

LOCATION AND DESIGN DIVISION

INSTRUCTIONAL AND INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: VDOT FIBER OPTICS INFRASTRUCTURE	NUMBER: IIM-LD-230.1 IIM-OD-13-01.2
SPECIFIC SUBJECT: CONDUIT SYSTEMS FOR FIBER OPTICS	DATE: AUGUST 9, 2013
	SUPERSEDES: IIM-LD-230 IIM-OD-13-01
LOCATION & DESIGN DIV. APPROVAL: B.A. Thrasher, PE State Location and Design Engineer Approved August 9, 2013	OPERATIONS DIVISION APPROVAL: Dean Gustafson, PE, PTOE State Operations Engineer Approved July 31, 2013

Changes are shaded.

EFFECTIVE DATE

- These instructions are effective upon receipt for all projects included in the first bullet under "POLICY" that have **not** completed the Field Inspection Team Meeting. For projects that have gone beyond this milestone meeting, the Project Manager should discuss applicability with the appropriate Assistant State Location and Design Engineer.
- The information within this Memorandum shall terminate effective December 31, 2019 and may be extended prior to sunset for a five year period effective upon the review and approval of the State Location and Design Engineer and the Operations Division Administrator or equivalent VDOT management of those responsibilities.

BACKGROUND

- In 1991 Congress created the Intelligent Transportation System (ITS) program with four key functions:
 1. Promote implementation of a technically integrated and jurisdictionally coordinated transportation system across the country.
 2. Support ongoing applied research and technology transfer.
 3. Ensure that newly developed ITS technologies and services are safe and cost-effective.
 4. Create a new industry by involving and emphasizing the private sector in all aspects of the program.

- A key component of Intelligent Transportation Systems is a high bandwidth, highly reliable and scalable communications system. Fiber optic networks provides these capabilities and provides an ideal communication foundation for ITS.
 - Communication systems are comprised of: fiber optic cables, conduits, fiber optic junction boxes, marker poles, communication hubs and network equipment. These systems will be solely used to support VDOT's ITS / Operations Program.
 - A successful fiber optic system in freeway environments is achieved through ensuring:
 1. safety in the high speed freeway corridor.
 2. minimal impact on the existing transportation system.
 3. a minimal maintenance component.
 4. a location that minimizes any effect on future highway expansion or reconstruction areas.
 5. functionality for future ITS expansion.
 - A Task Force from the American Association of State Highway and Transportation Officials (AASHTO) developed a "Design Guide for Fiber Optic Installation on Freeway Right of Way", dated December 2002. This document serves as a FHWA publication to be used by State DOT's as a guideline and is not to be considered a policy issued by FHWA or AASHTO. This document covers the planning, design and construction of fiber optic systems.
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PROCEDURE

- The Project Manager (PM) will include a representative from the Operations Division's Project Delivery Section (for Tier 2 projects) or the Region's Area Traffic Engineer, Regional Traffic Operations Manager or its Designee (for Tier 1 projects) and the Right of Way and Utilities Division at the Scoping meeting on the following projects:
 - All limited-access highways, including bridges
 - All primary highways, including bridges
 - Secondary roads leading into and out of VDOT Residencies and District Offices
 - Secondary roads that intersect any interstate highways, or major primaries
- If VDOT fiber optic infrastructure exists, maintenance of those assets during construction will be a key consideration in addition to replacement design. The Roadway Designer will check with the Regional Traffic Operations Manager if there is existing VDOT fiber optic infrastructure within the project limits.
- Operations Division's Project Delivery Section, Regional Operations and the Design Team will jointly determine if a project will have the fiber optic conduit system included. This will be based on the location of the new roadway or widening, the length of the project, the long-term plan for the roadway under consideration and VDOT's needs.

- Once the decision has been made to include multi-duct systems for fiber optics, the Project Manager will include a representative from the Operations Division's Project Delivery Section for Tier 2 projects or the Region's Area Traffic Engineer, Regional Traffic Operations Manager or its Designee for Tier 1 projects in all project team meetings and pertinent correspondence. The Traffic Designer will be responsible for design and placement of conduit and junction boxes.
 - All fiber optic cables placed in the VDOT right of way should be installed within a conduit system that is buried underground. It is cost effective, efficient and creates the least impact if all conduits are placed in the same trench at the same time.
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DECISION MAKING PROCESS

- The project team will provide information on potential use of the multi-duct system by VDOT and recommend whether the project should include provisions for future fiber optics.
 - The estimated cost per mile for a multi-duct system with two 1 ¼" and one 2" conduits is approximately \$100,000 to \$125,000.
 - Estimated costs should be updated for specific project requirements and may vary considerably based on terrain, soil conditions and amount of right of way available.
 - It should be noted that a copy of the signed and sealed As-Builts for the conduit system shall be submitted to the Regional Traffic Operations Manager.
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DESIGN

Placement

- The installation of the conduit run should be placed in front of the tree line or as far from the travel lane as possible and coordinated with the Design Team.
- The clear zone and unpaved shoulder may be identified as alternative feasible locations for multi-duct systems for fiber optic placement.
- Fiber Optic Junction Boxes shall be placed along the fiber optic conduit and should be spaced every 1500' for Limited Access and non Limited Access roadways and at all signalized locations or proposed signal locations.
- All Fiber Junction Boxes shall be placed outside of Sidewalks and Shared use paths whenever possible.

- VDOT has established a procedure to not allow installations along the median, except when crossing under or over a roadway or if there is no other alternative. Placing fiber in the median should be done only as a last resort. All other feasible options should be investigated first.
- Coated steel pipe casing may be preferred when locating fiber optic conduit on a bridge or large box culvert. If multiple conduits are required to span across a bridge, it may not be practical to use steel casing because of the weight. In this case, HDPE or PVC is considered an appropriate alternative. The conduit may be attached to the bridge or bored under the waterway.
- Steep slopes may cause problems for locating fiber optics due to instability and erosion of the soil around guardrail posts. If it is necessary to cross a run of guardrail, Directional Boring should be used.

Depth of Cover

- In most cases a minimum of 30 inches should provide an adequate cover to protect the system. Conduit can be installed in a shallower situation if needed due to pipes or underground structures.

Size and Number of Conduits

- Typically a conduit bank will consist of three conduits, to include two 1¼" ITS conduits and one 2" spare power conduit. The 2" conduit shall be gray and the 1¼" conduits shall have one colored orange and one colored white.
- Additional conduits may be recommended based on the location and VDOT needs.
- Final decision on the number of conduits is to be determined by the Operations Division.

Features to Include

- Conduit lines or multi-ducts
- Trenching (see Road and Bridge Standards Section 1300 for ECI-1)
- Install Junction Boxes for fiber optic cable in accordance with the ITS Special Provisions. In addition, install junction boxes with cast iron frames and covers when placed in roadways or paved shoulders. Conduit shall enter through a pre-formed knockout or core-drilled hole in the side of the manhole at a minimum depth of 18". Cable racks are to be installed in all cable vaults.
- Standard Fiber Optic junction boxes shall allow hand access from outside the structure. Typically made from composite materials in a variety of shapes and sizes and are either bottomless or with solid bottoms; typically 24" by 36" but vary; often installed as a single unit with a minimum buried depth of 24", can be stacked to obtain desired height.

- **Large Fiber Optic Junction Boxes** should be designed into fiber optic networks where there are existing or planned ITS devices, communication hubs, Traffic Signals or other network facilities and used to allow for easy changes to the network. As a last resort, **Large Fiber Optic Junction Boxes** may be constructed some distance from the planned ITS device location due to construction or environmental constraints. These are typically **48" X 48"** and with a depth of **36"**.
 - Fiber Optic Marker Balls or similar technology and Locator Tape shall be placed in all trenched or plowed conduit runs.
 - **Large / Standard / Intermediate Fiber Optic Junction Boxes**
 - **Large Fiber Optic Junction Boxes** are used for splicing points, and the storing of additional fiber optic cable slack.
 - **Standard Fiber Optic Junction Boxes** are used for major transition points and the storing of additional fiber optic cable slack.
 - **Intermediate Fiber Optic Junction Boxes** are used to assist for pulling during the cable installation.
 - All Junction Boxes for Fiber Optic Cable shall have a Non-Skid surface and shall be stamped "VDOT FIBER OPTICS".
 - There are to be no electrical pull boxes **within a run of fiber optics**.
 - ITS Conduit and ITS **Junction** Box Special Provisions are available inside VDOT at the following site:
https://insidevdot.cov.virginia.gov/div/OSD/OD_Section/StdSpecProv/Default.aspx
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PERMITS

- Several environmental permits are generally required prior to approval of the project. Please refer to the following IIMs:
 - IIM-LD-11: http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/IIM11.pdf
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 - IIM-LD-195: http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/IIM195.pdf
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DESIGN DETAILS

- The following design details are available in the CADD cell library at sheet2000.cel:
 - FO_INSTALL Fiber Optic Installation Details
 - FO_PULLBOX Fiber Optic **Junction** Box Details