

ORIGINATION FORM

Date: October 15, 2012

Originator: Jeff Morgan

Contact Information: Traffic Engineering and Operations, Traffic Systems Section
850-410-5600

Specification Title: CONDUIT.

Specification Section, Article, or Subarticle Number: 630

Why does the existing language need to be changed? The specification must be updated to consolidate material requirements from the Minimum Specifications for Traffic Control Signals and Devices (MSTCSD) and the Standard Specifications for Road and Bridge Construction (SSRBC). This activity is a planned part of an ongoing specification consolidation effort. In addition, the content is being revised to reflect current needs and practice and to update various referenced standards.

Summary of the changes: The changes merge and update content from the MSTCSD and SSRBC.

Are these changes applicable to all Department jobs? If not, what are the restrictions? This requirement is typically applicable to all jobs, but specifically those using conduit.

Will these changes result in an increase or decrease in project costs? If yes, what is the estimated change in costs? No increase or decrease in project costs is expected.

With who have you discussed these changes? Impacted product manufacturers and in-house stakeholders (C-team).

What other offices will be impacted by these changes? Specifications and Estimates, Construction, Maintenance, and Roadway Design.

Are changes needed to the PPM, Design Standards, SDG, CPAM or other manual? Yes. Coordination of changes is an ongoing effort of the Consolidation of Products and Specifications (COPS) working group in conjunction with the C-team.

Is a Design Bulletin, Construction Memo, or Estimates Bulletin needed? No.

Contact the State Specifications Office for assistance in completing this form.

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Florida Department of Transportation

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ANANTH PRASAD, P.E.
SECRETARY

MEMORANDUM

DATE: December 12, 2012
TO: Specification Review Distribution List
FROM: Trey Tillander, State Specifications Engineer
SUBJECT: Proposed Specification: **6300000 Conduit - REVISED.**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Jeff Morgan of the Traffic Engineering and Operations Office to consolidate material requirements from the Minimum Specifications for Traffic Control Signals and Devices (MSTCSD) and the Standard Specifications for Road and Bridge Construction (SSRBC). This activity is a planned part of an ongoing specification consolidation effort. In addition, the content is being revised to reflect current needs and practice and to update various referenced standards.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965TT or trey.tillander@dot.state.fl.us. Comments received after **January 2, 2013**, may not be considered. Your input is encouraged.

TT/dt
Attachment

CONDUIT.

(REV ~~11/12-2028/10/116~~-12)

SECTION 630 (Pages 780 – 784) is deleted and the following substituted:

SECTION 630 CONDUIT

630-1 Description.

Furnish and ~~install~~ conduit for traffic control signals and devices, *highway lighting*, and other electrically powered or operated devices as shown in the ~~plans and design standards~~.

630-2 Materials.

630-2.1 Conduit: Use materials that have been tested and listed *by a Nationally Recognized Testing Laboratory* ~~as defined in the National Electrical Code (NEC) for the specific use to meet~~ the following industry standards:

Schedule 40 and 80 Polyvinyl Chloride (PVC)¹ UL 651
Fiberglass Reinforced Epoxy² UL 2420
Intermediate Metal³ ~~ASTM A135/A135M, UL 1242~~
..... ~~ASTM A513, ASTM A568/A568M~~
Rigid Galvanized Metal^{3,4} UL 6
Rigid Aluminum⁴ UL 6A
PVC Coated Intermediate Metal⁴ ASTM A135/A135M,
..... ASTM A513, ASTM A568/A568M, NEMA RN1-2005
Liquid Tight Flexible Metal ~~UL- 360~~
High Density Polyethylene (HDPE) Standard Dimension
Ratio (SDR) 9-11⁵ ASTM F2160
*HDPE SDR 13.5*⁵ ~~ASTM F2160, NEMA- TC-7~~
Schedule- 40 and 80 HDPE ~~UL 651A~~

¹Use conduit with solvent type slip-fit plastic couplings unless approved by the Engineer.

²Use conduit having a minimum stiffness value of 250. Ensure that each section has a duct bell with an integral gasket on one end and a duct spigot on the other end.

³Use conduit that is hot-dipped galvanized *with a minimum coating of 1.24 ounces per ft² square foot on both the inside and outside of the conduit.* ~~with both ends reamed and threaded~~ *The weight of the zinc coating shall be determined using ASTM- A90.*

⁴Use conduit with both ends reamed and threaded.

⁵Can be used with preassembled cable and rope-in-conduit.

630-2.2 Locate Wire: *Ensure that locate wire is a single copper conductor with a minimum gauge of #No. 12 AWG.- Ensure locate wire is insulated using a 45- mil minimum thickness polyethylene sheath that is orange in color and marked to identify the manufacturer and the conductor size.*

630-2.3 Locate Wire Grounding Unit: *Furnish and install a locate wire grounding unit (WGU) as shown in the plans or directed by the Engineer. Ensure that locate wires are attached*

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to a wire grounding unit (WGU) dedicated to safely dissipating high transient voltages or other foreign electrical surges induced into the designated system. Ensure the WGU conforms to the following:

1. ~~Allows signals generated by locate system transmitters to pass through the protection system without going to ground.~~
2. ~~Ensure that~~ The protection system automatically resets and passes locate system transmitter signals after the unit has grounded to dissipate over-voltages.
3. ~~Ensure that the WGU is~~ intended for below ~~or above~~ grade applications. Ground the WGU to a driven rod within 10 feet of the system using a No. 6-AWG #6 single conductor wire with green insulation. Ensure that the WGU is enclosed for protection from environmental hazards and is accessible for connection of portable locate system transmitters.
4. ~~Ensure that~~ The WGU system meets the following minimum standards listed in Table 1 for surge protection:

Table 1: Minimum Standards for Surge Protection	
Surge Element	3-element maximum duty fail-safe gas tube.
Rating	40,000 A surge capacity (single-cycle, 8 by 20 microsecond waveform).
Life	Minimum 1,000 surges (1000 A to ground).
Fail-Safe	Integral fail-shortened device.
Insulation Resistance	1,000 megohm minimum at 100 volts of direct current (V _{DC}).
Clamp Voltages	a. Impulse at 100 Volts per Microsecond: Typically 500 volts. b. Direct Current: 300 to 500 volts.

630-2.4 Warning Tape: Ensure that the buried cable warning tape is flexible, elastic material 3 inches wide, 6 mil thick, intended for burial and use as an underground utility warning notice. ~~Ensure~~, and that the surface of the warning tape is coated and sealed to prevent deterioration caused by harsh soil elements. Ensure that the warning tape color follows the American Public Works Association color code for underground utilities ~~is orange~~ and has “CAUTION: FDOT CABLE ~~BURIED BELOW~~,” or other wording approved by the Engineer, permanently printed on its surface. Ensure that the tape material and ink colors do not change when exposed to acids, alkalis, and other destructive chemical variances commonly found in Florida soils.

~~Ensure that the warning tape color is orange and has “CAUTION: FDOT CABLE BURIED BELOW,” or other wording approved by the Engineer, permanently printed on its surface.~~

630-2.5 Route Markers: Route markers may be either a ~~S~~standard ~~R~~route ~~M~~marker (SRM) type or an ~~E~~lectronic ~~R~~route ~~M~~marker (ERM) type. Ensure ~~T~~the SRM is a rigid, tubular, driven post used for location and notification purposes only. Ensure ~~T~~the ERM ~~should be~~ is physically identical to the SRM, but also includes a termination board to provide aboveground access to locate wire buried alongside conduit and cable runs.

Ensure that each SRM is labeled and identified as an FDOT fiber optic cable marker unless otherwise shown in the ~~p~~Plans. ~~Ensure that~~ The labels must include the Department’s logo, contact information for the local FDOT District, and a telephone number to call prior to any excavation in the area. Ensure that the identification information is permanently imprinted on the top fitting, and will not peel, fade, or deteriorate with prolonged exposure to the typical roadside environmental hazards. ~~Ensure that all route markers used on~~

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~~the project are new and consistent in appearance.~~

630-2.5.1 Standard Route Marker (SRM): Ensure that ~~the SRM posts are white with an orange top fitting cover that is orange with black or white lettering and graphics. Ensure that the SRM is a tubular configuration, and both the marker post and the top fitting are made from virgin Type- 111 HDPE. Ensure that any fasteners used with the SRM are constructed of stainless steel.~~

Comment [s4]: Updated to reflect current industry practice.

Ensure that all SRMs have a minimum ~~OD~~ outside diameter of 3.5 inches with a minimum wall thickness of 0.125- inches ~~wall thickness~~. Ensure that the top fitting cover is a minimum of 1.5 feet long and has an ~~OD~~ outside diameter of 3.75 inches with a minimum wall thickness of 0.125- inches ~~wall thickness~~. Ensure that each SRM provides a tensile strength of 4,200 pounds per square inch as required in ~~the ASTM- D638 standard~~. Ensure that each SRM is manufactured for use in temperatures range of -minus 30° to 165°-F ~~as per the in accordance with NEMA TS 2 standard~~.

Ensure that ~~each~~ SRM can withstand an impact force of 70 pounds per foot ~~pounds of impact force at 32°-F as required in the accordance with ASTM- D2444, standard before and after UV conditioning for 2,000- hours as required in the accordance with ASTM G53- 88154 standard~~. Ensure that the control sample of any material ~~employed tested maintains a minimum of 70 percent of its original tensile strength as required by the ASTM D638 standard~~.

Comment [dt5]: ASTM G53-88 was superseded by ASTM G154.

Ensure that ~~an~~ SRMs installed at the minimum 2- foot depth can withstands at least one ~~vehicle impact at 45- miles per hour by a car or truck vehicle weighing no less at least than~~ 3,500 pounds and that: ~~After impact, ensure that the post returns to an upright position within 10 degrees of vertical alignment within 30- seconds from the time of impact.~~

630-2.5.2 Electronic Route Marker (ERM): Ensure ~~that the~~ ERMs meet the same material and performance requirements as the SRMs with the following exceptions. Equip each ERM with a removable, top-fitting cover that is black with white lettering. Ensure that each ERM contains a terminal board equipped with locate wire and ground connectors.

Ensure that the terminal board is made from corrosion-resistant materials and includes terminal facilities labeled according to function and provides: ~~Ensure the terminal board includes~~ uniform spacing between connection points.

630-3 Installation Requirements.

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630-3.1 General: Install the conduit in accordance with NEC or National Electrical Safety Code (NESC) requirements ~~and the Design Standards, Index No. 17721 (underground) and Design Standards, Index No. 21210 (bridges and approach slabs)~~. Consider the locations of conduit as shown ~~in the pPlans as approximate~~. Construct conduit runs as straight as possible, and obtain the Engineer's approval ~~of for~~ all major deviations in conduit locations from those shown ~~in the pPlans~~. ~~Include buried cable warning tape with all trenched conduit. Mark the location of the conduit system with route markers as shown in the Plans and approved by the Engineer. Ensure that all route markers used are new and consistent in appearance.~~

Comment [s6]: Moved from Materials subarticle 630-2.4.

For conduit installed by directional bored ~~conduit~~, install in accordance with Section- 555. For conduit installed by jack and bore, install in accordance with Section 556.

~~Do not place more than the equivalent of four quarter bends or 360 degree of bends, including the termination bends, between the two points of termination in the conduit, without a pullbox. Obtain the Engineer's approval to use corrugated flexible conduits for short runs of 6 feet or less.~~

Comment [s7]: Changed to reflect current lighting practice.

Use only intermediate metal conduit, rigid galvanized metal conduit, rigid

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aluminum conduit or PVC coated intermediate metal conduit for above-ground electrical power service installations *and rigid galvanized metal conduit or rigid aluminum conduit for underground electrical power service installations*. Meet the requirements of Section 562 for coating all field cut and threaded galvanized pipe.

Use ~~S~~Schedule- 80- PVC or fiberglass reinforced epoxy conduit on bridge decks.

Use HDPE with an SDR number less than or equal to 11, Schedule- 80 PVC or Schedule- 40 PVC, for underground installations in earth or concrete for traffic control signal and device applications.

Use HDPE with an SDR number less than or equal to 13.5, ~~S~~Schedule- 80 PVC, or ~~S~~Schedule- 40 PVC for underground installations of electrical conduit in earth or concrete for lighting applications and landscape irrigation sleeve applications.

Use HDPE with an SDR number less than or equal to 13.5, ~~S~~Schedule- 80 PVC, ~~S~~Schedule- 40 PVC, rigid galvanized metal, or rigid aluminum for underground installations of electrical conduit in concrete for lighting applications.

Do not place more than the equivalent of three quarter bends or 270 degree of bends, including the termination bends, between the two points of termination in the conduit, without a pull box. Obtain the Engineer's approval to use corrugated flexible conduits for short runs of 6 feet or less.

~~Install underground conduit as shown in the Design Standards, Index No. 17721. Install conduit on bridges and approach slabs as shown in Index No. 21210.~~

When a conduit installation changes from underground to above-ground, make the change a minimum of 6 inches below finished grade.

~~Include buried cable warning tape with all trenched conduit.~~

Install a No. 12- AWG pull wire or polypropylene cord inside the full length of all conduits. Ensure that a minimum of 24 inches of pull wire/cord is accessible at each conduit termination.

Ensure the conduit includes all required fittings and incidentals necessary to construct a complete installation.

When earth backfill and tamping is required, place backfill material as per Section 120 in layers approximately 12 inches thick, and tamp each layer to a density equal to or greater than the adjacent soil.

When backfilling trenches in existing pavement, use a ~~commercially available sand-cement (approximately 10:1 mix ratio)~~flowable fill meeting the requirements of Section 121.

Provide a standard clearance between underground control cable and electrical service cable or another parallel underground electrical service cable that meets NESC requirements.

Prevent the ingress of water, dirt, sand, and other foreign materials into the conduit prior to, during, and after construction. Exclude water and debris from buried conduit and from the top riser assembly of above-ground conduit using a foam-sealing material, rubber plug, or other device designed for this application and approved by the Engineer.

~~Ensure that the conduit fill ratio (outer cable diameter to inner conduit/duct diameter) does not exceed 50 %.~~

630-3.1.1 Fiber Optic Cable Conduit: Install the conduit system so the fiber optic cable maintains a minimum bend radius of 20 times the cable diameter. Use approved methods for connecting inner duct or conduit within or between plowed portions, trenched

Comment [s8]: Brought in from 715-9.2

Comment [s9]: Changed to reflect current lighting practice.

Comment [s10]: Moved from Materials subarticle 630-2.4.

Comment [s11]: Already covered by requirement to meet NEC and NESC.

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portions, and bored portions. Submit the conduit manufacturer's coupling method and material to the Engineer for approval.

~~630-3.1.2 Fiber Optic Cable Locate Wire: Ensure that the locate wire is a single copper conductor with a minimum gauge of AWG#12. Furnish locate wire that is insulated using a 45 mil minimum thickness polyethylene sheath that is orange in color and marked to identify the manufacturer and the conductor size. Bury locate wire along the centerline of the top outer surface of installed conduit, as shown in the Plans, or as directed by the Engineer. Install locate wire in the trench or bore with all underground conduits to provide end to end electrical continuity for electronically locating the underground conduit system. Do not install locate wire in a conduit with fiber optic cable.~~

~~Do not run locate wires into field cabinets. Terminate locate wires at the first and last pull boxes in the conduit run or as shown in the plans. Ensure that wire termination occurs only at the top of a pull box.~~

~~In a trenching operation, install the locate wire no more than 3 inches above the conduit. Ensure that the locate wire enters all pull boxes and splice boxes, and that a minimum of 10 feet of slack locate wire is coiled and neatly stored in each box.~~

~~In a boring operation, install the locate wire in an encasement, install the conduit detection wire external to the conduit with no separation between conduit and wire, or use conduit with integral locate wire. Locate wire may also be placed in the void between the inner wall of conduit and innerduct(s) contained within the conduit as long as no other cables are present within the void.~~

~~Drill a hole in the pull box or splice box for wire entry as shown in the Plans. Fill any gaps between the locate wire and the hole it passes through with nonshrink grout or a similar sealant suitable for the application and approved by the Engineer.~~

~~Perform continuity tests and insulation resistance tests on all locate wires. Provide the Engineer with all test results. Replace or repair defective locate wire at no additional cost.~~

~~Make locate wire splices in a flush grade level box. Ensure that locate wire splices are waterproof and suitable for direct burial. Ensure that locate wire splices at the pull box meet NEC requirements. Ensure that locate wire splices are constructed of and in the following order: a mechanical crimp connection with a butt sleeve, an oxide preventing aerosol lacquer, mastic electrical splicing tape, and standard electrical tape using methods and materials approved by the Engineer. At the completion of the installation, provide the Engineer with as-built drawings that document all splice locations.~~

~~Install locate wire grounding units (WGU's) in pull boxes and splice boxes as shown in the plans or directed by the Engineer. Mount the device in a location high enough from the bottom of the box to allow access to terminal facilities without disturbing cables present within the box. Terminate the locate wires and connect the WGU to ground per the manufacturer's instructions.~~

~~Test the locate wire system after installation to ensure that it functions and can be used to accurately locate the conduit system.~~

~~630-3.2 Conduit Sizes: Size the conduit to be used on all installations, unless otherwise shown in the Contract Documents. Use conduit of sufficient size to allow the conductor to be installed without any damage and meeting NEC requirements. Use conduit that is at least 2 1/4 inches in diameter, with the following exceptions:~~

Comment [s12]: Deleting since this is covered by Design Standard 17700.

Comment [s13]: Lighting conduit is minimum 2 inches. Most traffic signal and ITS conduit is minimum 2 inches.

~~Except for the~~ conduit protecting the ground wire on the side of a pole, use conduit that is at least 1/2 inch in diameter.

For traffic control signal and device electrical service conduit, use the minimum conduit size required by the local maintaining agency and the electrical service provider.

Comment [s14]: Added to reflect current practice based on D3 input.

630-3.3 Conduit Joints: Make conduit joints using materials as specified by the manufacturer. When conduit crosses an expansion joint of a structure and where shown in the ~~p~~Plans, install an expansion or expansion/deflection fitting as specified by the manufacturer. Certify that expansion/deflection fittings are rated to accommodate a minimum rotation of 30^o ~~degrees~~ and that both the expansion and expansion/deflection fittings are rated to accommodate the anticipated longitudinal movement (minimum ~~of 2-~~ inches for deflection fittings and 0.7 inches for expansion/deflection fittings). Ensure that all installed joints are waterproof. As an exception to the threaded coupling for intermediate metal conduit, at locations where it is not possible to screw the threaded coupling properly, the Contractor may use a waterproof slip-joint coupling approved by the Engineer. Secure the joint, and tighten threaded connections.

Prior to insertion into the coupling, clean, prime and coat the ends of PVC conduit with a solvent-type cement as specified by the manufacturer.

630-3.4 ~~Field Cutting of PVC Coated Intermediate Metaling:~~ Apply ~~the~~ PVC coating to ~~the exposed metal entire~~ surfaces of the conduit, except for the threads, to attain a nominal thickness of 40 mils. Ensure that the coating is free of sags and ~~or~~ drips.

Attach the coupling to the conduit prior to the application of the coating for conduit of 1 inch diameter or less.

Use a coupling with sleeve extensions on conduit larger than 1 inch. Ensure that the sleeve extensions on all threaded female openings have a length equal to the diameter of the conduit up to and including size number 53.

630-3.5 Conduit Terminations: Fit the terminating ends of all metal conduit and metal conduit sleeves with an appropriate bushing.

For conduit to be encased in concrete, wrap with tape or otherwise protect all terminations to prevent the entrance of concrete.

Connect new underground conduits to existing underground conduits with a pull box.

Install conduit terminating in a concrete strain pole through the cable entry hole and up the center of the pole to a location approximately 6 inches below the handhole.

Seal conduits terminating in a controller base, pole, pull box, junction box, or pedestal base with ~~duct Seal, or an equivalent~~ moisture resistant sealant approved by the Engineer.

Comment [s15]: Deleting to avoid proprietary call out.

For a controller base, pole or pedestal base, and junction boxes, terminate conduit runs into the center of the base or box at least 2 inches above the surface of the base.

~~630-3.6 Existing Underground Facilities: Coordinate with any potential conflicting underground utilities prior to starting all excavating, boring or jacking operations at the project site.~~

630-3.67 Restoration of Trench Areas: Restore the conduit trench construction area to an acceptable condition. Such work includes repair or replacement of all pavement areas, sidewalks, *driveways*, curbs, structures, landscaping, ~~or~~ grass areas (~~and including removal of excavated materials and spoils~~), *removal and disposal of drilling fluids, and backfilling areas* disturbed by the conduit ~~trench~~ *installation*.

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~~630-3.8 Jacking Conduit:~~ Use either intermediate metal conduit or rigid galvanized metal conduit as the sleeve when installation of a conduit requires jacking under paved surfaces, railroads, etc., with either PVC or fiberglass reinforced epoxy conduit installed in the jacked sleeve. Do not disturb any pavement without the approval of the Engineer.

Comment [s16]: Covered by Section 556.

630-3.79 Above-Ground Installation: Use conduit designed and manufactured for use in long-term above-ground applications with UV stabilization to prevent material deterioration. Securely attach above-ground conduit installations to the surface of the supporting structure using conduit straps. As a minimum, use conduit straps located on 5 foot centers. Use galvanized metal conduit straps when installing intermediate metal conduit, fiberglass reinforced epoxy conduit, rigid galvanized conduit, rigid aluminum conduit or PVC coated intermediate metal conduit above ground.

Use the same PVC coating for the metal straps as the conduit, when using PVC coated intermediate metal conduit.

~~630-3.810 Elbows:~~ Use only preformed or field constructed conduit elbows. The radius of curvature of the inner edge of any bend shall not be less than shown below:

Comment [s17]: Unnecessary wording.

Size	Standard Radius
1/2 inch	4 inches
3/4 inch	4 1/2 inches
1 inch	5 1/2 inches
1 1/4 inches	7 1/4 inches
1 1/2 inches	8 1/4 inches
2 inches	9 1/2 inches
2 1/2 inches	10 1/2 inches
3 inches	13 inches
3 1/2 inches	15 inches
4 inches	16 inches
5 inches	24 inches
6 inches	30 inches

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630-3.9 Fiber Optic Cable Locate Wire: Install locate wire in the trench or bore with all underground conduits to provide end-to-end electrical continuity for electronically locating the underground conduit system. Bury locate wire along the centerline of the top outer surface of installed conduit, as shown in the Plans, or as directed by the Engineer. ~~Install locate wire in the trench or bore with all underground conduits to provide end-to-end electrical continuity for electronically locating the underground conduit system. Do not install locate wire in a conduit with fiber optic cable.~~

~~Do not run locate wires into field cabinets. Terminate locate wires at the first and last pull boxes in the conduit run or as shown in the Plans. Ensure that wire termination occurs in a pull box as shown in the Design Standards, Index No. 17700.~~

~~In a trenching operation, install the locate wire no more than 3 inches above the conduit. Ensure that the locate wire enters all pull boxes and splice boxes, and that a minimum of 10 feet of slack locate wire is coiled and neatly stored in each box.~~

~~In a boring operation, install the locate wire in an encasement, install the conduit detection wire external to the conduit with no separation between conduit and wire, or~~

use conduit with integral locate wire. ~~Locate wire may also be placed in the void between the inner wall of conduit and innerduct(s) contained within the conduit as long as no other cables are present within the void.~~

~~Perform continuity tests and insulation resistance tests on all locate wires, and provide the Engineer with all test results. Replace or repair defective locate wire at no additional cost.~~

~~Make locate wire splices in a flush grade-level box. Ensure that locate wire splices are waterproof and suitable for direct burial. Ensure that locate wire splices at the pull box meet NEC requirements. Ensure that locate wire splices are constructed of and in the following order: a mechanical crimp connection with a butt sleeve, an oxide-preventing aerosol lacquer, mastic electrical splicing tape, and standard electrical tape. At the completion of the installation, provide the Engineer with as-built drawings that document all splice locations.~~

~~Install locate wire grounding units (WGUs) in pull boxes and splice boxes as shown in the Plans or directed by the Engineer. Mount the device in a location high enough from the bottom of the box to allow access to terminal facilities without disturbing cables present within the box. Terminate the locate wires and connect the WGU to ground per in accordance with the manufacturer's instructions.~~

~~Test the locate wire system after installation to ensure that it functions and can be used to accurately locate the conduit system.~~

630-3.101 Route Markers: ~~Install route markers for fiber optic cable installations and ensure the as shown in the plans and as directed by the Engineer. Ensure that route markers are plumb and level with the notification information clearly visible when viewed from the side facing the roadway. Place route markers at a 1 foot offset from the conduit system or as shown in the plans. Ensure that markers are set within the right of way. Set the route markers concurrently with the conduit system installation and prior to the fiber optic cable installation. Install route markers of the type as shown in the plans and as followsing:~~

- ~~1. Ensure that route markers are plumb and level with and the notification information is clearly visible when viewed from the side facing the roadway.~~
- ~~2. Markers are set within the right of way. Place route markers at a 1 foot offset from the conduit system or as shown in the plans.~~
- ~~3. Markers are placed at a 1 foot offset from the conduit system or as shown in the Plans. Ensure that markers are set within the right of way.~~
- ~~4. The top of the marker post is a minimum of 5 feet and maximum of 6 feet above the finish grade~~
- ~~5. Markers are spaced a maximum of 500 feet apart.~~
- ~~6. A clear line of sight is So that maintained a clear line of sight is maintained from one marker to the next.~~
- ~~2. A maximum distance apart of 500 feet.~~
- ~~37. Markers are installed On both sides of the roadway at any crossing point where the conduit system changes to the opposite side of the roadway.~~
- ~~48. Markers are installed At the center point of any conduit run between two pull or splice boxes.~~
- ~~59. Markers are installed At gate locations when the conduit system is adjacent to a fence line.~~
- ~~610. Markers are installed On both sides of a stream, river, or other water crossing, and on both sides of aboveground attachments such as bridges and walls.~~

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Comment [s18]: Added since Lighting does not use route markers.

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~~7. On both sides of aboveground attachments, such as bridges and walls.~~

~~Remove and replace all marker posts damaged during installation at no additional cost. Ensure that the top of the marker post is a minimum of 5 feet and no more than 6 feet above the finish grade. Ensure that route marker signs are labeled with a unique identification number, as detailed in the Plans or as approved by the Engineer. Provide as-built documentation at the completion of installation that includes identification number and location of all installed route markers and correlates the marker to the fiber optic infrastructure that it signifies.~~

~~Ensure that installation of ERMs includes connection of the route marker to the locate wire associated with the conduit run that the markers identify. Install locate wire through the base of the marker and terminate the locate wires to connectors mounted on the terminal board inside the marker. Install an underground magnesium anode at a minimum of 10-feet away from the marker and perpendicular to the conduit system. Terminate the anode lead on the connector mounted on the terminal board inside the marker. Install the bond straps between the anode connector and all locate wire connectors to provide cathodic protection for the locate wire conductor.~~

630-4 Method of Measurement.

630-4.1 General: Measurement for payment will be in accordance with the following work tasks.

630-4.2 Furnish and Install: The Contract unit price per foot of conduit, furnished and installed, will include furnishing all hardware and materials ~~and all testing~~ as specified in ~~the this~~ Section and the Contract Documents, and all labor, ~~casings, removal of excavated materials and spoils, removal and disposal of drilling fluids, locate wire, trenching, boring, backfilling, flowable fill~~ and restoration materials necessary for a complete and accepted installation.

~~Payment for conduit placed in the underground or attached to bridges will be based on the horizontal pathlinear feet of the installed conduit measured in a straight line between the centers of pull boxes, cabinets, poles, etc. No allowance will be made for sweeps or vertical distances above the ground or within the structure, or below the ground.~~

~~Payment for conduit placed underground will be based on the horizontal length of the trench or bore measured in a straight line between the centers of pull boxes, cabinets, poles, etc., in linear feet, regardless of the length or number of conduits installed. No allowance will be made for sweeps of vertical distances above the ground or within the structure, or below the ground. No additional payment will be made for multiple conduits in the same trench.~~

~~Furnishing, installing, and testing the locate wire is included in the cost of the conduit. Furnishing and installing pull wire/cord is included in the cost of the conduit.~~

~~Furnishing and installing route markers as required in the plans is included in the cost of the conduit.~~

~~Payment for conduit placed aboveground or bridge mounted will be based on the actual length of conduit installed.~~

630-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment for conduit placed under existing turf will be made as ~~underground/open trench~~.

Payment for conduit placed under existing pavement (roadway, driveways, or sidewalk) will be made as ~~underpavement~~ directional bore. If conduit is being placed under both existing turf and existing pavement between two pull boxes, payment for the total pull box-to-pull box length will be made as ~~underpavement~~ directional bore. Payment for conduit placed by jack &

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bore will be made as jack & bore, for the total pull box to pull box length.

No additional payment will be made for multiple conduits in the same trench.

-No payment adjustment will be made if the Contractor chooses to use an alternative method approved by the Engineer.

No payment will be made for failed bore paths, injection of excavatable flowable fill, products taken out of service, or incomplete installations.

No payment will be made for ~~underpavement~~ directional bore or jack & bore until a Bore Path Report has been delivered to the Engineer.

Payment will be made under:

Item No. 630- ~~21~~ Conduit - ~~per foot~~LF.

Comment [s20]: Updated to be consistent with Estimates Bulletin.

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