

SPECIAL SPECIFICATION

SECTION 25140S

EXTERIOR TELECOMMUNICATIONS PATHWAYS

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SPECIAL SPECIFICATION
SECTION 25140S
EXTERIOR TELECOMMUNICATIONS PATHWAYS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Section Includes: Material and installation of outdoor raceway system for inter-building telecommunication cabling at Sandia National Laboratories, New Mexico (SNL/NM).

Install cable system design as described in Statement of Work in its entirety.

- B. Drawings shall delineate inter-building cable system by locations of duct banks, manholes, pullboxes, and conduit entrances into buildings.

- C. Project may contain both Red - Sandia Classified Network (SCN), and Black – Sandia Restricted Network (SRN) and Sandia Open Network (SON) systems.

Red systems require special security procedures. Contact the MESA Protected Transmission System (PTS) Coordinator through the Sandia Designated Representative (SDR) for information supplementing this specification. All work performed on Red Systems shall comply with United States Department of Energy (DOE) requirements, which may or may not be explicitly indicated or noted in the Contract documents.

- D. All or part of Work may be included in Project, as stated in Contract documents.

- E. Related Sections: Refer to the following sections for related work.

1. Division 1, Section “Descriptive Submittals.”
2. Division 1, Section “Environment, Safety and Health for construction and Maintenance Service Contracts.”
3. Division 2, Section “Earthwork”
4. Division 3, Section “Cast-In-Place Concrete”
5. Division 25, Section “Administration Requirements.”
6. Division 25, Section “Quality Assurance and Documentation.”
7. Division 25, Section “Telecommunications Equipment Rooms”

8. Division 25, Section “Main Distribution Frames and Service Entrances.”
9. Division 25, Section “Interior Telecommunications Pathways”
10. Division 25, Section “Telecommunications Cabling”

1.02 REFERENCES

- A. Electronics Industries Association/Telecommunications Industries Association (EIA/TIA)
 - 758 Customer-Owned Outside Plant Telecommunications Cabling Standard
- B. National Fire Protection Association (NFPA)
 - 70 National Electrical Code (NEC)
- C. Occupational Safety and Health Administration (OSHA)
 - 29 CFR Part 1910 Permit-Required Confined Spaces for General Industry; Final Rule
- D. American National Standards Institute (ANSI)
 - C2 National Electrical Safety Code
 - C80.1 Rigid Steel Conduit, Zinc Coated
 - C80.6 Intermediate Metal Conduit
- E. National Electrical Manufacturer’s Association (NEMA)
 - FB1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - RN1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - TC2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
 - TC3 PVC Fittings for Use With Rigid PVC Conduit and Tubing
 - TCB2 NEMA Guidelines for Selection and Installation of Underground Non-metallic Duct
- F. American Association of State Highway & Transportation Officials (AASHTO)
 - Standard Specification for Highway Bridges
- G. Underwriter’s Laboratories, Inc. (UL)
 - 6 Rigid Metal Conduit

651 Schedule 40 and 80 Rigid PVC Conduit

1242 Intermediate Metal Conduit

H. American Society for Testing and Materials (ASTM)

A48 Gray Iron Castings

A123 Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips

A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A569 Steel, Sheet and Strip, Carbon (0.15 maximum percent), Hot-Rolled, Commercial Quality

C33 Standard Specification for Concrete Aggregates

I. Supplementary References: Publications listed below are not referenced in this specification. Publications are listed as they contain design and technical criteria that are pertinent to Project. Commencement of work shall indicate a working familiarity on the part of the Contractor with each of these standards.

1. Telecordia Technologies, Inc. (formerly known as Bellcore)

GR-356 Generic Requirements for Optical cable Innerduct and Accessories

2. Building Industry Consulting Service International (BICSI)

Telecommunications Distribution Methods Manual

Telecommunications Cabling Installation Manual

Customer-Owned Outside Plant Design Manual

3. Electronics Industries Association/Telecommunications Industries Association (EIA/TIA)

568A Commercial Building Telecommunications Cabling Standard

569-A Commercial Building Standard for Telecommunications Pathways and Spaces

570 Residential and Light Commercial Telecommunications Wiring Standard

606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

607 Commercial Building Grounding and Bonding Requirements for Telecommunications

1.03 DEFINITIONS

- A. Intra-Building Cable: Network Cable within building.
- B. Inter-Building Cable: Network Cable between buildings.

1.04 SUBMITTALS

- A. General: Submit materials descriptions, catalog cuts, shop drawings, and/or samples in accordance with conditions of Contract documents and Division 1, Section "Descriptive Submittals." Refer to Contract documents for additional requirements.
- B. As-Built Drawings: Submit dated as-built drawings for review with SDR at two-week intervals, beginning at Project start date, or as specified elsewhere in Contract documents.
 - 1. Call attention to entry by circling affected area.
 - 2. If as-built work is not complete, Contractor will be so advised by SDR, and Contractor shall complete work as required.

1.05 QUALITY ASSURANCE

- A. Material and installation shall meet requirements of NFPA 70 and ANSI C2.
- B. Material, when applicable, shall be approved by a Nationally Recognized Testing Laboratory (NRTL).
- C. Monitor and maintain quality control over manufacturers, suppliers, subcontractors, work force, site conditions, products, and services to ensure Work is of specified quality.
- D. Workmanship: Install material and equipment in neat and workmanlike manner, in accordance with NEC Section 800-6.

Specified requirements represent minimum acceptable quality for Work. Comply with industry standards except when more stringent requirements are specified herein, and tolerances indicate higher standards or more precise workmanship.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide equipment necessary to handle, transport, and deliver materials, including SFM, from storage site to work area.
- B. Store components in original wrappings, and protect from dirt, weather and construction work traffic.
- C. Coordinate with SDR at least three days in advance for pick up of SFM. Emergency supply situations will be handled by the SDR on a case-by-case basis.

- D. Thoroughly inspect materials for damage before taking custody, including SFM. Inform SDR within one workday if SFM are found to be damaged. Failure to do so may result in material replacement at Contractor's expense as determined by SDR.
- E. Return unused SFM with an inventory to SDR immediately after product usage is complete.

1.07 WARRANTY

Contractor shall supply a warranty as specified in Section "Quality Assurance and Documentation."

PART 2 - PRODUCTS

2.01 GENERAL

All materials shall be new and applicable as listed, labeled, or approved by the Underwriters' Laboratories, Inc. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired in a manner approved by SDR.

2.02 CONDUIT AND DUCT SYSTEMS - GENERAL

Conduit and duct systems shall be of the type specified in the drawings and shall meet the requirements herein.

- A. Conduits shall be joined in such a way as to prevent solid matter from entering the joints. Joints shall form a continuous smooth interior surface between joining conduit sections so that cable will not be damaged when pulled past the joint.
- B. Conduit installed on bridges, building roofs, or high temperature areas shall incorporate expansion joints. Metallic conduit on a bridge shall be grounded.
- C. Pullboxes shall be "PG" style box assemblies of composolite as manufactured by Quazite Corporation or approved equal. Material compressive strength shall not be less than 11,000 PSI. Covers shall be heavy duty steel with lock and logo as indicated. Boxes shall be stackable for extra depth.
- D. Conduit for fiber optic cable shall have high capacity flexible high density polyethylene multiple channel innerduct manufactured by EATON/Fitzplastic or as specified on Contract drawings. The number of channels shall be specified on the contract drawings.

2.03 METALLIC CONDUIT - GENERAL

- A. All steel conduits , RGS or IMC, in direct contact with the earth shall receive a protective covering which shall be mechanically applied in a factory or field plant especially equipped for this purpose. (Ref. Section 2.07)
- B. No conduit shall be covered with backfill until after the approval of the Sandia Delegated Representative is obtained.

2.04 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid steel conduit: Material shall comply with UL 6 and ANSI C80.1. Rigid, threaded, thick-wall, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.
- B. PVC externally coated conduit: Material shall comply with NEMA RN 1; rigid steel conduit with external 20 mil PVC coating and internal galvanized surface.
- C. Fittings and conduit bodies: Material shall comply with ANSI/NEMA FB 1; threaded type, material to match conduit.

2.05 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Galvanized steel conduit: Material shall comply with UL 1242 and ANSI C80.6. Rigid, threaded, light weight steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.
- B. Fittings and conduit bodies: Material shall comply with ANSI/NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.

2.06 NON-METALLIC CONDUIT - CONCRETE ENCASED

- A. Conduit: Material shall comply with UL 651 and NEMA TC2; schedule 40 PVC or schedule 80 PVC as indicated on the drawings.
- B. Fittings and conduit bodies: Material shall comply with NEMA TC3.
- C. The concrete for the duct envelope shall conform in quality to all requirements for placing and curing as described in the concrete specifications. No concrete shall be poured until inspection is obtained. Backfilling shall not be started until the concrete has set for 5 hours. No duct shall be covered with backfill until after approval is obtained.
- D. For vertical stub-ups, horizontal bends, and any off-sets greater than 22° in primary electrical and communication underground conduit runs, use PVC-coated rigid steel or IMC factory bends. The minimum radius shall be 24 inches for 3 inches and smaller conduit and 36 inches radius for conduit larger than 3 inches. Half-lapped application of corrosion protection tape is an acceptable alternate to PVC coating. Standard radius conduit can be used for secondary electrical conduit as specified on drawings.

2.07 CORROSION PROTECTION

One of the following methods shall be used for metal conduit below grade:

1. 3M Scotchwrap 51, 20 mils thick used in conjunction with 3M Scotchwrap Pipe Primer applied as recommended by manufacturer.
2. Factory coated PVC on rigid conduit.

2.08 DIRECT BURIED CABLE - GENERAL

- A. Trench shall be opened to specified depth complete length of cable run. Bottom of trench shall be leveled and tamped. Remove obstructions, large rocks, and debris.
- B. Bedding material for cable shall conform to the requirements of ASTM C33 Fine Aggregate and shall be installed to a level uniform depth of 4" in the trench prior to cable installation.

2.09 MANHOLES - GENERAL

- A. Manholes can be either precast concrete or cast-in-place as designated on the drawings.
- B. Drainage shall be provided to keep the manholes free of water during construction.

2.10 MANHOLES - PRECAST CONCRETE

- A. Manufacturer shall have documented experience in the manufacture of manholes for a minimum of three years.
- B. Base course material shall be sand, 3 inches minimum compacted 95%.
- C. Precast concrete: Air-entrained, 4000 psi minimum compressive strength at 28 days.
- D. Reinforcing: AASHTO HS-20; bridge loading.
- E. Manhole Shape: As indicated on drawings.
- F. Inside Dimensions: As indicated on drawings.
- G. Wall Thickness: AASHTO HS-20; bridge loading.
- H. Include 40-inch diameter grooved opening in top section for frame and cover for power manholes and 36-inch diameter grooved opening for communication manholes.
- I. Frame and Cover Sections: 36-inch diameter clear opening for power manholes and 30-inch diameter for communication manholes.
- J. Include one 12-inch drain opening and two 1-inch ground rod openings in base, one each diagonally opposite corners, not less than 6 inches or greater than 12 inches from the wall.
- K. Window for Duct Entry: Unless otherwise specified on drawings, 9-6 inch knockouts 3 rows of three on 8.56 inch centers shall be provided on each wall with top row of knockouts not less than two feet below top of manhole. Reference contract drawings for specific construction details.
- L. Include cable pulling irons opposite each duct entry.
- M. Include inserts for cable racks on three foot centers.

- N. Include metal ladder in manhole, steps at 16 inches on center, ladder bolted to manhole neck.
- O. Install sealants at all joints in manholes. Ram-Nek, Kent Seal or approved equal sealants shall be used to seal the joints in this manhole.

2.11 MANHOLES - CONCRETE CAST-IN-PLACE

- A. All provisions of Sections 2.10 and 2.12 shall apply.
- B. Concrete shall be 3000 psi minimum compressive strength at 28 days in conformance with requirements of Division 3, Section "Cast-In-Place Concrete."
- C. Provide reinforcing under the provisions of Division 3, Section "Cast-In-Place Concrete."

2.12 MANHOLE ACCESSORIES

- A. Manhole Frames and Covers: As detailed or scheduled on drawings, double cover. Outer covers shall be ASTM A48; Class 30B gray cast iron, machine finished with flat bearing surfaces. Outer covers shall be round and shall have "Signal" and "SNLA" in permanent lettering. Inner cover shall be aluminum as specified.
- B. Sump Covers: Material shall conform to ASTM A48; Class 30B gray cast iron.
- C. Pulling Irons: 7/8 inch diameter steel bar forming a triangle of 9 inches per side when set. Galvanize to ANSI/ASTM A153 for irregular shaped articles. Locate opposite each duct entry.
- D. Cable Rack Inserts: Steel channel insert with minimum load rating of 800 pounds, length to match cable rack channel. Locate 3' on center.
- E. Cable Rack Channel: 1-1/2 x 3/4 inch steel channel wall bracket, 48 inch length, with cable rack arm mounting slots on 1-1/2 inch centers.
- F. Cable Racks: ANSI/ASTM A569; steel channel, 1-1/2 x 3/4 x 14 inches with fiberglass reinforced polyester or porcelain cable supports and fastener to match mounting channel.
- G. Manhole Ladder: Cast iron, suitable for manhole shape and construction. Primed and painted light grey.
- H. Waterproofing: Exterior coating of manholes shall be required. The coating shall be a waterproofing type bitumastic or asphaltic material such as Koppers 300M or approved equal.
- I. Ground Rods: 3/4" x 10' Copperweld.
- J. Grade Rings: Pre-cast concrete (4000 psi. minimum compressive strength at 28 days) with inside diameter equivalent to manhole opening specified in Section 2.10H. The ring shall have circumferential rebar #3 minimum with a trowel finish to provide a true plane within 1/8 inch, as determined with a 5-ft straight edge.

PART 3 - EXECUTION

3.01 CONDUITS - GENERAL

- A. The entire trench between terminal points of the conduit run shall be opened before any conduit is laid in order to determine if any obstructions exist. Install duct to locate top of ductbank at depths as indicated on drawings. Any existing utility line crossings are to be as built on drawings showing: type of line, size, and depth below the surface.
- B. Duct banks shall have conduit joints staggered at least six inches, both vertically and horizontally.
- C. Spacers shall be used where more than one duct is installed and shall be the standard product of the duct manufacturer for the type and size duct. They shall be located at five foot intervals, secured to the ducts with #16 gage iron wire. The spacers shall be securely anchored to the bottom of the trench to prevent ducts from floating during concrete pouring. Unless otherwise noted on drawings, 4" conduit shall have an approximately 7.5 inch spacing center-to-center, both horizontally and vertically; 5" conduit shall have an approximate 8.56 inch spacing center-to-center.
- D. Continuous spading during pouring shall be performed to ensure a flow of concrete between and under ducts to eliminate voids. Mechanical vibrators shall not be used.
- E. Terminate conduits in an end bell at manhole and building foundation penetrations. Stub-ups of rigid or IMC duct in equipment pads shall have insulated grounding bushings.
- F. Apply corrosion protection tape, half lapped, to non-PVC-coated underground metallic conduit and fittings that are in direct contact with earth only.
- G. Conduit and duct runs shall be short, straight runs between points of the system. Bends shall be laid out with the greatest possible radius.
- H. Duct runs shall be graded to drain toward one or both terminal points of the duct run. The slope shall not be less than 2 inches for every 100 ft. of length, unless otherwise shown on contract drawings.
- I. Conduits and duct runs shall be installed on compacted soil when entering a manhole, building foundation, crossing a road, railroad track, or bridge abutment to prevent shear stress on the conduit.
- J. All paving and concrete cuts shall be made with a concrete saw. All surfaces to be replaced shall match existing and shall be in accordance with applicable concrete or asphalt specifications.
- K. Conduit penetrations into buildings or through above ground foundations, shall be sealed with duct seal or conduit sealer to prevent gas or water entry.
- L. Trenching and backfilling shall be in accordance with Division 2, Section "Earthwork."

- M. Cables shall be pulled into the duct as shown on the drawings, and as specified in Division 25, Section "Telecommunications Cabling." Empty ducts shall have a 1/4" polypropylene rope provided with 2 feet of slack minimum at each end with both ends secured.
- N. When multiple channel innerducts (Opti-Duct/FO-DUCT) are pulled through conduit, secure every 10-ft section so as to prevent rolling of channels within conduit. Leave one-foot ends protruding from face of manhole. Follow the remainder of innerduct manufacturer's installation instructions to install innerduct.
- O. Conduit or duct banks shall maintain 1 foot vertical and 1 foot horizontal separation from other utility lines where possible. A separation of 6 feet is desired from steam lines, except at a crossing where power duct shall cross under the steam line with a minimum of 1 foot vertical separation.
- P. A warning tape shall be installed one foot above duct. The warning tape shall be of inert plastic film 4 mils thick specifically formulated for prolonged use underground, resistant to alkalis and acids found in soil. It shall have a tensile strength of 30 pounds per 3 inch wide strip. The tape shall bear a continuous printed message repeated every 36 inches. The tape shall be Terra Tape Standard 250 manufactured by Reef Industries, Inc., or approved equal. The tape shall be colored in accordance with American Public Works Association (APWA) recommended color code for marking buried lines of all types. Current recommended color is Orange for telecommunications.
- Q. Swab Duct: use suitable caps to protect installed duct against entrance of dirt and moisture.

3.02 CONCRETE ENCASED CONDUITS

- A. Provide minimum four inch concrete cover at bottom, top, and sides of conduit or duct bank.
- B. A mandrel 1/4" - 3/8" smaller than the conduit shall be pulled through each conduit. A circular wire brush the same diameter of the conduit shall be pulled through the conduit.
- C. Conduit stub outs shall be RGS or IMC capped and not encased in concrete for future accessibility. Capping shall prevent moisture or debris from entering the duct system.

3.03 DIRECT BURIED CABLE - GENERAL

- A. The cable shall be reeled from the cable reel to trench avoiding dragging it over the surface of the ground. The cable shall not be under tension after installed in the trench.
- B. Bedding material as specified in 2.08B shall be used as backfill to cover the cable a uniform depth of 4".
- C. The remaining trench shall be backfilled screening out sharp rocks and other debris so as to avoid damage to the cable. Backfilling and tamping shall be in accordance with the Specification on Excavation, Fill, Backfill, and Trenching.

- D. A plastic warning tape shall be installed one foot above the cable the complete length of the trench. For telecommunications the tape shall be Orange in color with black lettering "Warning Buried Signal Lines" Terra Tape or equivalent.

3.04 MANHOLES - PRECAST CONCRETE

- A. Excavate, install base material, and compact base material. Compact to 95% density or as required by manufacturer.
- B. Install, seal, and waterproof precast sections in accordance with manufacturer's instructions.
- C. Use precast grade ring sections to bring manhole entrance to proper elevation.
- D. Install manholes plumb and level.
- E. Set the top of each manhole to finished elevation.

3.05 MANHOLES - CAST-IN-PLACE CONCRETE

- A. Form cast-in-place manholes, inside and outside surfaces, in accordance with provisions of Division 3, Section "Cast-In-Place Concrete."
- B. Manhole Shape: As indicated on drawings.
- C. Inside Dimensions: As indicated on drawings.
- D. Wall Thickness: As indicated on drawings.
- E. Form window for duct entry as indicated on plans.
- F. Include 12 inch drain opening and two 1-inch ground rod openings in base section.
- G. Cast cable pulling irons in place opposite each duct entry window.
- H. Cast inserts for cable racks in place at three ft. centers.

3.06 MANHOLE ACCESSORIES

- A. Where manhole drainage is into sewers, suitable traps shall be provided to prevent entrance of sewer gas into manholes and duct systems.
- B. Install two ground rods with top protruding 4 inches above manhole floor. Connect ground rods with 4/0 bare copper run around perimeter of inside manhole at floor. Copper conductor connection to ground rod to be exothermic.
- C. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum.
- D. Attach cable racks to inserts after manhole construction is complete.

END OF SECTION