
Special Specification 6139

Multi-Duct Conduit System



1. DESCRIPTION

Furnish and place conduit of the type and sizes shown on the plans and as directed by the Engineer. Install conduit system suitable for installation in an outdoor underground environment including constant immersion in water.

Ensure all conduit and materials furnished are new, UL-listed, and meet NEMA and NEC requirements.

Unless otherwise shown on the plans, fabricate expansion joints and conduit from a material similar to the connecting conduit.

Provide all components of the Multi-Duct Conduit (MDC) system by the same manufacturer.

Ensure the material used to construct the MDC system conform to the material and performance requirements of the Bellcore document TR-NWT-000356, Issue 2, October 1992, "Generic Requirements for Optical Cable Innerduct," relating to material quality and performance standards. Also conform these conduit products to the requirements of ASTM-D1785, ASTM-D2122, and ASTM-D2412 which address quality issues, such as materials, requirements, workmanship, test methods, retest and rejection, and marking and quality assurance and performance.

Furnish, install and test the MDC system. Provide as incidentals all required sweeps, bends, repair couplings, ground box/manhole termination kits, alternative outer ducts, adapters, pre-assembled split repair kits, lubrication access fittings, tug-plugs, slit-innerduct plugs, hangers, brackets, expansion joints, and accessories to complete the MDC system. Provide all materials for installation and testing.

2. MATERIALS

Ensure the MDC system is a pre-assembled conduit section manufactured from a 4 in. round outer duct containing four factory installed round inner ducts. Ensure the inner ducts are held together in a square configuration by a system of spacers. Design the spacers, which hold the individual conduits in formation, be capable of locking them tightly together to prevent free twisting of the inner ducts.

Ensure the MDC, including respective bends, couplings, adapters, and other accessory fittings, contains a coupling body for sealing the outer and inner ducts of adjacent conduit sections in an end to end relationship.

Manufacture without the use of adhesives factory assembled length and associated bends of all multi-duct to allow for inner duct movement relieving internal stresses experienced during field handling and due to variations in coefficient of thermal expansion.

Ensure the MDC has available a complete line of available accessory items including, but not limited to, alternative outer ducts, sweeps and bends, repair couplings, ground box/manhole termination kits, pre-assembled split repair kits, and lubrication access fittings.

Provide a single protective end cap for each end of all 20 ft. conduit sections, factory bends and fittings to minimize the risk of damage to the conduit system during shipping and handling.

Do not exceed the ovality of the conduit system by 5%.

Ensure the MDC system can perform in underground installation in an ambient temperature range of minus 30°F to 130°F without degradation of material properties. Ensure the conduit system is resistant to most harsh chemicals and/or protected against degradation due to oxidation or general corrosion. Ensure the conduit system is capable of being direct buried by trenching or boring with no special consideration to using selective backfill.

Ensure the conduit system is free of visible cracks, holes or other physical defects that would degrade its performance. Ensure it is as uniform as practical in respect to overall dimensions, color, density, thickness etc. Ensure the conduit system have a UV light stabilizer, which will protect it for a minimum of 12 mo. in direct sunlight. Ensure the conduit system have durable identification showing the name and trademark of the manufacturer, conduit size, date of manufacture, and "Texas Department of Transportation - Fiber Optic Cable System" identification.

- 2.1. **Outer Duct.** Ensure the 4 in. round outer duct MDC is heavy walled schedule 40 polyvinyl chloride conduit (PVC) as shown in the plans and as directed by the Engineer. Ensure schedule 40 PVC conduit respectively meet the requirements of schedule 40 PVC conduit conform to telecommunication industry standard TC-2, UL 651, and the NEC and incorporate a longer integral bell in place of the standard 3-1/2 in. bell to accommodate the length of the coupling body.

Ensure the average OD of the 4 in. schedule 40 outer duct is 4-1/2 in. minimum. Ensure the wall thickness for the schedule 40 is 0.237 in. minimum.

- 2.2. **Inner Ducts.** Ensure inner ducts is extruded from a 90% Virgin High-Density Polyethylene (PE) compound. Blend this compound to produce inner ducts for use in multi-duct systems. Ensure the characteristics of this blend add rigidity to the extruded PE inner ducts, minimize the differences between the expansion and contraction rates of PVC and the PE inner ducts, create a burn resistant PE inner duct to minimize the chance of damaging the inner duct during the cable placing operation, and provide a permanent dry lubricant that is extruded within the wall of the inner duct.

Incorporate inner ducts longitudinal ribs within the extruded wall.

Ensure inner duct is uniquely defined by the extrusion of a different color for each of the inner ducts; colors will be orange, yellow, red, and white. Place the white inner duct directly in-line with the manufacturer's identification on the outer duct for ease of identification and installation.

Extrude inner ducts in a controlled outer diameter (OD) fashion. Ensure inner duct has a minimum ID of 1.25 in. and minimum wall thickness of 0.075 in.

- 2.3. **Coupling Body.** 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 upon field assembly. Ensure this coupling body incorporates sealing devices to facilitate field assembly and prevent water and foreign material leakage from outside the multi-duct system and to prevent air leakage from inside the inner ducts. No lubricant is required for field assembly of this conduit system and assembly is accomplished solely by hand without use of special tools.

Ensure the coupling body with its sealing member(s) seal the outer walls of the inner ducts and the inner wall of the outer duct providing an airtight seal from within the inner duct system and a watertight seal from the outside of the outer duct.

Ensure the gasket or sealing member(s) is an anti-reversing design in such that the lengths of conduit stay joined together without the need for solvent cement.

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.

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

3. CONSTRUCTION

Place conduit in accordance with the lines, grades, details and dimensions shown on the plans or as otherwise approved by the Engineer. Unless otherwise shown on the plans, install underground conduit MDC a minimum of 48 in. deep. Installation of conduit must be in accordance with the requirements of the 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 and as directed by the Engineer. 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. Fit the ends of all empty inner duct placed for future use with caps.

Trench excavation and backfilling must be as shown on the plans and in accordance with Item 400, "Excavation and Backfill for Structures," except for measurement and payment. Place a detectable underground metalized Mylar conduit marking tape, approved by the Engineer, over the MDC on top of a 24 in. backfill, prior to final backfill of the trench. Ensure the marking tape is imprinted every 18 in. with "TxDOT Conduit and Fiber Optic Cable System - Call (817)-370-3664 Before Proceeding." 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.

The furnishing and installing of the detectable underground metalized Mylar conduit marking tape along the MDC system will not be paid for directly, but is subsidiary to this Special Specification.

Jacking and boring when required must be in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box," except for measurement and payment.

3.1. Testing.

It is the policy of the Department to require performance testing of all materials and equipment not previously tested and approved. If technical data is not considered adequate for approval, the Engineer may request samples for test. The contract period will not be extended for time lost or delays caused by testing prior to final Department approval of any items.

Unless otherwise specified, ensure all inspection requirements are satisfied prior to submission for the Engineer's inspection and acceptance. The Engineer reserves the right to have his representative witness all tests.

The results of each test are compared with the requirements specified herein. Failure to conform to the requirements of any test is counted as a defect and the materials are subject to rejection by the Engineer. Rejected materials may be offered again for retest provided all non-compliances have been corrected and retested and evidence thereof submitted to the Engineer.

3.1.1. **Examination of Product.** Each conduit system component is examined carefully to verify that the materials, design, construction, markings, and workmanship comply with the requirements of its specification.

3.1.2. **Testing of Product.** Ensure the coupling body seals the inner duct so that after the application of 100 psig to an inner duct, the inner duct is capable of maintaining a minimum of 15 psig for 24 hr. Employ, at his expense, an approved independent commercial testing laboratory to perform the above test. Submit certified reports of such test to the Engineer.

Furnish the Department with certified documentation of compliance with PVC and PE requirements based on random testing of products by an independent testing laboratory. Such testing must be in accordance with all ASTM, NEMA Standard TC-2, UL 651, and Bellcore standards as referenced in this specification.

Additionally, send a 10 ft. section of the MDC to the Construction Division. The Construction Division will test the product in accordance with UL- 651 Resistance to Crush and Resistance to Impact. Failure to conform to the requirements of these tests is counted as defect and the materials are rejected. Rejected materials may be offered again for retest provided all non-compliances have been corrected and retested by the Construction Division. Only those materials meeting the test requirements and passing TxDOT Construction Division will be considered for this project.

Final acceptance is determined at field site by the Engineer. The Engineer will send a random field sample to the Construction Division for testing before final acceptance can be determined.

3.2. **References.**

Submit 3 references, preferably State Departments of Transportation, where this supplier's conduit system has functioned successfully for a period of no less than 1 yr. Reference data must include current name and address of organization, and the current name and telephone number of an individual from the organization who can be contacted to verify system installation. Provide this information prior to documentation submittal. Failure to furnish the above references will be sufficient reason for rejection of the supplier's equipment.

4. **MEASUREMENT**

This Item will be measured by the foot of the conduit system furnished, installed and tested in accordance with this specification.

5. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided for under "Measurement" will be paid for at the unit price bid for "Multi-Duct Conduit System" of the various types and sizes as specified. This price is full compensation for furnishing, and installing conduit; for jacking, boring, excavating, furnishing and placing backfill, replacing pavement structure, sod, riprap, curbs or other surface; for furnishing and installing all fittings, sweeps, bends, repair couplings, adapters, ground box/manhole termination kits, pre-assembled split repair kits, lubrication access fittings, hangers, brackets, expansion joints, detectable underground metalized Mylar conduit marking tape; and for all labor, tools, equipment and incidentals.