SECTION 27 1000

STRUCTURED CABLING

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LANL MASTER SPECIFICATION SECTION

Word file at <https://engstandards.lanl.gov>

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| Rev. 9 Summary of Changes Added 3.6 on J-hooks, straps, and non-continuous cable support. |

This template must be edited for each project.  In doing so, specifier must add job-specific requirements. Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer. Once the choice is made or text supplied, remove the brackets. The specifications must also be edited to delete specification requirements for processes, items, or designs that are not included in the project - and specifiers’ notes such as these. Additional tailoring requirements are contained in ESM [Chapter 1](http://engstandards.lanl.gov/ESM_Chapters.shtml#esm1) Section Z10 Att. F, Specifications.

To seek a variance from requirements in the specifications that are applicable prior to work, contact the Engineering Standards Manual Communications [POC](http://engstandards.lanl.gov/POCs.shtml). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Specification developed for ML-4 projects. For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality sections.

Seismic: If the items covered by this Section are not subject to seismic design, or are exempt per ASCE 7 paragraph 13.1.4, then prior to editing this Section to be Project-specific, refer to Sections 26 0548.16, *Seismic Controls for Electrical Systems*, and 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, as applicable. See also the “Seismic Spec Editing Guide for Electrical,” and flowchart, web posted with the LANL Master Specs.
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1. GENERAL

Install telecommunications system in accordance with LANL ESM Chapter 19 D60, NFPA 70 Articles 770 and 800, and requirements in this Section.

* 1. SECTION INCLUDES
		1. Telecommunications pathways including conduit, raceway, and cable tray systems including:
			1. Installation of telecommunications backbone cables.
			2. Installation, termination, and testing of horizontal cables and outlets.
			3. Telecommunications terminal boards.
	2. LANL-FURNISHED EQUIPMENT FOR project-installed cabling system
		1. Category 6A unshielded twisted pair (UTP) horizontal cable (used to connect telecommunications outlets to all new buildings).
		2. Any new building which will be located on LANL property with a usage expectancy of less than 10 years may utilize a Category 5E horizontal cabling system. Building remodels and retrofits will utilize, at a minimum, a Category 5E horizontal cabling system. Category 6A will be used if:
			1. The building already has Cat 6A installed, or
			2. Future networking needs require a 6A horizontal cabling solution (e.g., over 10-year usage expectancy).

Confer with LANL Communications Group SMEs for any specific installation requirement that may arise.

* + 1. Telecommunications outlet/connectors.
		2. Telecommunications backbone cables.
		3. Audio/video communications cabling.
		4. Intercom system cabling.
	1. LANL FURNISHED AND INSTALLED EQUIPMENT
		1. Telecommunications entrance cable.
		2. Cross-connect equipment.
		3. Telecommunications systems electronics equipment.
		4. AV system electronics equipment.
		5. WiFi: distributed antenna systems (DAS); network trunk systems.
	2. LANL-PERFORMED WORK
		1. LANL will terminate telecommunications backbone cables.
		2. Structure/structural inspection and acceptance are required prior to the placement of any Category 5E or 6A UTP cables, and then inspection of the placement and terminations of all Category 5E or 6A UTP cables. Face plates must remain off outlets until physical inspections of terminations have been completed by LANL Telecommunications Group.

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Seismic: If the items covered by this Section are not subject to, or exempt from, seismic design then delete 1.5 A and B.

* Otherwise, see the seismic portion of the previous author note.

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* 1. RELATED SECTIONS
		1. Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, for requirements.
		2. Section 26 0548.16, *Seismic Controls for Electrical Systems*, for [seismic-design criteria,] submittal requirements, devices for seismic restraint, and installation requirements for these devices.
	2. ACTION SUBMITTALS

Submit to LANL Telecommunications Group:

* + 1. Qualification certifications of cable installers (prior to commencement of applicable scope(s) of work).
		2. Test reports in a Fluke Linkware electronic format for each installed and terminated fiber and Category 5E or 6A horizontal cable. Deliver test results to the LANL Telecommunications Group that will review the electronic test results to determine acceptable conformance and archive. Cables must meet all testing requirements before cable is accepted.
	1. INSTALLER QUALIFICATIONS
		1. Minimum qualifications with current certifications
			1. Category 5E UTP cable installers:
				1. Registered BICSI ITS Installer 2 copper.
			2. Category 6A UTP cable installers:
			3. Registered BICSI ITS Installer 2 copper.
			4. Certified Systimax installer or directly supervised by a certified Systimax installer.
			5. Optical fiber installers:
				1. BICSI Installer 2 Optical Fiber

1.8 COORDINATION

* + 1. Submit all phases of design review to the LANL Telecommunications Group for review and approval. Provide 100% drawing set to the LANL Telecommunications Group for final approval prior to construction.
		2. Contact the LANL Telecommunications Group Quality Assurance Inspector to schedule a structure/structural inspection before cabling is placed.
		3. Schedule installation of horizontal cabling and outlet/connectors to start after the completion of application of finishes to walls and after the completion of the telecommunications room(s) to minimize potential for damage to cables. Notify the LANL Telecommunications Group of the placement schedule for inspections.
	1. BackBone Cabling
		1. Design backbone and entrance pathways in accordance with LANL Engineering Standards Manual Chapter 19, Section G50 Site Communications.
		2. Copper backbone cable is ARMM cable, 24 AWG, UL listed as type CMR.
		3. Fiber optic backbone cable is UL listed as type OFNP or OFNR, tight-buffered single mode or multimode cable with a mixture of single-mode and multi-mode fibers.
1. PRODUCTS

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Seismic editing

For items that are subject to seismic design, if Project Specification includes 26 0548.16, and if mounting and/or anchorage devices are to be used that differ from those specified in 26 0548.16, they must be described herein (in PART 2).

Seismic: Delete 2.1 if items are not subject to, or exempt from, seismic design.

Otherwise, retain the article and edit its content based on the following:

- 1st paragraph is for items that do not have to operate/function post seismic event.

- 2nd paragraph is for items that must operate/ function after a seismic event (i.e., they are Designated Seismic Systems, or DSSs).

* If paragraph applies, the “E” drawings for the items shall also state that the items are Designated Seismic Systems.

If paragraph applies, edit it in accordance with content of 26 0548.16 and/or 01 8734.

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* 1. SEismic Performance requirements
		1. The structured cabling shall remain in place without separation of any parts when subjected to the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] \*\*\*OR\*\*\* as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 26 0548.16, *Seismic Controls for Electrical Systems*].
		2. The structured cabling is a Designated Seismic System and, as such, shall remain in place and be fully operational following the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] \*\*\*OR\*\*\* as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 26 0548.16, *Seismic Controls for Electrical Systems*].

2.2 TeleCommunications Rooms

* + 1. Install telecommunications rooms in accordance with LANL Engineering Standards Manual Chapter 19 Section D60 (e.g., Section D6010, article *1.2 Telecommunications Rooms*) and Example Drawing [D5030](https://www.lanl.gov/orgs/eng/engstandards/Dwgs_Details.shtml#electrical), *Telephone-Data Equipment Closets and Riser Diagram*.
	1. DISTRIBUTED COMMUNICATIONS AND MONITORING
		1. Install Public Address (Voice Paging) System in accordance with LANL Engineering Standards Manual Chapter 19 Section D60 (D6060.10 “Distributed Audio-Video Communications Systems”).
	2. Horizontal Pathways
		1. Install horizontal Pathways in accordance with LANL Engineering Standards Manual Chapter 19 Section D60 (“Horizontal Pathways” heading).
		2. Install Category 5E or 6A UTP horizontal cables per design from each telecommunications outlet to the telecommunications terminal board or the telecommunications cabinet.
		3. Allow at least three cable runs per telecommunications outlet unless otherwise designated by LANL Telecommunications Group.
	3. Conduits
		1. Install conduit for telecommunications in maximum lengths of 100 ft. between pull points and no more than 225 degrees of bend between junction boxes. Install a junction box at any reverse bend.

 Required Conduit Sizes per Outlet for Distance/Bend Situation (Cat 6A cable)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Less than 50 ft. between pulling points. No more than 225 ~~t~~ota~~l~~ degrees in bends40% fill allowed | More than 50 ft. between pulling points.No more than 225 total degrees in bends40% fill allowed |
| Cables per Outlet | 1-3  | 1” | 1-1/4” |
|  5-8 | 1-1/4” | 1-1/2” |

* + 1. Provide conduits for service, backbone, and horizontal cables as indicated on the drawings or as required for a complete telecommunications pathway system.
		2. Place white tape at intervals not to exceed 10’ where possible and in change of direction to identify unclassified interior telecommunications routes for all new and legacy conduit if it is part of design.
		3. Install EMT or IMC conduit unless otherwise required in LANL Telecommunications design.
		4. Install the telecommunications service entrance conduits as indicated by LANL Telecommunications Group. Turn up the telecommunications conduits at the left rear corner of the telecommunications room adjacent to the left wall. Seal the building end of entrance conduits to prevent rodents, water, or gasses from entering the building.
		5. Install conduits for backbone cables between telecommunications rooms.
			1. Install two 4-inch conduits between vertically associated telecommunications rooms.
			2. Install two 3-inch conduit between telecommunications rooms on the same floor.
		6. Install an individual 1” conduit unless otherwise specified for telecommunications horizontal cables from each telecommunications outlet to the telecommunications terminal board, raceway, or telecommunications cable tray.
		7. Install a 1” conduit from the telecommunications room to the elevator controller in the elevator equipment room. Coordinate installation with elevator subcontractor.
		8. Install a 1” conduit from the telecommunications room to the fire alarm control panel. Install a 6” x 6” x 4” box adjacent to the fire alarm control panel. Connect box to fire alarm control panel with a 3/4” nipple.
		9. Install a 1” conduit from the telecommunications room to the electrical equipment room. Coordinate location with electrical metering equipment installer.
		10. Install a 1” conduit from the telecommunications room to the BAS equipment room per design.
		11. Install a 1” EMT conduit from the telecommunications room to the wireless device locations per design.
		12. Specify conduit runs with no more than 100 feet between pull points.
		13. Specify conduit runs with no more than 225 degrees of bends between pull points.
		14. Specify a pull box at any reverse bend.
		15. Use bends on telecommunications conduits 2 inches trade size and smaller with a minimum inner edge radius 6 times the conduit internal diameter.
		16. Use bends on telecommunications conduits larger than 2 inches trade size with a minimum inner edge radius 10 times the conduit internal diameter.
		17. Do not use conduit bodies for changes in direction or as junction boxes. Mogul LBs may be used in some cases when a j-box cannot be installed; prior written approval from LANL Telecommunications Group SME is required.
		18. Install raceway-measuring tape in empty raceways. Leave no less than 12 inches of slack at each end of the tape. Secure each end of tape.
		19. Install conduits and sleeves approximately 4” above structural floors with bushings. Place conduits a minimum of 1-5/8” from the wall.
		20. Place each metallic telecommunications conduit with either an insulated throat fitting or an insulating bushing.
		21. Maintain physical separation or barriers between telecommunications pathways and sources of electromagnetic interference.
	1. Wireless Systems
		1. Install Wireless Systems in accordance with LANL Engineering Standards Manual, Chapter 19, Section D60 (e.g., D6090 1.7 “IEEE 802.11 Wireless Systems”).

2.7 Pulling Tape

1. Provide and install pulling tape in wireways, raceways, and cable trays with permanently printed measurements in 1-foot increments and a minimum of 170‑lb. tensile strength. Manufacturer: Greenlee 21562.
2. In 3” and larger conduits, place a mule tape with permanently printed measurements in 1-foot increments and a minimum of 1250‑lb. tensile strength. Neptco WP1250P.

2.8 SURFACE METAL RACEWAY

* + 1. Refer to Section 26 0533, *Raceways and Boxes* (e.g., 2.17 Power and Communications Surface Metal Raceway, para. G-I).
		2. Provide and install G6000 raceway where electrical and communications comingle. Install communications channel on top of dual comm/electrical raceway.

2.9 CABle TRAY Systems

* + 1. Install a dedicated cable tray system for backbone cables and horizontal cables as indicated on LANL Telecommunications Group design drawings or as required for a complete telecommunications pathway system.
		2. Provide and install ladder type cable tray with maximum 9-inch rung spacing.
		3. Install cable tray so there will be not less than 12 inches of clearance above and to the side of tray to permit access for installing and maintaining cables. Locate cable trays below suspended mechanical equipment, piping, and ductwork that would impede access to the cable tray.
		4. Place cable tray supports so that the support spans do not exceed span ratings of cable tray sections.
		5. Install cable tray systems per the Drawings and according to manufacturer's instructions.
		6. Ground and bond cable tray systems in accordance with Article 3.8 of this Section.
		7. Select cable tray sizes for horizontal cables based on 40% of the projected fill in addition to 20% for future growth.
		8. Install cable tray around the perimeter of each telecommunications room and above the equipment racks.
			1. Locate cable tray with edge at least 8 inches from perimeter walls.
			2. Provide at least one cable tray dropout fitting for each rack in each telecommunications room; place three additional dropout fittings for cable management. Install cable tray dropout fittings at locations directed by the LANL Telecommunications Group.
			3. Extend cable tray to each open telecommunications equipment rack.
		9. Install vertical cable tray in telecommunications room(s) to support backbone cables rising to upper floors.
		10. Install cable tray system to distribute horizontal cables from the telecommunications room(s) to locations near the telecommunications outlets. Locate cable tray concealed above corridor lift-out ceilings. Connect to the cable tray in the telecommunications room(s).
		11. Install cable tray at least 6 inches away from fluorescent or HID lighting fixtures to help mitigate electromagnetic interference.

2.10 OUTLET BOXES

1. Use 4-11/16 inch square, 2-1/8 inch deep outlet boxes with single gang raised device covers for telecommunications and television outlets served by 1 inch conduit for up to 4ea. CAT5E or no more than 3ea. CAT6A cables.
2. Use 5-inch square, 2.875-inch-deep outlet boxes with single gang raised device covers for telecommunications and television outlets served by conduits 1" or larger or for 4ea. CAT6A cables.
3. Locate each telecommunications outlet within 3 ft. of a suitable electrical power outlet; group and align power and communications outlets so a symmetrical appearance results.
4. Above the fire alarm control panel, install a 6” x 6” x 4” box.
5. Extend a 1-inch conduit to the nearest telecommunications room.
6. Extend a 1-inch conduit to the fire alarm control panel.
	* 1. Install outlets at locations indicated on the drawings. Outlet boxes shown on the Drawings are in approximate locations unless dimensioned. Verify locations with designer before rough-in.
		2. Locate each outlet within 36 inches of a suitable receptacle power outlet.
		3. Group and align telecommunications outlets and power outlets so a symmetrical appearance results unless specified on drawings.

2.11 PULL AND Junction BOXES

1. Provide a minimum of 6” x 6” x 4” pull and junction boxes with the following minimum dimensions for other boxes: Three times the trade size diameter of the largest conduit in addition to the sum of the remaining conduits.
2. Label all junction boxes “Communications” with mechanically generated labels.

2.12 TERMINAL BOARDS

* + 1. Use 3/4-inch thick APA grade A-B interior plywood without voids.
		2. Paint front, back, and all edges with two coats of white or light gray, intumescent latex, fire-retardant paint with a Class A fire rating.
		3. Use 1/4” aluminum backboards in buildings that will handle or store transuranic waste or other material that will require non-combustible backboards.
		4. Install terminal boards plumb and attach securely to the building structure with approved fasteners into the studs at not more than 30 inches on-center vertically and horizontally.
		5. Install aluminum backboards plumb where required and attach securely to the building structure using approved fasteners or anchors.

2.13 CATEGORY 5E and 6A UTP CABLEs

* + 1. Cable: UL listed as type CMP for use in ducts, plenums, and air handling spaces.
		2. A typical network port consists of three Belden Cat5E or Systimax Cat6A unshielded twisted pair cables.
		3. Handle and install horizontal cable according to cable manufacturers’ instructions. Have the manufacturer’s installation instructions available at the work site.
1. Copper horizontal cable will be UL listed as type CMP (plenum-rated), 4-pair, 23-gauge, Category 6A, unshielded twisted pair (UTP) cable with a maximum outside diameter of 0.265 inches or Category 5E unshielded twisted pair (UTP) cable with a maximum outside diameter of 0.195 inches.
2. Do not subject horizontal cable to a bending radius of less than 6 times the cable outside diameter.
3. Do not subject horizontal cable to more than 25 lb. pulling tension.
4. Do not kink or excessively twist cable.
5. Do not skin or damage cable sheath or conductor insulation.
	* 1. Store cable for 24 hours in the installation area ambient temperature before installing per manufactures specifications.
		2. Do not “through-pull” cables at boxes, fittings, or cabinets where a change of raceway alignment occurs.

2.14 TELECOMMUNICATIONS OUTLET/CONNECTORS

* + 1. Each telecommunications outlet will consist of a plastic faceplate with three 568B configured RJ45 modular connectors with one blank.
		2. Cable connections are made to insulation-displacing-type (IDC) connectors using an approved punch-down tool.
		3. Manufacturers: Krone and Systimax. No substitutions or equivalencies.
		4. Manufacturers/Models: Belden Cat5E 1701A; Systimax Cat6A GigaSpeed X10D 2091B. No substitutions or equivalencies.
		5. Use Systimax 5NF4 CAT5E or CS44P-10 CAT6A for exterior cabling in conduit.
1. execution

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For structured cabling that is subject to seismic design, if Project Spec includes 26 0548.16, and if requirements associated with installation, testing, and inspection of mounting and/or anchorage devices differ from those requirements in 26 0548.16, they must be described herein (in PART 3). Also, if this is applicable, identify special types of seismic-control devices required for each application using the same terminology used for those devices in PART 2.

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* 1. EXISTING WORK
		1. Remove exposed telecommunications cables, including abandoned cables above accessible ceiling finish. Patch surfaces where removed cables passed through building finishes.
		2. Refer to NFPA 70 for removal of abandoned telecommunication raceways and boxes.
		3. Provide access to existing telecommunications cable connections remaining active and requiring access. Modify installation or install access panel.
	2. VERIFICATION OF CONDITIONS
		1. Verify telecommunications pathway installation is complete and supported.
		2. Verify that installation of telecommunications rooms is complete.
		3. Examine raceways and building finishes receiving telecommunications cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.
		4. Contact the LANL Telecommunications Group Quality Assurance Inspector to schedule a structure/structural inspection before cabling is placed.
			1. Minimum conduit size for horizontal cabling: 1-inch unless otherwise specified by the LANL Telecommunications Group.
			2. For OSP conduits requirements refer to LANL Engineering Standards Manual Chapter 19, Section G50 Site Communications.
	3. GENERAL
		1. Install telecommunications system in accordance with LANL ESM Chapter 19 Section D60, NFPA 70 Articles 770 and 800, and requirements in this Section.
		2. Maintain physical separation or barriers between telecommunications pathways and sources of electromagnetic interference.
	4. Cable Tray Installation
		1. Install cable tray around the perimeter of each telecommunications room and above the equipment racks.
			1. Locate cable tray with edge at least 12 inches from perimeter walls.
			2. Provide at least one cable tray dropout fitting for each rack in each telecommunications room; place three additional dropout fittings for cable management. Install cable tray dropout fittings at locations directed by the LANL Telecommunications Group.
			3. Extend cable tray to each open telecommunications equipment rack.
		2. Install vertical cable tray in telecommunications room(s) to support backbone cables rising to upper floors.
		3. Install cable tray system to distribute horizontal cables from the telecommunications room(s) to locations near the telecommunications outlets. Locate cable tray concealed above corridor lift-out ceilings. Connect to the cable tray in the telecommunications room(s).
		4. Install cable tray at least 6 inches away from fluorescent or HID lighting fixtures to help mitigate electromagnetic interference.
		5. Install cable tray so there will be not less than 12 inches of clearance above and to the side of tray to permit access for installing and maintaining cables. Locate cable trays below suspended mechanical equipment, piping, and ductwork that would impede access to the cable tray.
	5. CONDUIT INSTALLATION
		1. Install the telecommunications service entrance conduits as indicated by LANL Telecommunications Group. Turn up the telecommunications conduits at the left rear corner of the telecommunications room adjacent to the left wall. Seal the building end of entrance conduits to prevent rodents, water, or gasses from entering the building.
		2. Install conduits for backbone cables between telecommunications rooms.
			1. Install two 4-inch conduits between vertically associated telecommunications rooms.
			2. Install two 3-inch conduits between telecommunications rooms on the same floor.
		3. Install an individual conduit for telecommunications horizontal cables from each telecommunications outlet to the telecommunications terminal board, raceway or telecommunications cable tray.
		4. Install a 1” conduit from the telecommunications room to the elevator controller in the elevator equipment room. Coordinate installation with elevator subcontractor.
		5. Install a 1” conduit from the telecommunications room to the fire alarm control panel. Install a 6” x 6” x 4” box adjacent to the fire alarm control panel. Connect box to fire alarm control panel with a 3/4” nipple.
		6. Install a 1” conduit from the telecommunications room to the electrical equipment room. Coordinate location with electrical metering equipment installer.
		7. Install a 1” conduit from the telecommunications room to the BAS equipment room per design.
		8. Install a 1” EMT conduit from the telecommunications room to the wireless device locations per design.
		9. Use bends on telecommunications conduits 2 inches trade size and smaller with a minimum inner edge radius 6 times the conduit internal diameter.
		10. Use bends on telecommunications conduits larger than 2 inches trade size with a minimum inner edge radius 10 times the conduit internal diameter.
		11. Do not use conduit bodies for changes in direction or as junction boxes. Mogul LBs may be used in some occasions when a j-box cannot be installed. Prior written approval from LANL Telecommunications Group SME is required.
		12. Install raceway-measuring tape in empty raceways. Leave no less than 12 inches of slack at each end of the tape. Secure each end of tape.
		13. Install conduits and sleeves approximately 4” above structural floors with bushings. Place conduits a minimum of 1-5/8” from the wall.
		14. Place each metallic telecommunications conduit with either an insulated throat fitting or an insulating bushing.
	6. J-hooks, straps, and non-continuous cable support
		1. Where indicated, and wherever cable is placed outside of conduit, raceway, or other continuous supports, communications cable must be supported by approved, wide-base, non-continuous, non-combustible support devices. These devices include, but are not limited to, J-hooks, straps, and saddles.
		2. Non-continuous, horizontal cable support must be spaced at no more than 48” intervals. Additionally, supports must be placed at all changes in direction for individual or groups of cable.
		3. Supports must be securely fastened to permanent building structure. Ceiling tile hanger wire is not considered part of the permanent building structure and must not be used as support. Supports must be installed at the same elevation as cable tray and conduit infrastructure, except where required to maintain minimum clearance around other building systems.
		4. Size supports per manufacturer's requirements based on 70% fill rate for the proposed cable type and cable load.
		5. Supports must be compliant with UL® 2043 and suitable for plenum spaces.

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Seismic: Having flexible connections (between the boxes, or rigid raceways, and other nonstructural components to which these are associated) are one of the requirements for the exemption from seismic design. Ensure such connections are indicated on the drawings in the applicable location(s). This only applies to raceways larger than 2½ inches, as 2½ inch and below are considered flexible.

Regardless of whether the system is exempt from seismic, flexible connections shall be used at seismic-control joints.

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* + 1. Install flexible conduit sections where raceways cross expansion joints or seismic joints, where they are attached to parts of the structure with a potential for differential seismic displacement, and where they connect to equipment with designed anchors (seismic controls) or vibration isolators. Refer to Section 26 0529, *Hangers and Supports for Electrical Systems* [and Section 26 0548.16, *Seismic Controls for Electrical Systems]*.
			1. For raceway systems larger than Trade Size 2-1/2, install a minimum of 4 feet of flexible conduit, maximum length as limited by the NEC.
			*Note: Raceways that are Trade Size 2½ or less are considered flexible for the sake of seismic requirements.*

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Seismic: Edit the following subparagraph to match Project requirements; accommodate minimum 4 inches of movement unless seismic analysis indicates a larger seismic differential displacement in any direction. Coordinate with Section 26 0548.16 – Seismic Controls for Electrical Systems. Refer to LANL ESM Chapter 5 and ASCE 7 Chapter 13.

Delete if not subject to seismic design.

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* + - * 1. Arrange the flexible conduit sections to accommodate 4 inches of movement in all directions.
	1. OUTLET BOX INSTALLATION
		1. Install outlets at locations indicated on the drawings. Outlet boxes shown on the drawings are in approximate locations unless dimensioned. Verify locations with designer before rough-in.
		2. Locate each outlet within 36 inches of a suitable receptacle power outlet.
		3. Group and align telecommunications outlets and power outlets so a symmetrical appearance results.
	2. TERMINAL BOARD INSTALLATION
		1. Install pre-painted terminal board lining three walls of each telecommunications room from the floor to 8 ft. above the floor.
		2. Install terminal boards plumb and attach securely to the building structure with approved fasteners into the studs at not more than 30 inches on-center vertically and horizontally.
		3. Install aluminum backboards plumb where required and attach securely to the building structure using approved fasteners or anchors.
	3. GROUNDING and Bonding
		1. Provide a ground bar for each terminal board.
			1. Furnish 10-inch x 2-inch x 1/4-inch, 14-hole copper ground bar with 1-inch standoff insulators.
			2. Drill ground bar with 7/16-inch bolt holes at (1 and 3/4) x 2-inch NEMA spacing for two-hole irreversible compression lugs.
			3. Locate a telecommunications main grounding bus bar in the entrance telecommunications room, each “satellite” telecommunications room, each server equipment room, and at each telecommunications equipment rack not located in a dedicated room. Place ground equal to the main electrode ground size.
1. Mount busbar on 2‑inch standoff insulators. Label ground bars appropriately (TMGB, TGB, or TB).
2. Bond the telecommunications main grounding bus bar to the building electrical system main electrode ground bar using a dedicated 4 AWG conductor with 600V insulation and connected with two-hole, hydraulically compressed, cable lugs.
3. Terminate the ground cable in telecommunications duct bank(s) to the ground bar in the entrance telecommunications room(s) using hydraulically compressed cable lugs.
	* 1. Ground protector with a green #6 AWG ground to TMGB.
		2. Ground cable tray system to TMGB with a green #6 AWG.
		3. Metal cable trays containing only >50v conductors shall be electrically continuous through approved connections or the use of a green #6 AWG bonding jumper.
		4. Bond cable tray sections, fittings, and connected raceways per NFPA 70, 250.96, using bolted mechanical connectors or bonding jumper.
		5. Where cable tray systems are discontinuous, a green bonding jumper sized #6 AWG shall connect the two sections of cable tray and the raceway or equipment.
		6. Bond all metallic telecommunication raceways to the ground bar. Bond individual or groups of raceways to the ground bar.
		7. Use approved, NRTL-listed fittings and bonding jumpers to make telecommunication raceways electrically continuous.
		8. Use approved, NRTL-listed fittings to bond telecommunication conduits to cable trays.
		9. Install a ground bar at lower right corner of the left wall terminal board in each telecommunications room.
		10. Connect ground bar(s) to the building main electrode ground bar with 4 AWG 600V insulated ground cable.
		11. Terminate 4/0 AWG ground cable in the telecommunications duct bank on the entrance telecommunications room ground bar. Make connections to ground bar(s) and bonded objects using hydraulic-compression-type two-hole lugs. Clean connectors and connection points prior to fastening.
		12. If exposed or potentially subject to physical damage, place grounding cables in Sch. 80 PVC conduits.
		13. If ferrous metal conduit is installed, place grounding bushings on both ends and bond ground wire continuously through bushings to ground bar.
		14. AWG #6 or smaller cable may use one-hole, crimp-on lugs.
		15. Bond telecommunications cable tray to the ground bar with minimum #6 AWG cable.
	1. cABLE INSTALLATION
		1. Handle and install horizontal cable according to cable manufacturers’ instructions. Have the manufacturer’s installation instructions available at the work site.
			1. Do not subject horizontal cable to a bending radius of less than 6 times the cable outside diameter.
			2. Do not subject horizontal cable to more than 25 lb. pulling tension.
			3. Do not kink or excessively twist cable.
			4. Do not skin or damage cable sheath or conductor insulation.
		2. Obtain cable handling and installation requirements for backbone cable from the LANL Telecommunications Group.
		3. Examine raceways to receive cables for compliance with installation tolerances and other conditions. Do not proceed until unsatisfactory conditions have been corrected.
		4. Clean foreign matter from interior of boxes and conduits before installing cables.
		5. Store cable for 24 hours in the installation area ambient temperature before installing per manufactures specifications.
		6. Do not “through-pull” cables at boxes, fittings, or cabinets where a change of raceway alignment occurs.
		7. Comply with Articles 770 and 800 of the NFPA 70.
		8. Install backbone cables between telecommunications closets. Leave 15 feet of slack at each termination point designated by LANL Telecommunications Group. LANL subcontractor will terminate backbone cables.
		9. Install Category 5E or 6A UTP horizontal cables per design from each telecommunications outlet to the telecommunications terminal board or the telecommunications cabinet.
			1. Install 3 cables to each 3-port outlet; this will be typical unless otherwise noted per LANL Telecommunications design.
			2. Leave 15 feet of slack at the cross-connect end and 12 inches of slack at the outlet end.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Delete the following articles if there is no television system on the project.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. Install two horizontal cables from each monitor (aka AV) outlet to the telecommunications room equipment rack per design provided by the LANL Telecommunications Group. Leave 8 feet of slack cable at the equipment rack and 12 inches at the outlet end.
		2. Terminate horizontal telecommunications cables on telecommunications outlet/connectors in accordance with designation T568B, per figure (6-2) “Optional Eight Position Jack Pin/Pair Assignments” reproduced below, using an approved punch-down tool. Leave 8" of slack in cables. Coil cable into outlet box and install faceplate on outlet box.



* + 1. Terminate horizontal telecommunications cables on cross connect equipment with an approved punch-down tool. Terminate cables in ascending order by room number, cubicle or workstation, and port number as directed by the LANL Telecommunications Group.
	1. Identification
		1. Uniquely identify each cable and port faceplate, and each fiber housing panel cover in the rack(s). Consult the LANL Telecommunications Group for latest requirements (may differ slightly from the figure below). Provide a tag made with a mechanically produced label with black text on white background.
			1. For communication cable, provide label at both ends using a numbering scheme as follows:


 **New Port Layout**

* + 1. Install an identifying label on each conductor connected to the telecommunications ground bar(s).
		2. Place white tape at intervals not to exceed 10’ where possible and in change of direction to identify proposed interior telecommunications routes for all new and legacy installations.
	1. Fiber
		1. Fiber optic horizontal cable will be UL listed as type OFNP (plenum-rated) cable with an outside diameter of approximately 0.24 inches.
		2. The installing subcontractors shall terminate all fiber optical backbone cables.
	2. ACCEPTANCE TESTING
1. Copper
	* + 1. Perform a channel test acceptance test with a DSX Fluke cable analyzer on each installed and terminated Category 5E or 6A UTP horizontal cable per. Replace cables that do not pass acceptance tests. Marginal pass test results will not be accepted.
			2. Provide electronic test results in Link Ware format to the LANL Telecommunications Group via LANL Subcontract Representative. LANL will review all test results for conformance and approve when acceptable.
		1. FIBER
			1. Test using a Fluke optical time domain reflectometer (OTDR).
				1. The loss across a multimode fiber connector pair shall not exceed 0.60 dB of loss per mated pair total value plus 0.10 dB loss per 100 feet of fiber cable length.
				2. The loss across a single mode fiber connector pair shall not exceed 0.50 dB per mated pair plus 0.03 dB loss per 100 feet of fiber cable length.
			2. Test using the launch and tail method.
			3. If test reveals a failure at the splice or otherwise, a second bidirectional Fluke power meter test is required after repair or replacement.

END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification 27 1000, Rev. 9, dated July 19, 2023.