
10450 – TRAFFIC SIGNAL INSTALLATION

(Last Revised 6/21/05)

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[PART 1 – GENERAL](#)

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.
- B. Section 02200 – Earthwork
- C. Section 02275 – TRENCHING, BACKFILLING, & COMPACTION OF UTILITIES.
- D. Section 02400 – CURB AND GUTTER, DRIVEWAYS, AND SIDEWALKS
- E. Section 02920 – SEEDING, SODDING, AND GROUNDCOVER
- F. VDOT *Road and Bridge Specifications*, latest revision.
- G. AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, latest revision.
- H. City of Fairfax Street Lighting Policy, latest revision.
- I. City of Fairfax Erosion and Sedimentation Control Ordinance

1.2 SUMMARY

- A. This specification covers signals and traffic management systems and street lighting.

1.3 DEFINITIONS

- A. **GENERAL:** For the purposes of this specification, the following definitions refer to signals and traffic management systems and street lighting items that come under the authority of the VDOT or the City of Fairfax as specified within this section and other sections of this manual.
 - 1) **Backplate:** A black plate attached to the perimeter of a traffic signal head for the purpose of improving visibility of signal head lenses when the signal is backlit by the sun.

- 2) **Loop** (Inductive Detection Loop): A loop conductor placed within a sawed slot in the pavement which provides a signal to the traffic signal controller indicating either the presence of or passing of a vehicle over the loop.
- 3) **Mast Arm**: A cantilevered steel arm attached to a pole for the purpose of carrying traffic signals, cable, signs, and appurtenances.

1.4 SUBMITTALS

- A. Submit product data and shop drawings for the following:
 - 1) Signal cabinet and controllers: Wiring and phasing diagrams for signal cabinet and controllers and appurtenances, remote cable harness connector pin diagrams, warranties, etc.
 - 2) Signal cabinet foundation bolt template
 - 3) Loop Sealant Material
 - 4) Foundation reactions for metal strain poles and support mast arms. Design assumptions shall include allowances for wind and ice loads and shall be in accordance with the current AASHTO regulations.
 - 5) Concrete break test results for steel strain pole foundations
 - 6) Soil Geotechnical analysis, if requested by Public Works Director.
 - 7) The contractor shall provide 3 sets of as-built drawings to the City of Fairfax within 30 days of completion of the project. The drawing may be copies of the original Traffic Signal Plan with actual locations sketched in.

1.5 QUALITY ASSURANCE

- A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

1.6 QUALITY STANDARDS

- A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A595	Standard Specification for Steel Tubes, Low-Carbon, Tapered for Structural Use

1.7 STANDARD ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AADT	Annual Average Daily Traffic
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
FS	Federal Specifications
MSDS	Material Safety Data Sheets
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
UL	Underwriters' Laboratories, Inc.
VDOT	Virginia Department of Transportation

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handling/Storage:

- 1) All signal controller equipment and cabinetry, and signal heads shall be delivered to the appropriate City of Fairfax department. No equipment is to be delivered direct to the field from a manufacturer or supplier.
- 2) Steel poles, mast arms, and pole bases shall be delivered to the appropriate City of Fairfax department. Do not store directly on the ground. Set on wooden slats or pallets.
- 3) Observe NEC and NESC requirements for handling and storage of all electrical controls, cabinets, wiring, etc.

1.9 PROJECT CONDITIONS

- A. The Contractor is responsible for obtaining all applicable permits (building permit) making application for service and paying permit fees.
- B. If applicable, before commencing construction, Contractor shall obtain a copy of approved encroachment permit and keep on site during construction.
- C. Protect structures, utilities, sidewalks, pavements, pavement markings and other facilities, and lawns and existing exterior plants from damage caused by traffic signal and electrical lighting operations.

- D. **Safety:** The Contractor shall keep the work area surface in a safe a satisfactory condition during the progress of the work.

1.10 COORDINATION

- A. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 48 hours notice prior to anticipated disturbance or interruption.
- B. If necessary, coordinate emergency traffic control with the City of Fairfax Police Department and VDOT.
- C. Coordinate bagging of new signal heads on new installations with the VDOT and City of Fairfax.
- D. Repair of pavement markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.
- E. It shall be the responsibility of the Contractor to notify MISS UTILITY at 1-800-552-7001, 48 hours prior to the start of any excavations or construction work. Call the City of Fairfax Public Utilities Department at 703-385-7920 for water/sewer service interruption. After hours, call, 703-385-7924.

Other Private Utilities:

Utility	Company	Phone
Electricity	Dominion Virginia Power	1-888-667-3000
Gas	Washington Gas	1-800-752-7520
Phone	Bell Atlantic/Verizon	703-954-6222
Cable TV	Cox Communication	703-378-8422

- F. Protect undisturbed lawns, shrubs, and trees and promptly repair damages caused by operation.

1.11 PUBLIC CONVENIENCE

The Contractor shall at all times so conduct his work as to insure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to insure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the Public Works Director.

1.12 TRAFFIC CONTROL

- A. When working within any City or VDOT System road or highway, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the *VDOT Road and Bridge Specifications*.

- B. Traffic Maintenance shall comply with the latest revision of the VDOT *Standard Specifications for Roads and Structures*, Section 701, *Traffic Signs* and Section 512, *Maintaining Traffic*, as well as other applicable sections.
- C. When traffic signals or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the VDOT or Public Works Director. Provide 48 hours notice prior to anticipated disturbance or interruption.
- D. Traffic signal operation to be restored in a timely fashion as directed by the Public Works Director.

1.13 WARRANTY

The Contractor shall guarantee his work against defects due to poor workmanship or poor construction for a period of 12 months after completion and acceptance of his work.

PART 2 – PRODUCTS

2.1 SIGNALS AND TRAFFIC MANAGEMENT SYSTEMS

2.2.1 SIGNALS AND TRAFFIC MANAGEMENT SYSTEMS MATERIALS

Comply with the applicable sections of Section 703, *Traffic Signals* of the VDOT *Road and Bridge Specifications*. Materials to be supplied by the contractor:

- A. Anchor bolts and anchor bolt templates.
- B. Traffic Signal Poles (Mast Arm Pole, Strain Pole, Pedestrian Pole, and Wood Pole).
 - 1) **Guy Assemblies:** **Guy assemblies** shall meet the applicable requirements of Section 703.03, *Procedures* of the VDOT *Road and Bridge Specifications*.
 - 2) **Mast arms:** Unless otherwise specified by the Public Works Director, mast arms shall be Aluminum Association Alloy 6061-T6, 6063-T6, or approved equal with a satin brush finish and furnished individually wrapped. See also Sections 229 – *Aluminum Alloy* and 700.02, *Materials* of the VDOT *Road and Bridge Specifications*.
 - 3) **Metal Poles:** Metal poles shall meet the applicable requirements of Sections 229 – *Aluminum Alloy* and 700.02, *Materials* of the VDOT *Road and Bridge Specifications*.
 - 4) **Wood Poles:** Wood poles shall meet the applicable requirements of Sections 236 – *Wood Products* and 700.02, *Materials* of the VDOT *Road and Bridge Specifications*.
- C. Conduit and fittings shall be of the size as shown on the Plans.
- D. Conduit shall be Schedule 40 PVC.

- E. All couplings, elbows, and bushings shall be schedule 40 PVC or approved equal.
- F. Pull line shall be nylon jet line, 500 lb test strength.
- G. Grounding wire shall be No. 8 AWG solid copper wire.
- H. Junction boxes shall be VDOT standard in accordance with VDOT *Road and Bridge Standards, Volume I and II*.
- I. Concrete for all pole foundations shall be Class A air entrained high early strength Portland cement concrete and shall meet the requirements of Section 217, *Hydraulic Cement Concrete* of the *VDOT Road and Bridge Specifications*.
- J. Washed gravel shall be VDOT #57 stone or approved equal.
- K. Expansion joint filler material shall meet the requirements of 02400, *Curb and Gutter, Driveway and Sidewalks*.
- L. Grounding rods shall be 5/8-inch x 8-foot copper clad steel.
- M. Loop detector sealant shall be polyester system or polyurethane material designed to meet the physical properties for sealing inductive loop pavement cuts. Epoxy sealants are unacceptable.
 - 1) Polyester systems shall be Bondo #606 or equal.
 - 2) Polyurethane materials shall be 3M Detector Loop Sealant or approved equal.
- N. Loop wire shall be No. 14 AWG type XHHW, stranded single conductor copper wire.

PART 3 – EXECUTION

3.1 CONSTRUCTION OF SIGNALS AND TRAFFIC MANAGEMENT SYSTEMS

3.1.1 GENERAL

- A. **Signals and Traffic Management Systems:** Signals and Traffic Management Systems shall meet these specifications and the applicable requirements of Section 703, *Traffic Signals* of the *VDOT Road and Bridge Specifications*.
- B. The lengths of conduit shown on the plans are approximate lengths. The Contractor shall determine the exact lengths of conduit in the field.
- C. The conduit shall be installed in reasonably close conformity with the lines shown on the plans. Conduit runs may be changed to avoid obstructions with the approval of the Public Works Director.
- D. It shall be the Contractors responsibility to locate all storm drains, water lines, sanitary sewers, and existing traffic signal equipment and to take all precautions

to protect these facilities. The Contractor, at this expense, shall repair any damage caused by the Contractor's operation.

- E. In the case of conflict arising between proposed locations of traffic signal equipment and existing utilities, the Contractor shall relocate the traffic signal equipment subject to the approval of the Public Works Director.

3.1.2 TRENCHING

- A. All trenching across roadways shall be performed using boring operation unless otherwise directed by the Public Works Director.
- B. Unless otherwise shown or approval by the Public Works Director, conduits shall be placed at a minimum depth of 24 inches and a maximum depth of 36 inches in the City of Fairfax right-of-ways. Within VDOT right-of-ways, in accordance with VDOT Regulations, all conduits shall be buried with a minimum cover of 36 inches.
- C. All trenching shall conform to the City of Fairfax, Public Facilities Manual [Section 02275 – Trenching, Backfilling, and Compaction of Utilities](#) for Structures and Pipelines and for Roadway Restoration.
- D. Open trenching operation backfill shall be free of cinders, broken concrete, or other hard abrasive materials prior to conduit placement.

3.1.3 CONDUIT INSTALLATION

All conduits shall be schedule 40 PVC or equivalent unless otherwise specified by the Public Works Director. The size of the conduit shall be specified on the plan.

- A. Conduits crossing roadway shall be installed by direct boring, conduits installed underneath the sidewalk shall be installed by open trench. Where more than one conduit is installed, the conduit may be laid side-by side or on top of another conduit with a 1-inch separation between the conduits. Separation of conduits shall be performed by use of manufactured prefabricated conduit spacing units.
- B. Change in direction of conduits shall be accomplished by the use of standard bends.
- C. The sum of the bend angles in a single run of conduit shall not exceed 360 degrees.
- D. Public Works Director or his/her representative must inspect all open trench conduit runs prior to backfill.
- E. Conduit risers shall be installed on wood poles or traffic signal poles. Conduits shall be attached to poles with conduit clamps or banding, length of riser shall be determined by Public Works Director. A rain tight entrance cap with plastic wire entry knockouts shall be installed at the top of each riser.
- F. Pull line shall be installed in all conduits.

- G. All empty conduits shall be plugged with duct seal or approved conduit end cap inside of junction boxes and foundations.

3.1.4 JUNCTION BOXES

- A. Traffic signal junction box materials and installations shall meet the requirements of Section 238, *Electrical and Signal Components* and Section 703, *Traffic Signals* of the VDOT *Road and Bridge Specifications*.

3.1.5 FOUNDATIONS

- A. The foundation of the type specified shall be installed as shown on the foundation details.
- B. Concrete shall be mixed and poured in accordance with Section 404, *Hydraulic Concrete Cement Operations* of the VDOT *Road and Bridge Specifications*.
- C. The anchor bolt pattern shall be accurately set and shall be left in place until the forms can be removed. The anchor bolts shall extend above the finished top of the foundation for the lengths specified in the foundation details.
- D. All foundations shall be hand floated until the top is smooth and level.
- E. The ground rod shall be installed in the junction box located next to the foundation, unless otherwise directed by the Public Works Director. If ground rod is selected to be installed in undisturbed earth, there shall be a 2" minimum coverage. Ground wire shall be attached to the ground rod with a grounding clamp and shall be continuous and unspliced from the ground rod to ground lugs. Three feet of lead wire shall be left in all pole and cabinet foundations.
- F. The Contractor shall install the traffic pole on cured foundations as directed by the Public Works Director.
- G. A minimum of two 2" conduits and one 1" conduit for the ground wire will be required in all pole foundations.
- H. For controller cabinets, the open ends of conduits shall be placed within the anchor bolt pattern and shall be minimum of 6 inches from the work pad and 12 inches from the back edge of the foundation.
- I. The concrete work pad shall be placed on a 2 to 4 inch bed of VDOT #57 stone, raked level and consolidated before placement of concrete.
- J. A ½-inch expansion joint, meeting the requirements of [Section 02400 – Curb & Gutter, Driveways & Sidewalks](#), shall be placed between the work pad and the foundation.
- K. The concrete work pad shall have a broom finish. The foundation shall be hand floated until smooth and level and shall have chamfered edges.
- L. Concrete pole foundations must cure 2 weeks before traffic poles can be set unless high early strength concrete (Class A4.5 minimum) is used.

3.1.6 LOCATING CONDUIT

- A. A 1 ¾ inch wide yellow plastic locator tape shall be placed directly over the conduit line during backfill operation at a depth of 12 inches below the finished surface in all open trench installation locations.
- B. Where conduit passes under a curb, an “X” shall be cut into the curb over the conduit.

3.1.7 LOOP DETECTOR STUB OUT

Shall be classified as the conduit from a small junction box located behind the curb and gutter to the roadway as shown on the standard detail or approved plans.

- A. One 1-inch Schedule 40 PVC conduit shall be installed for each loop detector.
- B. The conduit shall be 18 to 24 inches below grade entering the junction box.
- C. The conduit shall be installed underneath the curb and gutter and shall be stubbed up into the pavement 2 inches below finish grade with a 90-degree conduit elbow.
- D. The hole in the pavement shall be filled with a 1-inch layer of duct seal if loop is not installed after installation of stub out.
- E. Once the loop has been sawed and loop wire placed, the hole shall be filled with loop sealant such that the wire is encased.

3.1.8 LOOP INSTALLATION

- A. Traffic signal loop detector shall consist of a minimum of one 6 ft x 40 ft loop cut, or of the shape and dimensions indicated on the plans, in each lane.
- B. The loop wire shall be a continuous run from the loop to the loop detector stub out.
- C. All loops shall be wired in a clockwise direction.
- D. Each loop shall have 3 turns of wire unless otherwise noted by Public Works Director.
- E. All loop lead-ins shall be marked for loop identification in accordance with instructions on loop detail sheet.
- F. Each loop installation from saw-cut to sealing shall be completed within the same working day.
- G. The Contractor shall notify the Department of Public Works 24 hours in advance of the start of loop installation so that the loop location can be marked on the roadway.

- H. The Contractor shall saw cut the roadway using a diamond or abrasive power saw. The saw cut shall be neat and true to the location markings.
- I. The saw cut slot shall be a minimum of ¼ inch wide and 3 inches deep except in areas where a concrete roadway overlaid with asphalt are encountered. The Public Works Director shall determine additional depth in this case.
- J. The Department of Public Works will make every effort to avoid locating loop detectors or lead-ins across expansion joints in concreted roadways. Where a loop detector or lead-in must cross an expansion joint the Contractor will drill a 2-inch diameter hole to a depth equal to the saw cut.
- K. All corners of the loop that are cut by a saw shall be drilled with a 2-inch diameter hole equal to the depth of the saw cut.
- L. All corners where loop wires turn shall be rounded smooth so that there are no jagged edges or protrusions, which may damage the wire.
- M. Each loop shall have its own home run to the nearest loop detector stub out.
- N. Saw cuts shall be clean, dry, and free from dust, grit, oil, and moisture before placement of the loop wire.
- O. Loop wire installation shall be made without damage to the wire or its installation. The wire shall be placed without kinks or curls and there shall be no straining or stretching of the insulation. Any wire with cuts, breaks, nicks, or stretching will not be accepted.
- P. The loop wire shall be installed at the bottom of the saw cut slot. A blunt object, similar to a wooded paint stirrer shall be used to seat the wire. Use of screwdrivers or other sharp tools will be cause for rejection.
- Q. A 2-inch diameter hole shall be used to cross expansion joints and cracks in roadway. The loop wire installation shall include a “wobble” (slack in wire) to allow for movement of the wire as the joint expands and contracts. The wire in the hole shall be encapsulated with duct seal. The hole shall be filled with 50% duct seal and 50% loop sealant.
- R. The two lead-in wires from the loop to the junction box shall be twisted together with a minimum of 2 turns per foot. Care shall be taken to make sure the wire is not stretched during the twisting process.
- S. The contractor shall leave a minimum of 6 feet of lead-in wire coiled in the junction box before hook-up.
- T. All loops shall be tested in the presence of the Public Works Director or his/her representative before sealant is added. Loop resistance shall be less than 5 ohms and loop resistance to ground shall be greater than 1 megohm. Loops failing these tests shall be rewired.

3.1.9 LOOP SEALANT

- A. The sealant shall be mixed and applied in accordance with the manufacturer's directions and specifications.
- B. The sealant shall not be poured into the saw cut when the temperature is below 50-degree F. or during precipitation of any kind.
- C. The sealant shall completely surround the wire or cover the duct seal and fill the saw cut. The Contractor shall ensure that there is minimum sealant on the surface of the roadway along the saw cut.
- D. The sealant shall not be over poured. When the sealant has hardened it shall not be higher than the surrounding roadway and shall not be more than 3/8 inch below the surface of the roadway.
- E. The Contractor shall make sure that the sealant has hardened sufficiently so as not to track before allowing traffic to move over the area.

3.1.10 RESTORATION

The Contractor shall restore all areas disturbed by his operation to conditions equal to or better than existing conditions.

3.1.11 CLEANUP

- A. Disposal: remove surplus materials, unsuitable soil, trash, and debris and legally dispose of off-site.

END OF SECTION 10450

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