 2" on all sides.	TM482

Tips and Tricks

Typical foundations used at signals (See illustration on next page):

Cabinet foundations:
1. Controller Cabinet
2. Service Cabinet

Pedestal foundations:
1. 1 (Small)
2. 2 (Medium)
3. 3 (Large)

Only pedestal foundation no. 3 contains reinforcing steel. There is no reinforcing steel in pedestal foundations no. 1, no. 2, or cabinet foundations.

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

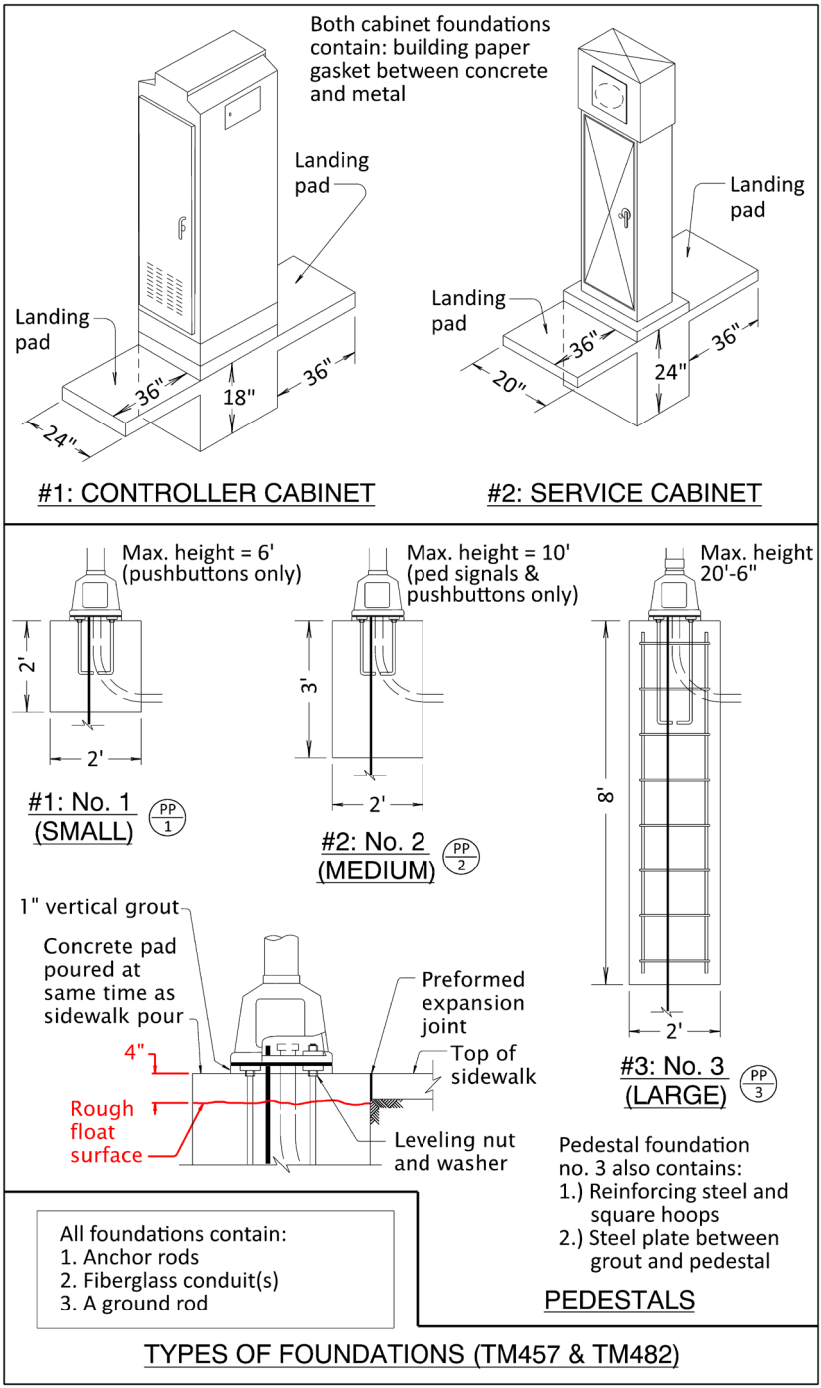
Typical RRFB foundations will use pedestal foundation no. 3. See TM493.

Field verification forms are NOT required for pedestals or cabinets.

Inspector Action	
Verify type of foundation, location of foundation, and finish grade before excavating.	Plan Sheets & Page 134
PEDESTAL FOUNDATION NO. 3 ONLY - Verify cage for vertical bar size, ties, and clearance.	TM457
Verify the anchor rod projection for pedestals is not more than 4 inches above the top of the foundation.	TM457
Verify correct number and sizes of FIBERGLASS conduit are installed and grouped together at top.	Plan Sheets & Page 136
Verify anchor rod diameter and length, rod circle diameter, and proper alignment in template.	TM457
Verify ground rod is installed in foundation.	TM457 & TM482
Witness concrete testing done by a certified QCT and verify concrete meets contract requirements.	00960.43 to 00440.14(a)

Typical Sources of Info:
Specs: 00960.43, 00440, & 00540.48(a)
Std. Dwg: TM457 & TM482
Plan Sheets: NO
Blue Sheet/Green Sheet Info: Pgs.2 (Reinforcing Steel on QPL) & 38

Bubble Note(s) See pg. 213:
Not Applicable


Both cabinet foundations contain: building paper gasket between concrete and metal
Landing pad
Landing pad
36"
18"
36"
24"
#1: CONTROLLER CABINET
Landing pad
Landing pad
36"
36"
20"
24"
#2: SERVICE CABINET
Max. height = 6' (pushbuttons only)
2'
2'
#1: No. 1 (SMALL)
PP 1
Max. height = 10' (ped signals & pushbuttons only)
3'
2'
#2: No. 2 (MEDIUM)
PP 2
Max. height 20'-6"
8'
2'
#3: No. 3 (LARGE)
PP 3
1" vertical grout
Concrete pad poured at same time as sidewalk pour
4"
Rough float surface
Preformed expansion joint
Top of sidewalk
Leveling nut and washer
Pedestal foundation no. 3 also contains:
1.) Reinforcing steel and square hoops
2.) Steel plate between grout and pedestal
PEDESTALS
All foundations contain:
1. Anchor rods
2. Fiberglass conduit(s)
3. A ground rod
TYPES OF FOUNDATIONS (TM457 & TM482)

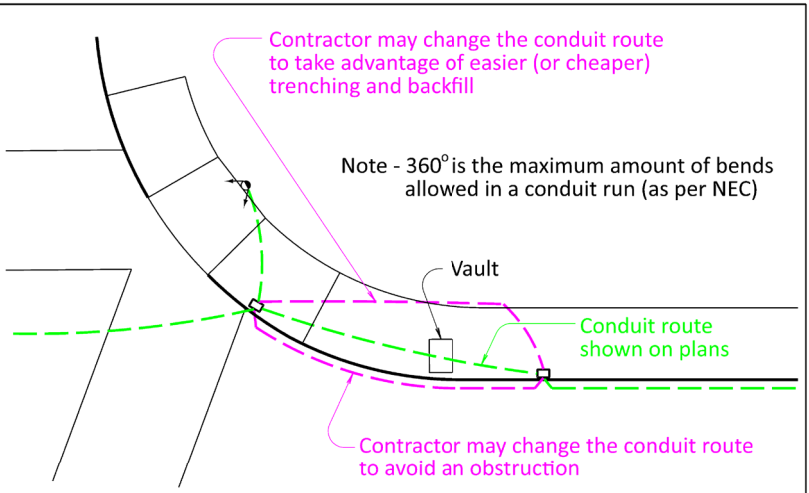
Conduit Trenching

Key Enforceable Items	
Contractor may install conduit by either open trenching or horizontal directional drilling. Horizontal directional drilling (HDD) is required if shown on the plan sheets. See illustration on next page.	TM471 & Plan Sheets
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. See illustration on next page.	TM471
Trench adequate depth to provide minimum cover for conduit.	TM471
Hold trench width to a practical minimum.	TM471
Saw-cut pavement before trenching with an approved pavement saw. An “earth saw”, “conduit wheel”, etc. are not approved.	TM471
Tips and Tricks	
Utilities shown on plans are approximate. Unlocated utilities are expensive and dangerous.	
Plans sheets may specify horizontal directional drilling (HDD) in order to not 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.	
Hand-trenching may be necessary in landscape, irrigated areas, under curb lines or for utility conflicts.	
Inspector Action	
Verify that utility locates have been completed prior to trenching.	00150.50(c)
Verify layout of all foundations (poles, pedestals, and cabinets) and all junction boxes prior to trenching.	Plan Sheets
Check permit to ensure that greater trench depths aren't required by the electrical permitting agency.	TM471
Measure the trench depth to verify the required minimum cover depth will be met.	TM471

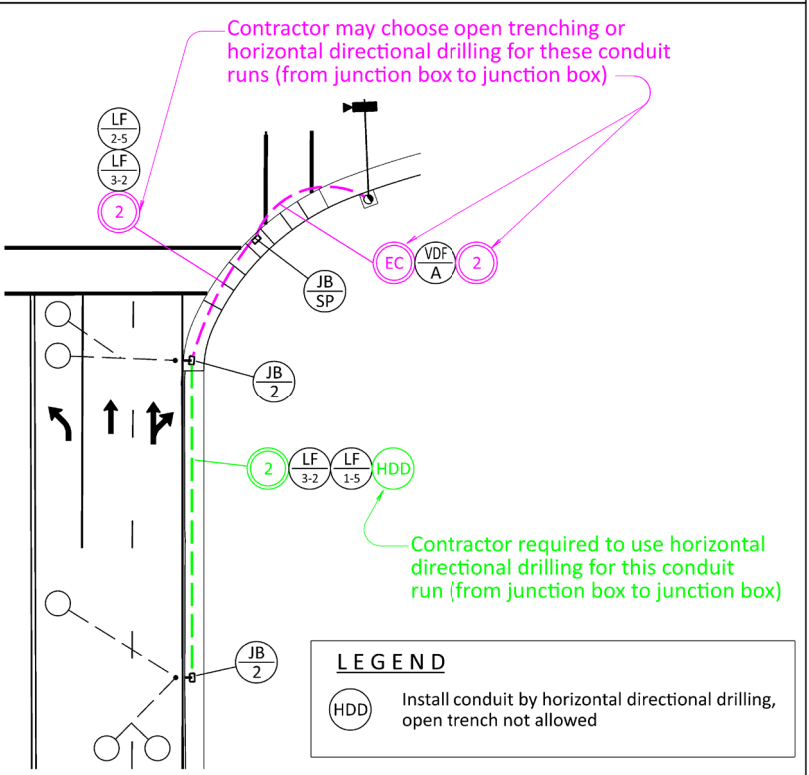
Typical Sources of Info:
Specs: 00960.40 & 00960.41
Std. Dwg: TM471
Plan Sheets: YES (for HDD requirements only)
Blue Sheet/Green Sheet Info: NO

Bubble Note(s) See pg. 213:

HDD



CONDUIT ROUTING (TM471)



TRENCHING REQUIREMENTS (TM471)

Conduit Installation

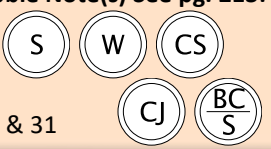
Key Enforceable Items	
The contractor has the option to use a larger size conduit than specified at no extra cost to agency.	TM471
Conduit material requirements: • Conduit elbows must be FIBERGLASS • Conduit risers in junction boxes must be PVC • Conduit in foundations must be FIBERGLASS • Conduit installed underground may be any rigid non-metallic material (PVC, HDPE or Fiberglass)	TM471
Conduit for future use shall be installed with a pull line and sealed with a conduit plug.	TM471
Conduit installed under railroads requires a sleeve. See page 210 for more information.	00960.42(e)
Conduit installed on structures requires expansion fittings as per section 00583.40.	00962.42(f)
Conduit must be installed by licensed electrician.	Oregon Law: Page 113
Conduit must be same size outlet-to-outlet (no reducers).	TM471
Conduits require bushings and conduit plugs at both ends.	TM471

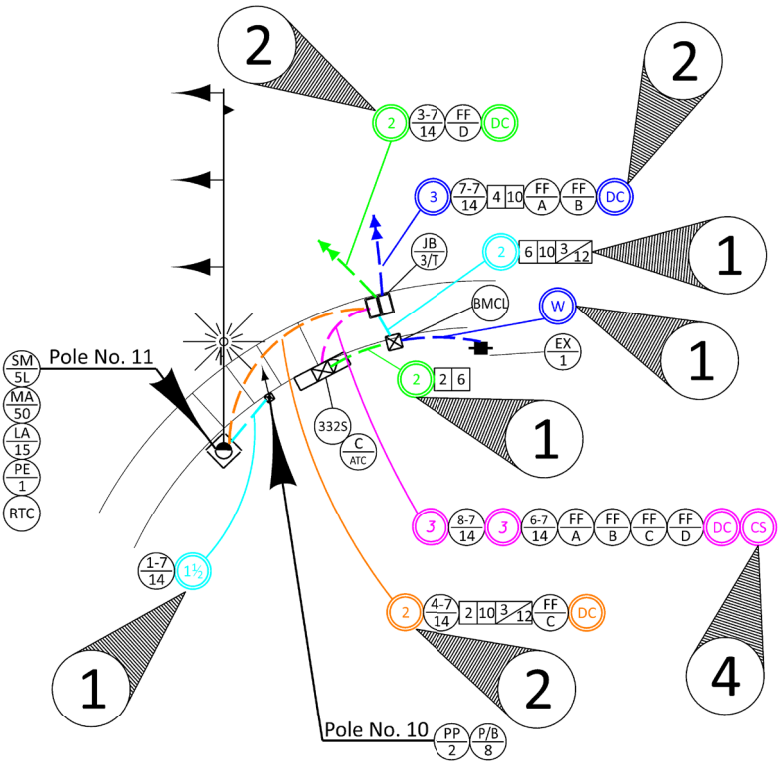
Tips and Tricks
Rigid metallic conduit installed underground is no longer used for new construction. However, small amounts of rigid metallic conduit are still used, such as hanging vehicle signals & signs on a span wire per TM456.
Contractor can choose to use any approved non-metallic conduit unless otherwise shown or specified. Most commonly used material is PVC.
If conduit is installed by horizontal directional drilling, HDPE material is common as it eliminates joints in the conduit run.
Duct tape can be temporarily installed on the ends of conduit to keep debris out during the installation before the wires are pulled.

Inspector Action	
Coordinate a supplemental inspection by agency electricians (required).	TM471 & Page 107
Verify size, material, and number of conduits in each trench. See illustration on next page.	Plan Sheets & TM471

Typical Sources of Info:
Specs: 00960.42
Std. Dwg: TM471
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 25, 26, 27, 30, & 31

Bubble Note(s) See pg. 213:





LEGEND

- (S) Install (S=size) inch conduit
- (DC) Detector conduit (See Detector Plan)
- (W) Install conduit and wire as required by power company
- (CS) Install 2" conduit stub (For future use, cap ends)
- (N) (N=number) conduits installed in trench

NUMBER OF CONDUITS IN EACH TRENCH (PLAN SHEETS)

Trench Backfill

Key Enforceable Items			
See Illustration on next page	Sand Blanket	Non-metallic conduit installed in “Unsurfaced Areas” require a sand blanket.	TM471
		Non-metallic conduit installed under “Existing Paved Areas” do NOT require a sand blanket.	TM471
	Backfill Material	Trenches located under “Unsurfaced Areas” require selected granular backfill material in compacted in 6” layers.	TM471
		Trenches located under “Existing Paved Areas” require CLSM backfill.	TM471
Plug all conduit ends during backfill operation, to keep debris from entering conduit. Keep plugged until wire is pulled.			TM471
Place underground marking tape in all trenches NOT using CLSM for backfill.			TM471

Tips and Tricks
Contractor should be cautioned "Do not backfill until inspected".
Caution: conduit can 'float up’ when using CLSM backfill.
CLSM = Controlled Low Strength Material (See 00442).
Metallic conduit is no longer an option for underground conduit on traffic signal installations – must use rigid non-metallic conduit only as shown in TM471.

Inspector Action	
Determine if a sand blanket is required (based on the location of the conduit trench). See illustration on next page.	TM471 & Plan Sheets
Determine the backfill material requirements (based on the location of conduit trench). See illustration on next page.	TM471 & Plan Sheets
Verify underground warning tape is installed for conduit installed in “Unsurfaced Areas”.	TM471
Coordinate a supplemental inspection by agency electricians (required).	TM471 & Page 107

Typical Sources of Info:

Specs: 00442 (For CLSM requirements) & 00960.10 (Backfill material)

Std. Dwg: TM471

Plan Sheets: NO

Blue Sheet/Green Sheet Info: Pg. 32

Bubble Note(s) See pg. 213:

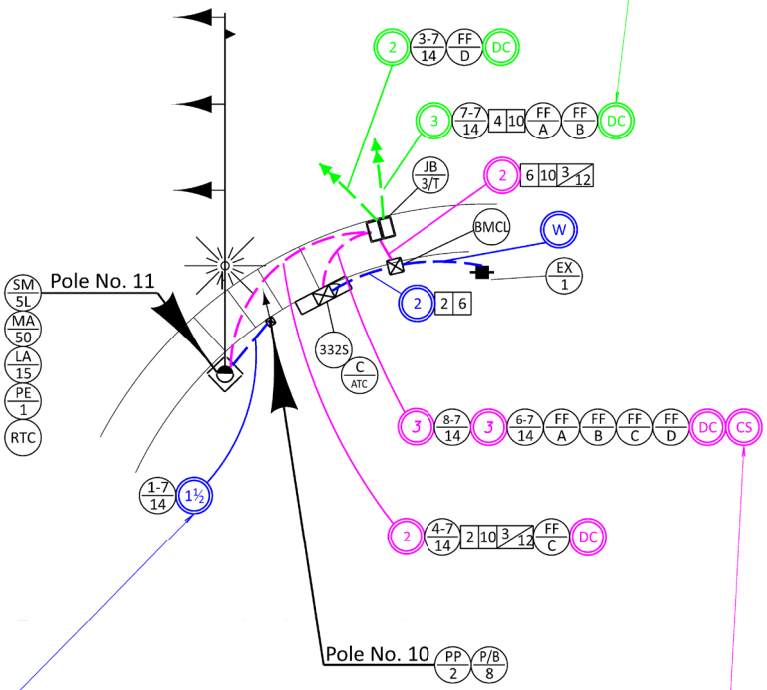
Not Applicable

Backfill requirements for conduit installed in roadway:

1. If project includes new subgrade and pavement:
   "Unsurfaced Areas" backfill requirement applies

2. If project includes inlaying/overlaying new pavement:
   "Existing Paved Areas" backfill requirement applies

3. If Project does not include paving work:
   "Existing Paved Areas" backfill requirement applies



Backfill requirements for conduit installed in landscaped area:

1. "Unsurfaced Areas" backfill requirement applies

Backfill requirements for conduit installed in new or existing sidewalk:

1. "Unsurfaced Areas" backfill requirement applies
   (note: existing sidewalk requires removal
   and replacement as per 00960.40)

BACKFILL REQUIREMENTS DETERMINED BY LOCATION OF CONDUIT (TM471)

Junction Box Location

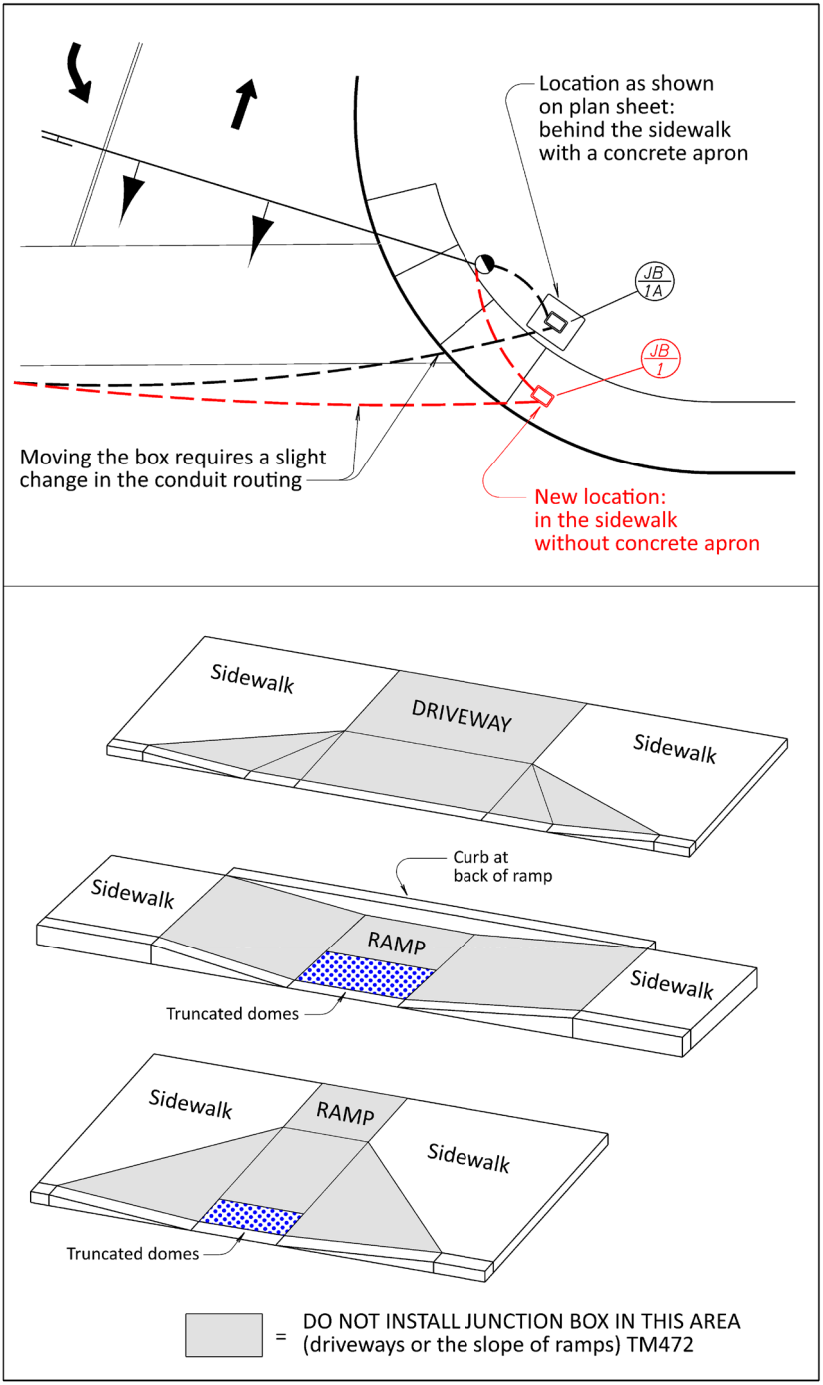
Key Enforceable Items	
Junction box locations shown on the plans are approximate unless otherwise detailed with specific location information. If the plans do not provide detailed location information, adjustments can be made to better fit site conditions.	TM472 & Plan Sheets
Do not space junction boxes more than 300 feet apart. Do not space hand holes more than 1000 feet apart.	TM472
Junction boxes must have a concrete apron when installed in unsurfaced areas, such as gravel shoulders or in landscaped areas. See illustration on next page.	TM472 & Plan Sheets
Junction boxes with a concrete apron must be located a minimum of 2 feet from the edge of a sidewalk or edge of a ramp.	TM472
Tips and Tricks	
Cast iron junction boxes are required when installed in traffic areas. It is NOT desirable to place junction boxes in traffic areas as maintenance access becomes difficult. As such, cast iron junction boxes are rare. If a cast iron junction box is used on a project, details for installation will be shown in the plan sheets (not a standard drawing).	
Junction boxes in sidewalks may be subject to incidental traffic.	
Junction boxes near curb ramps or for retrofit projects may be shown on the plan sheets with specific location information (station/offset/elevation/dimensioned from other objects). If the location of these junction boxes needs to change, contact the EOR for a solution.	
Junction boxes for traffic signals come in three different sizes: JB/1 = small, JB/2 = medium and JB/3= large (see TM472 for dimensions).	
Inspection Action	
Compare signal plans to roadway plans and existing facilities for any conflicts.	Plan Sheets
Verify location of curb radius, sidewalk, crosswalks, and curb ramps.	Plan Sheets
Verify the edge of pavement and pedestrian landings in non-curbed sections.	Plan Sheets
Verify approximate location of detector loops.	Plan Sheets
Verify junction box size.	Plan Sheets & TM472
Verify junction boxes are NOT installed in the slope of ramps, driveways, or in traffic areas. See illustration on next page.	TM472

Typical Sources of Info:

Specs: NO
Std. Dwg: TM472
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 33 & 34

Bubble Note(s) See pg. 213:

HH/1 HH/2 HH/3 JB/1 JB/2 JB/3 JB/3/TA JB/1A JB/2A JB/3A


Location as shown
on plan sheet:
behind the sidewalk
with a concrete apron
JB
1A
JB
1
Moving the box 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
(driveways or the slope of ramps) TM472

Junction Box Installation

Key Enforceable Items	
Conduit must enter the junction box from underneath (exception: hand holes) and be near the end walls.	TM472
Do not install in traffic areas, slopes of ramps, or driveways.	TM472
Locate junction box 12” from back of curb and 12” from back of sidewalk.	TM472
Install a type 1 delineator to mark to junction boxes located in unsurfaced areas.	TM472 & TM570
Top of junction box shall be flush with surrounding grade or top of curb.	TM472
Tandem junction boxes are installed 4” apart.	TM472
Lid shall be marked with appropriate label (“Signals”, “Street Lighting”, etc.).	TM472
Install a recessed lid rated for incidental traffic.	Blue Sheets
Lid is held down with two stainless steel or brass hex head bolts.	TM472
Tips and Tricks	
Place junction box on bedding and backfill sides with well compacted material.	
Junction box should not have any contact with conduits.	
Inspector Action	
Verify finish grade for top of junction box.	Plan Sheets & Survey Info
Verify junction box size.	Plan Sheets & TM472
Verify excavation for the junction box is deep enough. Junction box depth varies from 12” to 36” with an additional 12” (min.) depth needed for the ¾” – 0” crushed rock bedding.	TM472
Verify number, size and location of PVC conduit risers in the junction box. See illustration on next page.	Plan Sheets & TM472

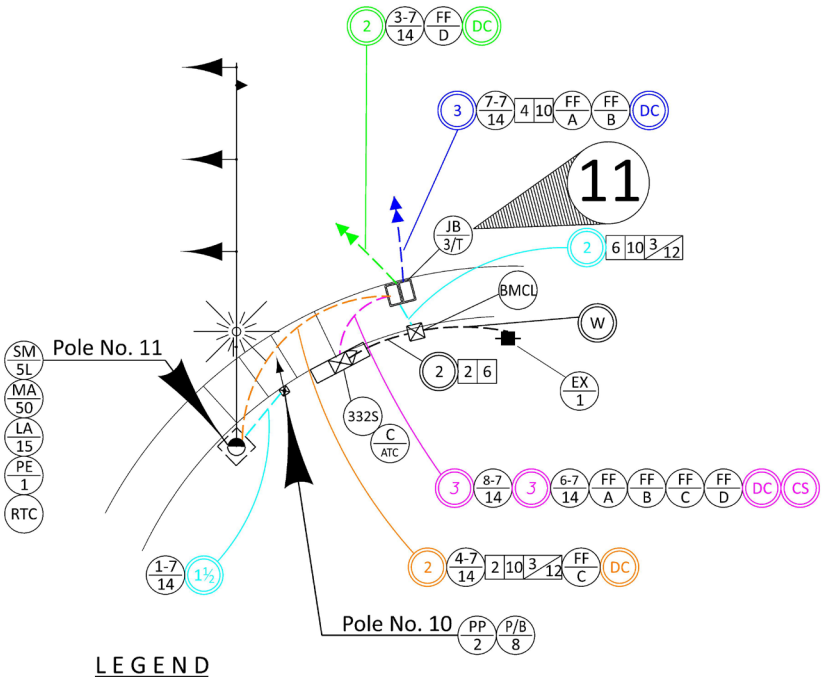
Typical Sources of Info:

Specs: NO
Std. Dwg: TM472
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 33 & 34

HH 1 HH 2 HH 3

Bubble Note(s) See pg. 213:

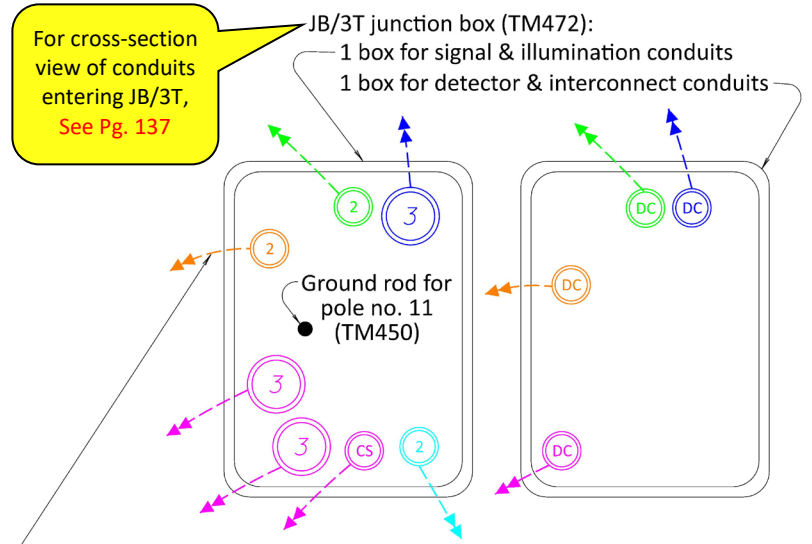
JB 1 JB 2 JB 3 JB 3/T
JB 1A JB 2A JB 3A JB 3/TA



LEGEND

N (N=number) conduits installed in junction box

For cross-section view of conduits entering JB/3T, See Pg. 137



EQUIPMENT INSIDE A JUNCTION BOX

Pedestal Installation

Key Enforceable Items	
Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. Break concrete test cylinders to verify.	00960.43 to Table 00540-1, & 00440
Pedestals use leveling nuts/washers.	TM457
Pedestal foundation no. 3 requires a ½" thick galv. steel plate under the frangible base. Foundation no. 1 and no. 2 do not. See illustration on next page.	TM457
Install a four inch concrete closure pour that matches the sidewalk grade after the pedestal has been installed and leveled. DO NOT FORGET THE PREFORMED EXPANSION JOINTS AROUND THE FOUNDATION.	TM457
Install a one inch max. grout pad with a ¾" inch diameter pole drain (weep hole).	TM457
Pedestal foundation no. 3 requires a collar. Foundation no. 1 and no. 2 do not. See illustration on next page.	TM457

Tips and Tricks

The entire assembly (frangible base with compatible 4" diameter pipe, and metallic cap) is included in the blue sheet item for pedestals.

Pedestals are designed to break-away if struck by a vehicle.

Reinstall handhole cover until wiring can be completed to keep debris out.

It is critical to make sure the pipe length used is not more than the maximum assembly height stated in TM457 for the type of foundation installed, as the frangible base that accepts the pipe is the same for all three foundations:

- Foundation no. 1 = 6' max. height: for mounting pushbutton(s) only
- Foundation no. 2 = 10' max. height: for mounting pushbuttons(s) and pedestrian signal(s) only
- Foundation no. 3 = 20'-6" max. height: for all other equipment mounted over 10' as per TM457, TM492, TM493 or plan sheets. For example, vehicle signal(s), RRFBs, ramp meter assemblies, and various flashing beacon assemblies.

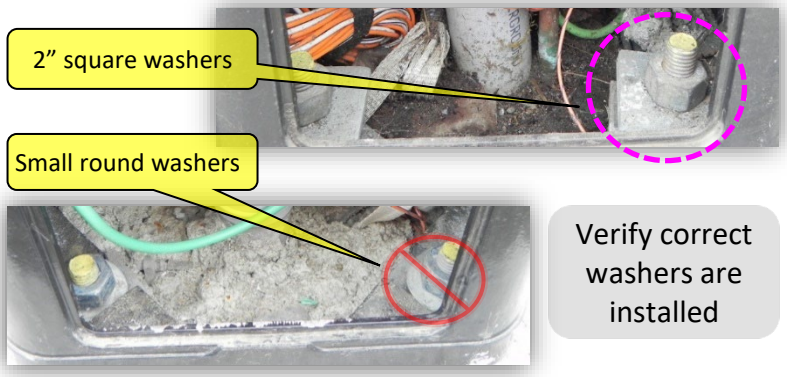
Inspector Action	
Verify the pipe length that is needed based on the equipment that is mounted (2 inches required between the pole cap and last piece of equipment mounted). See illustration on next page.	Plan Sheets & TM457
Verify 2" square washers are used. See illustration on next page.	TM457
Verify pole cap is installed.	TM457

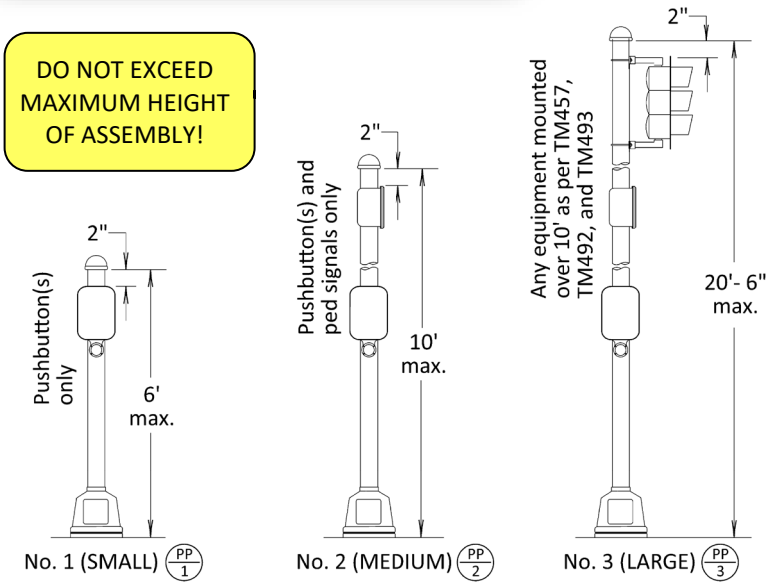
Typical Sources of Info:

Specs: 00960.43
Std. Dwg: TM457
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pg. 24

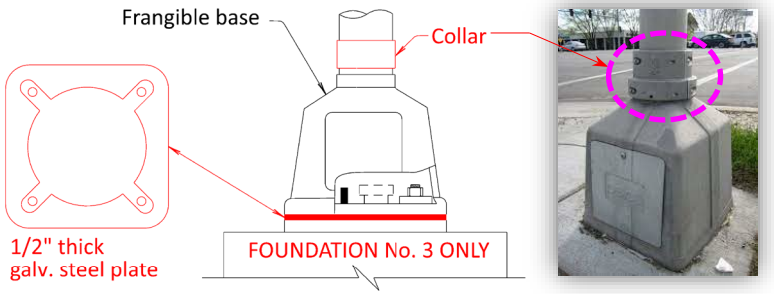
Bubble Note(s) See pg. 213:

PP N PP NS





FIELD VERIFY LENGTH OF PIPE REQUIRED (TM457)



PEDESTAL FOUNDATION NO. 3 INSTALLATION (TM457)

Mast Arm Pole Installation

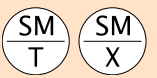
Key Enforceable Items	
Repair galvanizing damage from handling.	00962.46(j)(1)
Concrete foundation requires 7 days of cure AND must reach design strength (3000 psi) before it can be loaded. Break concrete test cylinders to verify.	00962.43, 00440, Table 00540-1, & TM651 Note #15
Lubricate anchor rods and nuts according to 02560.70.	00962.46(j)(2)(a)
Install leveling nut & washer on anchor rods.	TM652 & 00962.46(j)(2)(a)
Install top washer & nut, rake pole to counteract load using leveling nuts.	00962.46(j)(2)(a)
Tighten anchor rods and perform final tightening.	00962.46(j)
Install a four inch concrete closure pour that matches the sidewalk grade after the pole has been installed and leveled. DO NOT FORGET THE PREFORMED EXPANSION JOINTS AROUND THE FOUNDATION.	TM653
Install a one inch grout pad with a ¾" inch diameter pole drain (weep hole).	TM653
Poles and arms can be round or octagonal but two types shall not be mixed on project.	TM651, Note #5

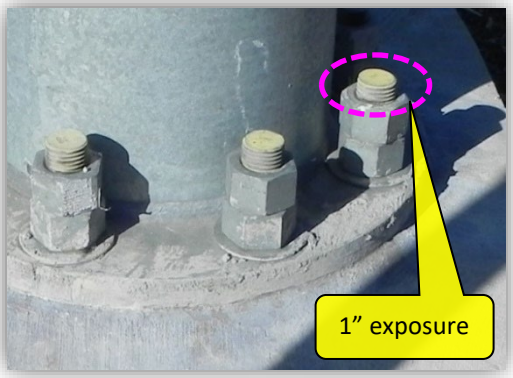
Tips and Tricks
Reinstall handhole cover until wiring can be completed to keep debris out.
SM6L and SM7L mast arm poles have unique requirements. See TM655 thru TM658 and project plans for more info.

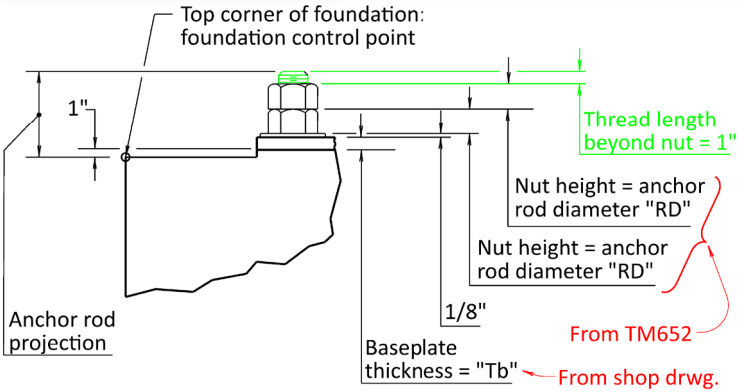
Inspector Action	
Verify the pole tag is installed on pole.	00962.46(i)
Verify the recessed terminal cabinet door can be easily closed.	TM654
Check pole for deviation from straightness.	00962.46(f)
Inspect factory welding for recessed terminal cabinet and verify orientation of terminal cabinet.	TM654, Plan Sheets & 00962.46(g)
Check for wire hanger hook ("J" hook) inside pole near mast arm connection and grounding lug near pole base.	TM450, TM452, TM652 & 00962.50
Check mast arm connection plate flatness.	00962.46(k)
Verify the anchor rod rotation past snug tight via pen markings.	00962.46(J)(2)(a)
Verify the anchor rod thread projection is 1" above the top nut. See illustration on next page.	TM653

Typical Sources of Info:
Specs: 00962.46(j)
Std. Dwg: TM650 thru TM654
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO

Bubble Note(s) See pg. 213:







Example:

Anchor rod projection for SM5L pole = 1" + "Tb" 1¾" + ⅛" + "RD" 2" + "RD" 2" + 1" = 7 ⅞"

ANCHOR ROD PROJECTION (TM653)

Mast Arm Connection

Key Enforceable Items		
Apply lubricant to high strength (HS) bolt threads and bearing surfaces that will turn during installation (washer to nut location)		00962.46(j)(2)(c), 00962.46(j)(2)(d) to 02560.70
HS bolts in tapped holes (4-bolt arm connections)	Tighten to a snug tight condition. Final tightening with felt tip pen marks.	00962.46(j)(2)(d)(1) to 00962.46(j)(2)(e)
	Rotational capacity tests are not required from the manufacturer or repeated in the field.	00962.10
HS thru bolts (8-bolt arm connections)	Tighten using direct tension indicator (DTI) washers. See illustration on next page. Note: For SM6L & SM7L poles: TM657 to TM656 note #24 to 00962.46(j)(2)(c)	TM652 to TM651 Note #22 to 00962.46(j)(2)(c)(1)
	Rotational capacity tests are required to be performed by the manufacturer AND in the field.	00962.10 to 02560.20 & 02560.60

Tips and Tricks

Make sure the mast arm won't block active signal indications. If any active indications are blocked, the mast arm must be removed. It can only be installed when the blocked indications are inactivated (e.g., day of signal turn-on). Plans sheets may specify this.

SM6L and SM7L mast arms have unique requirements. See TM655 thru TM658 and project plans for more info. Dual mast arms also have unique requirements – see plans.

Luminaire arms are mounted to the mast arm pole with HS bolts in tapped holes.

Review DTI video & spec notes (March 2016) *

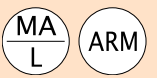
* Website links & QR scan codes provided starting on Pg. 227

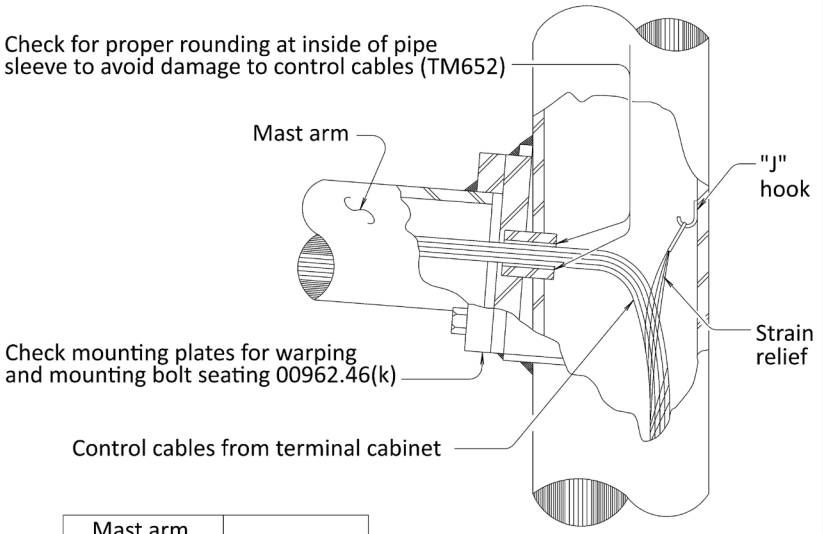
Inspector Action	
Check pipe sleeve at the mast arm mount for proper rounding.	TM652 or TM657
Determine the type and number of bolts required for each mast arm connection (HS bolts in tapped holes or HS thru bolts).	TM652 or TM657
Verify mast arm connection bolt diameter, bolt circle, and bolt spacing for each mast arm (see the standard drawing table).	TM652 or TM657
Check for mast arm plate straightness and mast arm mounting plate fit/bolting (look for warped plates or bolts not seating).	00962.46(k)
Check bolt geometry: Bolt length is flush or extends beyond outer face of nut when installed.	00962.46(j)(2)(c)(2), 00962.46(j)(2)(d)(2) to 02560.05
Coordinate with agency electricians to check DTI orientation and gap refusals after installation. Must refuse all spaces except 1 with a 0.005 inch feeler gauge. See illustration on next page.	00962.46(j)(2)(c)(2)

Typical Sources of Info:

Specs: 00962.46(j) & 02560
Std. Dwg: TM650 thru TM652, TM656 & TM657
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO

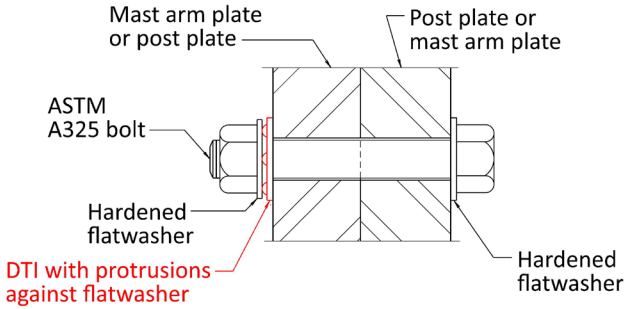
Bubble Note(s) See pg. 213:





	Mast arm length (TM652)	Mast arm pole type	
HS Bolts in Tapped Holes	15'	SM1	4-Bolt connection NO DTI NO rotational capacity testing
		SM1L	
	20' or 25'	SM2	
		SM2L	
	30' or 35'	SM3	
		SM3L	
HS Thru Bolts	40' or 45'	SM4	8-Bolt connection DTI Required Rotational capacity testing required
		SM4L	
	50' or 55'	SM5	
		SM5L	
	60' or 65'	SM6L	
	70' or 75'	SM7L	

MAST ARM CONNECTION (TM450 & 652)



H.S. THRU-BOLTS CONNECTION DTI DETAIL (TM652)

Service Cabinet & Commercial Power Hook-up

Key Enforceable Items	
Contractor obtains the required permits and arranges for utility to inspect the service cabinet and make the electrical hookup.	00960.03 & 00960.46
Utility will not provide power (energize) until AFTER the electrical permitting agency has approved the service cabinet installation. The service cabinet must be energized prior to the field testing inspection by agency electricians.	00960.46
Conduit and wiring between the commercial power source and service cabinet are specified in the electrical permit. See illustration on next page.	TM485, Plan Sheets, & Permit

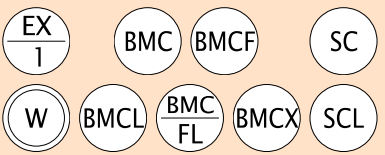
Tips and Tricks
Install service cabinet and associated equipment early on to allow the utility ample time to schedule their work.
Wire from the service cabinet to the controller cabinet is installed in a separate conduit. Wire typically consists of 2 No. 6 AWG XHHW wires and a bond wire.
The meter base is inclusive to the service cabinet in permanent installations. A stand-alone meter base and stand-alone service cabinet mounted to a wood pole are used only for temporary signals.
The gasket between the concrete foundation and the service cabinet helps prevent the cabinet from corroding.
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.
If the electrical permitting agency questions why some traffic signal electrical equipment does not have a UL listing, show them the red sheets. See page 3 for more info.

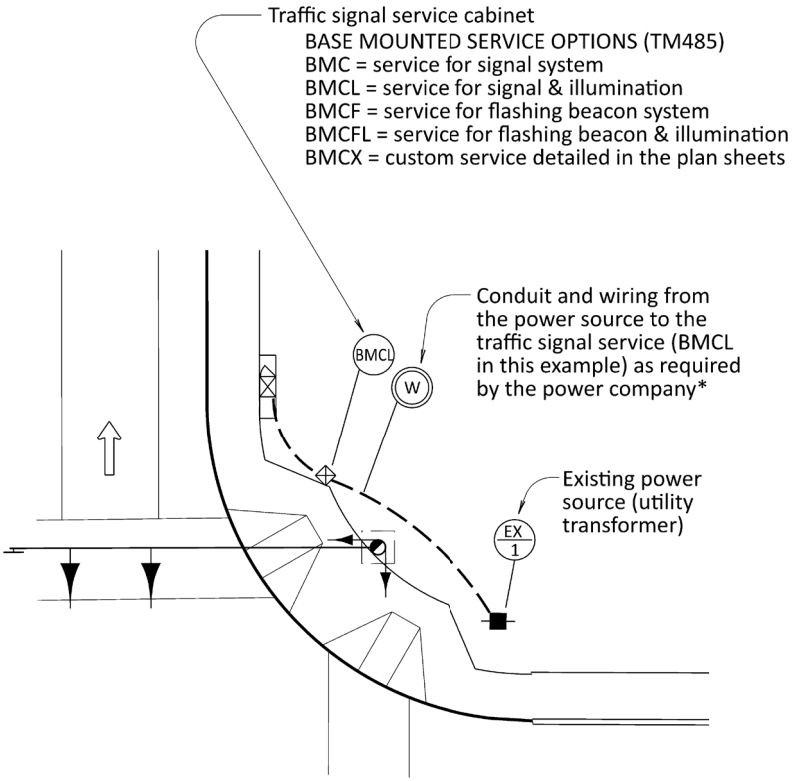
Inspector Action	
Verify location of the power source and service cabinet.	Plan Sheets
Verify the gasket between foundation and service cabinet is installed.	TM482
Verify there are 2 ground rods a minimum of 6' apart (one ground rod is located in the service cabinet foundation).	TM482 & Page 168
Coordinate a supplemental inspection by the electrical permitting agency (required) after the service cabinet is installed.	00960.46, Oregon Law & Page 107

Typical Sources of Info:

Specs: 00960.03, 00960.45(d), & 00960.46
Std. Dwg: TM482 & TM485
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 11, 12, & 62

Bubble Note(s) See pg. 213:





BASE MOUNTED SERVICE (TM485)

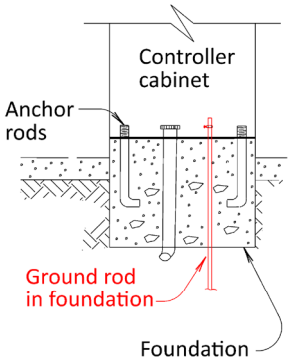
Bonding & Grounding

Key Enforceable Items	
Drive ground rods, attach appropriate size grounding electrode conductor and grounding lug.	00960.45
Ground rods for permanent structures must be installed in a junction box or a foundation as shown. The ground rod for temporary wood poles may be buried and is the only exception.	TM450, TM453, TM454, TM457, & TM482
All ground and bond wires must be stranded conductors.	00960.45(b)
Tips and Tricks	
Bonding and grounding can get complicated so this is one area where requesting assistance from agency electricians is STRONGLY suggested.	
Bonding and grounding is typically necessary for all conduits with AC conductors and for all signal poles, pedestals, controller cabinet, and service cabinet.	
Bonding to the junction box is not required in a non-metallic junction box with non-metallic lid.	
Two ground rods are required at the service cabinet as per TM485 to eliminate the need to test resistance to ground. This requirement is more stringent than NEC code.	
DC circuits are used for pedestrian push buttons, loop detection systems, and fire preemption systems. AC circuits are used for signal and pedestrian indications.	
Inspector Action	
Verify the ground rod is in the correct location for all poles, pedestals, controller cabinet, and service cabinet. See illustration on next page.	TM450, TM453, TM454, TM457, & TM482
Verify the ground rod extends above the foundation or the bottom of the junction box 2 to 3 inches to allow for properly attaching the clamp and wire.	00960.45(c)

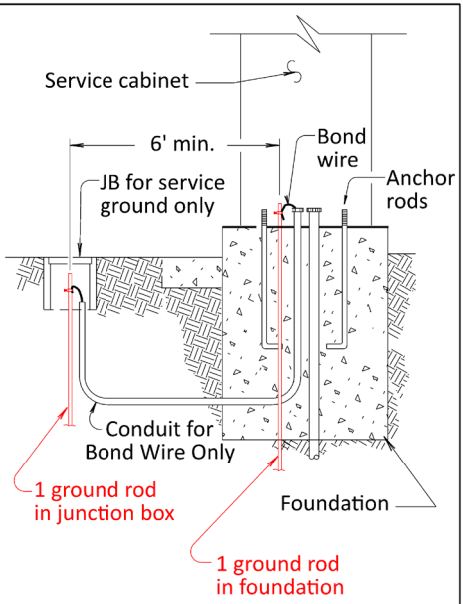
Typical Sources of Info:
Specs: 00960.45
Std. Dwg: TM450, TM453, TM454, TM457, TM482, & TM485
Plan Sheets: NO
Blue Sheet/Green Sheet Info: Pgs. 37 & 38

Bubble Note(s) See pg. 213:

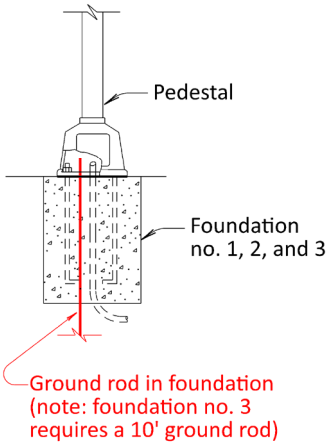
Not Applicable



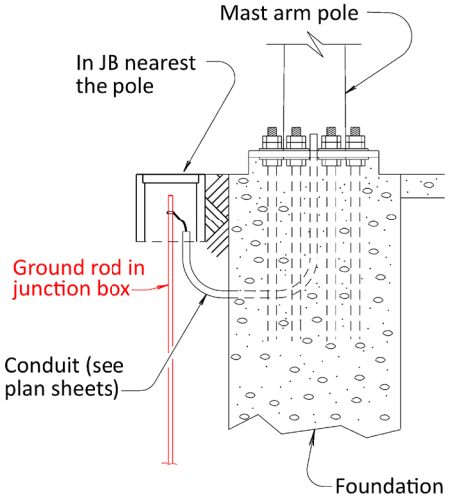
CONTROLLER CABINET (TM482)



BASE MOUNTED SERVICE CABINET (TM482)



PEDESTAL (TM457)



POLE (TM450)

GROUND ROD LOCATIONS

Pulling Wires & Cables

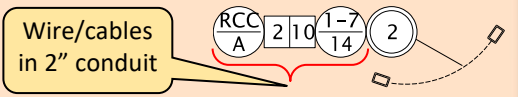
Key Enforceable Items		
Always pull wires and cables by hand in a straight line with the conduit opening, using a pulley device if necessary to achieve a straight line.		TM470
Use approved lubricant to reduce pulling strain and prevent insulation damage.		TM470
Wires and cables shall be continuous (no splicing) from terminal block to terminal block (splicing loop wire to feeder cable in the junction box is the only exception). See page 194 for video/radar wiring and page 196 for fire preemption wiring. See illustration on next page.		TM470
Do not tie or tape conductors or cables together inside conduit.		TM470
2 feet of slack wire/cable in: • Junction boxes (except first JB nearest controller cabinet) • Poles	6 feet of slack wire/cable in: • First junction box nearest the controller cabinet • Controller cabinet • Service cabinet	TM470

Tips and Tricks
Typically requires one person pulling wire and one person feeding wire in the conduit.
Do not use any mechanical means to apply or multiply pulling force.
Do not route illumination circuit wiring through controller cabinet.

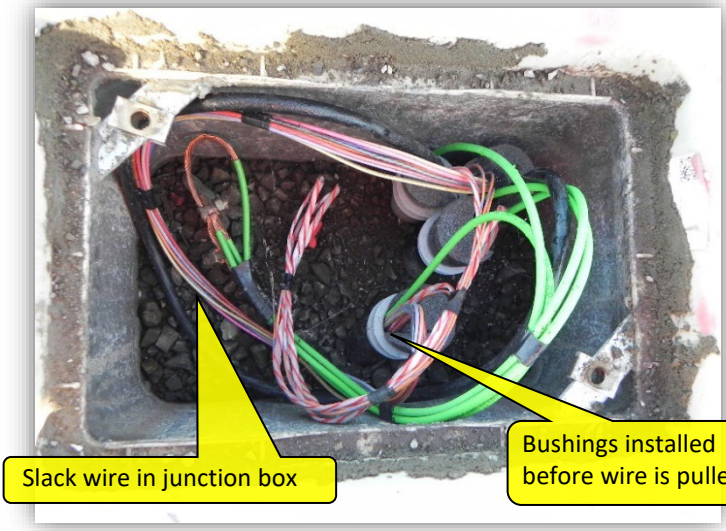
Inspector Action	
Verify that all conduit bushings are installed before pulling wires. See illustration on next page.	TM471
Verify that bond wire (if required) is included in conduits.	00960.45
Verify tracer wire (TFFN) is included in conduits.	TM470
Verify conduit is clean before pulling wires by witnessing the contractor use a mandrel and compressed air (existing conduit and new conduit).	00960.42(a) and (b)
Inspect pulled ends of conductors for insulation damage.	Workmanship
Verify conduit plug is installed in conduit after wires are pulled.	TM471
Verify pull line is installed in conduits shown for future use.	TM470 & Plan Sheets

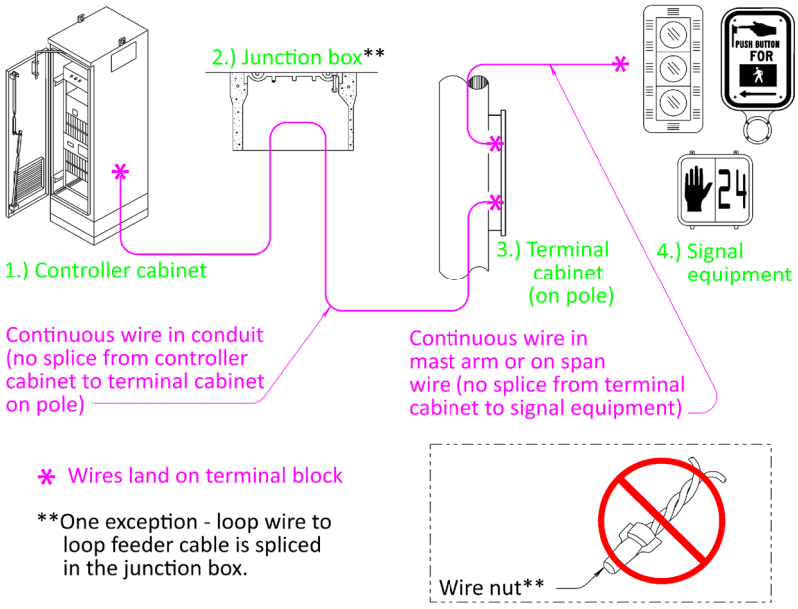
Typical Sources of Info:
Specs: NO
Std. Dwg: TM470
Plan Sheets: NO

Bubble Note(s) See pg. 213:



Blue Sheet/Green Sheet Info: Pgs. 26, 27, 31, 37, 39, 40, 41, 42, & 55





TRAFFIC SIGNAL WIRE SPLICING (TM470)

Wiring Poles, Mast Arms, and Spanwires

Key Enforceable Items	
Use cable strain reliefs to support wiring at "J" hooks above mast arm connections.	TM450, TM652, &TM657
Wire mast arms with control cables (one 7 conductor wire cable per vehicle signal).	TM470
Control cables for spanwire installations will exit/enter the bottom of the terminal cabinet using watertight compression fittings and are attached to the messenger cable with cable ties every 6 inches.	TM452
Tape off ends of extra (spare, unused) conductors.	TM470
Wires and cables shall be continuous (no splicing) from terminal block to terminal block. Splicing loop wire to loop feeder cable in the junction box is the only exception.	TM470
Leave 2 feet of slack wire in the pole base.	TM470
Do not terminate fire preemption or illumination wiring in terminal cabinet.	TM450, TM456 & 00970.42

Tips and Tricks
Wiring poles consists of single conductors or control cable brought into the pole terminal cabinets via underground conduit. Wiring the mast arm or span wire consists of control cable from the terminal cabinet to the various pieces of equipment. See illustration on next page.
Signal conductors are normally 7 conductor, No. 14 AWG control cables.
Illumination conductors are normally XHHW No. 10 AWG.
Become familiar with the wiring shown on plans.
The details for wiring traffic signals can be hard to remember if you don't work with it all the time, so this is one area where requesting assistance from agency electricians is STRONGLY suggested.

Inspector Action	
Verify "J" hooks above mast arm connection on mast poles.	TM450, TM652, & TM657
Verify the number of cables attached to each messenger cable.	Plan Sheets

Typical Sources of Info:

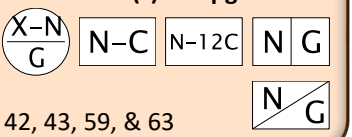
Specs: 00970.42

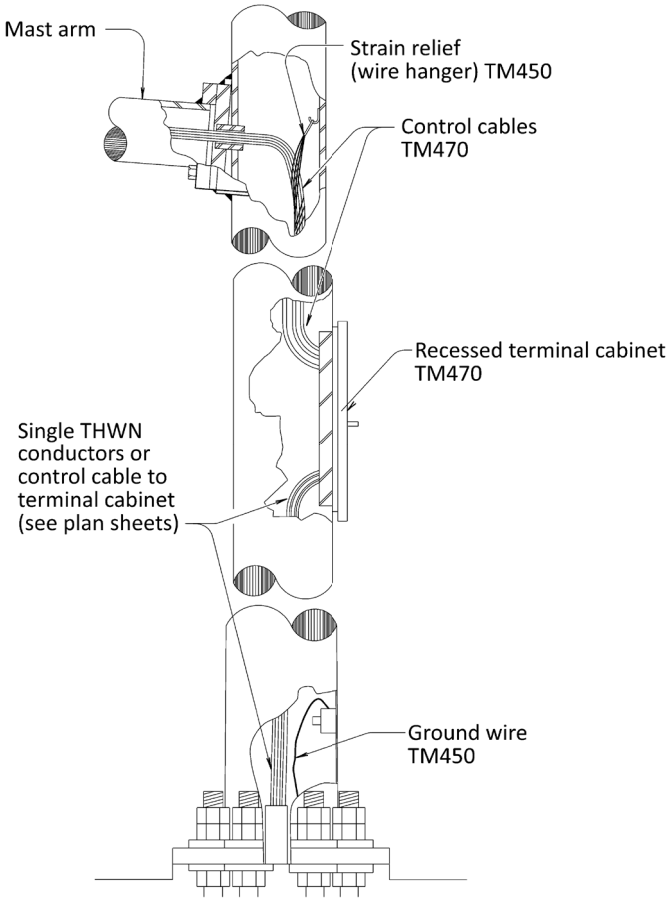
Std. Dwg: TM450, TM452, & TM470

Plan Sheets: YES

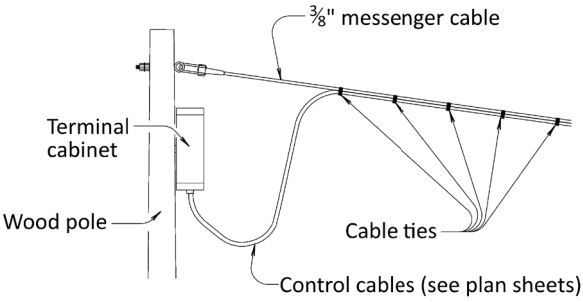
Blue Sheet/Green Sheet Info: Pgs. 15, 37, 39, 42, 43, 59, & 63

Bubble Note(s) See pg. 213:





MAST ARM POLE WIRING (TM450, TM470 & PLAN SHEETS)



TEMPORARY SPANWIRE WIRING (TM452 & PLAN SHEETS)

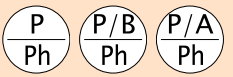
Pedestrian Signals

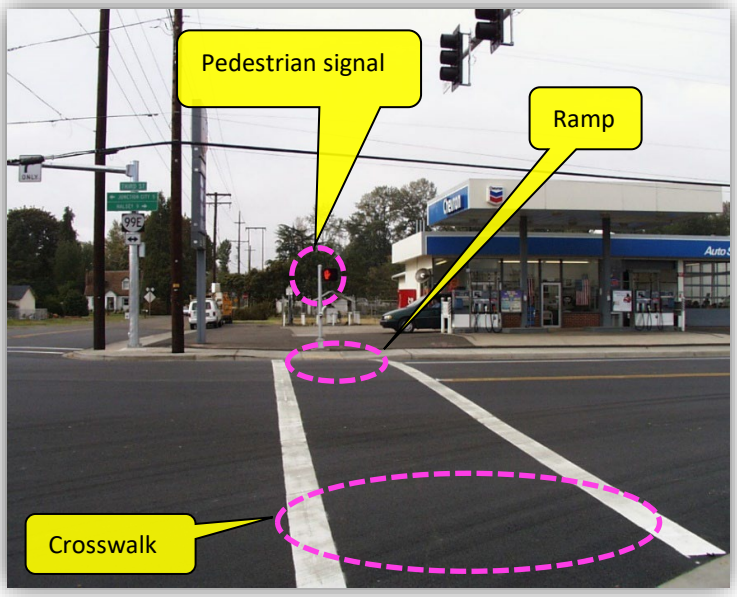
Key Enforceable Items	
Housing, doors, and visors may be powder coated aluminum or polycarbonate.	Blue Sheets & Plan Sheets
Drill pole for clamshell mount (two ½ inch NF stainless steel allen head cap screws).	TM467
If the project requires removing existing pedestrian signals, install pipe plugs to plug the hole(s) in the metal support.	00990.45
Tips and Tricks	
Hinged mounting brackets (clamshell mounts) are a two-piece, ready-to-use assembly into which the pedestrian signal is installed.	
PLUMBING PIPE AND FITTINGS are not permitted.	
Clamshells should 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.	
Inspector Action	
Verify orientation of clamshell mount (pole/pedestal has been drilled at proper location).	Plan Sheets (Pole Entrance Chart)
Verify angle of crosswalk before mounting head. In the field, check visibility and line-of-sight of pedestrian signal from far end of crosswalk and adjust as necessary. See illustration on next page.	Plan Sheets
Verify that the pedestrian signal can be opened for maintenance.	TM467
Verify crosswalk and ramp placement with respect to the pedestrian signal. See illustration on next page.	Plan Sheets
Verify that temporary covers are installed over the pedestrian signals until the signal is turned-on.	00990.50
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, TM453 & TM457

Typical Sources of Info:

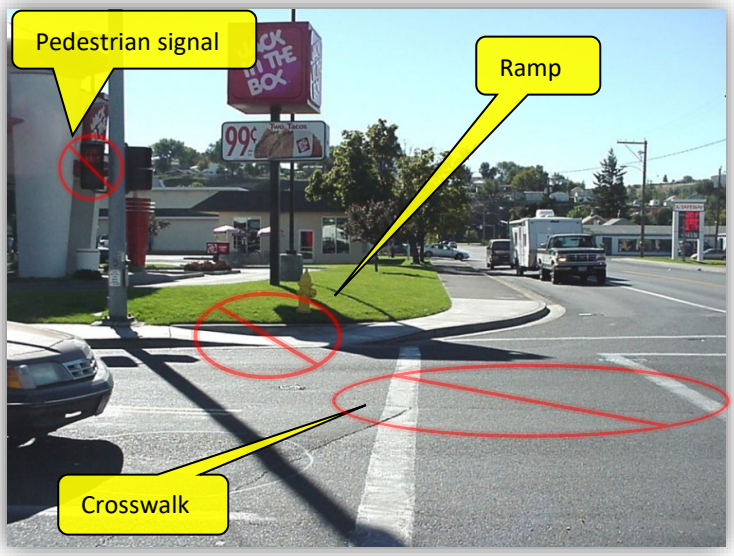
Specs: 00990.50
Std. Dwg: TM467
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 10, 23, 44, 45, & 46

Bubble Note(s) See pg. 213:





Pedestrian signal, ramp access, and crosswalk should all line up, as shown in top picture. If you notice this is not the case, as shown in bottom picture, notify the EOR.



Pushbuttons: ADA Compliance Information

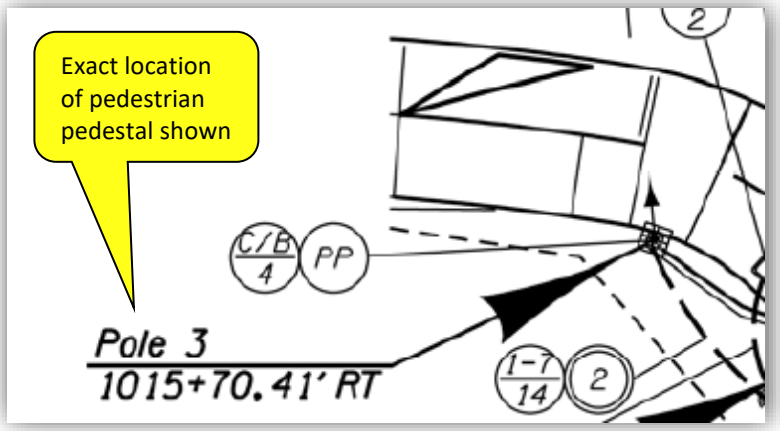
Tips and Tricks

Pedestals and poles with pushbuttons are precisely located by the EOR with station/offset/elevation detailed in the roadway and signal plan sheets. This location should achieve compliance with ALL pushbutton placement requirements and ODOT documentation processes. **NOT FOLLOWING THE PLANS MAY RESULT IN PUSHBUTTONS THAT ARE NOT ADA COMPLIANT.** See example of signal plans on this page and example of roadway plans on next page.

If constructability issues arise and modifications to station/offset/elevations shown in the plan sheets appear necessary, NOTIFY THE EOR IMMEDIATELY. The EOR is responsible for re-design and verifying modifications meet all ADA and documentation requirements.

Plans will also show any unique details (e.g., incorporating curb into pedestal foundation).

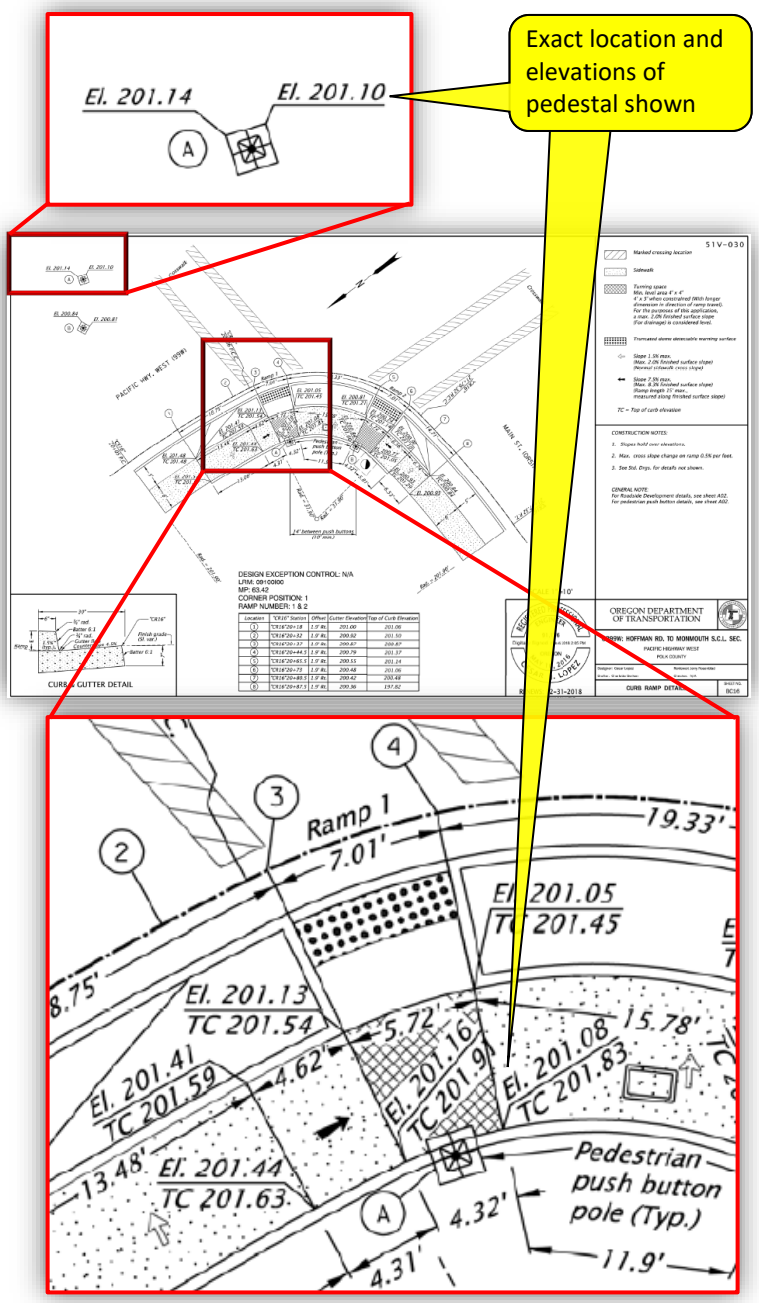
Signal Plan Sheet Example



		See TM650 thru TM653	EQUIPMENT ON POLE				
POLE NO.	DWG. NO.	TYPE	PED. SIGNAL/BUTTON DEG.	TERM. CABINET DEG.	SIGN DEG.	RADAR UNIT DEG	PHOTO ELECTRIC CELL
1	MB32	SM4L		180	270	235	
2	MB32	PP	90				
3	MB32	PP	355				

Exact mounting location of pushbutton on the pedestal shown

Roadway Plan Sheet Example

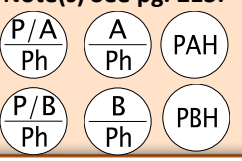


Pushbuttons

Key Enforceable Items	
Pushbuttons are installed in a one-piece assembly which includes the sign.	Blue Sheets
If the project requires removing existing pushbuttons, install pipe plugs to plug the hole(s) in the metal support.	00990.45
Tips and Tricks	
Pushbuttons will typically be mounted on pedestals as it tends to be more difficult to meet design requirements when pushbuttons are mounted to a signal mast arm pole.	
The 10" ADA reach distance cannot be met if the pushbutton is mounted on a pedestal or pole located behind a curb.	
Use of extension brackets is discouraged as a solution to meet the 10" ADA reach distance. It is always better to install the standard pushbutton installation whenever possible (pushbutton takes less abuse from the public, easier maintenance, and improved aesthetic).	
Inspector Action	
Verify angle of crosswalk before mounting pushbutton. The face of the pushbutton shall be mounted parallel to the crosswalk. See illustration on next page.	Plan Sheets & TM467
Verify that pole has been drilled at proper orientation to mount the pushbutton.	Plan Sheets (Pole Entrance Chart)
Verify the mounting height of pushbutton is 3.5 to 4 feet above the paved surface near the pole (measured from the center of the pushbutton). See illustration on next page.	TM450, TM452, TM453 & TM457
Verify that the ADA Reach Distance for the pushbutton is 10" or less (measured from obstruction to pushbutton). See illustration on next page.	TM467
Verify the grades in the vicinity of the pushbutton (e.g., sidewalk, ADA ramps, shoulder) match the grades shown in the plans.	Roadway Plan Sheets
Fill out the roadway curb ramp inspection forms.	Internal Procedure
Verify that temporary covers are installed over the pedestrian pushbuttons until the signal is turned-on.	00990.51
For audible pedestrian signals (contained within the pushbutton), coordinate with region traffic to verify the correct message is used.	Green Sheets

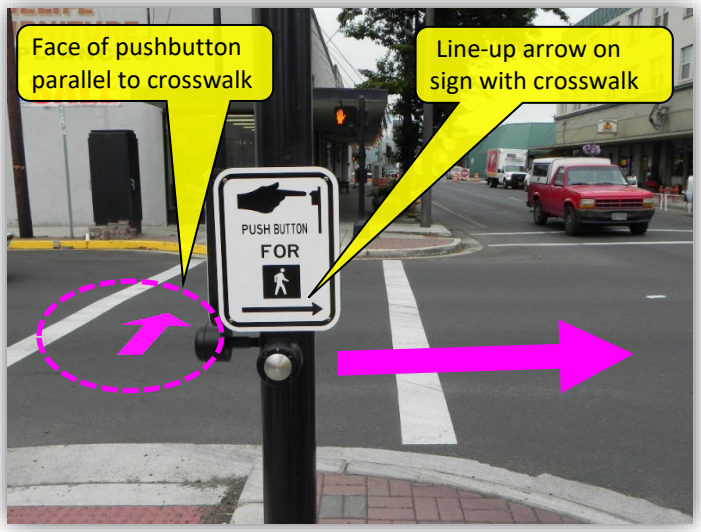
Typical Sources of Info:
Specs: 00990.51
Std. Dwg: TM467
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 10, 23, 47 & 89

Bubble Note(s) See pg. 213:




10 inch max. reach to pushbutton
Obstruction (edge of curb)
Level clear space for wheelchair user within 10 inches of the pushbutton


3.5 to 4 feet vertical from center of pushbutton to surrounding surface


Face of pushbutton parallel to crosswalk
Line-up arrow on sign with crosswalk
PUSH BUTTON
FOR

Vehicle Signal Installation

Key Enforceable Items	
Signals shall line up over lane lines as shown on the plans and according to the spacing detailed in the pole entrance chart. See illustration on next page.	Plan Sheets
If the project requires removing existing vehicle signals, install pipe plugs to plug the hole(s) in the metal support.	00990.45

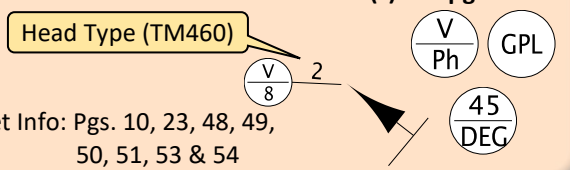
Tips and Tricks
Vehicle signals are comprised of individual signal face sections configured to create any signal head type (modular construction). See illustration on next page.
Material may be polycarbonate (heavy duty) as per the plans or specifications.
Mounted to mast arms and poles with a vehicle signal bracket. See Page 182.
Suspended from messenger cable with a span wire hanger, conduit, and tri-stud adapter. See Page 132.
The plan sheets or special provisions will specify if louvers or non-standard visors are required. Region traffic will verify the visibility of the signal indication meets requirements at the signal turn-on.
The plan sheets or special provisions will specify if tattletale lights are required.
Active signal heads shall not be covered with a temporary cover as they can still be seen through the bag and can cause confusion.

Inspector Action	
Verify the type of signal head to be installed. Verify if louvers, cut-off visors, or tattletale lights are to be installed.	Plan Sheets & TM460
Verify the indications are LED with clear lenses.	Blue Sheets
Verify the material (aluminum or polycarbonate).	Plan Sheets & Blue Sheets
Verify all hardware and fasteners are stainless steel.	TM460
Verify correct vertical clearance between the bottom of the equipment and the pavement is 18 feet minimum to 19 feet maximum.	TM450 & TM452
Verify self-tapping stainless steel pan head screws with flat washers (attached to screw) are used to install the backboard.	TM460
Verify that temporary covers are installed over the signal heads until the signal is turned-on.	00990.50

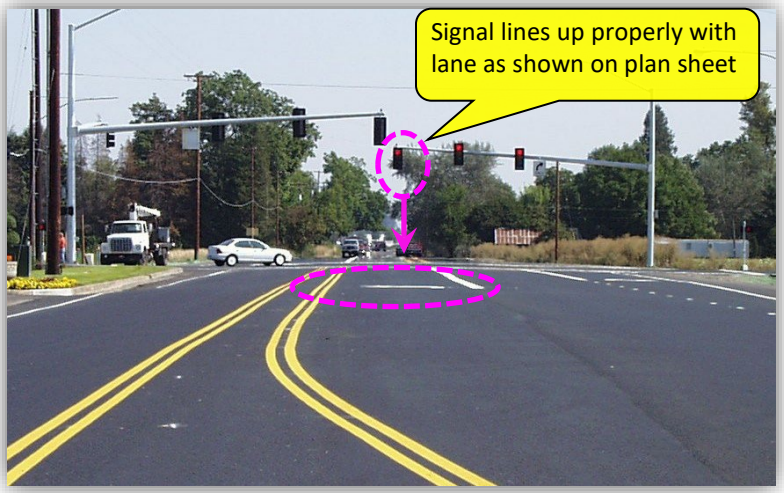
Typical Sources of Info:

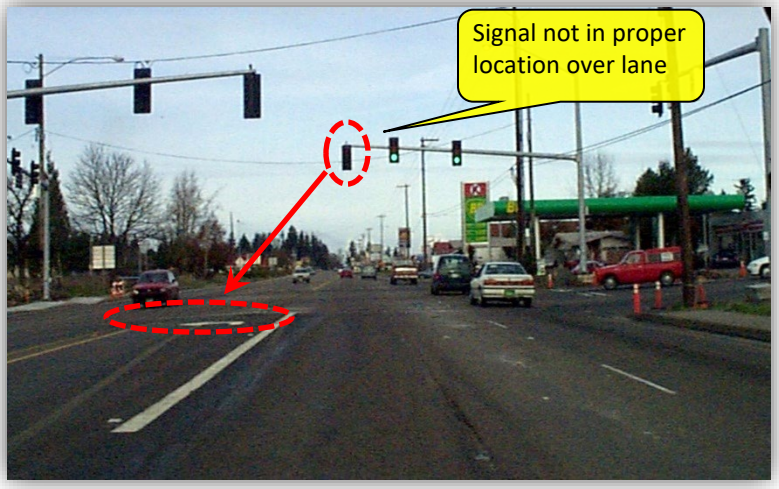
Specs: 00990.50
Std. Dwg: TM460
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 10, 23, 48, 49, 50, 51, 53 & 54

Bubble Note(s) See pg. 213:



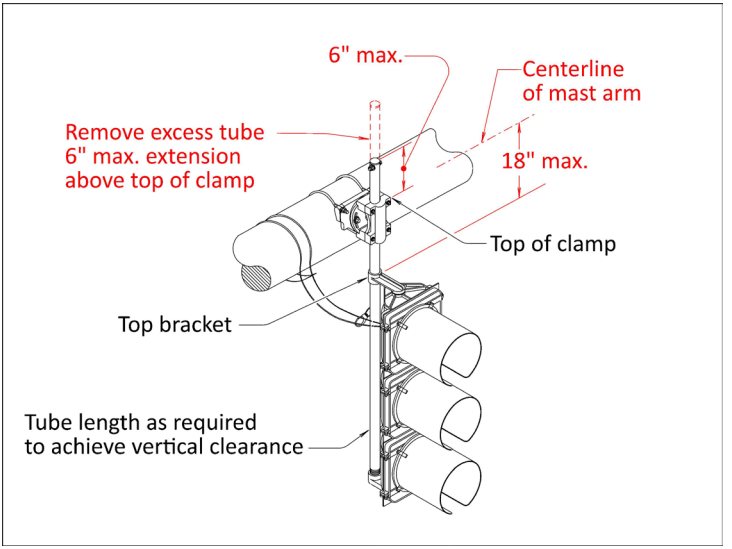
Single vehicle signal head section. Additional sections are bolted together to create the head types shown on TM460





Vehicle Signal Bracket

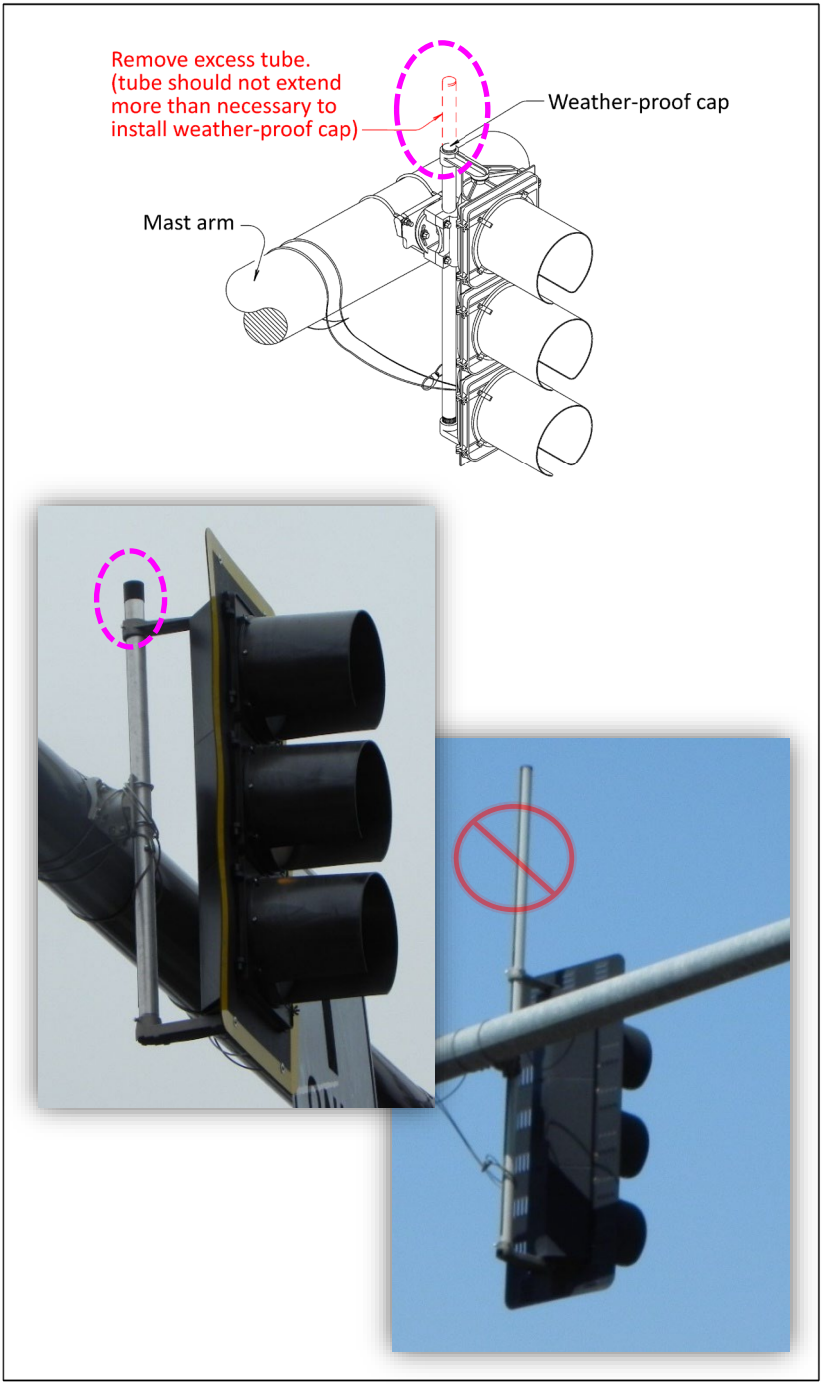
Key Enforceable Items	
Vehicle signal brackets require a safety cable.	TM462
Trim excess portion of gusseted tube. See illustration on this page and next page.	TM462
Drill and tap pole and install chase nipple for wire entry into pole.	TM462
Tips and Tricks	
Vehicle signal brackets are used to suspend equipment from mast arms and vertical poles. They also provide a cable entrance into the equipment. This includes the 4 inch side pole mount for mounting vehicle signals on pedestals.	
Install hardware with anti-seize compound. Do not over tighten.	
Inspector Action	
Verify spacing of equipment mounted on mast arm.	Plan Sheets
Verify correct vertical clearance between the pavement and the bottom of the equipment on the mast arm is met, 18 feet minimum to 19 feet maximum.	TM450
Verify 18 inch maximum length of gusseted tube from centerline of mast arm to top of bracket. See illustration on this page.	TM462



Typical Sources of Info:
Specs: NO
Std. Dwg: TM462
Plan Sheets: YES (pole entrance chart)
Blue Sheet/Green Sheet Info: Pgs. 22 & 52

Bubble Note(s) See pg. 213:

Not Applicable


Remove excess tube.
(tube should not extend
more than necessary to
install weather-proof cap)
Weather-proof cap
Mast arm

Sawcutting Detector Loops

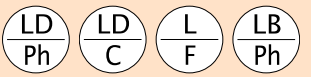
Key Enforceable Items	
Flush sawcut with high pressure water stream before cuttings dry. Blow out water and debris with high pressure/volume air, dry slot thoroughly with air or use a vacuum/extractor system.	00990.41(b)

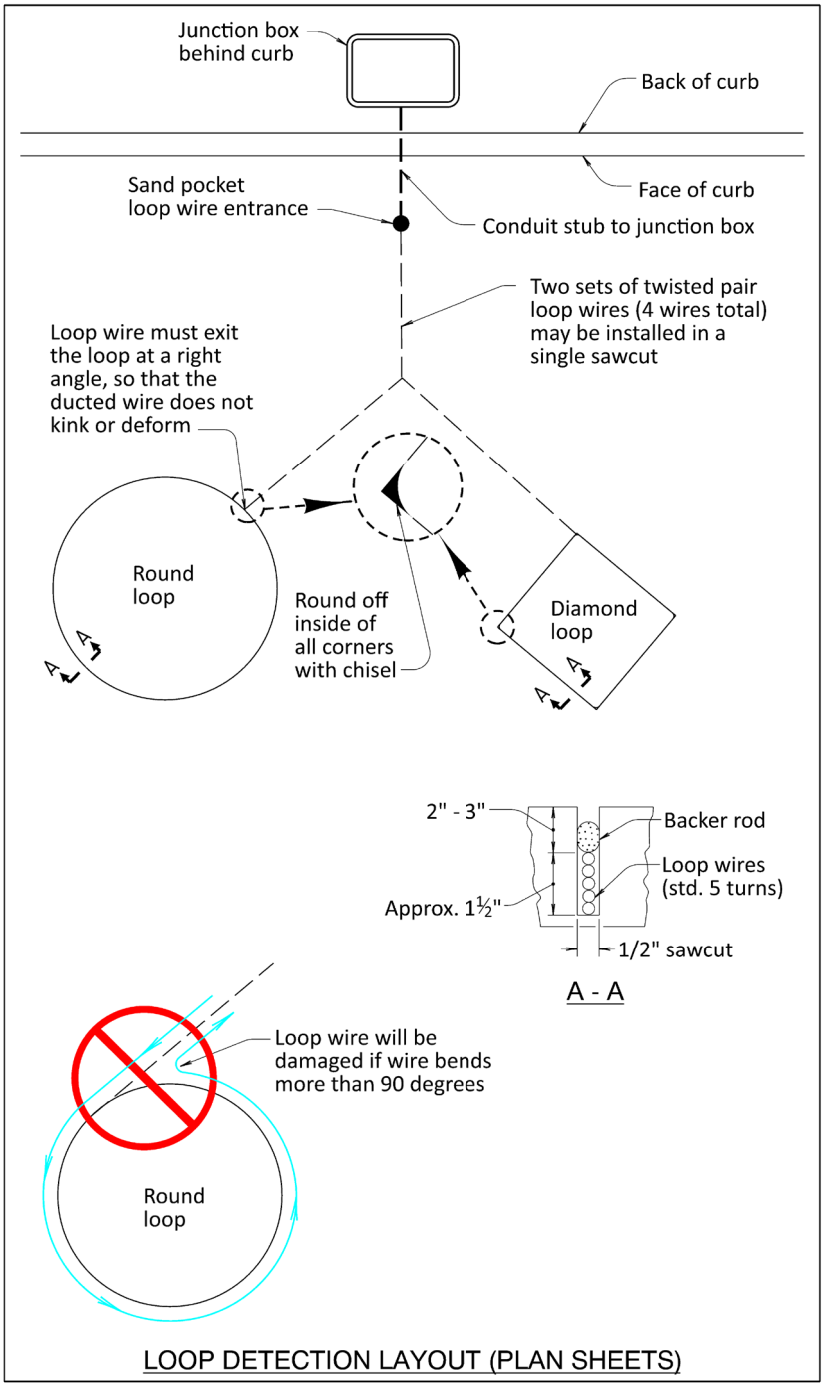
Tips and Tricks
Loop detection is no longer the standard form of detection and will be phased out. If loops are used on a project, the plan sheets and special provisions will contain all installation details.
Sawcutting provides a slot in the pavement for the loop wires to be installed.
Loop wire returns cannot be routed through adjacent loops.
Detector loop installations are the most failure-prone portion of a signal. Careful construction according to the plan sheets and special provisions greatly reduces this failure rate.

Inspector Action	
Prior to sawcutting, verify the marked-out loop locations (centered in the lane line and proper distance from stop line) and the loop wire returns. Coordinate a supplemental inspection by region traffic (required).	Plan Sheets & Page 107
Verify sawcuts are at least ½ inch wide.	Plan Sheets
Verify sawcuts are deep enough to allow the minimum 2 inch cover over all wires placed in slot. See illustration on next page.	Plan Sheets
STOP construction if sawcut is deep enough to reach subbase/subgrade and contact EOR for options.	Plan Sheets
Verify all rocks and any other material in bottom of sawcut is removed.	00990.41(b)
Coordinate supplemental inspection by agency electricians (required).	00990.41(a) & Page 107
Verify sawcut angles are no more than 90 degrees and all corners are rounded off to prevent kinking and insulation damage of the loop wire. See illustration on next page.	Plan Sheets

Typical Sources of Info:
Specs: 00990.41
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: NO

Bubble Note(s) See pg. 213:





LOOP DETECTION LAYOUT (PLAN SHEETS)

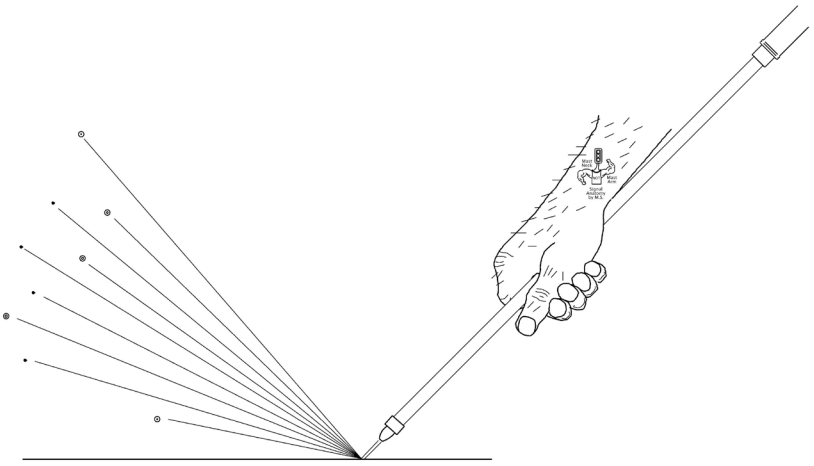
Loop Wire

Key Enforceable Items	
If loops are installed in series, each pair of loop wires must return to the junction box before connecting the loops in series.	Plan Sheets
Wedge 1 inch lengths of backer rod into all sawcuts to hold the loop wire down. The baker rod segments should be placed no more than 12 inches apart and 6 inches from any corners.	Plan Sheets
Five turns of loop wire (to form the loop) is standard. See illustration on next page.	Plan Sheets
Loop wire returns are twisted 4-6 turns per foot from the loop to the splice in the junction box. See illustration on next page.	Plan Sheets
Tips and Tricks	
Loop detection is no longer the standard form of detection and will be phased out. If loops are used on a project, the plan sheets and special provisions will contain all installation details.	
Installing detector loop wires requires good practices and great care to avoid damage which is not readily apparent. Loops may function initially and then fail later when moisture intrudes through minor damage to the wire insulation.	
Loops located more than 500 feet from the controller cabinet may require more than 5 turns of wire. Plan sheets will state how many turns are required.	
Twisted pairs in a too-narrow slot can hang up requiring excessive force to properly seat in bottom of sawcut.	
Avoid kinking, deforming, or stepping on the loop wire.	
Inspector Action	
Prior to installing loop wire: Verify sawcut for adequate width and depth, absence of foreign debris, and ensure it is dry. See illustration on next page.	00990.41(b) & Plan Sheets
Witness installation of loop wire into sawcut using a blunt, non-metallic tool. The loop wire should slip effortlessly into a ½ inch wide slot. If it doesn't, STOP INSTALLATION and find out why.	00990.41(b)
Obtain report from contractor for testing of each loop during the following phases of installation: 1. Before splicing and sealing 2. Before splicing after sealing 3. After splicing and sealing Provide copies of the report to TSSU.	00990.41(d)
Coordinate a supplemental inspection by agency electricians (required).	00990.41(a) & Page 107

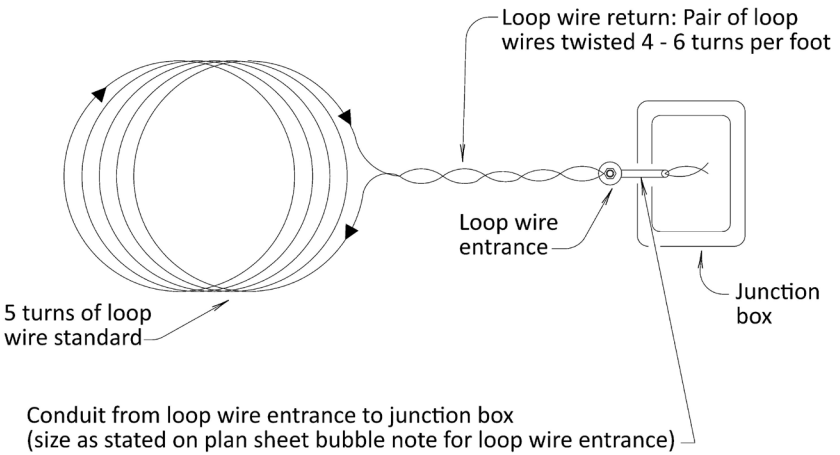
Typical Sources of Info:
Specs: 00990.41
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 2 (backer rod from QPL) & 56

Bubble Note(s) See pg. 213:

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. Special provisions 00990.41(b)



PREPARING THE SAWCUT BEFORE INSTALLING LOOP WIRE



LOOP WIRE INSTALLATION (PLAN SHEETS)

Loop Wire Entrance

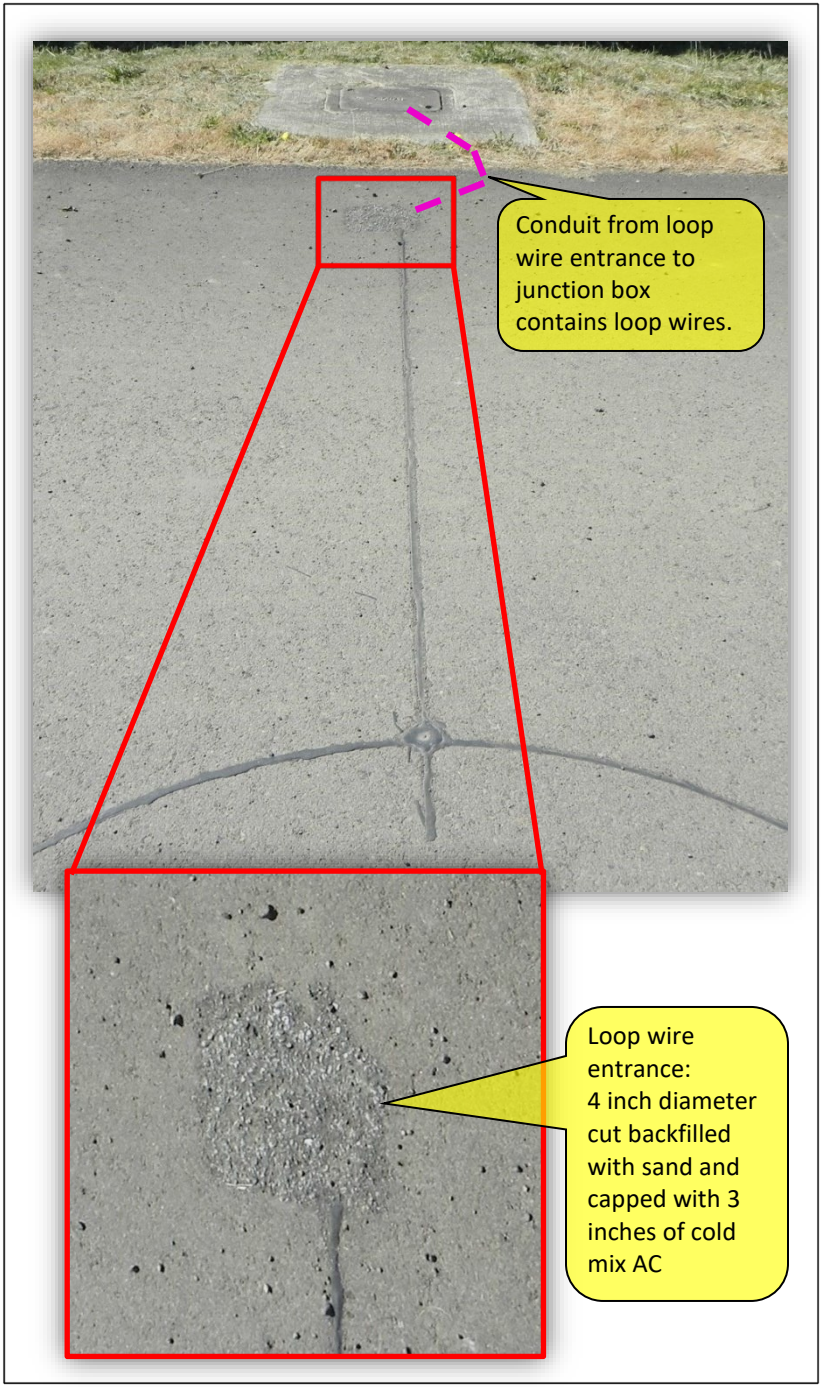
Key Enforceable Items	
4 inch minimum diameter core drill opening.	Plan Sheets
After installing loop wires, seal conduit with conduit plug and backfill loop wire entrance with sand. Leave room to install the cold mix AC cap.	Plan Sheets
Cap loop wire entrance with 3 inches of cold mix AC, not loop sealant. See illustration on next page.	Plan Sheets

Tips and Tricks
Loop detection is no longer the standard form of detection and will be phased out. If loops are used on a project, the plan sheets and special provisions will contain all installation details.
The loop wire entrance provides easy access to the loop wire and conduit stub in the pavement. In the event of a loop failure, the loop can be re-cut into this entrance point.
In the past, there were two types of loop wire entrances. Now there is only one type: 1. SAND POCKET – A 4 inch diameter opening cut into pavement, filled with sand and capped with AC cold mix. See illustration on next page.
Take care not to damage conduit stub.
An improper sawcut into the loop wire entrance (sand pocket) may allow loop sealant to get into the conduit.

Inspector Action	
Verify conduit stub is correct size (typically 2 inches).	Plan Sheets
Witness installation of at least one loop wire entrance and verify requirements shown on plan sheets and special provisions.	Plan Sheets

Typical Sources of Info:
Specs: NO
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pg. 56

Bubble Note(s) See pg. 213:


Conduit from loop wire entrance to junction box contains loop wires.
Loop wire entrance:
4 inch diameter cut backfilled with sand and capped with 3 inches of cold mix AC

Sealing Detector Loops

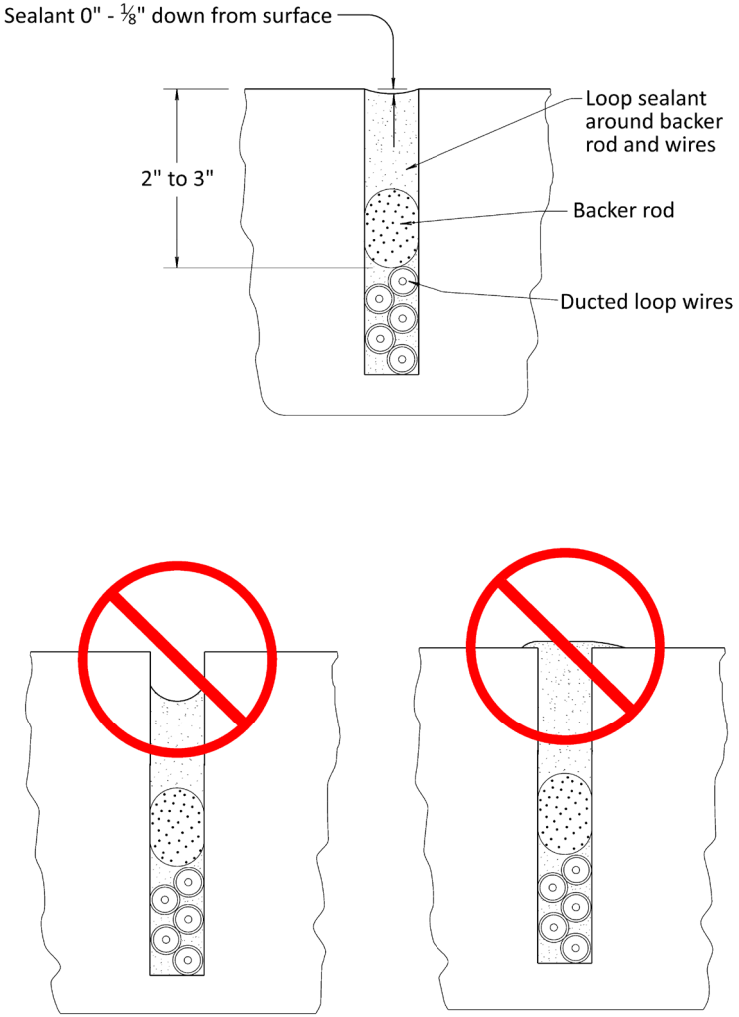
Key Enforceable Items	
Place sealant directly into the sawcut, using manufacturer's recommendations.	00990.41(c)
High temperature sealants must be placed in lifts to avoid heat damage to the loop wire insulation.	00990.41(c)
Surface of the sealant should be within a 1/8 inch of the pavement surface without protruding. See illustration on next page.	Plan Sheets
Use only QPL listed sealants. Loop sealants shall be proportioned, mixed, and installed in accordance with manufacturer recommendations.	00990.10
DO NOT QUICK COOL SEALANT WITH WATER.	00990.41(c)

Tips and Tricks
Loop detection is no longer the standard form of detection and will be phased out. If loops are used on a project, the plan sheets and special provisions will contain all installation details.
The sawcut must be clean and DRY before sealing.
Do NOT seal loops at temperatures below 40°F (as per manufacturer instructions).
On sloped sections, duct tape can be used to contain the sealant in the sawcut. Remove tape after sealant is fully cured.
STOP construction if sealant runs or puddles on pavement surface until contractor corrects the placement method.

Inspector Action	
Verify backer rod segments are in place.	Plan Sheets
Obtain report from contractor for testing of each loop during the following phases of installation: 1. Before splicing and sealing 2. Before splicing after sealing 3. After splicing and sealing Provide copies of report to TSSU.	00990.41(d)

Typical Sources of Info:
Specs: 00990.41
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pg. 2 (Backer Rod and Sealant from QPL)

Bubble Note(s) See pg. 213:
Not Applicable



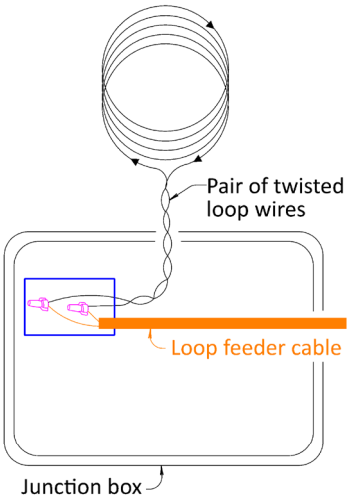
LOOP SEALANT INSTALLATION (PLAN SHEETS)

Detector Wiring Splice

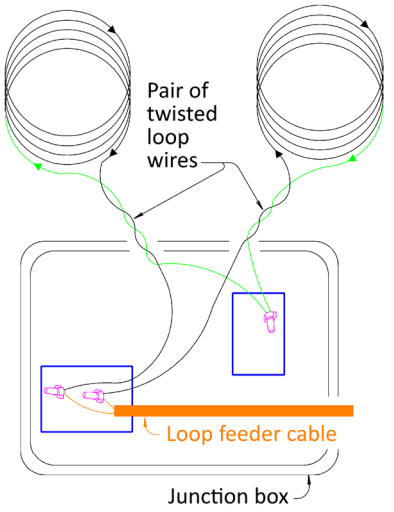
Key Enforceable Items	
Remove outer jacket of loop feeder cable, cut and remove drain wire and woven shield to approximately 4 inches back of intended splice.	Plan Sheets
Remove insulation from conductors, install screw on silicon grease filled wire connector, install black plastic self-locking straps, turn back wire connectors, insert into two piece plastic enclosure filled with silicon grease.	Plan Sheets
Splices are made inside the junction box (not in the loop wire entrance). See illustration on next page.	Plan Sheets
Do not ground the shield or drain wire in the junction box.	Plan Sheets
Tips and Tricks	
Loop detection is no longer the standard form of detection and will be phased out. If loops are used on a project, the plan sheets and special provisions will contain all installation details.	
Splices are used to connect a pair of loop wires to a loop feeder cable. Splices are also used to connect the loop wire of multiple loops (i.e., loops wired in series).	
The plan sheets and special provisions may state that use of the loop splice (two-piece plastic enclosure on the blue sheets) is NOT required.	
Inspector Action	
Verify both ends of the loop feeder cable and the loop wires are labeled with the correct loop number(s).	Plan Sheets
Verify which loops are wired in series (two or more loops connected to a single loop feeder cable). See illustration on next page.	Plan Sheets
Obtain report from contractor for testing of each loop during the following phases of installation: 1. Before splicing and sealing 2. Before splicing after sealing 3. After splicing and sealing Provide copies of report to TSSU.	00990.41(d)

Typical Sources of Info:
Specs: 00990.41(d)
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 55, 56, & 57

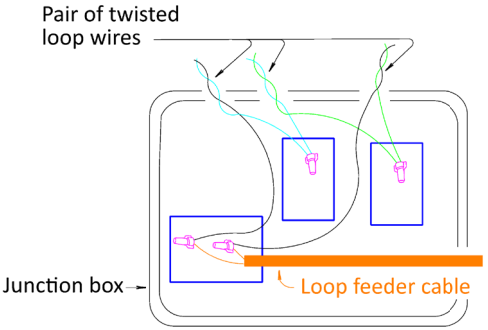
Bubble Note(s) See pg. 213:
Not Applicable

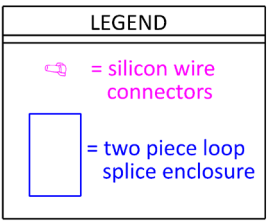


Loop Splice: Single Loop

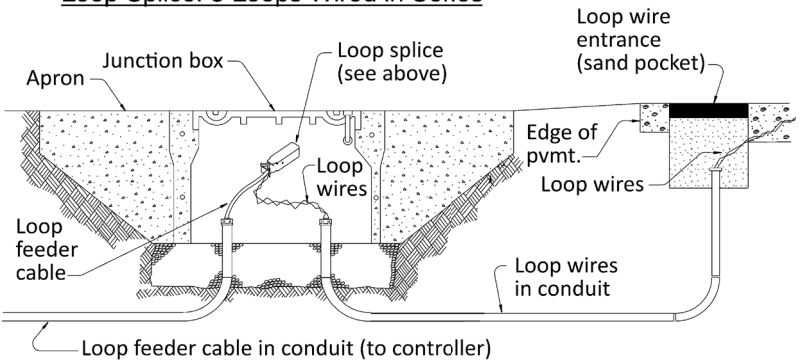


Loop Splice: 2 Loops Wired in Series





Loop Splice: 3 Loops Wired in Series



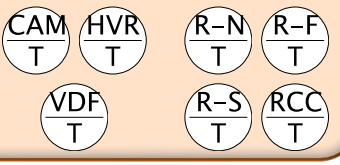
LOOP SPLICE INSTALLATION (PLAN SHEETS)

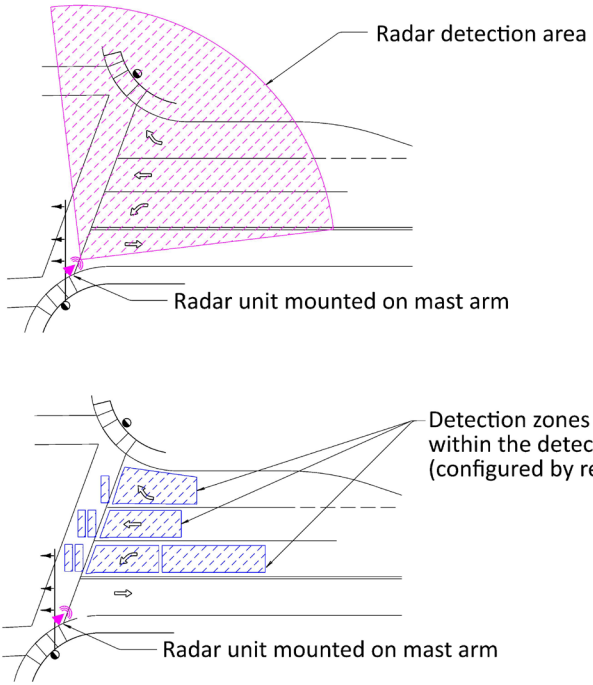
Video & Radar Detection

Key Enforceable Items	
Video and radar systems shall be from the green sheets only (no write-ins allowed).	Plan Sheets
Contractor is responsible for terminating video/radar detection wiring to the terminal blocks attached to the controller cabinet as shown in the cabinet print.	00990.42(a)
TSSU is responsible for installing and wiring the auxiliary devices not attached to the controller cabinet at the signal turn-on.	00990.70(f)
Connect the detector unit to the controller cabinet terminal blocks with a single, unspliced length of cable. See illustration on next page.	00160.07 (Manufacturer's Instruction)
Tips and Tricks	
Due to the extended testing timeframe for approving a video/radar system, write-in products for a project are not allowed.	
Region traffic is responsible for configuring the detection zones as shown in the cabinet print during the supplemental inspection for radar/video on-site set up and during the signal turn-on. This will require the contractor, agency electrician, or manufacturer's representative to adjust mounting height and/or the aim of the detection device as necessary. See illustration on next page.	
Inspector Action	
Verify the video/radar unit is installed at the appropriate location on the signal pole, mast arm, or luminaire arm.	Plan Sheets (Pole Entrance Chart)
Coordinate a supplemental inspection (required) with the manufacturer's representative and agency electricians for setting up the devices prior to the signal turn-on date.	00990.30 & Page 107

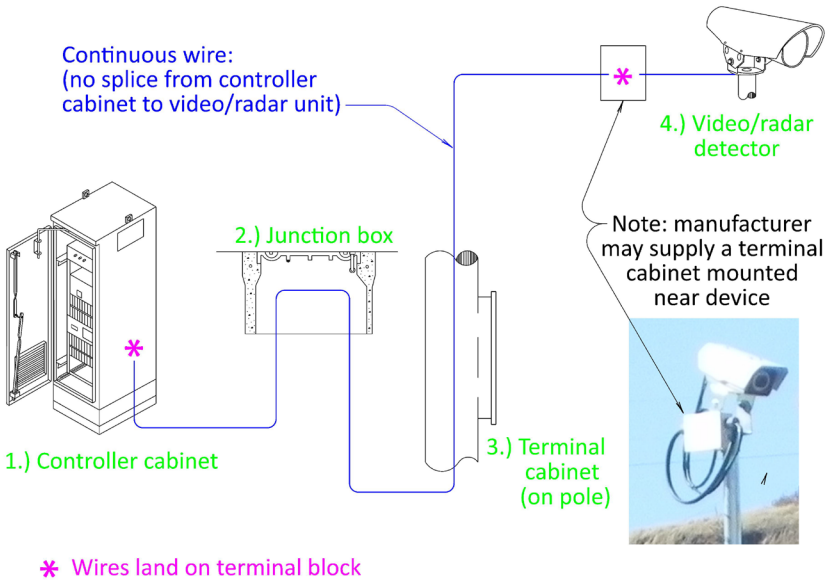
Typical Sources of Info:
Specs: 00990.30
Std. Dwg: TM466
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 36, 86, 87, & 88

Bubble Note(s) See pg. 213:





DETECTION ZONES (CABINET PRINT)



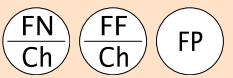
VIDEO/RADAR DETECTOR WIRING

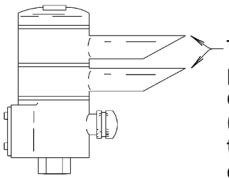
Fire Preemption System

Key Enforceable Items	
The preemption detector (field) unit is mounted up-right on a mast arm and hung upside down on a span wire.	Plan Sheets, TM450 & TM456
Connect the preemption detector (field) unit to the controller cabinet terminal blocks with a single, unspliced length of preemption feeder cable. See illustration on next page.	TM450 & TM456
Knock out the appropriate weep hole based on how the device is mounted (mast arm vs. span wire).	TM450 & TM456
Tips and Tricks	
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).	
If the preemption device is mounted to a vertical pole, the plan sheets will detail the installation information (e.g., mounting height, mounting details, and orientation on pole).	
Inspector Action	
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
Verify the number of barrels for each preemption detector (field) unit (either 1 or 2). See illustration on next page.	Plan Sheets

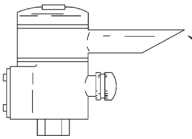
Typical Sources of Info:
Specs: NO
Std. Dwg: TM450 & TM456
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 80 & 81

Bubble Note(s) See pg. 213:





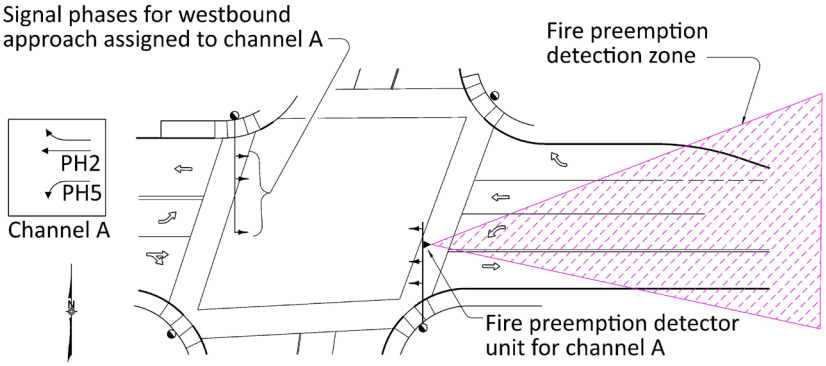
Two barrel preemption detector unit (may be assigned to one or two channels)



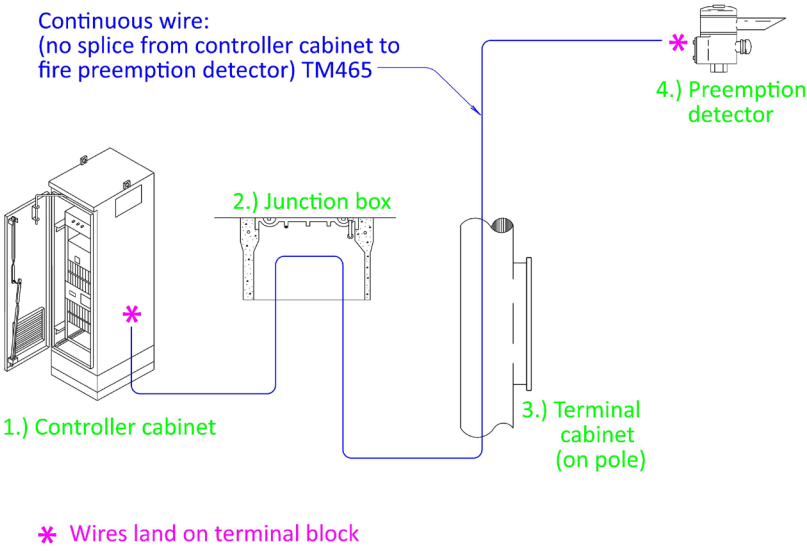
One barrel preemption detector unit (only assigned to one channel)

Plan sheets will state how many barrels and which channel(s) are assigned

NUMBER OF BARRELS (PLAN SHEETS)



DETECTION ZONE & CHANNEL ASSIGNMENT (PLAN SHEETS)



FIRE PREEMPTION WIRING

Luminaires (On Traffic Signal Mast Arm Pole)

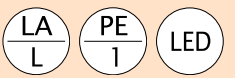
Key Enforceable Items	
Service cabinets for signals with illumination include a test switch.	TM485
Mount photocontrol electronic relay 30 feet above pole base plate or as shown.	00970.43
Luminaires must be installed level. If the roadway profile grade is greater than 4 percent, rotate the luminaire on the arm so that the side-to-side position is parallel with roadway grade. See illustration on next page.	00970.44

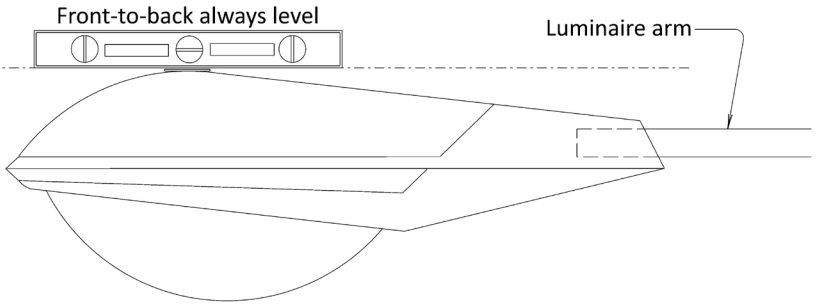
Tips and Tricks
Support conductors with a strain relief at the top of pole.
ODOT uses one photocontrol electronic relay per intersection to turn on all luminaires at the same time. Some local agencies use a photocontrol electronic relay on each luminaire to independently control each luminaire.
The in-line fuse holder is 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). See illustration on next page.
Wiring for illumination is not routed through the controller cabinet.
If a pole location is changed, consult EOR. Luminaire or arm length may need to be changed.
Luminaires attached to signal poles are shown on the signal plans. Stand-alone luminaires are typically shown on the illumination plan sheets.
SM6L and SM7L mast arm poles have unique requirements. See TM655 thru TM658 and project plans for more info.

Inspector Action	
Verify the luminaire arm length, luminaire type, and wattage.	Plan Sheets & 00970.15
Verify the luminaire arm is bolted to mast arm pole as per the requirements for HS bolts in tapped holes.	TM650 to TM629 to 00962.46(j)(2)(d) Page 164
Verify the lamp base is marked with month & year installed.	00970.44(b)
Verify the 7 day continuous and 7 day normal burn field test is conducted. Document any illumination that does not perform well during this time.	00970.70
Verify photocontrol electronic relay is located in the correct position on the mast arm pole.	Plan Sheets & TM450

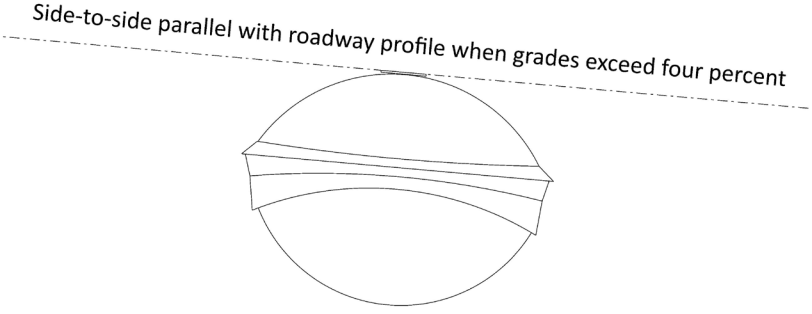
Typical Sources of Info:
Specs: 00970
Std. Dwg: TM450
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 28, 58, 59, & 60

Bubble Note(s) See pg. 213:



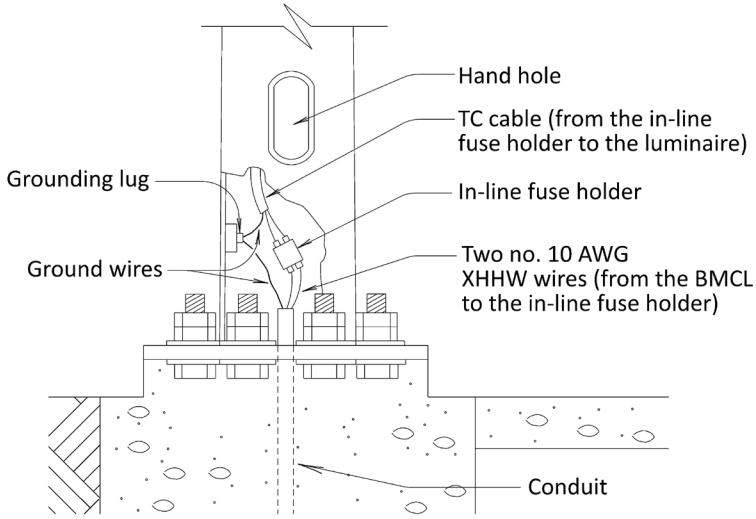


Side view



Front view

LEVELING THE LUMINAIRE (00970.44)



IN-LINE FUSE HOLDER & TC CABLE AT POLE BASE

Controller Cabinet

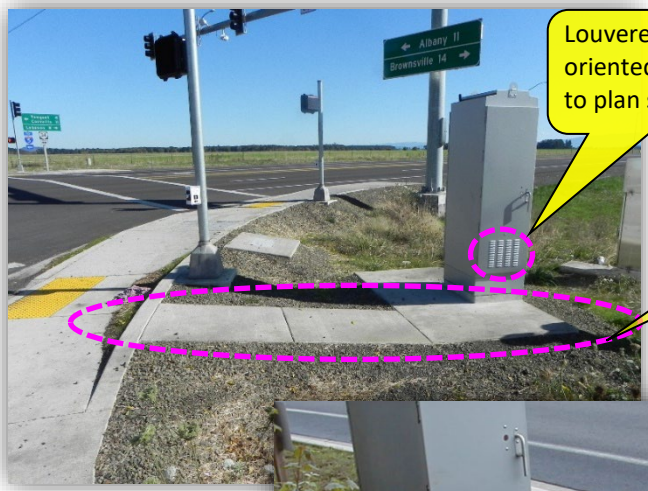
Key Enforceable Items	
All traffic signal control equipment as per the cabinet print (items listed in the green sheets) is submitted for physical, functional, & environmental testing. 6 week minimum for testing. Real-time TSSU chamber testing status & scheduling* can be viewed online.	00990.70(a) & (b) (*See web links and QR scan codes starting on pg. 227)
After testing, the controller cabinet (without the internal components) will be released to the contractor for installation.	00990.70(e) & (f)
TSSU will deliver and install all internal control equipment at day of turn-on.	00990.70(f)
Contractor is responsible for terminating all wires on the terminal blocks attached to the controller cabinet as shown in the cabinet print (input file, output file, fiber patch panel, etc.).	00990.42(a)
Install building paper gasket between riser frame and foundation. Install non-hardening water-tight seal between riser frame and controller cabinet.	TM482
Temporary signals: Return all agency furnished materials to TSSU (e.g., communication gear and ATC controller, etc.).	00227.42(a)
Most work required in any existing, operational controller cabinet is done by the agency (TSSU), NOT THE CONTRACTOR.	00990.40

Tips and Tricks
Model 332S controller cabinets are specified for most signal installations (both temporary and permanent).
The gasket between the concrete foundation and the riser frame helps prevent the riser frame and controller cabinet from corroding.

Inspector Action	
Verify the controller cabinet is properly installed on the foundation (gasket is in place, riser is in place, non-hardening watertight sealant used, bolts and washers tight).	TM482
Verify walkway is provided to controller cabinet if it is not installed flush to back-of-sidewalk. See illustration on next page.	TM482
Verify louvered door on controller cabinet is installed in the orientation shown on the plan sheets.	Plan Sheets
Provide the contractor with the cabinet print. The cabinet print is provided by the EOR to the resident engineer's office.	00990.70(a)

Typical Sources of Info:
Specs: 00990.12 & 00990.70
Std. Dwg: TM482
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 14, 61 & 72 (+ Green Sheet components)

Bubble Note(s) See pg. 213:


Albany 11
Brownsville 14
Louvered door oriented according to plan sheet.
Walkway


No walkway connecting controller cabinet to sidewalk.


Installed flush to back of sidewalk.

Field Testing Inspection & Signal Turn-On

Key Enforceable Items	
Contractor is required to provide a video/radar manufacturer's rep. on-site within 1 week of anticipated signal completion date.	00990.30
Contractor is required to be present during the signal turn-on or activation of new signal equipment at existing signals. Contractor is responsible for un-bagging signal heads and correcting any errors.	00990.40 00990.70(h)
TSSU will bring and install all of the components inside the controller cabinet (that have been tested and approved).	00990.70(f)
Note the date and time of the signal turn-on. After the traffic signals are turned on and operating as designed, the agency responsible for maintenance assumes operation and maintenance of the signal.	0990.70(h)
Turn-on does not constitute final approval.	00990.70(h)
Note the required advance notice timeframes for supplemental inspections.	**00990.70(b), (g), & (h),** & Page 107
Tips and Tricks	
Flaggers should be on-site during the signal turn-on. 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 local agency) provides the signal timing.	
Signal turn-ons on a Friday or the day before a holiday are strongly discouraged.	
Rule of thumb: Striping (crosswalks and stop lines) may be installed up to two weeks prior to the scheduled signal turn-on date.	
Inspector Action	
Coordinate with region traffic, agency electricians, TSSU, and the contractor to establish the signal turn-on date and time.	00990.70(h)
Coordinate a supplemental inspection by agency electricians (required for ALL projects: "Field Testing Inspection"). See illustration on next page	00990.40, 00990.70(g) & Page 107
Verify the contractor completes "punch list" items from the agency electrician's field testing inspection before the signal is turned on.	00990.70(h)
Verify appropriate striping and signing (temporary or permanent) is in place, such as: • Stop bars, crosswalks, lane lines, and lane use arrows • "Signal Ahead" and "New Traffic Pattern Ahead" signs (temporary signs to remain in place for 30 days), and lane use signs. • Cover/remove any inconsistent signing ("Stop" & "Stop Ahead" signs) and remove inconsistent striping.	Plan Sheets, 00220.02(a), 00222.40(c) & 00225.42

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

Bubble Note(s) See pg. 213:

Not Applicable

Project includes a new signal:

Field testing inspection occurs minimum 1 week prior to signal turn-on.

Project includes modifications to an existing, operational signal (e.g., replacing/adjusting/adding vehicle signals, pedestrian signals, pushbuttons, detection, and/or adding new wires/cables to an existing controller cabinet.)

Field testing inspection and activating the new signal equipment will need to occur during the same work shift. Coordinate with agency electricians and TSSU to enable scheduling the supplemental inspection 1 to 2 weeks prior the anticipated installation (and activation) of the new equipment. Note: Most work required in any existing, operational controller cabinet is done by the agency (TSSU), NOT THE CONTRACTOR (00990.40).

Final Clean-Up & Final Inspection

When all 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 (00150.90). Supplemental inspection is required for final inspection. See page 107 for more info.

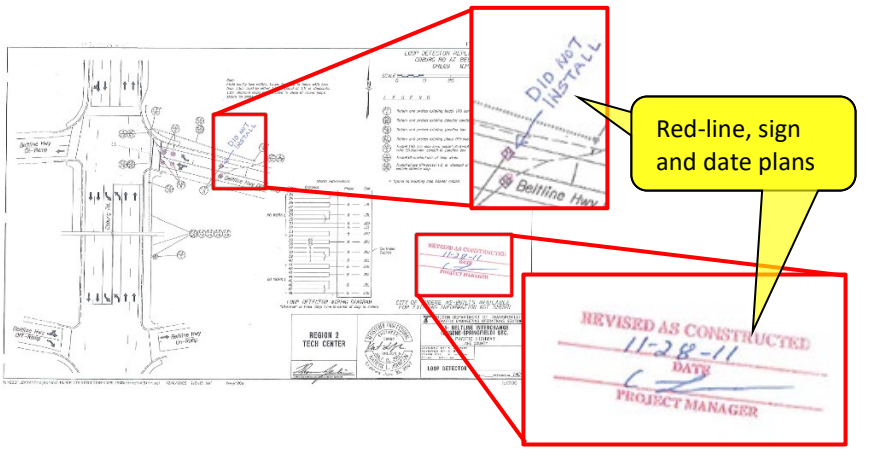
As-Constructed Drawings

Once the signal installation has been accepted, the contractor will prepare and submit as-constructed drawings (00960.71). The original plan sheets should be red lined to clearly show any changes and what was actually installed. The CTSI will process the as-constructed red-line drawings according to the ODOT Construction Manual AND send a copy to the state traffic signal engineer and EOR for review.

Any part of the traffic signal that differs from the original design needs to be noted so that others will have accurate information on how it was built. These drawings are important to agency electricians and designers for maintenance and future design purposes. Especially important to note are changes in:

- Location of junction boxes
- Vehicle/pedestrian signals
- Conduit runs
- Wiring
- Pole locations
- Utilities

The traffic roadway section will archive the as-constructed drawings on Filenet*..



* Website links & QR scan codes provided starting on Pg. 227

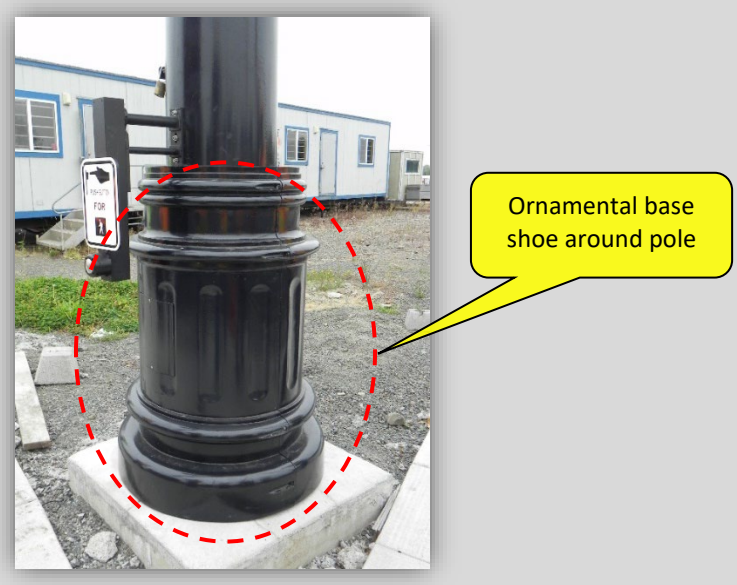
Other Signal Equipment

This manual explains typical traffic signal equipment and installation process. If your project contains a unique item or process, the EOR will include all information for materials and installation in the contract plan sheets and/or the special provisions.

Some types of signal equipment are only used in certain areas or for specific reasons. Several examples of signal equipment that are common, but used on an infrequent basis are shown on the next few pages to give you some familiarity. If you have any questions on your project, contact the EOR for assistance.

Ornamental Pole Treatments

Decorative features on or around the poles and pedestals. Typically used in historic downtown districts for aesthetics.

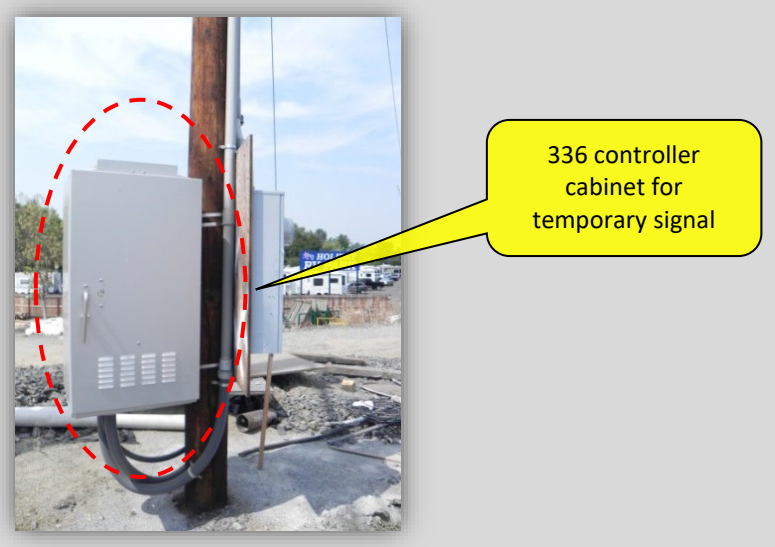


Paint or Powder Coating

Coloring of the signal equipment (e.g., poles, pedestals, and/or cabinets). Typically used in historic downtown districts for aesthetics.

336 or 336S Controller Cabinet

Small pole mounted controller cabinet. Typically used for temporary traffic signals or locations where a standard base mounted 332S cabinet cannot be installed.

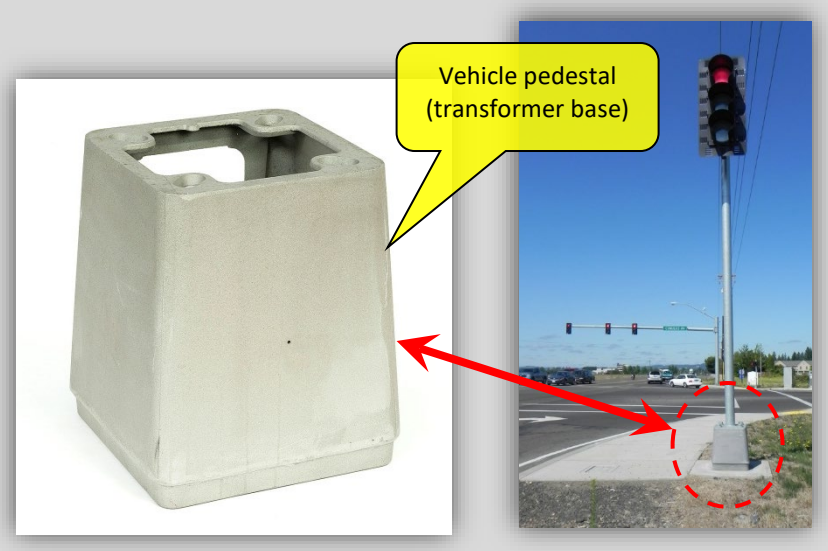


Bike Signals

Signal indications that have a red, yellow, and green bicycle symbol. Typically used in urban areas to facilitate safe and efficient movement of bike riders.

Vehicle Pedestal

Welded base plate bolted to a cast aluminum or galvanized cast iron transformer base. Former standard for mounting vehicle signal indications. The frangible base pedestal is now used instead (See TM457).



Flashing Beacon Installations

Key Enforceable Items	
Flashing beacon installations follow the 00990 (traffic signals) specification as they are similar to and use many of the same parts as a traffic signal. However, flashing beacons are simpler and therefore some exceptions may apply at the discretion of the agency.	00990
Certain flashing beacon assemblies are listed on the green sheets. See illustration on next page. All green sheet assemblies will include the necessary equipment with the exception of these items: • The pedestal (Use the blue sheets: page 24) • The static signs and sign mounts (See sign plans) • Pushbutton and mount (Use blue sheets: page 47) • Audible pedestrian signal (use green sheet specific item: page 89)	Plan Sheets & Green Sheets
Green sheet flashing beacon assemblies are not chamber tested. Flashing beacon assemblies with custom control systems using a 334 or 332S cabinet are chamber tested.	Plan Sheets & Green Sheets
Contractor is required to be present during the turn-on of the flashing beacon. Contractor is responsible for correcting any errors.	00990.70(h)
For pushbutton activated flashing beacon assemblies (e.g., RRFB), cover the pushbutton until it is operational.	00990.51
Tips and Tricks	
Region traffic (or the maintaining local agency) provides the signal timing for actuated flashing beacons. 24/7 flashing beacons do not require any signal timing.	
Flashing beacon assemblies have a beacon (not a vehicle signal) and there for do not require the beacon indication to be covered as per 00990.50.	
Unintegrated speed feedback assemblies (green sheets) are stand-alone devices without a flashing beacon and follow the 00991 specification. Note: The green sheet subcategories “Yellow+Speed Feedback”, “School + Speed Feedback (small or large)” are integrated with a ***flashing beacon*** (e.g., a flashing beacon plus a speed feedback sign operated by a single control system) and follow the 00990 specification.	
Inspector Action	
Coordinate with region traffic, agency electricians, TSSU, and the contractor to establish the flashing beacon turn-on date and time.	00990.70(h)
Coordinate a supplemental inspection by agency electricians (Required: “Field Testing Inspection”). See illustration on next page	00990.70(g) & Page 107
Verify the contractor completes “punch list” items from the agency electrician’s field testing inspection before the flashing beacon is turned on.	00990.70(h)

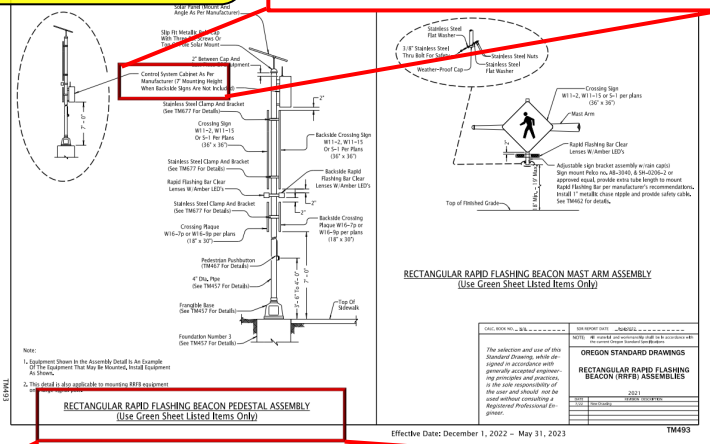
Typical Sources of Info:
Specs: 00990
Std. Dwg: TM493
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 24, 90, 91, 92, 93

Bubble Note(s) See pg. 213:

See next page for examples

Control system cabinet shown on the plans will use the language “as per the manufacturer”

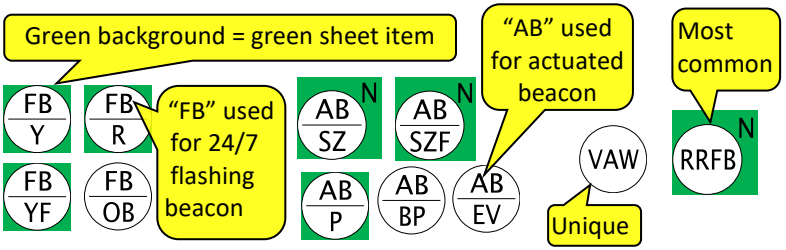
Control System Cabinet As Per Manufacturer (7' Mounting Height When Backside Signs Are Not Included)



RECTANGULAR RAPID FLASHING BEACON PEDESTAL ASSEMBLY
(Use Green Sheet Listed Items Only)

Plan sheets and/or the standard drawings will state the required green sheet category & subcategory with “(Use green sheet listed items only)” language

How to tell if the flashing beacon installation is on the green sheets? Look for the above items on the plans/standard drawings.



The various flashing beacon assemblies are shown above (as bubble notes), each with different equipment & operation. Read the plan sheet legend for details. See page 213.

Railroad Interconnection

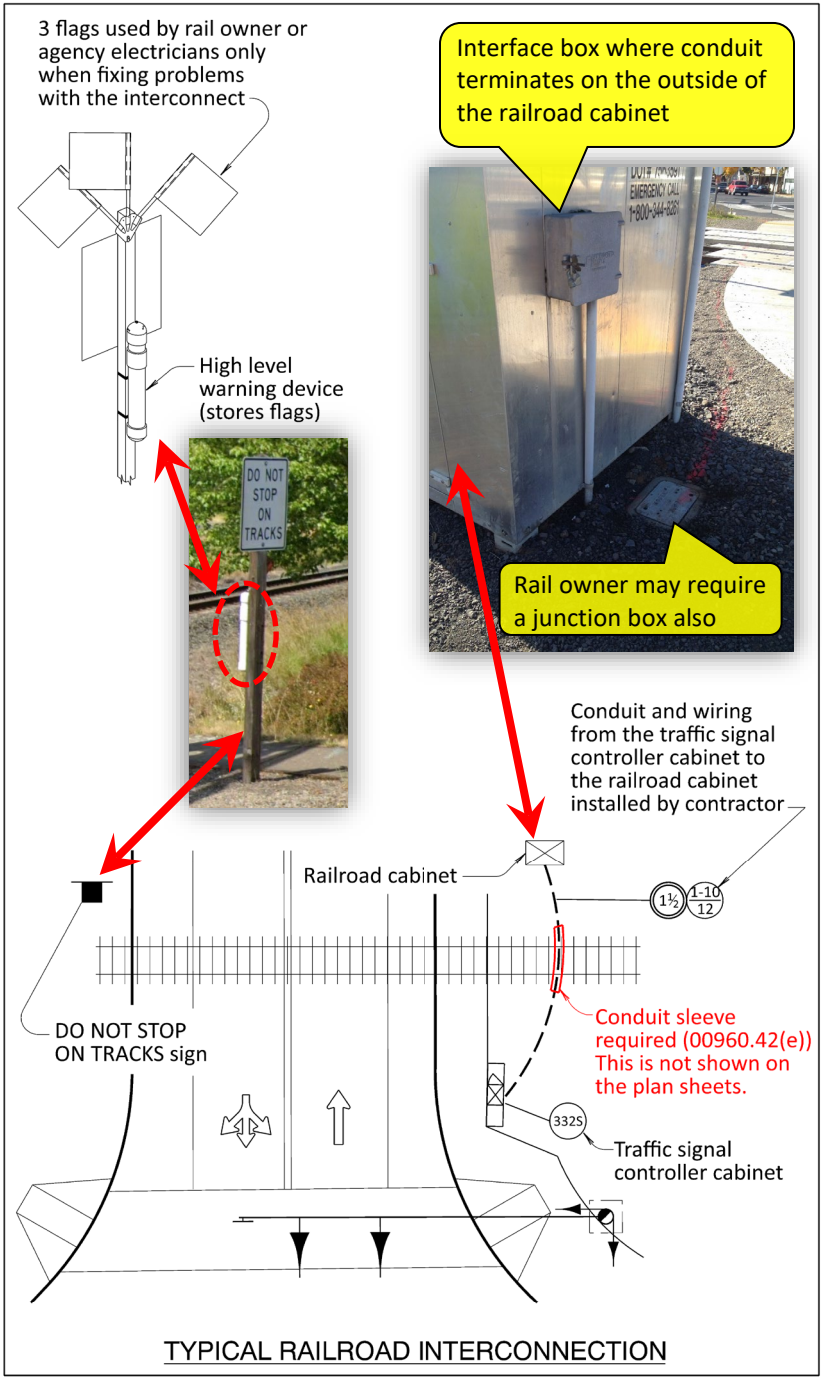
Key Enforceable Items	
Railroad interconnection consists of a hardwired connection (one control cable: 10 conductor, No. 12 AWG) between the traffic signal controller cabinet and the railroad cabinet. The rail owner will specify exactly where and how the contractor will terminate the conduit near the railroad cabinet. See illustration on next page.	Plan Sheets & 00990.47
Conduit installed under railroads requires a rigid metallic conduit sleeve. The rail owner will specify the sleeve and conduit depth requirements. See illustration on next page.	00960.42(e)
The contractor must notify the Engineer and receive permission prior to doing any work in the immediate vicinity of the railroad cabinet.	00990.47
Contractor is required get an agreement/endorsement with the rail owner to perform work near or within the railroad property. Railroad flaggers may be required.	00990.47 & 00170.01(e)
A "high level warning device" is required for railroad interconnection. It is installed behind the DO NOT STOP ON TRACKS sign. See illustration on next page.	Sign Plan Sheets

Tips and Tricks
Railroad interconnection is typically used when the rail crossing is located 215 feet or closer to the signalized intersection.
The crossing order is site specific and details the requirements of all the traffic control devices for the rail crossing and roadway features (e.g., curb design, lane widths, etc.) in the vicinity of the rail crossing. The EOR should confirm the plan sheets comply with the crossing order. The ODOT rail inspector will verify the project complies with the crossing order requirements as part of the final inspection (00150.90). NOT COMPLYING WITH THE CROSSING ORDER IS A FATAL FLAW.
The ODOT rail inspector and rail owner will also need to be present at the traffic signal turn-on to allow testing of the interconnection.
Modifications to an existing traffic signal may also require the presence of the ODOT rail inspector and/or rail owner when the modifications are activated – region traffic will verify and confirm if this is the case.

Inspector Action	
Verify size, material, and depth of conduit under railroad crossing.	00960.42(e)
Coordinate with region traffic, agency electricians, TSSU, the contractor, ***ODOT rail inspector, & rail owner*** to schedule the required "field inspection testing" and establish the signal turn-on date/time.	00990.40, 00990.70(h)& (g), Page 107

Typical Sources of Info:
Specs: 00170.01(e), 00960.42(e), & 00990.47
Std. Dwg: NO
Plan Sheets: YES
Blue Sheet/Green Sheet Info: Pgs. 25, 39, 78 (AC isolator)

Bubble Note(s) See pg. 213:
Not Applicable


3 flags used by rail owner or agency electricians only when fixing problems with the interconnect
High level warning device (stores flags)
DO NOT STOP ON TRACKS
Interface box where conduit terminates on the outside of the railroad cabinet
Rail owner may require a junction box also
Conduit and wiring from the traffic signal controller cabinet to the railroad cabinet installed by contractor
Railroad cabinet
1½
1-10
12
DO NOT STOP ON TRACKS sign
Conduit sleeve required (00960.42(e)) This is not shown on the plan sheets.
332S
Traffic signal controller cabinet
TYPICAL RAILROAD INTERCONNECTION

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Reading Plan Sheets

Standard drafting symbology is used to represent traffic signal equipment. This provides information to the user without using any text. 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 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:

Install model ATC controller. (Agency furnished)

"C" abbreviation for "Controller" and "ATC" abbreviation for "Advanced Traffic Controller"

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

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

Variable is always defined in **(text)**

"SM" abbreviation for "Signal Mast arm pole" and "**T**" is the variable. The variable will change as necessary on the plan sheet.

Regardless of experience level, it is always advised to read the bubble note legend text at least once because the EOR may change the typical text for site specific reasons. For example:

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

VS.

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

Abbreviations for **existing features** follow this standard layout - Retain & protect (EX), remove (RX), remove & relocate (RR), reinstall (RI), and abandon (AX):

If there is conflict between the drafting symbology and the bubble note, contact the EOR for clarification.

BASIC DRAFTING SYMBOLOGY

CABINETS

336 controller cabinet (door shows orientation)

332 controller cabinet (door shows orientation)

Base mounted service cabinet (BMC, BMCL, BMCF, BMCLF, or BMCX)

POLES

Mast arm pole and mast arm w/foundation

Steel signal pole shaft (no foundation)

Steel signal pole w/foundation

Wood pole

Pedestal w/foundation

Existing or proposed power supply pole

Pole anchor

LUMINAIRES

Luminaire head

SIGNALS

Vehicle signal head (new)

Vehicle signal head (existing)

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

Loop wire entrance (sand pocket) w/conduit into junction box

Radar detector

Video detection camera (new)

Video detection camera (existing)

Video or radar detection zone

MISCELLANEOUS

Crosswalk closure support

CONDUITS

Conduit (new)

Conduit (existing)

WIRES & CABLES

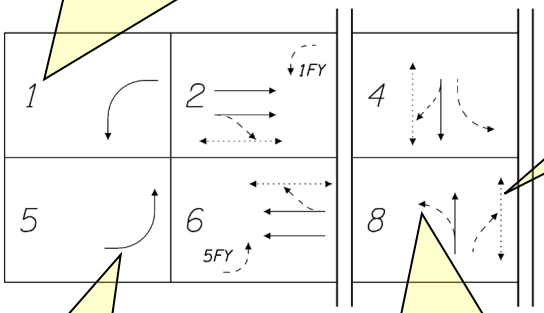
Loop wire

Span wire

READING PLAN SHEETS
(Phase Rotation Diagrams)

All **signalized** movements at the intersection are assigned to a phase number. The signalized movements in the phase rotation diagram should exactly match the lane use arrows in the signal plan (see next page).

A light dashed line with double arrows is a pedestrian phase. For example, this is ped phase 8.

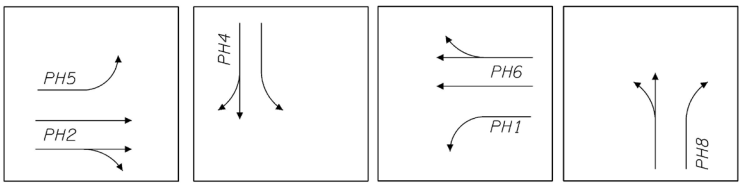


NORMAL PHASE ROTATION

A solid line indicates a protected vehicle movement (e.g., no other conflicting movements)

A heavy dashed line indicates a permissive vehicle movement (e.g., left or right turn must yield to vehicles and pedestrians)

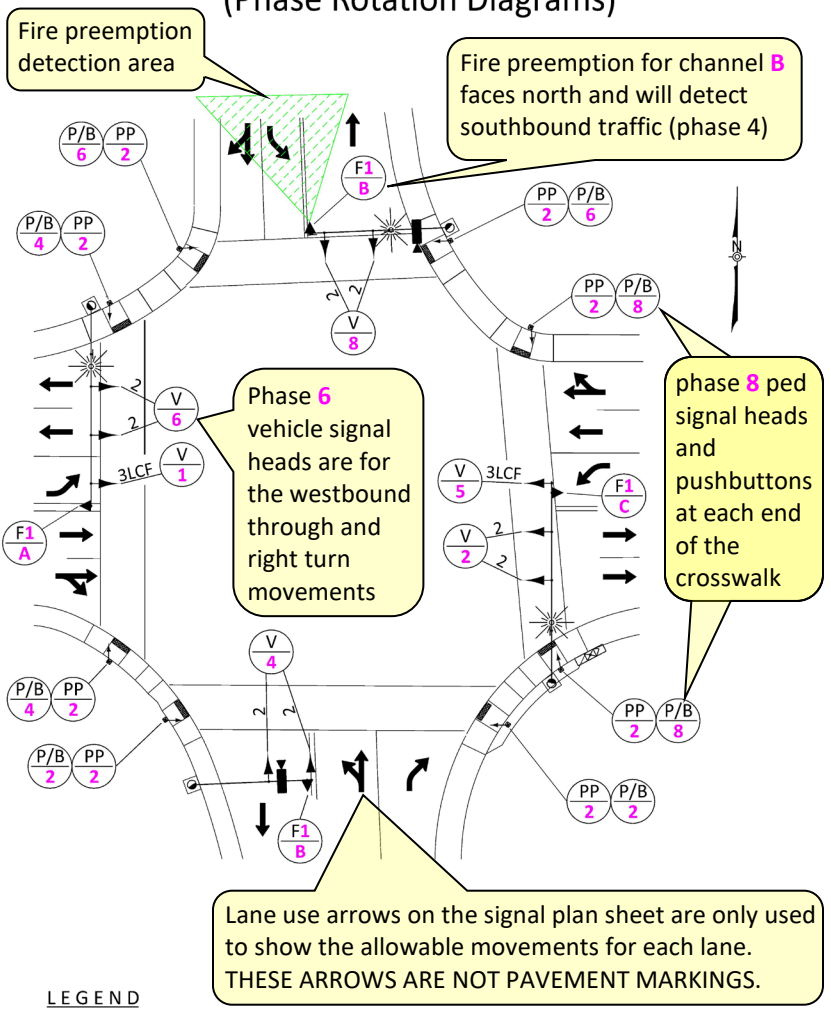
Knowing which phases are assigned to which movements helps the CTSI identify the location and purpose of equipment (e.g., vehicle signal heads, pushbuttons, etc.) and communicate better with the contractor, region traffic, TSSU, and agency electricians.



FIRE PREEMPTION

The phases on each approach leg are assigned to a fire preemption channel. For example, the eastbound traffic movements (phases 2 and 5) are assigned to channel A.

READING PLAN SHEETS
(Phase Rotation Diagrams)



LEGEND

PP / N	Install pedestal with frangible base on (N=number) foundation. (See TM457 for details)
V / Ph	Install phase **(Ph=phase)** vehicle signal with 2" fluorescent yellow reflective sheeting on backboard per std. dwg. TM460
P/B / Ph	Install phase **(Ph=phase)** countdown pedestrian signal with clamshell mount and pushbutton with mount
FN / Ch	Install channel **(Ch=channel)**, **(N=number)** barrel fire preemption detector unit

SIGNAL HEAD TYPES

2 = R: Y: G

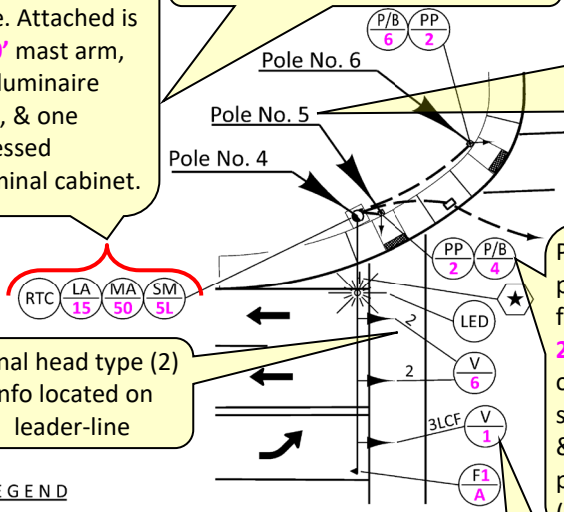
3LCF = RA: YA/FYA: GA

READING PLAN SHEETS
(Pole & Signal Indications)

Pole No. 4 is a Type SM**5L** signal pole. Attached is a **50'** mast arm, **15'** luminaire arm, & one recessed terminal cabinet.

Always read bubble notes from the leader-line out (**NOT** left to right)

Poles are labeled consecutively for entire project



Pole No. 5 is a pedestal, with foundation no. **2**. Attached is one pedestrian signal (phase **4**) & one pushbutton (phase **4**)

Signal head type (2) info located on leader-line

Install phase **1** vehicle signal

LEGEND

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
LA / L	Install **(L=length)** foot luminaire arm
RTC	Install recessed terminal cabinet
PP / N	Install pedestal with frangible base on (N=number) foundation. (See TM457 for details)
V / Ph	Install phase **(Ph=phase)** vehicle signal with 2" fluorescent yellow reflective sheeting on backboard per std. dwg. TM460
P/B / Ph	Install phase **(Ph=phase)** countdown pedestrian signal with clamshell mount and pushbutton with mount
FN / Ch	Install channel **(Ch=channel)**, **(N=number)** barrel fire preemption detector unit
LED	Install 168 watt light emitting diode luminaire, (See special provisions). Bond luminaire to pole grounding terminal
★	See signing plans for details on sign and attachment

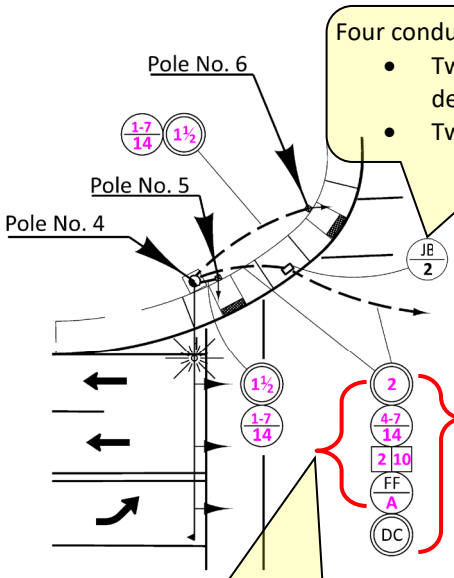
F1 / A

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

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

SIGNAL HEAD TYPES
2 = R: Y: G
3LCF = RA: YA/FYA: GA

READING PLAN SHEETS
(Conduit & Wiring)



Four conduits enter this junction box:

- Two conduits defined on detector plan
- Two **2”** conduits

2 conduits in these trenches (one **2”** and one defined on the detector plan)

In this **2”** conduit:

- **4** control cables with **7** No. **14** AWG conductors
- **2** No. **10** AWG XHHW wires
- 1 Fire preemption feeder cable for channel **A**

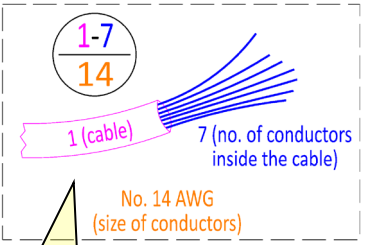
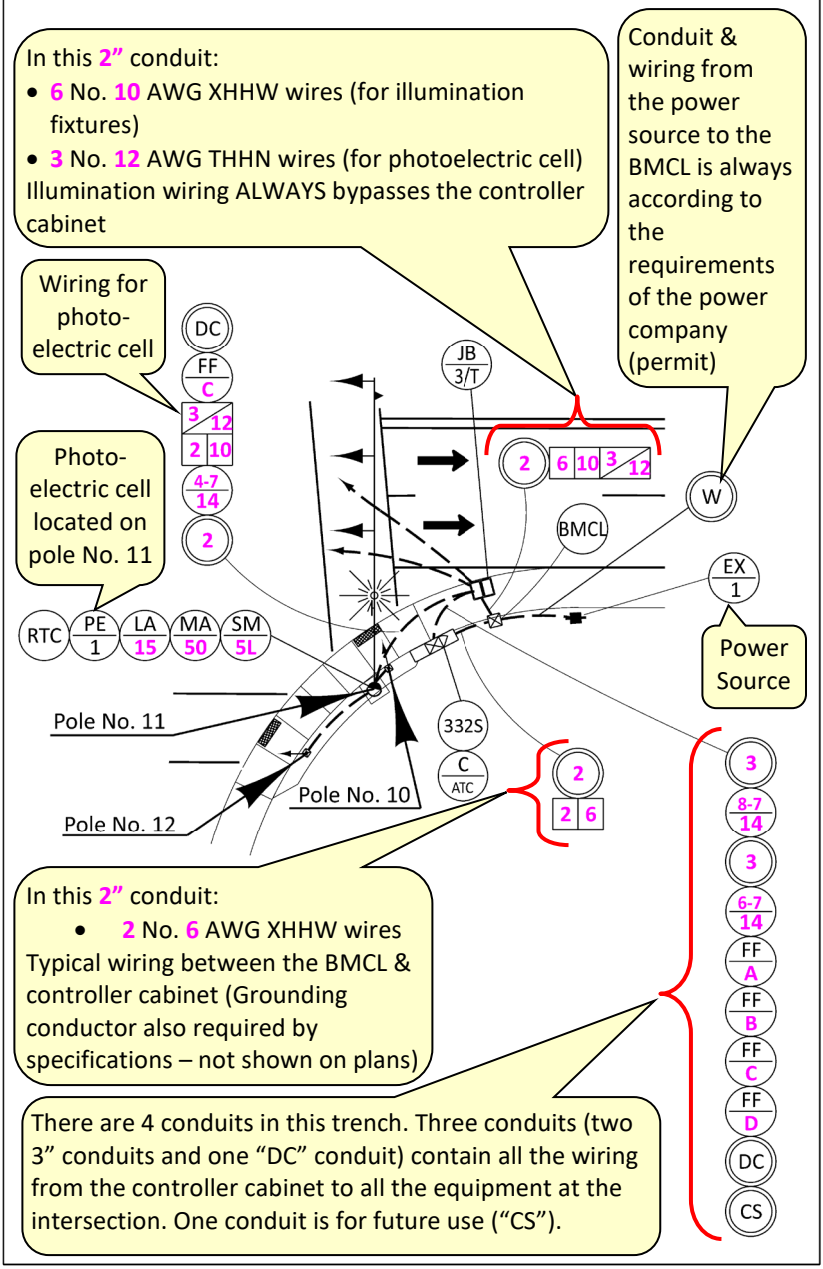


Illustration of control cable variables

LEGEND

JB 2	Install 22"x12"x12" (min. dimension) precast concrete junction box
S	Install **(S=size)** inch conduit
DC	Detector conduit (See Detector Plan)
X-N G	Install **(X=number of cables)** control cable(s) with **(N=number)** **(G= AWG wire size)** AWG conductors
N G	Install **(N=number)** No. **(G=AWG wire size)** XHHW wires
FF Ch	Install channel **(Ch=channel)** fire preemption detector feeder cable

READING PLAN SHEETS
(Cabinets & Controllers)



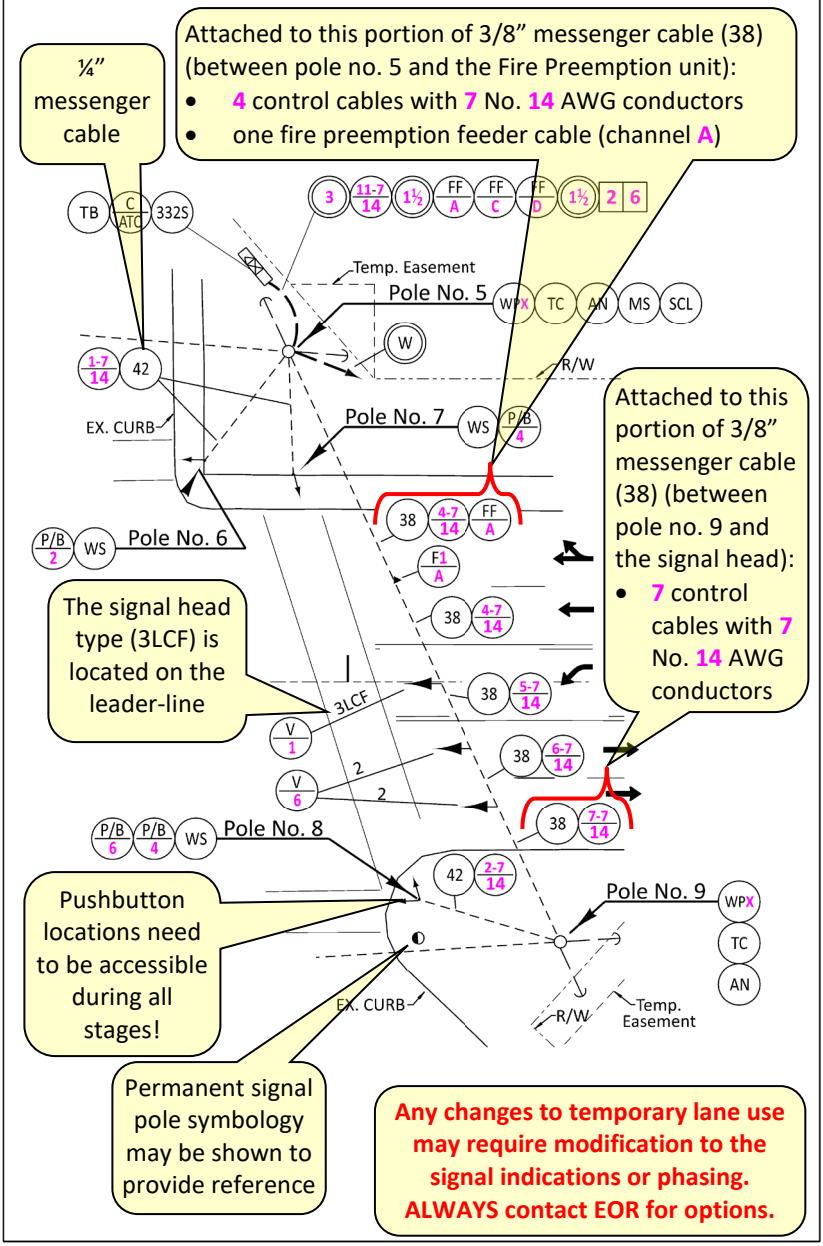
READING PLAN SHEETS
(Cabinets & Controllers)

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

LEGEND

332S	Install a model 332S cabinet & control equipment with riser frame, orient louvered door as shown
C / ATC	Install model ATC controller. (Agency furnished)
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
LA / L	Install **(L=length)** foot luminaire arm
RTC	Install recessed terminal cabinet
PE / 1	Install photo electronic control relay on pole, as per Std. Dwg. No. TM465
JB / 3/T	Install tandem 30"x17"x12" (min. dimension) precast concrete junction boxes (See TM472 for details)
S	Install **(S=size)** inch conduit
DC	Detector conduit (See Detector Plan)
CS	Install 2" conduit stub (For future use, cap ends)
W	Install conduit and wire as required by power company
X-N / G	Install **(X=number of cables)** control cable(s) with **(N=number)** **(G= AWG wire size)** AWG conductors
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

READING PLAN SHEETS
(Temporary Signal & Span Wire)



READING PLAN SHEETS
(Temporary Signal & Span Wire)

LEGEND

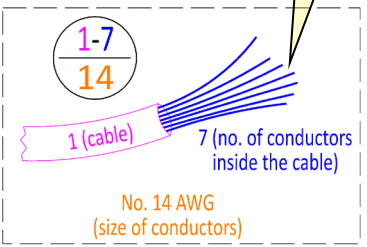
332S	Install a model 332S cabinet & control equipment with riser frame, orient louvered door as shown
C / ATC	Install model ATC controller. (Agency furnished)
TB	Install temporary (332S) traffic signal controller cabinet base
MS	Install 12O/240 volt meter base
SCL	Install service cabinet, 12O/240 volt, for both signal and illumination circuits
WPX	Install special **(X=non-standard)** treated wood pole (See, "Pole Entrance Chart")
WS	Install wood pedestrian pushbutton post
AN	Install back guy and anchor(s)
TC	Install terminal cabinet
V / Ph	Install phase **(Ph=phase)** polycarbonate vehicle signal with 2" fluorescent yellow reflective sheeting on backboard per std. dwg. TM460
P/B / Ph	Install phase **(Ph=phase)** polycarbonate countdown pedestrian signal with clamshell mount and pushbutton with mount
S	Install **(S=size)** inch conduit
N | G	Install **(N=number)** No. **(G=AWG wire size)** XHHW wires
38	Install galv. steel ⅜" messenger and ¼" tether cables
42	Install ¼" galvanized steel messenger cable
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

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

Always read legend at least once! EOR has modified the standard legend text, adding "polycarbonate" requirement.

This note includes a messenger **AND** tether cable

Illustration of control cable variables

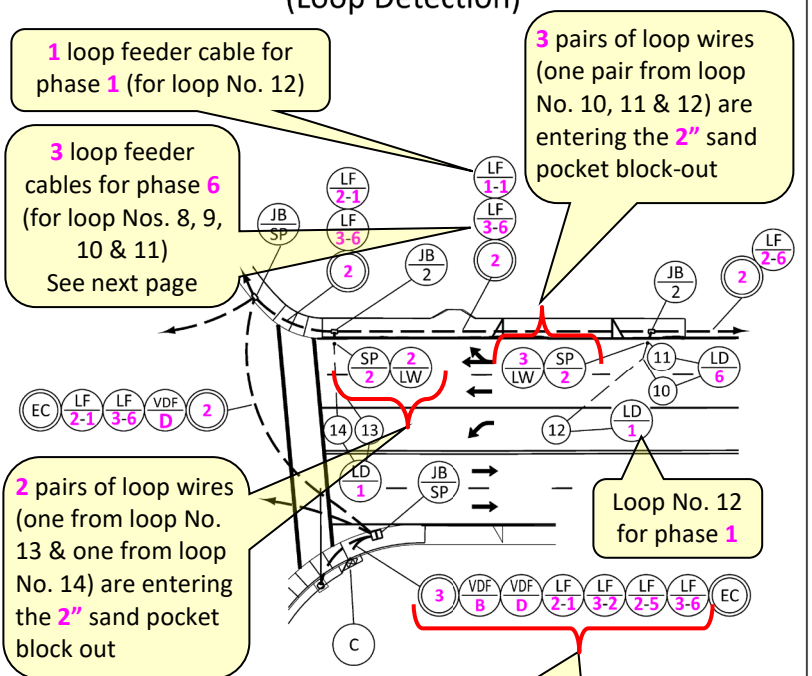


SIGNAL HEAD TYPES

2 = R: Y: G

3LCF = RA: YA/FYA: GA

READING PLAN SHEETS
(Loop Detection)



LEGEND

C	Install Controller cabinet (See Signal Plan)
JB / 2	Install 22"x12"x12" (min. dimension) precast concrete junction box
JB / SP	Junction box (See Signal Plan)
LD / Ph	Install phase **(Ph=phase)** 6' round or 4' diamond vehicle detector loop
N / LW	Install **(N=number)** pair of loop wires
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)
LF / X-Ph	Install **(X=number of cables)** phase **(Ph=phase)** loop feeder cables
VDF / T	Install video detection coaxial and power cable for camera **(T=Camera)**

LF 3-2

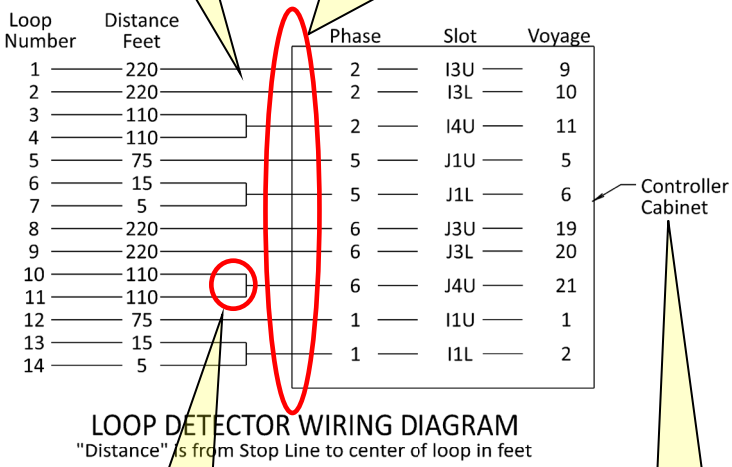
Replace variables in text when reading: "Install **(3)** phase **(2)** loop feeder cables"

READING PLAN SHEETS
(Loop Detection)

Total of 10 loop feeder cables entering the controller cabinet (Count the number of lines crossing into the controller cabinet).

For example there are 3 loop feeder cables for phase 6 (one for loop No. 8, one for loop No. 9, and one for loop Nos. 10, & 11).

Lines represent loop feeder cable



LOOP DETECTOR WIRING DIAGRAM

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

These loops are shown as wired in series. (Splice inside the junction box)

Box represents the controller cabinet

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Website Links

Inspector Certification Program
https://www.oregon.gov/ODOT/Construction/Pages/Inspector-Certification-Program.aspx

Traffic Signal Inspector Certification (CTSI) Training Information
Inspector's Manual for Signal Construction PDF (Click link of same name)
Order form for hardcopies of Inspector's Manual (Click "manual order form")
http://www.oregon.gov/ODOT/Construction/Pages/Signal-Inspector-Cert.aspx

Traffic Signal Standards Main Website
Blue, Green, and Red Sheets (Click "Product evaluation and approval")
Filenet: Archive of all traffic signal plan sheets (click "Drawing Archive")
http://www.oregon.gov/ODOT/Engineering/Pages/Signals.aspx

Qualified Products List (QPL)
http://www.oregon.gov/ODOT/Construction/Pages/Qualified-Products.aspx

Non Field-Tested Materials Acceptance Guide (NTMAG)
http://www.oregon.gov/ODOT/Construction/Pages/Structure-Services.aspx

Standard Drawings and Standard Drawing Reports
http://www.oregon.gov/ODOT/Engineering/Pages/Standards.aspx

Standard Specifications and Special Provision Boiler Plates
http://www.oregon.gov/ODOT/Business/Pages/Standard_Specifications.aspx

Field Verification Forms (for Signal Pole and Signal Pole Foundation Installation)
http://www.oregon.gov/ODOT/Engineering/Pages/Structures.aspx

Building Codes Division, Electrical License search
http://www.oregon.gov/bcd/licensing/Pages/search.aspx

Direct Tension Indicator (DTI) video and March 2016 specification Notes
http://www.oregon.gov/ODOT/Construction/Pages/QA.aspx

TSSU Chamber Testing Status and Scheduling
https://www.oregon.gov/odot/Maintenance/Pages/TSSU-Services.aspx

Requesting Changes

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 resident engineer'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.

CONTACT US:

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Scott.B.Cramer@ODOT.oregon.gov

Katie Johnson – Traffic Signal QC Engineer
503-302-7853
Katryn.L.Johnson@ODOT.oregon.gov

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Have Questions?

Find the right person on Pgs. 110 & 111

The CTSI is not expected to be an expert in traffic signals. ***USE YOUR RESOURCES!*** *Never hesitate to make contact if you have questions or need clarification. Communication is key to a good project now and better design in the future.*

Need Emergency Assistance?

Region 1 Dispatch: (503) 283-5859
Region 2 Dispatch: (503) 362-0457
Region 3 Dispatch: (541) 858-3103
Region 4 & 5 Dispatch: (541) 383-0121

Key Approvals & Responsibilities	Responsible Party	Reference
Blue Sheets: Approving Write-In items (with cut sheet)	State Traffic Signal Engineer (EOR for ITS items)	Pgs. 5 - 9
Blue Sheets: Inspecting and Accepting items installed on project	CTSI	
Green Sheets: Approving Write-In items (with cut sheet)	State Traffic Signal Engineer (EOR for ITS items)	Pgs. 67 - 71
Green Sheets: Initial submittal	CTSI	
Green Sheets: Inspecting and Accepting items installed on project	TSSU or Agency Electricians	
Performing electrical work	Licensed Electrician ("S" or "J")	Pgs. 112 & 113
Pole submittals and shop drawings	EOR or Traffic Structures Engineer	Pg. 2
Any changes made in the field	EOR	Pg. 105
Coordinating supplemental inspections	CTSI	Pg. 107
Field Inspection Reports (FIR) for all QPL items installed on project	CTSI	Pg. 2
As-constructed drawings	Contractor	Pg. 204