Special Specification 6131
Multi-Duct Conduit System

1. DESCRIPTION

Furnish and place a Multi-Duct Conduit (MDC) system that is suitable for installation in an outdoor underground environment including constant immersion in water, and/or hung from a bridge without any degradation in the conduit.

2. MATERIALS

Provide new materials that conform to the details shown on the plans, the requirements of this Item, and to the requirements of the following Items:

- UL-listed
- Meet NEMA requirements
- Meet NEC requirements

Provide underground MDC that conforms to the requirements of the following items:

- Telcordia Technologies document GR-356, October 1995
- ASTM D1785
- ASTM D2122
- ASTM D2412

Provide aerial MDC that conforms to the requirements of the following items:

- ASTM D2996
- ASTM D2310
- ASTM D2517

Provide 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 expansion joints and conduit that is similar to the connecting conduit.

Furnish components of the MDC system that are provided by the same manufacturer.

Provide a pre-assembled conduit section manufactured from a 4-in. round outer duct containing 4 factory installed round inner ducts held together in a square configuration by a tightly locking system of spacers to prevent free twisting of the inner ducts.

Provide a coupling body for sealing the outer and inner ducts of adjacent conduit sections in an end-to-end relationship.

Provide a MDC system that is manufactured without the use of adhesives to allow for inner duct movement.

Provide a MDC system with the availability of a complete line of 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.

Provide a MDC system that conforms to the following requirements:

- A percent ovality of less than 5%.
- An underground system that performs in an ambient temperature range of -30°F to 130°F without degradation of material properties.
- An aerial system that performs in an ambient temperature range of -104°F to 200°F without degradation of material properties.
- Resistant to most harsh chemicals.
- Protected against degradation due to oxidation or general corrosion.
- Capable of being direct buried by trenching or boring with no special consideration to using selective backfill.
- Has a low coefficient of thermal expansion, such that expansion and contraction is minimal.
- Free of visible cracks, holes or other physical defects that would degrade its performance.
- Uniform as practical in respect to overall dimensions, color, density, thickness, etc.
- Contains a UV light stabilizer which will protect it, for a minimum of 12 mo., in direct sunlight.
- Durable identification showing the name and trademark of the manufacturer, conduit size, date of manufacture and “TxDOT - Fiber Optic Cable System.”

2.1. **Outer Duct**. Provide 4 in. round outer duct MDC heavy walled schedule 40 or schedule 80 polyvinyl chloride conduit (PVC) as shown on the plans. Incorporate a longer integral bell in place of the standard 3-1/2 in. bell to accommodate the length of the coupling body.

Provide Schedule 40 or schedule 80 PVC conduit that conforms to the requirements of the following items:

- Telecommunication industry standard TC-2
- UL 651
- The NEC

Provide 4 in. schedule 40, with an average outer diameter of 4-1/2 in. minimum. Provide 4 in. schedule 40 with a wall thickness of 0.237 in. minimum.

Provide a Fiberglass MDC that is bullet resistant, heavy walled, pure, high grade, filament wound fiberglass reinforced epoxy conduit. Provide conduit, elbows and fittings that are manufactured from the same resin/hardener/glass systems manufactured by the same filament wound system. Provide MDC aerial elbows, conduit, fittings and hangers that are gray in color.

Provide rigid metal MDC system that is hot-dipped galvanized steel conduit.

2.2. **Inner Ducts**. Provide inner ducts that are extruded from a 90%, or higher, Virgin High Density Polyethylene (PE) compound. Provide this compound specifically blended to produce inner ducts for use in MDC systems. Furnish this blend with characteristics that 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 longitudinal ribs within the extruded wall.

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

Provide inner ducts that are extruded in a controlled outer diameter that meet the requirements of Table 1.

Table 1
Inner Duct Requirements

Size	O.D.	I.D.
1-1/4 in.	1.670 Max	1.250 Min

Provide inner ducts that are capable of being stored, installed and used under any humidity.

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. Provide a coupling body that 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. Assemble solely by hand without use of special tools such that no lubricant will be required for field assembly of this conduit system.

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

Provide the coupling body with its sealing member(s) sealing 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.

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

Provide the field connection end of the internal coupling body that incorporates shaped target areas to accommodate self-alignment of the inner ducts with bore openings during field assembly.

Provide the coupling body that has 1 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 directed. Install underground MDC system at a minimum of 18 in. unless otherwise shown on the plans. Install conduit 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 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. Fit the ends of all empty inner duct with caps.

Trench excavate and backfill 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, as directed, over the MDC on top of a 6 in. backfill, prior to final backfill of the trench. Imprint the marking tape “TxDOT Conduit and Fiber Optic Cable System - Call TxDOT Before Proceeding” every 18 in. 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. Provide a bare copper no. 6 AWG in all multi-duct runs, if no other cable is to be installed in the MDC system.

3.1. **Testing.**

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

Compare the results of each test with the requirements specified herein. Failure to conform to the requirements of any test shall be counted as a defect and the materials will be subject to rejection by the Engineer. Offer rejected materials again for retest provided all non-compliances have been corrected and retested by the Contractor and evidence thereof submitted to the Engineer.

3.1.1. **Examination of Product**. Examine each conduit system component carefully to verify that the materials, design, construction, markings, and workmanship comply with the requirements of this specification.

3.1.2. **Testing of Product**. The coupling body must seal the inner duct so that after the application of 100 psi to an inner duct, the inner duct shall be capable of maintaining a minimum of 15 psi for 24 hr. Employ an approved independent commercial testing laboratory to perform the above test. Submit certified reports of test.

Furnish certified documentation of compliance with PVC, Fiberglass and PE requirements based on random testing of products by an independent testing laboratory. Such testing must conform with all ASTM, NEMA STANDARD TC-2, UL 651, and Telcordia Technologies standards as referenced in this specification.

3.2. **References.**

The MDC System Supplier shall 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. 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.

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 the type specified “Multi-Duct Conduit (RM)(4”)” and “Multi-Duct Conduit (PVC)(4”)(Bore).” 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, concrete, and detectable underground metalized Mylar conduit marking tape; and for all labor, tools, equipment and incidentals necessary to complete the work. Copper cable will not be paid for directly but shall be subsidiary to this Special Specification. The furnishing and installing of the detectable underground metalized Mylar conduit marking tape along the MDC system shall be subsidiary to this item.