

Traffic Signal Inspection Pocket Guide



**Bureau of Maintenance and Operations
Traffic Operation Section
Traffic Signal and Operational Analysis**

TRAFFIC SIGNAL INSPECTION POCKET GUIDE

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1	<p>1.0 Introduction</p> <p>1.1 Purpose and Limits of Pocket Guide</p> <p>This guide is intended to assist the Inspector (either on construction projects or Highway Occupancy Permit projects) in recognizing the components of a traffic signal, ensuring that all contract requirements are met in the traffic signal installation, and as a roadmap to the PennDOT traffic signal requirements. Although most common situations are addressed by standards, specifications and this handbook, not all situations may be covered and may require additional assistance from the District Signal Supervisor. Additionally, if field conditions differ from those shown on the plan or something doesn't seem to make sense, contact the Inspector In-Charge and the District Signal Supervisor as soon as possible to determine the proper course of action.</p>
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5	<p>1.2 Applicable Publications and Sections of the 408</p> <p>Information regarding traffic signals is included in the following PennDOT Publications which are all available at: http://www.dot.state.pa.us/Internet/Bureaus/pdBOS.nsf/FormsAndPubsHomePage?OpenFrameSet</p>
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7	<p>Publication 35 – Bulletin 15 Approved Material</p> <p>Publication 46 – Traffic Signal Engineering Manual</p> <p>Publication 72M –Standards for Roadway Construction</p> <p>Publication 111M – Traffic Control Pavement Makings and Signing Standards (TC-8600 and TC-8700 Series)</p>
8	<p>Publication 148 – Traffic Standards Signal (TC-8800 Series)</p> <p>Publication 149 – Traffic Signal Design Handbook</p>
9	<p>Publication 212 – Official Traffic Control Devices</p> <p>Publication 213 – Temporary Traffic Control Guidelines</p> <p>Publication 219M – Standards for Bridge Construction</p> <p>Publication 236M – Handbook of Approved Signs (Metric)</p>
10	<p>Publication 408 Highway Specifications, specifically:</p> <p>Section 951 Traffic Signal Supports</p> <p>Section 952 Controller Assembly</p>
11	<p>Section 953 Traffic Signal Systems and Communications</p> <p>Section 954 Electrical Distribution</p> <p>Section 955 Signal Heads</p> <p>Section 956 Detectors</p>
12	<p>Section 1104 Traffic Signals</p> <p>Follow the National Electric Code if PUB 408 DOES NOT provide specific direction</p>

1.3 Responsibilities of the Inspector

- Work with the contractor to make sure that construction of the traffic signal installation is completed safely with proper protection of the contractor’s employees, the traveling public and pedestrians in or adjacent to the work area.
- Verify that the items of work are done in accordance with the special provisions, the plans, Standard Drawings and in conformance with industry standards.
- Know the status of, and be involved in, coordination of the work and with the utilities that affect the progress of the work.
- For Department projects, coordinate with the District Traffic Unit if changes in the location of an item have a potential effect on the structural requirements of traffic signal supports, the visibility of the traffic signals and/or the operation of the vehicle detection.
- For HOP projects, coordinate with the municipality if changes in the location of an item have a potential effect on the structural requirements of traffic signal supports, the visibility of the traffic signals and/or the operation of the vehicle detection.
- Prior to the “turn-on” of new or revised traffic signals, verify, in conjunction with the District Traffic Unit, vehicle detection setup and controller operation, field testing and programming.
- Monitor and record any changes to the design plans so you can verify the Contractor’s As-Built plans.
- Verify that all materials installed are on the approved CS-201.

1.4 Responsibilities of the District Traffic Unit

- For Department projects, provide design and technical operation support to the Inspector.
- For Department projects, provide technical assistance to the Inspector when field conditions require any changes to the plan.
- Work closely with the Inspector if it is necessary to instruct the traffic signal contractor. Since instructions to the contractor may be construed as authorized additional work and he may make a claim, it is imperative that all instructions be closely coordinated with the field personnel. If something is observed that is not in accordance with the permit, specifications and/or standards, it is permissible to inform the contractor of the condition.
- Prior to the “turn-on” of new or revised traffic signals, verify, in conjunction with the Inspector, vehicle detection setup and controller operation, field testing and programming.
- Monitor and be available for questions and problems during the 30 day test period. Monitor final acceptance of the signals.
- Promptly review materials submitted on CS-201

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1.5 Districts and Signal Supervisor Phone Numbers

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District	Traffic Signal Supervisor Phone No.
1-0	(814) 678-7177
2-0	(814) 765-0501
3-0	(570) 368-4250
4-0	(570) 963-3187
5-0	(610) 871-4478
6-0	(610) 205-6567
8-0	(717) 787-9237
9-0	(814) 696-6855
10-0	(724) 357-2844
11-0	(412) 429-4970
12-0	(724)439-7268

2.0 General

2.1 Principles

1. Closely adhere to the contract documents. Any deviation from the drawings should only be done after consultation with the District Signal Supervisor.
2. Work with the contractor to ensure the safe and efficient flow of traffic during construction.
3. Take into account the future operational needs and municipal maintenance of the traffic signal.

2.2 Submittals and Approvals

1. Verify that the contractor completes and submits the CS-201 "Source of Supply-Traffic Items" and receives required approvals for all materials, equipment, and hardware from the District Materials Unit and/or District Traffic Unit prior to installation.

Sometimes this process can be lengthy, so the initial submissions should be made early in the project.

2. Typical materials requiring prior approval as specified in Section 1104.01 of Publication 408 are:

- Traffic Signal Structural Support (PennDOT Approved Shop Drawing)
- Traffic Signal Controllers
- Flasher units
- Signal (Vehicular and Pedestrian) and Light Emitting Diode (LED) modules
- Detector Amplifiers and/or Detection Systems
- Preemption Systems (if applicable)
- Pedestrian Pushbuttons and Accessible Pedestrian Signals (APS) (if applicable)
- Electrically operated signs (if applicable)

3. Work with the contractor to submit the following:
 - Three (3) copies of the cabinet wiring diagram and manufacturer's timing plan for each controller assembly. If there are changes to the timing plan during testing, three new sets of timing plans are required.
 - Three (3) copies of warranties, guarantees, instruction manuals, wiring diagrams and parts lists.

The form is titled "Source of Supply - Traffic Items" and includes fields for Project #, S.A., Section, County, Date, and a table with columns: Item No., Item Description, Material Description, Manufacturer/Plant/Location, Supplier, Building #, Building Sec., Building Part #, Make/Model, Initials, and Date.

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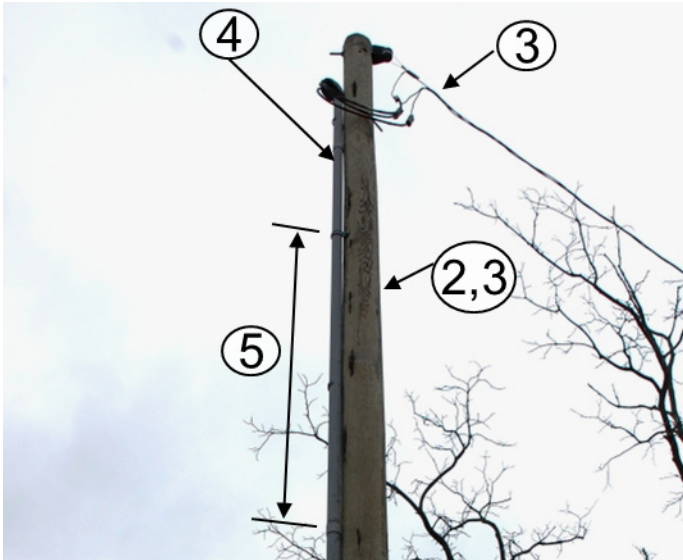
1	<p>2.2 Submittals and Approvals (Continued)</p> <ul style="list-style-type: none"> • Controller Assembly Instruction Manuals to be placed in each controller cabinet. • Two (2) keys for each controller cabinet lock (Two for the Number 2 cabinet lock and two police keys). • Shop Drawings and calculations for approval for all traffic signal supports on the project. The shop drawings are to be stamped by a Professional Engineer registered in Pennsylvania.
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3	<p>2.3 Miscellaneous Requirements and Information</p> <p>1. Verify that the contractor permanently marks the following materials with the manufacturer's name, serial number and model or part number:</p>
4	<ul style="list-style-type: none"> • Controller Unit • Conflict Monitor • Flashers • Relays
5	<ul style="list-style-type: none"> • Load Switches • Time-base Units, including GPS units • Detector Amplifiers • Detector Power Supplies • Detection Systems & equipment • Interfaces • Modems • Emergency Vehicle Preemption Units • UPS System
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8	<p>Verify that the contractor maintains removed controller assemblies as a unit and stores the material at the project site in a secure location. For further information, refer to <i>PUB 408, Section 1104.01</i></p> <p>2. Contact the District Signal Supervisor at least 7 calendar days before marking pole locations so it may be determined if a Traffic Unit Representative should be present.</p>
9	<p>3. Verify that, after the new installation is operational, the contractor removes all existing traffic signal supports (including those with traffic signals), flashing warning devices, and lane control signs and signal equipment, unless otherwise directed. All equipment removed shall be returned to the municipal traffic signal owner. The contractor should maintain removed controller assemblies as a unit and the material should be stored at the project site. The contractor should prepare a listing of the equipment for the municipal owner, make arrangements to deliver the equipment to the municipal storage area and receive a written receipt acknowledging receipt of the equipment. It is the contractor's responsibility to coordinate this transfer.</p>
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2.3 Miscellaneous Requirements and Information (Continued)

- 4. Document any damage to the equipment before its removal. The contractor is responsible for equipment damage during removal or storage. The contractor should provide notification to the inspector that the equipment was properly transferred to the municipal signal owner.
- 5. Unless otherwise noted, underground conduit, conductors, and detectors not interfering with new construction can be left in place. Foundations and junction boxes that are to be abandoned and are located outside of the shoulder area should be removed to 1 foot below final grade. Check with the Inspector In-Charge to determine what can be left in place. The contractor is responsible for disposal of the removed materials and to properly fill, compact, and landscape the resulting hole, including adding topsoil if necessary.
- 6. If there are any questions concerning deviation from *Publications 408 and 148*, the special provisions and the contract plans, it is critical that the Inspector contact the Inspector In-Charge and the District Signal Supervisor.
- 7. Existing traffic signals are to remain and continue their current operation until the new signal is operable, absent any provisions to the contrary. If an existing traffic signal must be turned off or turned to flashing operations, work with the contractor to provide flaggers or police control and obtain approval from the District Signal Supervisor and municipal signal owner prior to modifying the existing operation.
- 8. If any vegetation is obstructing the visibility of traffic signal indications (vehicular and pedestrian) or signs, work with the contractor to request and obtain approval to remove the obstructions.
- 9. Verify that the contractor identifies possible utility conflicts early. Contact the District Utility Coordinator and District Signal Supervisor to determine the corrective action if a utility conflict exists.
- 10. Verify that conflicting signs are bagged immediately after the signal is turned on. If the signs are to be removed, they should be removed as soon as possible.
- 11. Obtain from the contractor the name and telephone number of the person to be notified in the event of failures or malfunctions during the guarantee period.

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3.0 Electrical Service Connections (Sections 954 and 1104.05)
3.1 Electrical Service Type A (Wood Poles)



1. Verify that the Contractor coordinates with the utility company for location of the service feed.
2. Verify that wood utility poles are 30' – 40' high and set a minimum of 6' below grade on the low side of the sloped grade. *PUB 408 Sections 910.3(k) & 1101.11(a)*
3. Verify that poles are tall enough to provide proper vertical clearances for all attached wires, span wires and cable.
4. Verify that a minimum 2" diameter hot dipped galvanized rigid metallic conduit with a service head is used. *TC-8804 Sheet 1, PUB 408 Sections 954, 1101.09 & 1104.05(a)*.
5. Verify that conduit straps are no further apart than 4' center to center. *TC-8804 Sheet 1*

3.1 Electrical Service Type A (Wood Poles (Continued))

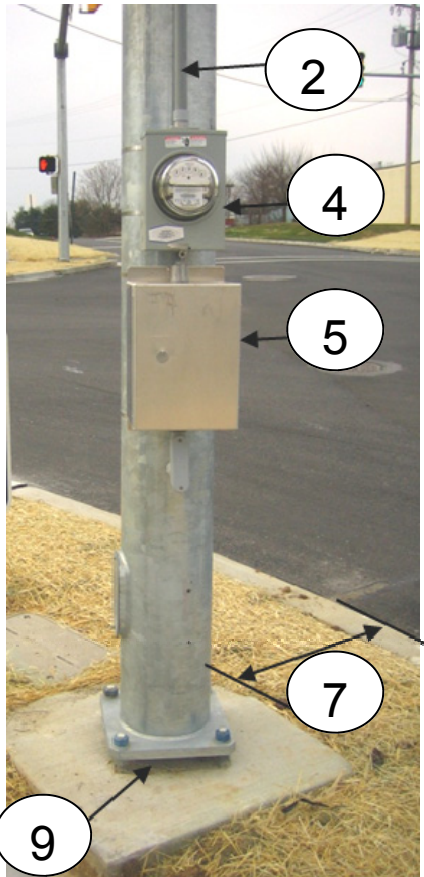
- 6. Verify that the Contractor coordinates the meter type and socket with the utility company *PUB 408 Section 1104.05 (d)3*
- 7. Verify that a service disconnect without an external handle is included. *TC-8804, PUB 408 Sections 954 & 1104.05 (d)*
- 8. Verify that a minimum 2" diameter conduit goes between the service disconnect and the controller to carry service conductors.
- 9. Verify that there is a ¾" minimum diameter conduit with a minimum #4 AWG grounding conductor connected to the ground rod and to ground bus in the service disconnect.

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3.2 Electrical Service Type B (Steel Poles)

1. Verify that Contractor coordinates with the utility company for location of the service feed.
2. Verify that a minimum 2" diameter hot dipped galvanized rigid metallic conduit with service head is used for service unless otherwise required by the utility company. *TC-8804 Sheet 1, PUB 408 Section 954 & 1101.09*
3. Verify that conduit straps are no further apart than 4' center to center. *TC-8804 Sheet 1*
4. Verify that the Contractor coordinates the meter type and socket with the utility company. *PUB 408 Section 1104.05(d)3*
5. Verify that a service disconnect without an external handle is included. *TC 8804 Sheet 1, PUB 408 Sections 954 & 1104.05(d)*
6. Verify that there is a 1" minimum diameter conduit in pole foundation with #4 AWG minimum grounding conductor to ground rod in earth adjacent to pole foundation.
7. Verify that the minimum clearance as indicated in Pub 149 is obtained. *TC-8801 sheet 1*
8. Verify that the electrical utility inspection occurred or was waived by the utility company. *PUB 408, Section 954.3 (f)*
9. Verify that non-shrink mortar is used beneath the base plate in paved areas and metal screening is placed beneath the base plate in unpaved areas. *Pub. 408 sec. 951.3(c)) TC-8801*
10. Clearances vary by facility, voltage and owner. If there is a question of appropriate clearance, contact the District Utility Administrator



3.3 Electrical Service, Type C (Installed on base mounted controller cabinet)

1. Verify that the Contractor coordinates the meter type and socket with the utility company. *PUB 408 Section 1104.05(d)3*
2. Verify that a minimum 2" diameter hot dipped galvanized rigid metallic conduit and fittings are used for service unless otherwise required by the Utility. *TC-8804*
3. Verify that a galvanized rigid steel 2" conduit is used between the meter and the disconnect enclosure. *TC-8804*
4. Verify that a galvanized rigid steel 2" conduit and fittings are used between the disconnect enclosure and the controller cabinet. *TC-8804*

3.4 Meter Socket and Disconnect (All Service Types)

1. Verify that the Contractor coordinates the meter type and socket with the utility company. *TC-8804 and PUB 408 Section 1104.05(d)3*
2. Verify that service conductors to the utility company connection point are #2 AWG minimum and, if required by the utility company, the correct color. *PUB 408 Section 1104.05(b)2 & TC-8804*
3. Verify that the power line surge protector is in accordance with *PUB 408 Section 1104.05(d)4.e & TC-8804 Sheet 1*
4. Verify that the service disconnect is rated at a minimum of 100 amps or as required by power company. *TC-8804*
5. Verify that ungrounded conductors, grounded conductors, and equipment grounding conductors to traffic controller are a minimum of #8 AWG. *TC-8804*
6. Verify that a galvanized steel, stainless steel, or aluminum service enclosure with hinged door and provisions for a padlock conforming to *NEMA Standard Type 3R, 3S, or 4* is provided. *Pub 408 Section 1104.05(d)4.a*
7. Verify that the ground wire is either bare or green insulated #8 AWG minimum. *PUB 408 Section 1104.05(b)3*
8. Verify that the grounding electrode from service is connected to the grounding lug inside the enclosure with a #4 AWG conductor. *PUB 408 Section 1104.05(f) & TC-8804*

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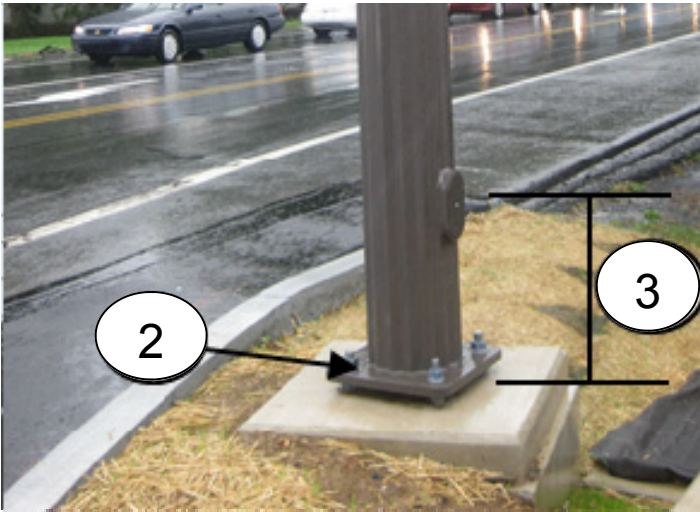
4.0 Traffic Signal Structural Supports (PUB 408 Sections 951 and 1104.02)

4.1 Foundations

1. Field-verify that traffic signal supports are located in accordance with the approved plans and that the minimum clearance as indicated in Pub 149 is obtained. *TC-8801 sheet 1*
2. Verify that the "Pennsylvania One Call System (#811)" notification was completed by the contractor and all acceptable clearances were obtained.
3. Contact the District Signal Supervisor to resolve any conflicts between existing utilities and the plan location of any support foundation.
4. Verify that the elevations for the traffic signal support foundations ensuring proper clearance above the roadway to the bottom of signal heads and/or signs and/or tether wire. The signal contractor is responsible for coordination with the prime contractor in determining pole foundation elevations. Changes to grades shown on the drawings must be factored into the signal contractor's determination of shaft height and foundation elevations. *See TC 8801*
5. Verify foundation type, depth and rebar configuration in *TC-8801*, which are determined by the following:
 - Approved Traffic Signal Support-mast arm length.
 - Approved Traffic Signal Support-Strain Pole-design tension and shaft length.
6. For a foundation within a sidewalk area, verify that the top of the foundation will be flush with the final finished surface.
7. For a foundation outside a paved sidewalk, verify that the top of the foundation will be at least 6" above the surrounding surface.
8. Verify that anchor bolts are clean, protected and placed at the same elevation. Verify that the bolt projection is sufficient to rake the support properly.
9. Verify that the Contractor has used the proper length anchor bolt considering the required embedment length and required projection as shown on *TC-8801*
10. Verify that all conduits are in place and will be able to fit within the footprint of the pole when it is set. The conduits must have 24 inches of cover to the top of subbase when they exit the foundation.

4.2 Traffic Signal Supports

1. Verify that traffic signal supports were inspected in the fabrication plant in accordance with *PUB 408 Section 1104.01*.
2. Verify that base plate anchor bolts, nuts and washers are installed and tightened in accordance with *PUB 408 Section 1104*. Verify that the distance between the bottom of each leveling nut and the concrete foundation is less than the bolt diameter.



3. Verify that the center line of the hand hole is 18" above the base plate. *TC-8801*
4. Verify that the minimum area of hand hole is 25 square inches with a minimum unobstructed width of 3.5". *TC-8801*
5. Verify that the opening in the hand hole frame is 7" in height, 3 1/2" in width, cut from 3" thick plate and protrudes from pole 3/4" minimum. *TC-8801 sheet 10*

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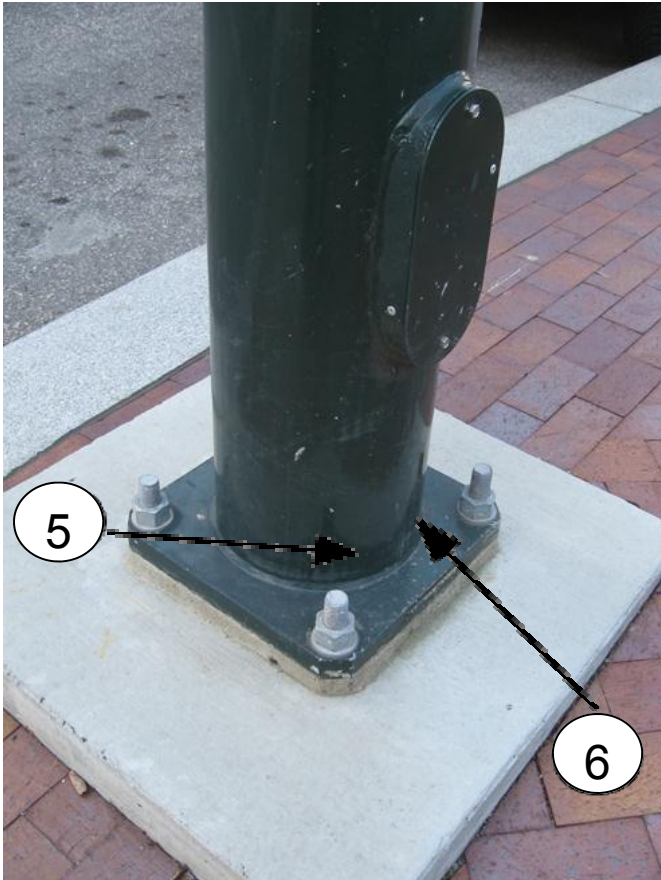
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4.2 Traffic Signal Supports (Continued)

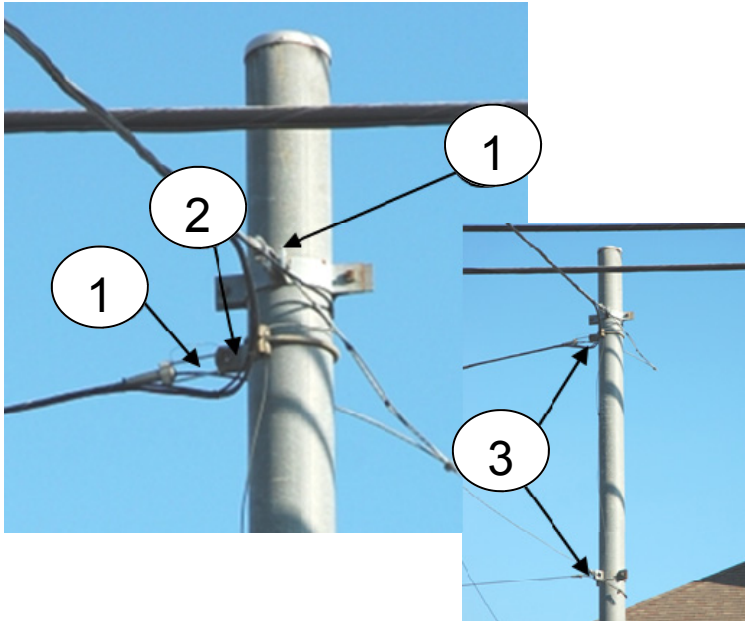
- 6. Verify that the cover plate is ¼" x 5" x 8" with a neoprene gasket cemented on and that it is tightly secured to the pole with fasteners. *TC-8801*
- 7. Verify that the ground lug is attached to the hand hole frame within the pole cavity. *TC-8801*



4.3 Mast Arms

- 1. Verify that the hand hole is installed 90° or 180° from the centerline of arm "A". *TC-8801*
- 2. Verify that approved and tested high strength bolts, nuts and washers are used to connect the mast arm to the pole shaft.
- 3. Verify that the observations for galloping as required by *TC-8801, sheet 1 of 10, note 16* are made.
- 4. Clearances vary by facility, voltage and owner. If there is a question of appropriate clearance, contact the District Utility Administrator.

4.4 Strain Pole

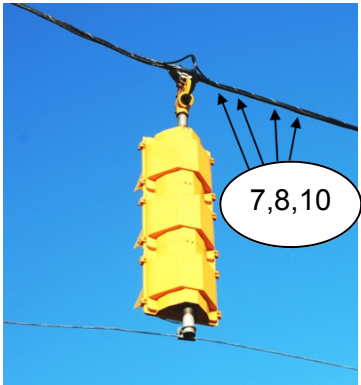
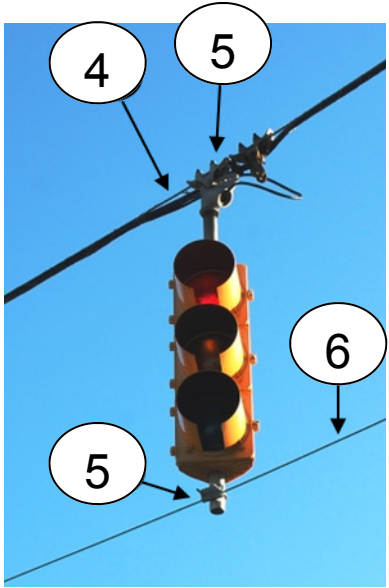


1. Verify with a visual inspection from the ground that the span wire is attached using a clamp with dead-end feed-thru strand -vise with stainless steel bail *TC-8801*
2. Verify with a visual inspection from the ground that the bonding clamp is suitable for use with any combination of copper, steel, or aluminum conductors. *TC-8801*
3. Verify with a visual inspection from the ground that the span wire and the tether wire are electrically bonded to the strain pole. Use a minimum #4 AWG bare copper, connected to the span wire and tether wire and attached with a lug to the strain pole or another method that assures electrical connectivity. *TC-8801*
4. Clearances vary by facility, voltage and owner. If there is a question of appropriate clearance contact the District Utility Administrator.
5. Verify that all tether clamps used to secure the bottom of a sign or signal head to a tether wire have sheet lead wrapped over the tether wire at the clamp connection and that the lead extends out both sides of the clamp approximately 1/4".
6. Verify that the tether cable clamp at the bottom of the signal housing is positioned correctly per *TC-8801, Detail III*.

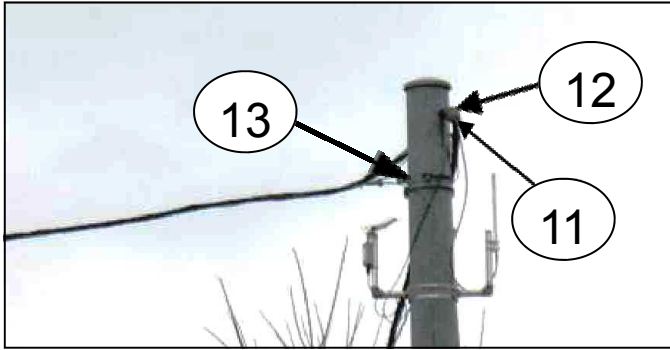
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4.4 Strain Pole (Continued)

4. Verify that the span wire used has breaking strength equal to or exceeding the design tension. *TC-8801*
5. Verify that signal heads are attached with span wire hanger, balance adjuster, cable entrance adapter and pipe as required to place top of all signs and signal heads at the same elevation. *TC-8801*
6. Verify that 1/8" diameter tether wire is used. *TC-8801*
7. Verify that lashing of the distribution cable to the span wire is accomplished with one of the following:
 - Preformed galvanized steel rods
 - Self-locking cable ties of outdoor type
 - Solid copper wire
 - Galvanized steel wire
 - Stainless steel wire
 - Cable rings and saddles
8. Verify that wire lashing makes one complete wrap at intervals not exceeding 6".
9. Verify that ends of wire lashing are secured to the span wire with an all-purpose split bolt connector.
10. Verify that cable ties are at intervals not exceeding every 12".



4.4 Strain Pole (Continued)



11. Verify that the cable entrance is a minimum of 4" in diameter. *TC-8801*
12. Verify with a visual inspection from the ground that an insulated grommet is used for weather proofing the wire inlet. *PUB 408 Section 1104.02(a)6*
13. Verify with a visual inspection from the ground the span wire and an individual clamp is used for each span wire or tether wire. *TC-8801*

4.5 Pedestal Poles

4.5.1 Pedestal Poles (Base Plate Type)

1. Verify that the pole is tall enough to provide 8' minimum, 10' maximum height above grade to bottom of signal housing. *TC-8803*
2. Verify that hand hole opening is 3" x 5" with a minimum frame thickness of 3/8" and that the centerline is 18" above the base plate. *TC-8803 and TC-8801*
3. Verify that the base plate is continuously welded to the pole. *TC-8803*
4. Verify that non-shrink mortar is used beneath the base plate in paved areas and metal screening is placed beneath the base plate of the pole in unpaved areas. *Pub. 408 sec. 951.3 (c)*
5. After erection of pole and mounting of signal hardware, verify that the minimum clearance as indicated in Pub 149 is obtained from curb to the nearest element of the pole or signal head. *TC-8801, TC-8803*

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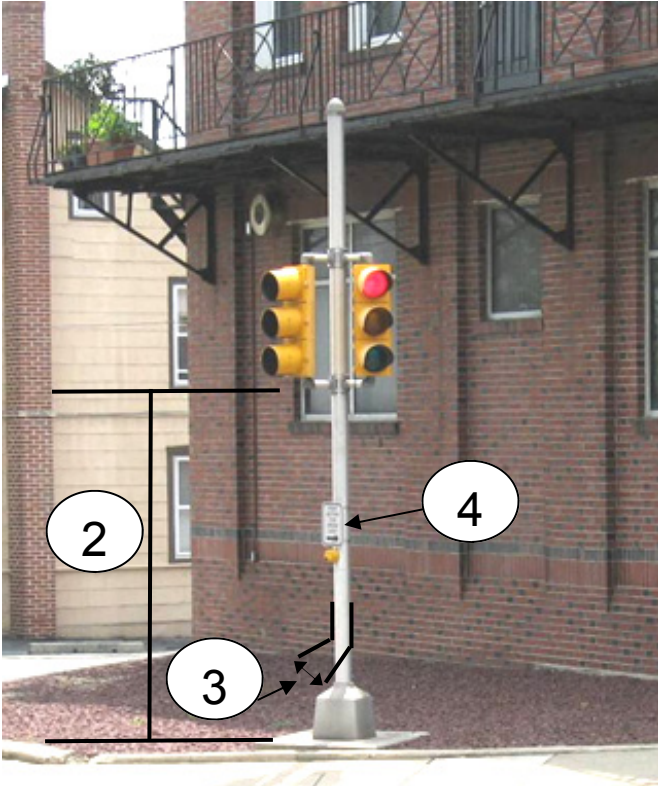
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4.5.2 Pedestal Poles (Cast Base Type)



1. Verify that the hand hole opening is 3" x 5" with a minimum frame thickness of 3/8". *TC-8803 and TC-8801*
2. Verify that the pole provides 8' minimum, 10' maximum height above grade to bottom of signal head. *TC-8803*
3. Verify that the outside diameter of the pole is 4.5". *TC-8803*
4. Verify that the Contractor coordinates the direction of the "Push Button" sign with phase called by associated push button. *TC-8803*
5. Verify that the pole to cast base connection is threaded or welded. If threaded make sure locking screw(s) are in place and tight to prevent turning of pole in cast base.
6. After erection of pole and mounting of signal hardware, verify the minimum clearance as indicated in Pub 149 is obtained from curb to the pole or nearest part of the signal housing. *TC-8801, TC-8803*
7. Verify that pedestal poles are set plumb and level.

4.6 Pedestrian Pushbutton Poles

1. Verify that poles are placed correctly in relation to the location of the curb ramps. *TC-8803*
2. Verify that the pole foundations are correct for the type of pushbutton pole being installed *TC-8803*
3. Verify that the poles are 3" Galvanized Rigid Steel Conduit, except Type C and Type F poles which should be 4.5" O.D. Schedule 40 *TC-8803*
4. Verify that the top of the pole is 60" (5 feet) above finished grade and that a galvanized steel or aluminum cap is in place *TC-8803*
5. Verify that all accessibility features are compliant with PennDOT Publication 13M (DM-2), Chapter 6, Publication 72M (RC Standards) criteria and Publication 149 *TC-8803*
6. Verify that the top of the foundation is flush with the surface of adjacent pavement when installed in pavement and that there is a 1/2 " pre-molded expansion joint filler between foundation and adjacent pavement *TC-8803*
7. Verify that if a pedestrian pushbutton extension arm is used, it is 3" or less. If it measures between 3" to 12", obtain district approval prior to installation. Do not allow installation of arms longer than 12". *TC-8803*

4.7 Wood Poles

1. Verify that temporary wood poles are in accordance with *PUB 408 Section 1104.02(f)*.
2. Verify that the Contractor installs service poles in accordance with *PUB 408 Section 910.3(k)*.

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1	<p>5.0 Traffic Signal Subsurface Facilities (PUB 408 Sections 954 and 1104.05)</p> <p>5.1 Trench and Backfill</p>
2	<p>5.1.1 Trench and Backfill Type I (in earth) TC-8804 Sheet 2 and PUB 408 Section 954.3</p>
3	<p>1. Verify that the trench is wide enough to allow proper installation, backfill and compaction of the trench and that at least 1" can be maintained between each conduit and between the conduit and the edge of the trench.</p>
4	<p>2. Verify that the trench is deep enough to provide at least 24" of cover to the top of the conduit. <i>TC-8806</i></p>
5	<p>3. Verify that plastic marking tape is placed in the last layer of back-fill material for the entire length of the trench. <i>Pub 408 Section 910.3.(c)</i></p>
6	<p>5.1.2 Trench and Backfill Type II (in sidewalk or paved shoulder) TC-8804 Sheet 2 and PUB 408 Section 954.3</p>
7	<p>1. Verify that special provisions do not call for special actions including full sidewalk slab replacement.</p>
8	<p>2. Verify that the sidewalk or paved surface is saw-cut at the nearest construction joint.</p>
9	<p>3. Verify that the trench is wide enough to allow proper installation, backfill and compaction of the trench and that at least 1" can be maintained between each conduit and between the conduit and the edge of the trench.</p>
10	<p>4. Verify that the trench is deep enough to provide at least 24" of cover from the top of the conduit to the bottom of the sub-base.</p>
11	<p>5. Verify that plastic marking tape is placed in the last layer of back-fill material for the entire length of the trench. <i>Pub 408 Section 910.3.(c)</i></p>
12	<p>6. Verify that the sub-base is replaced in kind.</p> <p>7. Verify that the pavement surface is replaced in kind.</p>

5.1.3 Trench and Backfill Type III (Roadway) TC-8804 Sheet 2 and PUB 408 Section 954.3

1. Verify that the trench is wide enough to allow proper installation, backfill and compaction of the trench and that at least 1" can be maintained between each conduit and between the conduit and the edge of the trench.
2. Verify that the surface on each side of the trench is saw-cut to a minimum depth of 3".
3. Verify that the trench is deep enough to provide at least 24" of cover from the top of the conduit to the bottom of the sub-base.
4. Verify that bedding soil for the conduits has been placed at the bottom of the trench. *PUB 408 Section 206.2(a)*
5. Verify that the contractor backfills the trench as soon as possible.
6. Verify that plastic marking tape is placed in the last layer of backfill material for the entire length of the trench. *Pub 408 Section 910.3.(c)*
7. Verify that the sub-base is replaced as specified within the construction plans or as specified in *PUB 408 Section 954*.
8. Verify that the trench is backfilled with Class A cement concrete up to the bottom of the existing sub-base.
9. Verify that the pavement is restored as specified in *PUB 408 Section 954*.

5.1.4 Trench and Backfill Type IV (Roadway) TC-8804 Sheet 2 and PUB 408 Section 954.3

1. Verify that the trench is wide enough to allow proper installation, backfill and compaction of the trench and that at least 1" can be maintained between each conduit and between the conduit and the edge of the trench.
2. Verify that the surface on each side of the trench is saw-cut to a minimum depth of 3".
3. Verify that the trench is deep enough to provide at least 24" of cover from the top of the conduit to the bottom of the sub-base.
4. Verify that bedding soil for the conduits has been placed at the bottom of the trench. *Pub 408 Section 206.2(a)*
5. Verify that plastic marking tape was placed within the last layer of backfill for the entire length of the trench. *Pub 408 Section 910.3*.
6. Verify that the sub-base and pavement are both replaced as specified within the construction plans or as specified in *Pub 408 Section 954*.

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5.1.5 Trench and Backfill Directional Boring *PUB 408 Section 954.3(b)*

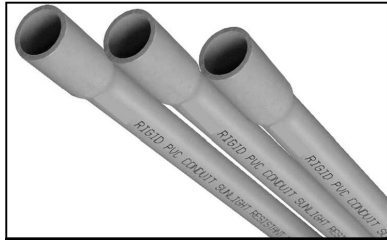
1. Verify that the Contractor has the appropriate erosion and sedimentation control measures in place prior to boring.
2. Verify that boring pits are a minimum of 2' from the edge of roadway.
3. Verify that boring is below the existing roadway subbase layer.
4. Verify that boring pits are covered with adequate protection if the drilling operation is left overnight.
5. Do not allow the use of pneumatic hammers.

5.2 Conduit *PUB 408 Section 1101.09(a) & (b)*

5.2.1 PVC (Polyvinyl Chloride)

1. Verify that all PVC conduit, conduit fittings, and conduit elbows are all supplied from the same manufacturer.
2. Verify that the cement is labeled by or recommended by the conduit manufacturer.

3. Verify that expansion/deflection fittings are provided for conduit mounted on or within structures. *Standard Drawing BC 721M (BC -721)*



4. Verify that conduit ends within junction boxes or foundations are restricted with a rodent-proof filler. *PUB 408 Section 954.3(c)*
5. Verify that the conduit maintains at least 12" separation from other underground utilities *PUB 408 Section 954.3(c)*
6. Verify that high impact spacers are in place every 8' on center if more than two rigid non-metallic conduits are installed in a common trench. *PUB 408 Section 954.3(c)*
7. Verify that underground conduits are at least 2" diameter unless otherwise specified. *PUB 408 Section 910.3(g) & TC-8804 Sheet 1*
8. Verify that each conduit shall have a bell end or bushing to protect cables leaving the conduit.

5.2.2 Rigid Steel *PUB 408 Section 910.3(g)*

1. Verify that the conduit is hot dipped galvanized.
2. Thread steel conduit for couplings and fittings.
3. Verify that threads are coated prior to assembly.
4. Verify that the Contractor is using manufactured sweep bends whenever possible.



5.3 Junction Boxes *TC-8804 Sheet 2*

1. Verify dimensions of the junction box based on box type and approved CS 201 form.
2. Verify that there is a minimum of 2 cubic feet of coarse aggregate (#57 or #8) under all junction boxes.
3. Verify that Type JB-26 and JB-27 are not located in a vehicular traffic area.
4. Verify that the rim of the box is 1" above final grade in earth or flush with final grade in paved surface areas.
5. Verify that the lid is non-slip and is secured by a minimum of two corrosion resistant fasteners.
6. Verify that a water-tight connection to the housing is provided. *PUB 408 Section 1104.05(c)*
7. Verify that the words "TRAFFIC SIGNAL" are imprinted on the lid. *PUB 408 Section 1104.05(c)*
8. Verify that cast iron or steel boxes have lids that are hot dipped galvanized with a closed cell neoprene gasket. Verify that there is a factory installed grounding stud and hex nut in rear of the box. *PUB 408 Section 1101.10(a) & BC-721M*
9. Verify that ground lugs are used to ground metal parts and that ground wires are not directly connected with the lid. *RC-81M & RC-82M*
10. Verify that the internal depth is in conformance with the depth specified for that type. *TC-8804 Sheet 2*
11. Verify that if the bottom is closed a 2" minimum drain hole is provided.



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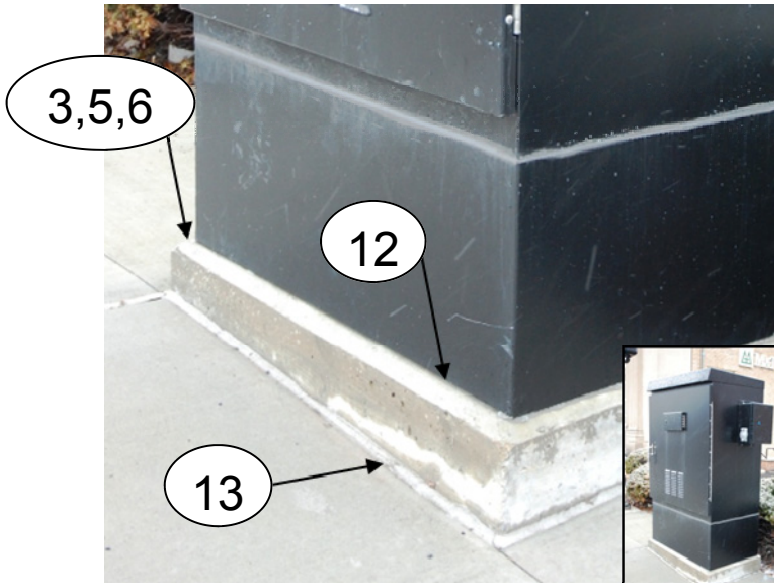
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1	6.0 Controllers (PUB 408 Sections 952 and 1104.03)
2	6.1 Approval Listings 1. Verify that the controller assembly is on the approved CS-201 form. 2. Obtain documentation from the contractor verifying the controller assembly was shop tested.
3	6.2 Controller Foundations (TC-8802)
4	6.2.1 In Earth 1. Verify that the plans call for a base mounted (Type I mounting) controller assembly. 2. Verify that the intersection and controller can be observed simultaneously from the proposed location prior to pouring the foundation.
5	3. Verify that the foundation is 4" larger than the cabinet on all sides.
6	4. Verify that the depth of the foundation is 31" plus the diameter of the largest conduit that runs through the foundation.
7	5. Verify that the concrete pad in front of the controller extends 28" from the cabinet face with a depth tapering from 12" at the cabinet foundation to 6" at the front edge of the concrete pad.
8	6. Verify that there is a 3/4" chamfer on all sides of the control cabinet foundation.
9	7. Verify that the top of the control cabinet foundation is elevated 4" above the finish grade at its lowest point.
10	8. Verify that there will be no conflicts between conduits and the cabinet before constructing the foundation.
11	9. Verify that a 1" diameter screened drain pipe is installed from the bottom rear of the cabinet to the edge of the foundation, discharging above grade.
12	10. Verify that the cabinet anchor bolts cast into the foundation are 1/2" x 12". 11. If anchor bolts are not used, verify that 1/2" x 3 3/4" expansion bolts are used. 12. Verify that caulking compound was applied around the entire cabinet enclosure between the base of the cabinet and the concrete foundation. Verify that caulking is in accordance with <i>PUB 408 Section 705.8</i> .

6.2.2 In Sidewalk or Paved Area

1. Verify that the plans call for a base mounted controller assembly (Type I mounting).
2. Verify that the intersection and controller can be observed simultaneously from the proposed location and there is no undesirable door opening, such as opening into traffic, prior to pouring the foundation.
3. Verify that the foundation is 4" larger than the cabinet on all sides.
4. Verify that the depth of the foundation is 31" plus the diameter of the largest conduit that runs through the foundation.
5. Verify that there is a 3/4" chamfer on all sides of the control cabinet foundation.
6. Verify that the top of the control cabinet foundation is elevated 4" above the finish grade at its lowest point.



7. Verify that there will be no conflicts between the conduits and the cabinet before constructing the foundation.
8. Verify that conduits entering the cabinet are plugged with an approved duct seal formed around the wires to prevent entry from water, insects, snakes or rodents.
9. Verify that a 1" diameter screened drain pipe is installed from the bottom rear of the cabinet to the edge of the foundation, discharging above grade.

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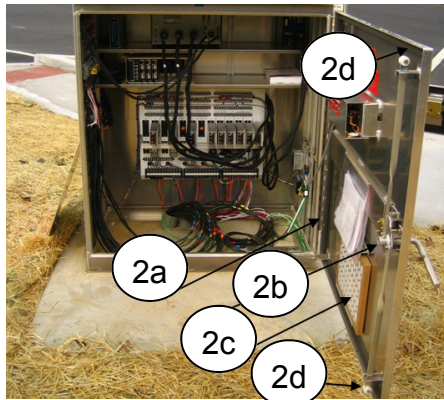
6.2.2 In Sidewalk or Paved Area (Continued)

- 10. Verify that the cabinet anchor bolts cast into the foundation are ½" x 12".
- 11. If anchor bolts are not used, verify that ½" x 3¾" expansion bolts are used.
- 12. Verify that caulking compound was applied around the entire cabinet enclosure between the base of the cabinet and the concrete foundation. Verify that caulking is in accordance with *PUB 408 Section 705.8*.
- 13. Verify that ½" pre-molded expansion joint filler was installed between the foundation and the surrounding paved area.

6.3 Controller Cabinets

6.3.1 Type I Mounting (Ground Mounted)

- 1. Verify that the plans call for a base mounted controller assembly (Type I mounting).
- 2. Verify that the controller cabinet is equipped with the following items:
 - a. Full height continuously welded piano hinge. *Type 170 - PUB 408 Section 1104.03 (b).2.f NEMA - PUB 408 Section 1104.03 (b)1.f.1*
 - b. Key operated spring lock. *Type 170 - PUB 408 Section 1104.03(b)2.f*
 - c. Cover vents with full perimeter frame disposable filter securely held in place. *NEMA - PUB 408 Section 1104.03(b)1.f.2*
 - d. Three point draw roller type door latching mechanism required. *Type 170 - : PUB408 Section 1104.03(b)2.f NEMA - : PUB 408 Section 1104.03(b)1.f.1*
 - e. 15" minimum clearance between bottom of cabinet and the terminals, equipment, or devices. *TC-8802*
- 3. Verify that conduits entering the cabinet are plugged with an approved duct seal formed around the wires to prevent entry from water, insects, snakes or rodents.

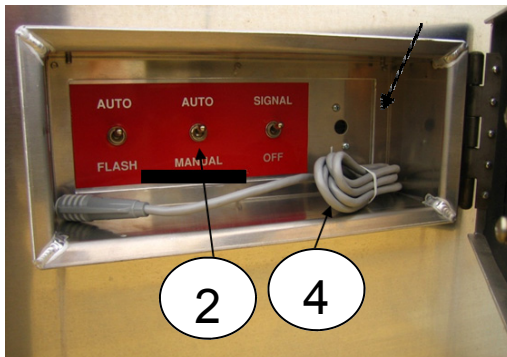


6.3.2 Type II Mounting (Pole Mounted)

1. Verify that the plans call for a pole mounted controller assembly (Type II mounting).
2. Verify that there is no undesirable door opening, such as opening into traffic
3. Verify that the bottom of the cabinet is not higher than 27" when the cabinet extends over a sidewalk or walkway.
4. Verify that the centerline of the cabinet is between 4'-3" and 4'-6" above final grade.
5. Verify that no portion of any equipment (except fan and light) is higher in the cabinet than the top of the door. *TC-8802*
6. Verify that the door latching mechanism is a three point draw roller type. *PUB 408 Section 1104.03(b)*
7. Verify that vents are covered with a full perimeter, framed, disposable, filter securely held in place. *NEMA-: PUB 408 Section 1104.03(b).1.f.2*
8. Verify that all terminals, equipment and devices are at least 3" above the bottom of cabinet. *TC-8802*

6.4 Manual Test Control

1. Review the requirements in *PUB 408* for the type of controller
 - Type 170 - *Sections 1104.03 (b)2.b & 1104.03(b)2.f*
 - NEMA - *Section 1104.03(b)1.b*
 - Type 2070 - *Section 1104.03(b)3.b*
2. Verify that the manual control panel includes a method to switch the signal from automatic to manual control.
3. Verify that the manual control panel is in a watertight enclosure compartment accessed separately from the main control cabinet and locked with a standard police key.
4. Verify that the plug in hand control cable is neatly tucked in the enclosure.



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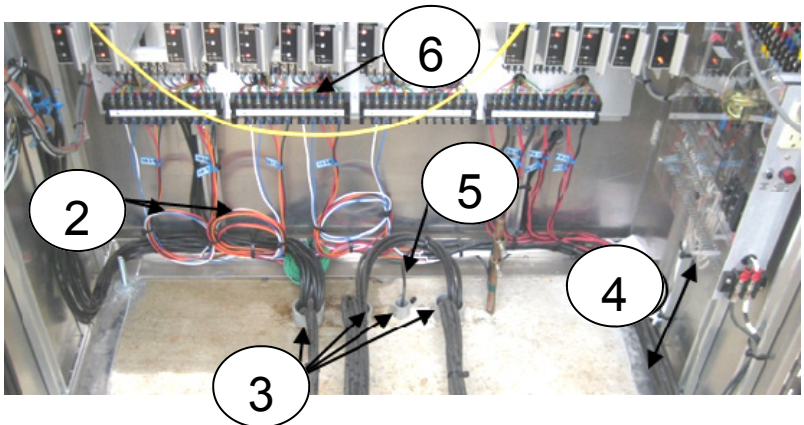
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6.5 Grounding Assemblies

1. Verify that ground rods are copper clad steel, at least 5/8" diameter and at least 10' long. *TC-8804*
2. Verify that ground rods are connected to the grounding bus in the service disconnect and/or support with a #4 AWG (min) bare copper ground wire. *TC-8804*
3. Verify that the ground wire is connected to the ground rod with either a bronze connector or an exothermic weld and that the connection is coated with approved corrosion inhibitor. *PUB 408 Section 1101.11(j) & TC-8802 & TC-8804*
4. Note that the ground rod is to be installed outside the foundation of the cabinet or support. *TC-8804*
5. Test in accordance with *910.3(q)*

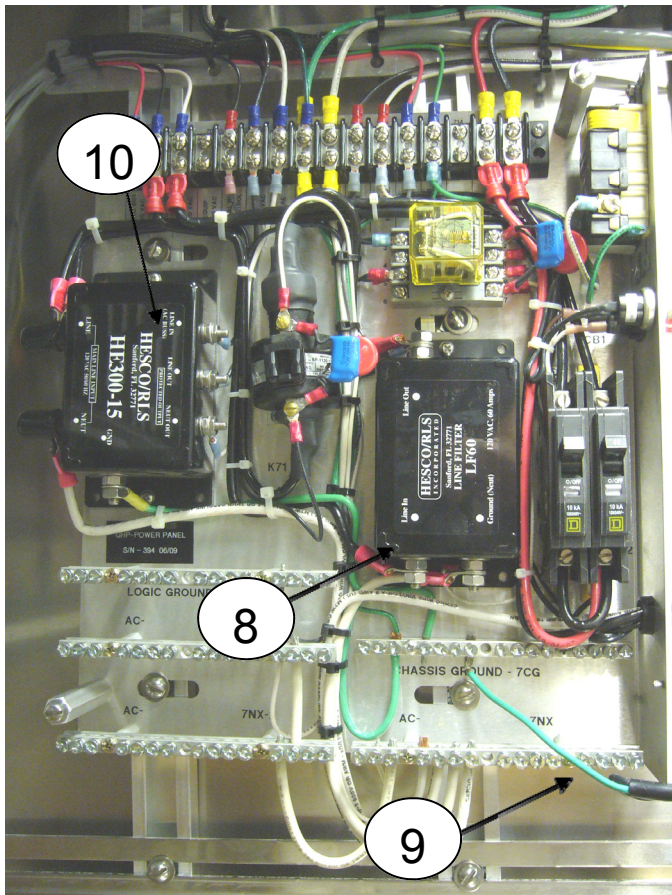
6.6 Control Equipment and Wiring Installation

1. Verify that the wiring and installation is done in a neat and workmanlike manner with all cables tie-wrapped. *PUB 408 Section 952.3(d)1*
2. Verify that the spare conductors of signal cable and interconnection cable are neatly wrapped in the cabinet and are the same length as the active conductors. *PUB 408 Section 952.3(d)1*
3. Verify that the conduit entry stubs are at least 3" high. *TC-8802*
4. Verify that there is a minimum of 15" between the bottom of the cabinet and terminals, equipment, and devices. *TC-8802*



6.6 Control Equipment and Wiring Installation (Continued)

5. Verify that a #8 AWG equipment grounding conductor is connected to the service disconnect. *TC-8804*
6. Verify that there is only one conductor per screw on the terminal block or use pressure-type mechanical lugs for multiple conductors. *PUB 408 Sect. 954.3(e)1*
7. Verify that the wiring and cables are neatly arranged and tie-wrapped. *PUB 408 Section 952.3(d)1*
8. Verify that RFI Line Filter conforms to *PUB 408 Section 1104.03 (c)3.b*
9. Verify that the chassis ground bar is connected to the grounding system.
10. Verify that the surge protection conforms to *PUB 408 Section 1104.03(c)3.c*



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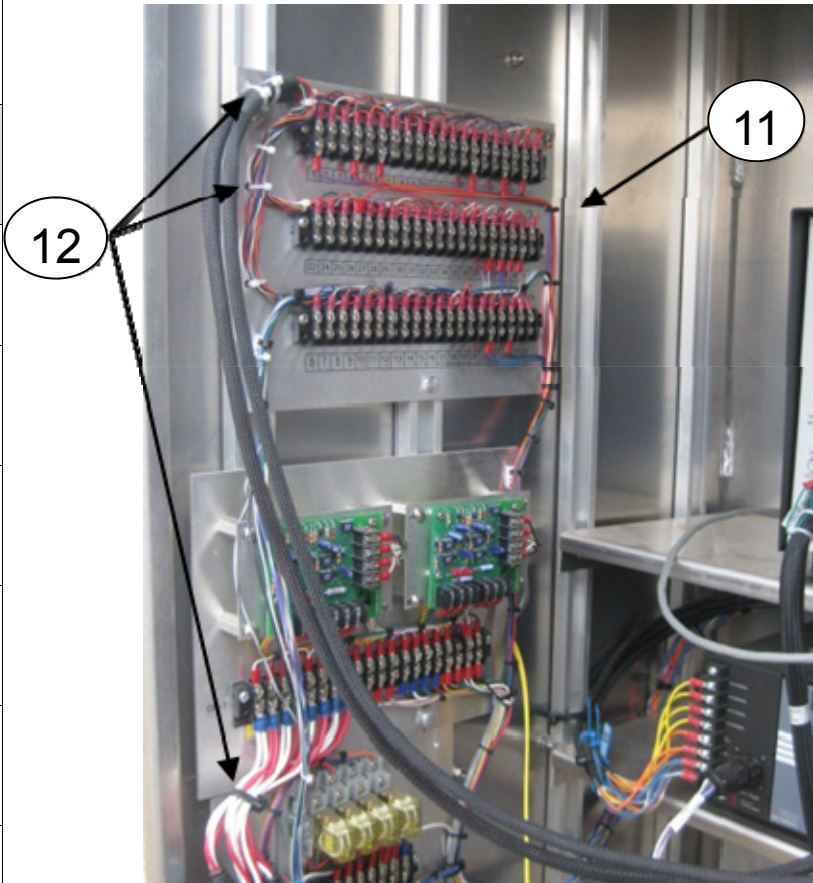
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6.6 Control Equipment and Wiring Installation (Continued)

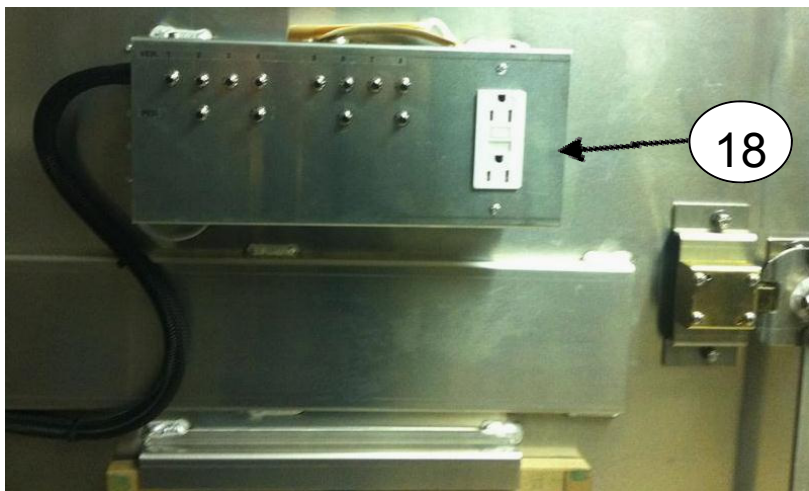
- 1 11. Verify that equipment is positioned in the cabinet so that all terminal strips are accessible without removing other equipment. *PUB 408 Section 1104.03(b)2.f*
- 2 12. Verify that the wiring and installation is neat with all cables tie-wrapped. *PUB 408 Section 952.3(d)1*
- 3 13. Verify that all grounding conductors have green insulation or are wrapped all the way around in green marking.
- 4 14. Verify that all neutral conductors have white insulation or are wrapped all the way around in white marking.
- 5 15. Verify that all wires are labeled with a unique wire or terminal number that indicates where it is to be connected.



6.6 Control Equipment and Wiring Installation (Continued)

- 16. If specified, verify that access to the transfer switch and twist lock receptacle for connection to an emergency generator is installed behind a locked enclosure with police access. *PUB 408 Section 1104.03(b)2.f*
- 17. Verify that there is a transfer switch relay to disconnect the permanent power source and connect the emergency power source. *PUB 408 Section 1104.03(b)2.f*
- 18. Verify that there is a Ground Fault Circuit Interrupter (GFCI) protected convenience outlet on a dedicated 20 amp minimum circuit. *PUB 408 Section 1104.5(j) and 1104.03(c)3.a*
- 19. If specified, verify that there is a UPS/Battery back-up capable of a minimum 4 hour back-up operation. *PUB 408 Section 1104.05(i)*
- 20. If specified, verify that a fiber optic patch panel is included.
- 21. If specified, verify that a fiber optic cable loop is included.

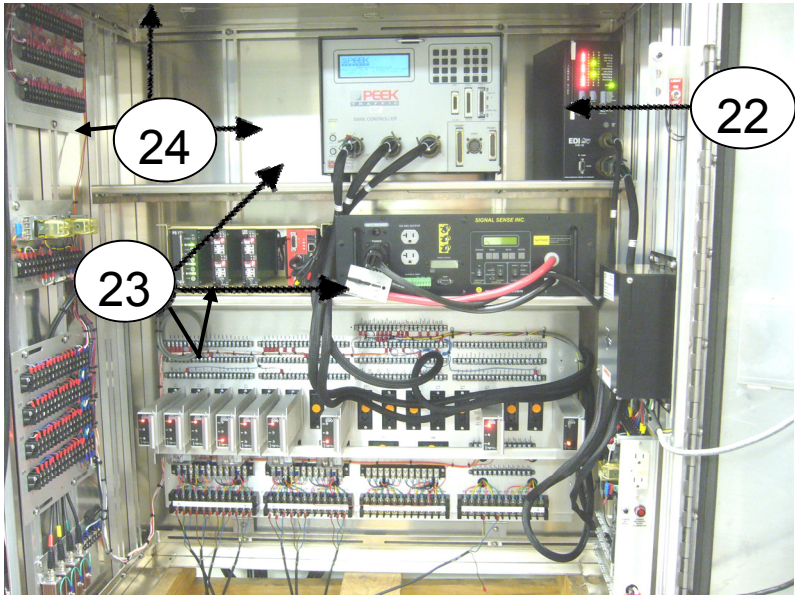
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6.6 Control Equipment and Wiring Installation (Continued)

- 22. Verify that all equipment indicator lights are not blocked and can be seen from the cabinet doorway. *PUB 408 Section 1104.03(b)2.f*
- 23. Verify that all equipment is installed upright and on its own rack or shelf and not stacked on top of other equipment. *PUB 408 Section 1104.03(b)2.f*
- 24. Verify that there is adequate room within the cabinet for equipment and servicing. *PUB 408 Section 1104.03(b)2.f*



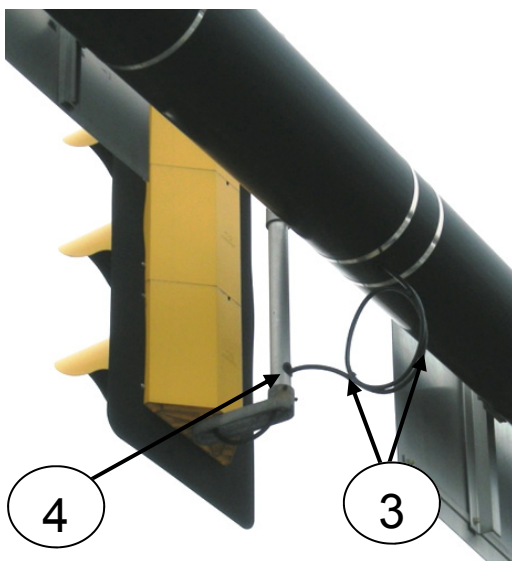
6.7 Programming and Timing

- 1. Verify with the District Signal Supervisor that the timing plans and operation shown on the plan is correct and to be used at time of "turn on".
- 2. Verify that the correct timing plans and operation shown have been programmed into the controller properly. Call the District Signal Supervisor, if required, to confirm correct programming.
- 3. With the Contractor, observe controller operation with the traffic signals "off" to verify correct controller programming.

7.0 Signal Indications (Sections 955 and 1104.06)

7.1 Vehicular

1. Verify that the signal housing and LED modules are the size and color specified on the traffic signal plan. Highway yellow is the standard signal housing color unless otherwise noted. *PUB 408 Section 1106(a)1*
2. Verify that overhead signals are installed with the top of the signal head at the same elevation prior to installing the tether wire. *TC-8801 Sheet 2*
3. Verify that drip loops at wire entrances to signal heads are secured with acceptable outdoor type cable ties. *PUB 408 Section 954.3(e)1 & 1104.05(b)5*
4. Verify that there is a grommet at the wire entrance to the mounting bracket. *TC-8801 Sheet 1*
5. If optically programmed signal heads are specified, verify that the Contractor coordinates the field programming of the signal heads with the District Signal Supervisor for cut-off and distance limiting.
6. Verify that the specific locations of overhead vehicular signal heads are as shown in the location indicated on the traffic signal permit plan.
7. Verify that the vehicular signal heads are generally aimed at approaching traffic that is 150' in front of the stop line.



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7.1 Vehicular (Continued)

8. Verify mounting hardware which includes:
 - Span wire hanger (Span wire installations)
 - Balance adjuster
 - Cable entrance fitting (Mast arm installations)
 - Pipe, as required, to keep the tops of all signal heads at the same elevation.
9. Verify that cable entrance fitting is positioned so that the cable entrance will be from the backside of the signal housing.
10. Verify that the visors, louvers and back plates indicated on the plan or in the specifications have been installed properly.
11. Verify that there is 15' to 19' of vertical clearance for overhead signal housings, unless otherwise specified on the traffic signal permit plan.
12. Verify that the minimum clearance as indicated in *Pub 149* is obtained from curb or edge of shoulder to the post mounted signal housings. *TC-8801*



7.2 Pedestrian

1. Verify that the type of pedestrian signal head housing and LED Modulal (Type A or Type B) is as called for on the plan.



2. Verify that the signal housing are the color specified on the plan or in the specifications. Highway yellow is the standard color unless otherwise noted. *PUB 408 Section 1106(a)1*

7.2 Pedestrian (Continued)

- 3. Verify that the signal housing are constructed of aluminum or polycarbonate resin. The contractor has the option to provide either unless otherwise specified. *PUB 408 Section 1106(a)1*
- 4. Verify that the minimum clearance as indicated in *Pub 149* is obtained from curb or edge of shoulder to the post mounted signal housing. *TC-8801*
- 5. Verify that the bottom of the signal head is between 7' and 10' above the sidewalk. If there is no sidewalk, verify that the bottom of the signal head is between 7' and 10' above the pavement grade at the centerline of the road. *TC-8801*

7.3 Preemption Fail Safe Indications

- 1. Verify that emergency vehicle preemption is specified and shown in the movement phase diagram.
- 2. Verify that the size and color of the confirmation light supplied by the contractor is in accordance with the specifications. Coordinate with the District Signal Supervisor and the municipality.
- 3. At signals with emergency vehicle preemption on intersecting approaches, verify that confirmation lights are associated with the proper approach.
- 4. Verify that pre-empt receivers are mounted in the right location and pointed in the correct direction.

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1	8.0 Electrical Distribution (<i>PUB 408 Sections 954 and 1104.05</i>)
2	8.1 Grounding <i>PUB 408 Section 954.3(d) and Section 1104.03(d)</i>
3	1. Verify that a continuous mechanical and electrical grounding system exists connecting the following items:
4	<ul style="list-style-type: none"> • Service disconnect enclosure • Controller assembly and cabinet • Traffic signal supports • Ground rods • Span wires • Tether wires • Steel conduit • Metallic junction boxes
5	2. Verify that Underwriter’s Laboratory listed bonding/grounding bushings are installed on the ends of all steel conduits and that the bushings are connected to the grounding system.
6	8.2 Signal Cable, Wiring and ID Tags
7	1. Verify that all signal cable, wiring and ancillary equipment are included on the CS-201 form.
8	2. Verify that lubricant is used to install cable in the conduit. If new cable is installed in existing conduit verify that the conduit was cleaned in accordance with <i>PUB 408 Section 910.3</i>
9	3. Verify that signal wires and cables are spliced only in pole bases using waterproof resin-filled wire nuts.
10	4. Verify that ground wires are spliced only in junction boxes.
11	5. Verify that all cables at splices in pole bases or cabinets are properly labeled or have ID tags attached.
12	6. Verify that all terminal connections have been banded and the appropriate coding used in accordance with <i>PUB 408 Section 954.3</i> .
	7. Verify that all spare and unused conductors have been terminated on the ground buss.
	8. Verify that enough signal cable slack is left for proper wiring connections and drip loops.
	9. For span wire installations, verify that the cable is lashed to the span wire in accordance with <i>TC-8801</i> .
	10. Verify that drip loops have been included in all signal cables entering signal head housings. Verify that the cable enters the signal head housing at an upward angle to prevent water from entering the signal head. Verify that the drip loops are secured with outdoor-type, self-locking cable ties. <i>TC-8801</i>

8.3 Wiring Diagrams *PUB 408 Section 1104.01(d)*

1. Verify that the contractor provides three (3) copies of the cabinet wiring diagram and manufacturer's timing plan for each controller assembly. If there are changes to the timing plan during testing, three new sets of timing plans are required.

8.4 Testing

1. Verify with the contractor that they certify that all equipment and material has been checked and is in operating order prior to it being energized.
2. Verify and document the faulty or defective material that was removed and replaced to correct the condition that halted the test.
3. Test grounding system in accordance with Pub 408 Section 910.3 (q)

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1	<p>9.0 Detection (Sections 956 and 1104.07)</p> <p>9.1 Vehicular</p> <p>9.1.1 Inductance Loops</p> <p>Cutting, Placing Wire and Sealing</p>
2	1. Inspector In-Charge will determine in which paving layer (wearing course, base course or be “pre-formed” under new concrete pavement) the plans or specifications call for the loop sensor to be installed.
3	2. Verify that sensors are located as indicated on the plan. Verify that the sawcutting will not go through pavement joints or areas of deteriorating pavement. Contact the District Signal Supervisor if there are any questions prior to installing loops.
4	3. Verify that the loop layout is in accordance with <i>TC-8806</i> and that the saw cut depth is constant for the entire loop sensor.
5	4. Verify that the slot is cleaned of moisture and debris, preferably with a compressed air hose.
6	5. Verify that the loop sensor wire is #14 AWG, <i>IMSA Specification 51-5</i> . It is an insulated wire inside a PVC tube. <i>PUB 408 Section 1104.07(b)1.a</i> .
7	6. Verify that each saw cut slot has the required number of turns of sensor wire per detector as required to provide the specified inductance.
8	7. Verify that all wires in a common slot are proceeding in the same direction.
9	8. Verify that the sensor wire is tamped into the slot with a non-metallic tool.
10	9. Verify that the saw cut ends one foot (1') from the edge of pavement and a rotary drill is used to make a hole in the pavement. Verify that the sensor wire is installed through conduit to the junction box by trenching through either the shoulder or sidewalk.
11	10. Verify that the splice of the sensor wire to the lead-in wire is made only inside the junction box. Verify that there is no other splicing of sensor wire. <i>TC-8806</i> .
12	11. Verify that the ends of the conduit are properly sealed with duct seal after the sensor wire is installed. <i>TC-8806</i> .
	12. Verify that the amplifiers are on the approved CS-201 form.
	13. Verify the values of the tests of the sensor after installation for leakage resistance, series resistance, and inductance before sealing the saw cut slot. <i>PUB 408 Section 956.03(a)1</i>

Cutting, Placing Wire and Sealing (Continued)

- 14. Verify that the sealant used to seal the saw cut is in *Bulletin 15* and that the manufacturer’s specifications for mixing and installation are followed. Verify that the sealant is not placed when the temperature is under 32° F or during precipitation. *PUB 408 Section 956.03(a)1*
- 15. Verify that the slot is filled to within one eighth inch (1/8") of the pavement surface.
- 16. Verify that the excess sealant is removed, but not with the use of solvents. Do not allow traffic on the sealant until it is properly cured.
- 17. Verify that location of the sensor wire is marked after installation to ensure that core samples do not sever the wire.
 - Verify that all excess loop sensor wire or lead-in wire is banded in the junction box to prevent movement which will result in false calls.
 - Verify after testing inductance, a copy of the inductance readings is placed, along with the make and model number of the testing equipment, in the controller cabinet.

Lead-in Cable and Splicing

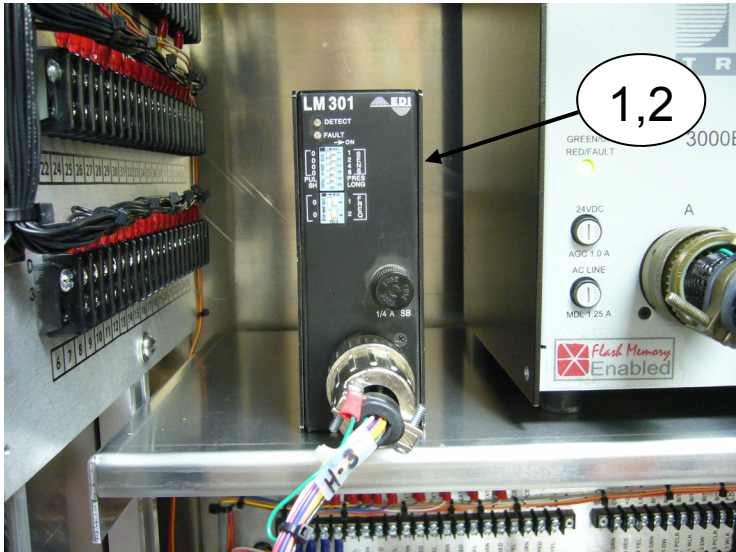
- 1. Verify that detector lead-in cable is #14 AWG, *IMSA Specification 50-2. PUB 408 Section 1104.07(a)2*
- 2. Verify that the detector lead-in cable is installed in one continuous length to the terminal strip in the controller cabinet. No splices are allowed in the lead-in cable.
- 3. Verify that the detector lead-in cable is spliced to the sensor wires as shown in *TC-8806* or by using another approved method.

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**9.1.1 Inductance Loops (Continued)
Amplifiers**

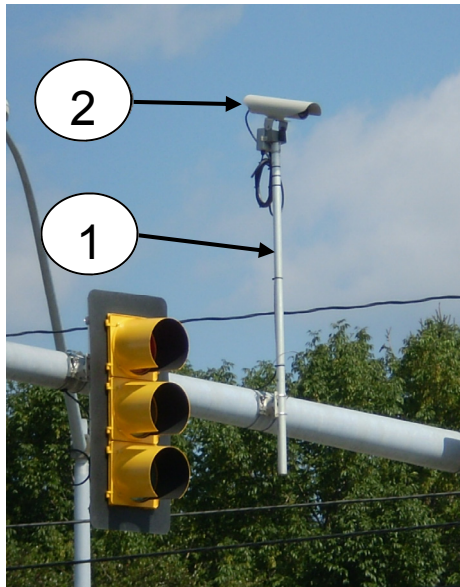
1. Verify that after connecting to the loop amplifier, the amplifier has been adjusted as per the manufacturer’s instructions to obtain the necessary sensitivity. Verify that no “false” calls are being placed by traffic moving in the opposite direction.
2. Verify that the loop amplifiers are labeled with the correct phase and movement.



9.1.2 Video Detection

1. Verify that the video detection camera is mounted at the highest point possible
2. Verify that each camera is provided with a sun shield.
3. Verify that all cables and connections are per the manufacturer's specifications.
4. Verify that each zone of video detection on the plans is covered by the system.

9.1.3 Microwave Radar, Digital Wave Radar, Magnetic and Magnetometer Detection Systems



1. Verify which type of detection system is specified. Coordinate with the District Traffic Signal Supervisor for the location and detection zone coverage.
2. Verify that all installation, cable and connections are per the manufacturer's specifications.

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9.2 Pedestrian Pushbuttons

1. Verify whether a standard pushbutton and sign or an accessible pedestrian signal and related equipment is called for on the plans or specifications.

9.2.1 Standard Pushbutton

1. Verify that the pedestrian pushbutton is installed so the centerline of the pushbutton is between 40" to 44" above the top of the foundation.
2. Verify that the pedestrian pushbuttons are at least 2" in diameter.
3. Verify that pushbuttons are located as per the plan. Coordinate with the District Signal Supervisor regarding any changes or questions prior to installation. *TC-8803*
4. Verify that vandal-proof (difficult to remove without special tools) stainless steel hardware is used to attach the pushbutton to the support.
5. Verify that the hole in the support was de-burred after drilling but prior to cable installation.
6. Verify that sealant was placed at the top of the pushbutton where it contacts the support.
7. Verify by field test that the proper phase and timing is called when the pushbutton is actuated.



9.2.2 Accessible Pedestrian Signal

1. Verify that the pedestrian pushbuttons are at least 2" in diameter.
2. Verify that pushbuttons are located as per the plan. Coordinate with the District Signal Supervisor regarding any changes or questions prior to installation. *TC-8803*
3. Verify that vandal-proof (difficult to remove without special tools) stainless steel hardware was used to attach the pushbutton to the support.
4. Verify that the hole in the support was de-burred after drilling but prior to cable installation.
5. Verify that pushbutton, speaker and vibrotactile device are attached to the support with the proper orientation to the applicable crosswalk. Verify that speakers are not attached to pedestrian indications.
6. Verify that sealant was placed at the top of the pushbutton, speaker and vibrotactile device where they contact the support.
7. Coordinate with the District Traffic Signal Supervisor to verify the types of audio messages to be used.
8. Verify by field test that the proper phase, audio messages and timing are called when actuated.
9. Verify the message displayed/operations of accessible pedestrian signals when emergency vehicle preemption is invoked.
10. If volume of pedestrian signals does not self adjust to ambient noise, manual adjustments will be required.

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9.3 Preemption Systems

1. Verify which type of preemption system is required by the plans and specifications
 - Audio,
 - Optical or
 - Global Positioning Satellite (GPS)
2. Verify the detector/receiver location prior to installation. A minimum distance of 500' away from the stop bar on the appropriate approach is recommended for a detection of an actuating vehicle.
3. Verify that any training requirements called for in the specifications are followed and that appropriate personnel are trained.
4. If there are issues with detection, work with vendor to test emergency vehicle sirens/emitters to confirm vehicles meet specifications.
5. If possible, it is desirable to test the preemption system with the municipality's actual responding units.

9.4 Other Preemption Systems

1. Seek guidance from the Traffic Signal Supervisor when railroad preemption or other complex signal operations are indicated.

10.0 Pavement Markings and Signs

10.1 Pavement Marking Locations

1. Verify the location of crosswalks and stop lines with the District Traffic Signal Supervisor prior to placement.
2. Verify coordination of pavement marking and detection zone locations.



10.2 Placement of Pavement Marking Material

1. Verify that the type of pavement marking material called for in the plan is applied in the field.
2. Coordinate the application of the pavement marking material with the contractor to ensure the material is applied at the correct time in the project progress and that the weather and pavement conditions are in accordance with the manufacturer's specifications.



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10.3 Sign Types and Locations

1. Verify the type of sign installation and location with the District Signal Supervisor prior to installation. *PUB 111M*
2. Verify that the signs provided are from an approved sign manufacturer and that the supplier's PennDOT identification number is on the back of each sign.
3. Verify that the date of installation is placed on the back of the sign with a permanent marker.
4. Verify that the faces of new signs are covered until project conditions are appropriate for their display.



11.0 Traffic Signal Systems (PUB 408 Sections 953 and 1104.04)

11.1 Equipment

1. Verify that the location of the master controller, master coordinating unit, or server matches the plans.
2. Verify that the required arrangements have been made with the municipality and the utility that will provide the communications connection.

11.2 Software

1. Verify the installation of the proper number of traffic signal system software packages, typically two; one package on a designated municipal computer and the other package on a designated Department computer. *PUB 408 Section 953.3(d)1*
2. Verify that all project specific intersection graphics, intersection data, overall system mapping, timing plans and other software programming has been completed. *PUB 408 Section 953.3(d)2*

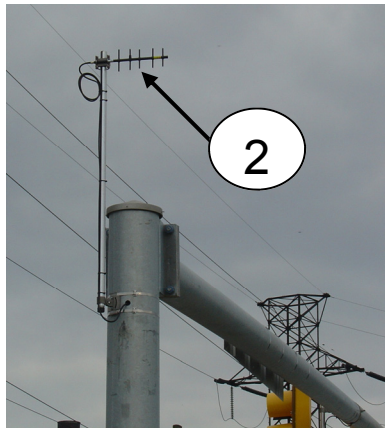
11.3 Training

1. Verify that the proper amount of training on the traffic signal system software has been completed. Amount of time varies by project. Coordinate with the District Signal Supervisor. *PUB 408 Section 953.3(d)3*

11.4 Communications

11.4.1 Radio *PUB 408 Section 953.3(e)*

1. Verify the appropriate radio units are installed at the master controller and the local controllers and that each radio unit has repeater capability.
2. Verify that the correct type of antenna is installed at each intersection as per the plan and that the antenna is pointed in the correct direction.



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11.4.1 Radio (Continued)

- 3. Verify that all coaxial cable and antennas are grounded properly and that lightning surge suppressors are installed correctly.
- 4. Verify that the Contractor monitors the radio communication system tests to evaluate and adjust the radio system before use.
- 5. Verify that the Contractor provides all warranties and product information from the contractor for all installed equipment.

11.4.2 Cable *PUB 408 Section 953.3(g)*

- 1. Verify that all equipment, control cable and communication cable have been installed per the manufacturer's requirements.
- 2. Verify that all cables are terminated on an approved terminal strip and do not have any splices.
- 3. Verify that the lightning and surge suppression equipment has been installed as specified.
- 4. Verify that the Contractor provides all warranties and product information from the contractor for all installed equipment.

11.4.3 Cellular *PUB 408 Section 953.3(h)*

- 1. Verify that the cellular modem has been installed at the master controller and the local controllers.
- 2. Verify that the correct type of antenna is installed at each intersection and the size matches the modem to be used.
- 3. Verify that surge protection for the cellular modem is in place and is properly grounded.
- 4. Verify that the Contractor provides all warranties and product information from the contractor for all installed equipment.

11.4.4 Telephone Dialup *PUB 408 Section 953.3(i)*

1. Verify that the dialup modem has been installed at the location as shown on the plans.
2. Verify that surge protection for the dialup modem is in place and properly grounded.
3. Verify that the Contractor provides all warranties and product information from the contractor for all installed equipment.

11.4.5 Fiber Optic Cable *PUB 408 Section 953.3(j)*

1. Verify that a fiber optic network switch has been installed at the master controller and the local controllers.
2. Verify that fiber optic cable has been installed between each controller location as shown on the plans.
3. Verify that a fiber optic patch panel has been installed in each controller cabinet.
4. Verify that the pulling strength and minimum bending radius of the fiber optic cable have not been exceeded.
5. Verify that the Contractor monitors all fiber optic performance tests and verify that they are completed with acceptable results. Document the results as specified.
6. Verify that the Contractor provides all warranties and product information from the contractor for all installed equipment.

11.5 Testing

See *Section 12.4* of this *Pocket Guide*.

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1	<p>12.0 Final Inspection and Testing</p> <p>12.1 Inspection, Turn-on Procedures and Flashing Operation (if required)</p>
2	<p>1. After the contractor indicates that a traffic signal installation is ready to be energized and all functional testing (including conflict monitor testing, preemption testing and communication testing) is completed and documented, contact the District Signal Supervisor to schedule a final review and “turn-on”. Correct any deficiencies found and timing plan changes prior to the “turn on”. Newly signalized intersections will be put in the “flashing” mode as directed by the District Signal Supervisor.</p>
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4	<p>2. Notify the appropriate municipal personnel to attend the “turn-on” and operational testing. Coordinate with the District Signal Supervisor.</p>
5	<p>12.2 30 Day Test</p>
6	<p>1. With the signal in full operation, monitor the 24 hour operating test for not less than 30 consecutive calendar days. Direct the contractor to correct any failure caused by malfunctioning parts or equipment, or faulty workmanship. The contractor should correct the condition in less than 24-hours after notification. <i>PUB 408, Section 1104.01(g)1</i></p>
7	<p>2. Energy costs are the responsibility of the contractor during the test period.</p>
8	<p>3. After any failure caused by malfunctioning parts or equipment, or faulty workmanship, is corrected, the 30 day operating test begins anew. The District Signal Supervisor shall be notified of failure and the restart if the new testing period. There is no time limit for how long the testing period may last if failures continue to occur. With the correction of each failure, the 30-day test period begins again. The signal must operate correctly for 30 consecutive days for the test to be satisfactorily completed.</p>
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10	<p>12.3 180 day Equipment Guarantee Period: (PUB 408 Section 1104.01(g)2)</p>
11	<p>1. After the 30 day test is satisfactorily completed, the 180 day equipment guarantee period begins. The in-service operation of mechanical and electrical equipment, the controller assembly and related components are included in the 180-day guarantee period. On HOP projects, it is the responsibility of the municipality to coordinate with the contractor for guarantee issues.</p>
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12.3 180-day Equipment Guarantee Period: *(PUB 408 Section 1104.01(g)2) (Continued)*

2. During this period the contractor has the following responsibilities:
 - Maintain equipment in the controller cabinet. Use additional locks, as necessary, to prevent entry by others.
 - Repair faulty workmanship, repair or replace defective materials or equipment, and correct malfunctions in the controller cabinet within 48 hours of commencing repairs.
 - Commence repairs no later than the working day following notification of failures or malfunctions.
 - Guarantee repairs or replacements for 30 days or the balance of the 180-day guarantee period, whichever is longer.

12.4 Systems Testing: *(PUB 408 Section 953.3(d)1 and Section 953.3(d)2)*

1. Verify that all software packages are in place and functional at the specified municipal location and/or Department computer.
2. After the successful completion of the 30 day test at every individual intersection, a separate 30 day operations test on the traffic signal system and the related communications system can begin. This 30-day test is separate and distinct from the 30-day test for each individual intersection.
3. With the signal system in full operation, monitor the 24 hour operating test for not less than 30 consecutive calendar days. Direct the contractor to correct any failure caused by malfunctioning parts or equipment, software, or faulty workmanship. The contractor should correct the condition in less than 24 hours after notification.
4. After any failure caused by malfunctioning parts or equipment, software, or faulty workmanship is corrected, the 30 day operating test begins anew. There is no time limit for how long the testing period may last if failures continue to occur. With the correction of each failure, the 30-day test period begins again. The signal system must operate correctly for 30 consecutive days for the test to be satisfactorily completed.

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