

SPECIAL SPECIFICATION
SECTION 25151S
TELECOMMUNICATIONS CABLING

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SPECIAL SPECIFICATION
SECTION 25151S
TELECOMMUNICATIONS CABLING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Section Includes: Material and installation and termination of telecommunications cabling at Sandia National Laboratories, New Mexico (SNL/NM).
1. Install cable system design as described in Statement of Work in its entirety.
 2. Supply tools and consumables for Project.
 3. Where telecommunications installation work is performed as part of a subcontract for a larger project, the General Contractor shall subcontract directly to the telecommunications subcontractor.
 4. Exterior and interior raceway systems shall be installed by a licensed and qualified telecommunications contractor or an electrical contractor under subcontract with a licensed and qualified telecommunications contractor. A qualified telecommunications contractor is a company that is certified by Avaya, Inc. as a value-added reseller (VAR).
 5. Cable terminations and testing shall be performed only by installers who are BICSI-certified at the Technician II level, as a minimum.
 6. Additional requirements for the telecommunications contractor are found in Division 25, Section "Quality Assurance and Documentation."
- B. Drawings shall delineate Telecommunications system by depicting raceway location and routing, locations of service entrance, Main Distribution Room (MDR), Intermediate Distribution Room (IDR), user outlets, and equipment locations.

Raceway and cable routing shown on Drawings are not intended to show all support or mounting hardware, or raceway bends, kicks, offsets, and couplings.

- 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 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. Project may have Contractor-furnished material and/or Sandia-furnished material (SFM) as detailed in Statement of Work and/or elsewhere in Contract documents.

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

- F. 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 25, Section “Administration Requirements.”
4. Division 25, Section “Quality Assurance and Documentation.”
5. Division 25, Section “Telecommunications Equipment Rooms”
6. Division 25, Section “Main Distribution Frames and Service Entrances.”
7. Division 25, Section “Interior Telecommunications Pathways”
8. Division 25, Section “Exterior Telecommunications Pathways”

1.02 REFERENCES

- A. Electronics Industries Association/Telecommunications Industries Association (EIA/TIA)

568A Commercial Building Telecommunications Cabling Standard

TSB-67 Technical Service Bulletin (Cable Testing/Tester)

- 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. 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. American National Standards Institute (ANSI)

Z136.1-1993 American National Standard for Safe Use of Lasers

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

GR-20 Generic Requirements for Optical Fiber and Optical Fiber Cable

GR-111 Generic Requirements for Thermoplastic Insulated Riser Cable

GR-196 Generic Requirements for Optical Time Domain Reflectometer (OTDR) Type Equipment

GR - 198 Generic Requirements for Optical Loss Test Sets (OLTS)

GR-409 Generic Requirements for Premises Fiber Optic Cable

GR-421 Generic Requirements for Metallic Telecommunications Cables

GR-492 Generic Requirements for Metallic Telecommunications Cable

GR-1009 Generic Requirements for Fiber Optic Clip-on Test Sets

GR-1081 Generic Requirements for Field-Mountable Optical Fiber Connectors

GR-1222 Generic Requirements for Fiber Optic Terminators

TR-TSY-000886 Generic Criteria for Optical Power Meters

TR-NWT-000131 Generic Requirements for Network Plenum Cable/Wire

TR-NWT-001137 Generic Requirements for Hand-Held Optical Power Meters

3. Building Industry Consulting Service International (BICSI)

Telecommunications Distribution Methods Manual

LAN and Internetworking Design Manual

Telecommunications Cabling Installation Manual

Customer-Owned Outside Plant Design Manual

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

- 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
- 526-14A Measurement of Optical Power Loss of Installed Multi-Mode Fiber Cable Plant – OFSTP-14
- 568-B.1 Commercial Building Telecommunications Standard Part 1: General Requirements
- 568-B.2 Commercial Building Telecommunications Standard Part 2: Balanced Twisted-Pair Cabling Components
- 568-B.3 Optical Fiber Cabling Components Standard
- 569-A Commercial Building Standard for Telecommunications Pathways and Spaces
- 570 Residential and Light Commercial Telecommunications Wiring Standard
- 598 Optical Fiber Cable Color Coding
- 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- 607 Commercial Building Grounding and Bonding Requirements for Telecommunications

5. Insulated Cable Engineers Association, Inc. (ICEA)

- S-80-576 Communications Wire & Cable for Premises Wiring

6. Underwriters Laboratories, Inc. (UL)

- 444 Communications Cables

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 the following in accordance with conditions of Contract documents and Division 1, Section “Descriptive Submittals.”
- B. Site Investigation Report: Submit as required in Part 3 – “Execution” for renovation work.

- C. Manufacturer's Data: Provide manufacturer's data for specified materials and all equipment not listed in Drawing TN/TJ6001STD.
- D. Quality Control
 - 1. Procedures: Provide the following, prior to beginning Work.
 - a. Written, detailed procedures including techniques for securing, protecting, and dressing transitions from OF and enhanced unshielded twisted pair (EUTP) cable to conductor to connector.
 - b. Written, detailed termination procedures for OF and EUTP conductors.
 - c. Written company quality policy including measures to be taken throughout Contract to ensure delivery of quality work to SNL.
 - 2. Contractor Qualifications: Provide certification that Contractor meets Quality Assurance requirements prior to beginning Work. Include the following:
 - a. Project list with descriptions of past projects that are similar in size, scope, complexity, and use of hardware. Provide client name, project manager, address, and current telephone number for each project listed. Project list shall document at least five years of corporate experience in termination and testing OF and EUTP cable.
 - b. Qualifications and training certifications of proposed on-site personnel. Include documentation verifying at least five years of field experience in OF and EUTP termination and testing. Provide copies of pertinent training certificates.
- E. As-Built Drawings: Submit dated as-built drawings for review with Sandia Delegated Representative (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.
- 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.
- 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 Division 25, Section "Quality Assurance and Documentation."

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide products that are new and currently in production.
- B. Do not use materials and equipment that have been removed from existing premises, except as specifically and expressly permitted by Contract documents or SDR.
- C. Products will be specified by industry standard names, unless specifically noted otherwise.
- D. Devices and equipment submitted for approval shall be used for the purpose intended. No deviation from SNL requirements and standards shall be permitted.

2.02 INTRA-BUILDING TELECOMMUNICATION CABLING AND TERMINATION COMPONENTS

- A. Twisted Pair Copper Cable: Provide manufacturer type, pair counts, part numbers, and comcodes as found in Drawing TN/TJ6001STD.
1. Substitutes shall not be accepted.
 2. Supply cable on reels of continuous lengths without splices.
 3. Follow color codes shown in Table 1 for termination of conductors in each twisted pair cable.
- B. Optical Fiber Cable: Substitutes shall not be accepted.
1. Supply cable on reels of continuous lengths without splices.
 2. Multi-Mode: Manufacturer type, fiber counts, part numbers, and comcodes specified in Drawing TN/TJ6001STD.
 3. Single Mode: Manufacturer type, fiber counts, part numbers, and comcodes specified in Drawing TN/TJ6001STD.
- C. Termination Components: Specified in Drawing TN/TJ6001STD. Substitutes shall not be accepted.
- D. EUTP Plenum Cable Supports: EUTP Plenum-rated cabling shall be installed in "Cable Cat" Wide Base Adjustable Cable Support Clips, CADDY CAT plenum-rated cable support in trunk runs alongside trunk conduit for optical fiber. EUTP Plenum-rated cabling shall be installed on J-hooks where routed from trunk cabling runs to individual outlets. Install cabling supports fastened to structure independently of any other support system, and as detailed on the Drawings.

2.03 LABELS

Refer to Division 25, Section "Administration Requirements" for labeling requirements.

PART 3 - EXECUTION

3.01 GENERAL

- A. Consult with SDR to verify areas that are confined spaces as defined in OSHA 29 CFR Parts 1910, requiring special permits for access. Comply with requirements of OSHA 29 CFR Part 1910, Section 146 when working in permit-required confined spaces.
- B. Locations of hazardous materials areas are shown on Drawings.
1. Avoid disturbance of hazardous materials in making acceptable modifications of raceway routing, mounting of equipment, and other work.
 2. Do not mount conduit, equipment, hangers, and other accessories on surface materials known to contain asbestos or other hazardous materials without written authorization from SDR outlining method of installation.

3. If hazardous materials or conditions not shown on Drawings are encountered, stop work immediately and vacate area. Take the following actions:
 - a. Immediately notify SDR of condition encountered.
 - b. Do not enter area or work in area until receiving written authorization from SDR.
- C. Do not install damaged or defective components.
 1. If SFM are found to be defective, immediately report problem to SDR and provide documentation with sufficient engineering data to confirm defect.
 2. Contractor shall receive replacement SFM materials only after defective materials have been returned to SDR and defect has been confirmed.
 3. If SFM are rendered unusable due to Contractor error or improper installation as determined by SDR, materials shall be replaced at Contractor's expense.
- D. Ensure that existing conduits are clean and free of obstructions prior to pulling cable. Install grounding bushings on conduits where required before pulling cable.
- E. Secure products in place with positive anchorage devices, designed and sized to withstand stresses, vibration, and distortion.
- F. Prepare as-built documentation beginning at Project start date. SDR will provide assistance in obtaining one set of reference drawings, if needed, for documentation purposes.

3.02 INSPECTION

- A. Variations: Drawings and other Contract documents indicate basic location, arrangement, and routing of equipment and components.
 1. Submit detailed description of proposed improvements and modifications to SDR for review that include: Drawings, manufacturer's literature, and detailed description of functional improvements.
 2. Do not proceed with incorporation of modifications and associated work until receipt of written approval from SDR.

3.03 CABLE INSTALLATION

- A. Install system components and appurtenances in accordance with manufacturer's instructions, as described in Contract documents, and as shown in Drawings.
- B. Install in accordance with NFPA 70.
- C. Horizontally- and Vertically-Installed Cable
 1. Do not use any cable lubricant.
 2. Plan cable pulls so that maximum number of cables required in conduit are pulled simultaneously.

3. Route cables via conduit and pullboxes for optical fiber (data) communications, and via exposed EUTP Cable pathways for voice and open data, identified and as shown on drawings.
 - a. Horizontal cable pathways for EUTP voice and data cabling shall be exposed within the ceiling space. Horizontal cabling bridging any inaccessible area shall be installed in conduit as indicated on the drawings. Wide Base Cable Support Clips shall support exposed cabling above ceiling space at intervals of no greater than five feet on center at main trunk runs. Cabling run to outlets from main trunk runs shall be supported by J-hooks spaced at intervals of no greater than five feet on center. Exposed cabling shall be routed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings and shall remain as accessible as possible after all building utilities have been installed.
 - b. All EUTP cable shall be routed in such a manner as to avoid possible transmission interference or degradation from all EMI sources present within the ceiling spaces, plenums, floors and walls where such cabling is installed. Any such possible interferences shall be brought to the attention of the SDR immediately.
4. Individual EUTP cable lengths shall not exceed 90 meters (295 feet) from IDR termination frame to user outlet. If cable length exceeds this distance, notify SDR. Do not place any cable at longer distances until directed to do so by SDR.
5. If deviations from Drawings are required, they shall be approved by SDR prior to placement of affected cables.
6. Do not install more cables in conduit than shown on Drawings, unless approved in writing by SDR.
7. If indirect attachments are used, match grip diameter and length to cable diameter and characteristics. Reduce pulling forces to ensure that optical fibers and twisted pair conductors are not damaged from forces being transmitted to strength member.
8. Do not exceed maximum tension specified by cable manufacturer.
9. Mechanical stress placed upon cable during installation shall be such that cable is not twisted or stretched.
10. Inspect cable jacket carefully for defects as cable is played off reel.
11. Take precautions during installation to prevent cable from being kinked, crushed, or being mishandled.
12. Do not exceed minimum bend radius of cable as recommended by manufacturer. Contractor is responsible for determining minimum bend radiuses for cable being placed, using manufacturer's latest information. The following minimum bend radius information is provided only as general guidance:
 - a. Short Term No Load: 10 times outer diameter

- b. During Installation: 20 times outer diameter
 - c. At Rest After Installation: 10 times outer diameter
 - d. Individual Buffered Fibers: 19 mm (0.75 inch)
13. Vertical Cable Runs: Use gravity to assist in cable placement.
- a. Start installation from top of run to bottom of run.
 - b. Hand-pull if possible.
 - c. If machine assistance is required, monitor pulling tension and do not exceed manufacturer's specified cable tension limits.
- D. Service loops shall be as shown on Drawings.
- E. Installation cable slack requirements are intended to minimize cable waste. After installation, cable slack shall be as shown on Drawings. If not shown or noted, provide pre-termination cable slack as indicated below.
- 1. Optical Fiber Cables (prior to termination)
 - a. User Outlet: Not less than 1.5 meters (5 feet), or more than 2 meters (6.5 feet)
 - b. LIU: Not less than 2 meters (6.5 feet), or more than 2.5 meters (8.2 feet).
 - 2. EUTP Cables, 4-pair (prior to termination)
 - a. User Outlet: Not less than 1.5 meters (5 feet), or more than 2 meters (6.5 feet)
 - b. IDR Termination Frame: All cables shall be able to reach furthest frame location plus 1 meter (3.2 feet).
 - 3. UTP and EUTP Cables, greater than 4-pair (prior to termination)
 - Not less than 5 meters (16.4 feet) beyond designated termination point.
- F. Cable Placement Within MDR or IDR: Route cables to termination points in as direct a path as possible.
- 1. Cable bundles shall be combed and each cable shall run parallel with other cables.
 - 2. After combing and straightening cables, separate cables into bundles according to routing requirements and termination points.
 - 3. Secure cable bundles with hook-and-loop cable strap material as listed in Drawing TN/TJ6001STD. Do not use cable ties manufactured from hard polymer material, such as plastic or nylon.

4. Begin to comb, bundle and strap cables within 2 inches (51 mm) of exit from conduit. Apply cable straps to bundles at intervals not greater than 12 inches (305 mm) for entire length of vertical and horizontal run.
- G. Splices: Do not use splices in cabling, unless pre-approved in writing.
1. Splices shall not be allowed in EUTP cable. Splices will be permitted in other cable types only as a last resort, subject to the following conditions:
 - a. Obtain written approval from the SDR prior to splicing cable.
 - b. Approval will be issued only on a case-by-case basis.
 - c. Document splice location and type, as part of as-built and record drawings.
 - d. Retest cable after splicing. If cable fails test, notify SDR of problem, and provide proposed procedures to eliminate deficiency.
 - e. Contractor shall correct deficiency, and retest all optical fibers that failed test procedures.
- H. Install rack-mounted and wall-mounted termination panels and frames as described in Contract documents.
- I. Install couplers, buildouts, and their support panels for optical connections at both ends of optical cables and for EUTP connections at user outlet.
- J. Install plastic user outlet box, front covers, back panels, and associated user outlet parts.
- K. Cover optical connectors, couplers, and buildouts with clean optical dust caps of appropriate type.

3.04 LABELING

- A. Refer to Division 25, Section "Administration Requirements" for labeling requirements.
- B. EUTP Cabling shall be bundled together with hook-and-loop cable strap material as listed in Drawing TN/TJ6001STD.

3.05 TERMINATION OF INTRA-BUILDING TELECOMMUNICATION CABLE

- A. Perform test sample amount of terminations designated by SDR, prior to beginning mass cable termination. Testing shall be performed in accordance with Division 25, Section "Quality Assurance and Documentation."
 1. Terminate both ends of each type of cable installed. Only a SNL/NM pre-qualified Contractor shall perform termination work under this Contract.
 2. Provide terminations and connections in accordance with cable and connector manufacturer's specifications.

3. Test terminated cables and submit test report within one week of performing terminations.
 4. Do not proceed with termination of remaining cables until test results have been reviewed and approved by SDR.
- B. Optical Fiber Cables: Terminate both ends of cables. After termination, provide cable slack as shown on Drawings.
1. If not shown, cables shall have the following minimum slack after successful termination.
 - a. One meter (3 feet) slack at user outlets.
 - b. One and one-half meters (5 feet) at LIUs and fiber distribution units.
 2. Firmly attach aramid yarn strength members at both ends of cable to prevent pullback damage.
- C. UTP and EUTP Cables: Terminate both ends of cables.
1. After termination, provide cables with enough cable slack for clean dress and to prevent stress and sharp bends on cables.
 2. Extra cable slack is not required for 4-pair cables provided that connections pass the required tests and cables are not stressed. Provide cables greater than 4-pair with minimum of 3 meters (10 feet) slack after successful termination. Neatly store slack in cable tray, or fasten to wall adjacent to termination location.
 3. Provide T568A 8-position modular, 4-pair EUTP connectors at user outlets, as listed in Drawing TN/TJ6001STD.
 4. For Data, terminate 4-pair EUTP cables in IDR on 110 blocks with 110C-4 punchdown clips as shown in Drawing TN/TJ6001STD. 110C-4 clips shall skip every 25th pair on 110 punchdown blocks.
 5. For Voice, terminate 4-pair EUTP cables in IDR on 110 blocks with 110C-4 punchdown clips. Terminate UTP cables (greater than 4-pair) with 110C-5 clips.
 6. Terminate UTP and EUTP cables with preserved wire pair twists as specified in EIA/TIA 568A.
 7. Termination frame 110 wiring block layouts and corresponding cable names shall be provided to Contractor by SNL/NM Telecommunications Operations Department.
- D. Attach 8-position modular connectors and their slide-in support plates at user outlets into user outlets.

3.06 TESTING OF INTRA-BUILDING CABLING

Testing shall be performed in accordance with Division 25, Section “Quality Assurance and Documentation.”

Contractor shall incur all costs for reterminating required by unacceptable test results.

END OF SECTION

TABLE 1

Cable Termination Color Codes

4 PAIR CABLE	25 PAIR CABLE	100 PAIR CABLE			
		BINDER			
		BLUE	ORANGE	GREEN	BROWN
1 WHITE/BLUE	1 WHITE/BLUE	1 WH/BL	26 WH/BL	51 WH/BL	76 WH/BL
2 WHITE/ORANGE	2 WHITE/ORANGE	2 WH/OR	27 WH/OR	52 WH/OR	77 WH/OR
3 WHITE/GREEN	3 WHITE/GREEN	3 WH/GN	28 WH/GN	53 WH/GN	78 WH/GN
4 WHITE/BROWN	4 WHITE/BROWN	4 WH/BN	29 WH/BN	54 WH/BN	79 WH/BN
	5 WHITE/SLATE	5 WH/SL	30 WH/SL	55 WH/SL	80 WH/SL
	6 RED/BLUE	6 R/BL	31 R/BL	56 R/BL	81 R/BL
	7 RED/ORANGE	7 R/OR	32 R/OR	57 R/OR	82 R/OR
	8 RED/GREEN	8 R/GN	33 R/GN	58 R/GN	83 R/GN
	9 RED/BROWN	9 R/BN	34 R/BN	59 R/BN	84 R/BN
	10 RED/SLATE	10 R/SL	35 R/SL	60 R/SL	85 R/SL
	11 BLACK/BLUE	11 BK/BL	36 BK/BL	61 BK/BL	86 BK/BL
	12 BLACK/ORANGE	12 BK/OR	37 BK/OR	62 BK/OR	87 BK/OR
	13 BLACK/GREEN	13 BK/GN	38 BK/GN	63 BK/GN	88 BK/GN
	14 BLACK/BROWN	14 BK/BN	39 BK/BN	64 BK/BN	89 BK/BN
	15 BLACK/SLATE	15 BK/SL	40 BK/SL	65 BK/SL	90 BK/SL
	16 YELLOW/BLUE	16 Y/BL	41 Y/BL	66 Y/BL	91 Y/BL
	17 YELLOW/ORANGE	17 Y/OR	42 Y/OR	67 Y/OR	92 Y/OR
	18 YELLOW/GREEN	18 Y/GN	43 Y/GN	68 Y/GN	93 Y/GN
	19 YELLOW/BROWN	19 Y/BN	44 Y/BN	69 Y/BN	94 Y/BN
	20 YELLOW/SLATE	20 Y/SL	45 Y/SL	70 Y/SL	95 Y/SL
	21 VIOLET/BLUE	21 V/BL	46 V/BL	71 V/BL	96 V/BL
	22 VIOLET/ORANGE	22 V/OR	47 V/OR	72 V/OR	97 V/OR
	23 VIOLET/GREEN	23 V/GN	48 V/GN	73 V/GN	98 V/GN
	24 VIOLET/BROWN	24 V/BN	49 V/BN	74 V/BN	99 V/BN
	25 VIOLET/SLATE	25 V/SL	50 V/SL	75 V/SL	100 V/SL