February 1, 2013

SPECIAL PROVISIONS
FOR
SECTION 750-B: ITS COMMUNICATIONS CONDUIT SYSTEM

The 2014 Edition of the New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction shall apply in addition to the following:

1.0 DESCRIPTION.

1.01 Furnish, install, and test ITS communications conduit system of the type and sizes shown on the plans. Install conduit system suitable for an outdoor underground environment including constant immersion in water.

ITS communications conduit is a pre-manufactured conduit with PVC, galvanized rigid metal, or fiberglass conduit as outer duct.

2.0 MATERIALS.

2.01 General. Provide new materials that are Underwriters Laboratory, Inc. (UL)-Listed and meet National Electrical Manufacturers Association (NEMA), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and National Electrical Code (NEC) most recent requirements.

Ensure the material used to construct the underground system conform to the material and performance requirements of the Bellcore Specification TR-NWT-000356, Issue 2, October 1992, “Generic Requirements for Optical Cable Innerduct”. Also conform conduit products to the requirements of ASTM-D 1785, “Standard Specification for PVC Plastic Pipe”, ASTM-D 2122, “Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings”, and ASTM-D 2412, “Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading”, which address quality issues, such as materials, requirements, workmanship, test methods, retest and rejection, and marking and quality assurance and performance.

Ensure the material used to construct the aerial system conform to the material and performance requirements of ASTM-D 2996, “Standard Specification for Filament-Wound “Fiberglass” Pipe”, ASTM-D 2310, “Standard Classification for Machine-Made “Fiberglass” Pipe”, and ASTM-D 2517, “Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings” , which address quality issues, such as materials, requirements, workmanship, test methods, retest and rejection, and marking and quality assurance and performance.

Ensure all components of the system are provided by the same manufacturer.

The conduit system consists of outer duct, locate wire (tracer wire), warning tape, pull tape, bends, couplings, adapters, and other accessory fittings, and when specified as a multi-duct system, inner ducts

The system shall provide mechanisms to ensure that conduit expansion and contraction stresses are normalized.

2.02 OUTER DUCT. Provide 4-inch outer duct unless otherwise shown on the plans. Ensure the outer duct has "NMDOT FIBER OPTIC COMMUNICATION" permanently printed on its surface every 24 inches.

2.02.1 PVC. Unless otherwise noted on the plans, provide schedule 40 PVC conduits for outer duct when the conduit system is buried. Polyvinyl chloride (PVC) outer conduit shall meet the requirements of NEMA TC-2, "Electrical Polyvinyl Chloride Conduit" or TC-6, "PVC Plastic Utilities Duct for Underground Installations", UL 651, "Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings", and the NEC.

2.02.2 GRC. Provide galvanized rigid metal conduit for outer duct when the conduit system is hung under a bridge with the total bridge length of 500 feet or less. Rigid metal outer conduits shall be galvanized in accordance with section 709.2.2 of NMDOT standard specifications.

2.02.3 Fiberglass. Provide fiberglass conduit for outer ducts when the conduit system is hung under the bridge with the total bridge length greater than 500 feet. Fiberglass outer conduits shall meet the requirements of NEMA-TC-14B, "Reinforced Thermosetting Resin Conduit and Fittings".

2.03 INNER DUCTS. When multi-duct conduit is called for, inner ducts shall consist of four ribbed 90% virgin High Density Polyethylene, HDPE, color coded ducts. Each duct shall have a minimum inside diameter of 1.25 inches and a minimum wall thickness of 0.075 inches. The four ducts shall be pre assembled in the factory and inserted into the outer duct/conduit or manufactured multi-duct conduit as an integrated multi-duct conduit.

Provide flat profile, low stretch polyester, 5/8-inch 2500 lb. minimum tensile strength pull tape with sequential markings in each empty inner duct.

The inner ducts shall be uniquely defined by the extrusion of a different color for each of the inner ducts. Colors shall be orange, yellow, red, and white. The white inner duct shall be placed directly in-line with the manufacturer's identification on the outer duct for ease of identification and installation.

The inner ducts will be held together by a system of spacers. The internal spacers shall be factory installed to hold the inner ducts in proper spacing and alignment to prevent free twisting. Spacers shall be molded from a high impact plastic, and be factory certified to withstand all handling pressures and stresses.

The inner ducts shall be the same type within the bends and within the straight sections.

2.03.01 Fabric Inner duct. Provide fabric inner duct, if specified in the plans. Fabric inner ducts come in various sizes and number of cells. Provide submittals of product based on number of cells specified in the plans to the ITS Engineer prior to construction.

Each fabric inner duct cell has to have a pull tape, and each individual pull tape shall have a color stripe for easy identification. If detectable fabric inner duct used, installation of a separate locate/tracer wire will not be required.

2.04 Coupling Body. The conduit system, including respective bends, couplings, adapters, and other accessory fittings, will contain a coupling body for sealing the outer and when specified inner ducts of adjacent conduit sections in an end to end relationship.

For systems with inner ducts provide a factory installed primary coupling body that is manufactured as a hard plastic coupling body incorporating conical shaped target areas to accommodate self alignment of each inner duct field assembly. Provide a coupling body that incorporates sealing devices to facilitate field assembly and prevent water and foreign material leakage from outside and to prevent air leakage from inside the inner duct(s). No lubricant should be required for field assembly of this conduit system and assembly shall be accomplished solely by hand without use of special tools.

Ensure the coupling body has a plurality of bores containing principal seals which are molded as an integral part of the coupling body.

Ensure the coupling body with its sealing members seals the outer walls of the inner ducts and the inner wall of the outer duct providing airtight seal from within the inner duct system and a watertight seal from the outside of the outer duct.

The gasket or sealing members shall be an anti-reversing design in such that the lengths of conduit stay joined together.

Ensure the field connection end of the internal coupling body incorporate shaped target areas to accommodate self alignment of the inner ducts with bore openings during field assembly.

The coupling body shall have one of the bore openings on the field assembly side uniquely identified to facilitate proper continuous inner duct alignment during field assembly.

2.05 Conduit Locate System. Place the locate system along any underground conduit installation. Ensure that the locate system includes aboveground route markers, warning tape, tone wire, and electronics that allow detection of buried conduit and other related underground facilities.

Furnish and install a system as shown in the plans and as directed by the Engineer. Ensure that the locate system provides:

1. An end-to-end electrical conductor, such as a locate wire, buried along the conduit system for conductive facility locating.
2. Visual notification of the presence of conduit installed on Department projects.
3. Public notification of potential hazards and contact information for public or private inquiries regarding the conduit system.
4. A means of locating any conduit system pull box or splice box that is buried.
5. Surge protection and dissipation of transient voltages that may be induced into the route marker system.

2.05.01 Warning Tape. Ensure that the buried cable warning tape is flexible, elastic material 6 inches wide, intended for burial and use as an underground utility warning notice. Ensure that the surface of the warning tape is coated and sealed to prevent deterioration caused by harsh soil elements. Ensure that the tape material and ink colors do not change when exposed to acids, alkalis, and other destructive chemical variances commonly found in New Mexico soils. Ensure that the warning tape color is orange as required by the American Public Works Association (APWA) Uniform Color Code, and has "CAUTION: NMDOT FIBER OPTIC CABLE BURIED BELOW, CALL BEFORE PROCEEDING" or other wording approved by the Engineer, permanently printed on its surface every 24 inches.

Include buried cable warning tape with all conduits.

2.05.02 Locate Wire. The locator wire shall be one #22 AWG electrical conductor, and shall be buried along the conduit system. It shall be coated to protect against corrosion.

2.05.02.01 Locate Wire Surge Protection: Furnish and install a locate wire surge protection system as shown in the plans or directed by the Engineer. Ensure that locate wires are attached to a surge protection system dedicated to safely dissipating high transient voltages or other foreign electrical surges induced into the designating system. Provide this grounding through a stand-alone system that does not include electric power or ITS device grounding. Ensure that the surge protection system normally allows signals generated by locate system transmitters to pass through the protection system without going to ground. Ensure that the protection system automatically resets and passes locate system transmitter signals after the unit has grounded to dissipate over-voltages. Ensure that the locate wire surge protection is intended for below- or above-grade applications. Ensure that the locate wire surge protection system is grounded to a driven rod within 10 feet of the system using a AWG #6 single conductor wire with green insulation. Ensure that the locate wire surge protection is enclosed for protection from environmental hazards and accessible for connection of portable locate system transmitters. Ensure that the locate wire surge protection system meets the following 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-shorted device.
Insulation Resistance	1,000 megohm minimum at 100 volts of direct current (VDC).
Clamp Voltages	a. Impulse at 100 Volts per Microsecond: Typically 500 volts. b. Direct Current: 300 to 500 volts.

2.05.02.02 Locate System Electronic Equipment: When specified provide locate system electronic equipment that is designed specifically for locating buried pipes and cables. Ensure that the locate system is able to detect the location and depth of the locate wire buried inside conduit and cable runs. Ensure that the locate equipment is capable of locating faults in the sheath of a buried locate wire. Ensure that locate system electronic equipment is provided with protective cases suitable for daily transport and storage of transmitters and receivers. Ensure that the locate system electronic equipment includes a transmitter, receiver, and

electronic markers as shown in the plans and approved by the Engineer.

2.05.02.02.01 Transmitter: Ensure that the transmitter is a portable unit designed to create and apply an identifiable signal onto a locate wire so that it can be located and traced with a receiver. Ensure the transmitter is capable of applying a trace signal using direct connection and inductive methods. Ensure that the transmitter output circuitry is protected against inadvertent connection to conductors carrying voltages up to 250V at 50/60Hz. Deliver the transmitter to the Engineer upon completion of the installation and acceptance of the work.

2.05.02.02.01.1 Electrical Specifications: Ensure that the system operates using 120VAC input power as well as self-contained, rechargeable battery power. Ensure that the transmitter can operate from battery power for a minimum of 10 hours per charge. Ensure that the transmitter is supplied with all chargers, cords, cables, and accessories required for standard operation.

2.05.02.02.01.2 Mechanical Specifications: Ensure that the transmitter's physical dimensions allow portability and storage in a case no larger than 16 inches x 12 inches x 5 inches. Ensure that the transmitter weight does not exceed 10 pounds.

2.05.02.02.01.3 Environmental Specifications: Ensure that the transmitter is constructed with impact-resistant materials, is weather resistant, and designed to operate unattended in all weather and climates found in the outdoor roadside environment. Ensure that operating temperature meets or exceeds -4º to 122º F.

2.05.02.02.01.4 Operation and Display: Ensure that the transmitter includes programming buttons and visual indicators or displays for self-contained setup and operation. Ensure that all transmitter functions and operational parameters are programmable using an onboard, man-machine interface. Ensure that the operational status, including battery strength and current device settings, are displayed on the transmitter.

2.05.02.02.01.5 Transmitter Output: Ensure that the transmitter is capable of generating radio frequency (RF) signals and audio tones. Ensure that RF and audio output levels are user selectable.

Output Frequency Requirements: Ensure that RF frequencies produced for locate operations are user-selectable. Ensure that the transmitter produces consistent, stable, and defined frequencies normally associated with locating and marking equipment. Ensure that the transmitter can transmit at least three different user-selectable frequencies, with at least one frequency in each of three general ranges, defined here as low (0-1 kHz), mid-range (1 kHz – 40 kHz), and high (40 kHz – 85 kHz) bands.

2.05.02.02.02 Receiver: Ensure that the receiver is a portable hand-held unit ergonomically designed and intended for the purpose of locating underground utilities, conduit, cable, and electronic markers. Ensure the receiver is capable of receiving all of the signals generated by the transmitter as well as those associated with electronic markers. Ensure that the receiver can serve as a marker locator by energizing and detecting electronic markers. Ensure that the receiver can passively locate cables transmitting power and RF signals. Deliver the receiver to the Engineer upon completion of the installation and acceptance of the work.

2.05.02.02.02.1 Electrical Specifications: Ensure that the system operates using self-contained,

rechargeable battery power. Ensure that the receiver can operate from battery power for a minimum of 10 hours per charge. Ensure that the receiver is supplied with all chargers, cords, cables, and accessories required for standard operation.

2.05.02.02.02.2 Mechanical Specifications: Ensure that the receiver's physical dimensions allow portability and storage in a case no larger than 30 inches x 12 inches x 9 inches. Ensure that the receiver weight does not exceed 6 pounds.

2.05.02.02.02.3 Environmental Specifications: Ensure that the receiver is constructed with impact-resistant materials, is weather resistant, and designed to operate in all weather and climates found in the outdoor roadside environment. Ensure that operating temperature meets or exceeds -4º to 122º F.

2.05.02.02.02.4 Operation and Display: Ensure that the receiver includes programming buttons and a graphical display for self-contained setup and operation. Ensure that all receiver functions and operational parameters are programmable using an on-board man-machine interface. Ensure that current operational status, including battery strength and current device settings, and current signal strength from targets are displayed on the receiver. Ensure that receiver sensitivity is adjustable. Ensure that the receiver includes an internal speaker and headphone output that is able to provide audible tones that indicate received signal strength. Ensure audible outputs include on/off and volume control. Ensure that the receiver is capable of locating buried locate wire and electronic markers within ±5% of actual depth. Ensure that the receiver can detect and visually displays the center line of a target locate wire within 3 inches of its actual location.

2.05.03 Installation Requirements:

2.05.03.1 Warning Tape: Install buried cable warning tape 6 to 8 inches below the finish grade, directly over any installed conduit and cable run.

2.05.03.2 Locate Wire: Locate wire shall be buried inside the conduit system.

2.06 Expansion Joints. Provide expansion joints having a material similar to the connecting conduit.

2.07 Termination Kit. Provide special termination kits from the conduit manufacturer for terminating the conduit in pull boxes or manholes. The kits shall provide for a water tight seal of conduit to structure wall and between inner ducts and outer ducts.

2.08 Bends/Sweeps/Elbows. Complete conduit rigid bend sections, including outer conduit and high temperature burn through resistant inner duct, shall be manufactured, and shall be complete with bell and spigot.

Conduit deflection should not deviate more than 1 in. horizontally and/or vertically per foot of running length of conduit (1:12 Rule).

For conduit deflection at locations such as crossings over canals, tunnels, transitions into structures, etc where a 1:12 rule cannot be achieved. Where long conduit sweeps are not possible, standard factory made conduit elbows of 11 ¼, 22 ½ or 45 degrees with a minimum radius of 24 inches should be specified. 90

degree cumulative turns must be made up of individual elbows. Where complex sites leave no other option, such as into and out of structures, and thus requiring near 90 degree turns, a minimum radius of 36 inches is required. Ninety-degree elbows should be avoided, as they require additional labor and equipment for cable installation, even on short runs. The smallest degree bend possible should be utilized to minimize cable installation challenges. There shall be no more than 360 degrees of cumulative bends between adjacent ITS pull boxes.

2.09 Stub-out. Where designated on the plans, the Contractor shall provide a stub-out from a manhole or pull box. The stub-out shall be of the size and length indicated in the plans and shall be capped. If no length is indicated stub-outs shall be 2" rigid electrical conduits, at least 3 ft in length from the pull box or manhole.

3.0 CONSTRUCTION REQUIREMENTS.

3.01 Installation. Place conduit in accordance with the lines, grades, details and dimensions shown on the plans or as directed by the engineer. Install underground conduit system at a minimum of 30 inches below the finished surface or pavement, or natural ground in unpaved areas.

When approved by the Project manager, the conduit may be placed up to, but not less than 18 inches below the surface elevation in unpaved areas where little future development is expected, or where underground utility conflicts occur at 30-in depth. Conduit shall be encased in concrete not less than 3-in on all sides for burial depths of less than 30 inches.

Conduit installations shall be a straight runs (within the allowable deflection) between pull boxes.

Install conduit in accordance with the requirements of the National Electrical Code (NEC).

Ream all conduit ends to remove burrs and sharp edges. Fasten all conduit placed on structures with conduit straps or hangers as shown on the plans or as directed. Fit the conduit terminations with bushings or bell ends.

Prior to installation of cables or final acceptance, draw a spherical template having a diameter of not less than 75 % of the inside diameter of the inner duct through the inner duct to insure that the inner duct is free from obstruction. Place fitted caps to the ends of all future use empty inner ducts.

3.02 Excavation and backfill. Excavation/trenching and backfill for all conduits shall be in accordance with the requirements of subsections 705.2.2 (Backfill Materials) and 705.3.2 (Excavation and Backfill) of the current New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction.

Where existing surfacing is removed for placing conduit, repair by backfilling with material equal in composition and density to the surrounding areas and by replacing any removed surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition.

Conduit layout shown on the plans is schematic. The location of utility poles, signs, vegetation and other stationary objects along the conduit path may not be shown but shall be identified by the Contractor as the conduit route is marked prior to trenching

3.03 Directional Drill/ Boring/ Jacking. Conduit crossing existing asphalt/concrete roadways shall be installed by directional drill unless other wise noted. This work shall be in accordance with subsection 709.3.3 of the current New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction.

3.04 Open Cut. Conduit crossing minor existing asphalt surface may be open cut as directed by the plans. Open cuts shall not be more than 3 inches nominal wider than the sum of outside diameter of the conduits installed. Asphalt shall be saw cut on both sides of the trench line prior to trenching, with a maximum width of 12" wider than the trench width. Backfill shall be flowable fill to within 2" of the top of the trench or to the bottom of the asphalt, whichever is deeper. Compacted asphaltic concrete shall be installed as the final cover of the trench. Depth of compacted asphaltic concrete shall be 2" or match surrounding depth.

Flowable fill shall be in accordance with section 516 of the current New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction.

4.0 Testing. The Contractor shall ensure each conduit system component to be examined carefully and verify that the materials are free from any physical damages such as cracking or chipping prior to installation.

Inspect all conduit locate system components and approve prior to installation. Fully test the locate wire system after installation to ensure that it functions and can be used to accurately locate the conduit system.

Ensure that the conduit route marker system is fully functional prior to installing the fiber optic cable.

The testing of the system components as an integrated unit shall be done by and at the expense of the Contractor under the direct supervision of the ITS Engineer or designee.

5.0 Documentation. Provide manufacturer's cut sheets and product specifications to the NMDOT ITS Engineer or designee for review and approval at least 30 days prior to ordering the materials.

5.01 Data Collection. Contractor shall provide following data included in GPS shape file of the system installed. GPS data shall be collected in WGS84 and decimal degrees format. In addition, the Contractor shall contact ITS Engineer to obtain the excel file template of documenting required data.

Project CN, Location, Cable Function, Cable Configuration,Telemetry Type, Conduit Size

6.0 Warranty. Ensure that the communications conduit system, have a five-year manufacturer's warranty from the date of final acceptance by the Engineer. If the manufacturer's warranties for the components are for a longer period, those longer period warranties will apply.

Ensure that the manufacturer's warranty on the communications conduit system is fully transferable from the Contractor to the Department. Ensure that these warranties require the manufacturer to furnish

replacements for any part or equipment found to be defective during the warranty period at no cost to the Department within 10 calendar days of notification by the Department.

7.0 METHOD OF MEASUREMENTS.

Communications Conduit System will be measured by the unit per linear feet.

8.0 BASIS OF PAYMENT

8.01 The accepted quantities of ITS Communications Conduit System will be paid for at the contract unit price per installed linear feet upon full completion of work as described in Section 8.02.

Pay Item	Pay Unit
Communications Conduit ……..……LIN.FT	
Multi-Duct Conduit ……..……..……LIN.FT	

8.02 Work Included in Payment. When Communications Conduit and/or Multi-Duct Conduit System is called for in the Contract, the accepted quantity complete in place will be considered full compensation for furnishing and installing all materials, labor, tools, equipment, trenching, boring/jacking, backfill, replacing any disturbed existing condition (pavement, curb, riprap,...), testing, documentation, and appurtenances necessary to complete the work as directed by the ITS Engineer or designee.

Materials shall be considered to include specified Conduits, conduits locate system, (including transmitter and receiver when specified) warning tapes, expansion joints, couplings, fittings, adapters, hangers, sweeps, bends, caps, termination kits, stub-outs, caps and miscellaneous hardware required.

The documentation of the system shall be provided by and at the expense of the Contractor. All documents shall be provided to the ITS Engineer or designee at least 30 days in advance of final acceptance. The documentation shall be approved by the ITS Engineer or designee prior to final acceptance of the ITS Communications Conduit System.