SECTION 26 0533

Raceways and Boxes FOR ELECTRICAL SYSTEMS

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LANL MASTER SPECIFICATION

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

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 specifier’s 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, contact the Engineering Standards Manual Electrical[POC](http://engstandards.lanl.gov/POCs.shtml#elec). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 01, *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 specification are not exempt from seismic design per ASCE 7 paragraph 13.1.4 then, prior to attempting to edit 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.

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1. GENERAL
	1. SECTION INCLUDES

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Edit the following paragraphs to match Project requirements. Delete items not applicable to Project.

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* + 1. Raceways and fittings
		2. Outlet boxes
		3. Pull and junction boxes, including conduit bodies
		4. Floor boxes
		5. Surface metal raceways
		6. Wireway.

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Seismic: If the items covered by this specification are exempt from seismic design then delete both of the following subparagraphs.

* 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
		1. Submit the following in accordance with project submittal procedures. Include data substantiating that materials comply with specified requirements.

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Edit the following subparagraphs to match Project requirements. Delete items not applicable to Project.

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* + - 1. Catalog data describing floor boxes.
			2. Catalog data describing surface metal raceway.
			3. Catalog data describing wireway.
	1. QUALITY ASSURANCE
		1. Comply with the *National Electrical Code* (NEC) for unlisted components and for installation requirements.
		2. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL), where such products are required by the NEC to be listed or such products contain an electrical hazard as follows:
			1. For AC circuits – Greater than 50 volts
			2. For DC circuits and/or batteries – Greater than 100 volts
	2. RECEIVING, STORING, AND PROTECTING
		1. Receive, store, protect, and handle products according to NECA 1 – Standard *Practices for Good Workmanship in Electrical Construction*.
1. PRODUCTS

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For items that are not exempt from seismic, 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).

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* 1. PRODUCT OPTIONS AND SUBSTITUTIONS
		1. Alternate products may be accepted; follow Section 01 2500, *Substitution Procedures*.

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Seismic: Delete article 2.2 if items are 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 raceway, or boxes, 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 raceway, or boxes, are Designated Seismic Systems 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. COATINGS AND FINISH
		1. Provide products that are suitable for the environment in which the products will be installed and used.
		2. The following raceway colors shall only be used for the indicated purposes:
			1. Blue: for building automation systems
			2. Red: for fire alarm systems
			3. Raceways shall not be painted to match the building finish.

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Edit the following articles to match Project requirements. Delete materials not applicable to Project.

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* 1. ELECTRICAL METALLIC TUBING AND FITTINGS (EMT)
		1. Furnish galvanized electrical metallic tubing (EMT) that conforms to UL797 – *Electrical Metallic Tubing*, NEMA C80.3 – *Steel Electrical Metallic Tubing (EMT)*.
		2. Furnish compression- or set-screw-type fittings that meet UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*. Furnish insulated-throat connectors.
	2. INTERMEDIATE METAL CONDUIT AND FITTINGS (IMC)
		1. Furnish intermediate metal conduit (IMC), nipples, elbows, and couplings that conform to UL1242 – *Intermediate Metal Conduit*, NEMA C80.6 – *Electrical Intermediate Metal Conduit (EIMC)*.
		2. Furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that meet the requirements of UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*.
	3. RIGID METAL CONDUIT AND FITTINGS (RMC)
		1. Furnish rigid metal conduit (RMC) that meets the requirements of UL6 – *Rigid Metal Electrical Conduit*, NEMA C80.1 – *Electrical Rigid Steel Conduit (ERSC)*.
		2. Furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that meet the requirements of UL514B and ANSI/NEMA FB1.
	4. RIGID NON-METALLIC CONDUIT AND FITTINGS (RNC)
		1. Furnish rigid non-metallic conduit (RNC) that conforms to UL651 – *Schedule 40 and 80 Rigid PVC Conduit*, NEMA TC 2 – *Electrical Plastic Tubing and Conduit*.
		2. Furnish non-metallic, solvent-welded socket fittings that meet the requirements of UL514C – *Non-Metallic Fittings for Conduit and Outlet Boxes*, and NEMA TC 3 – *PVC Fittings for Use with Rigid PVC Conduit and Tubing*.
	5. FLEXIBLE METAL CONDUIT AND FITTINGS
		1. Furnish galvanized steel flexible metal conduit that meets the requirements of UL1 – *Flexible Metal Electrical Conduit*.
		2. Furnish zinc-plated fittings that meet the requirements of UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*. Furnish insulated throat connectors.
	6. LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS
		1. Furnish liquid-tight flexible metal conduit that meets the requirements of UL360 – *Liquid-Tight Flexible Steel Conduit, Electrical*.
		2. Furnish zinc-plated malleable iron or zinc-plated steel liquid-tight fittings that meet the requirements of UL514B – *Fittings for Conduit and Outlet Boxes*, and ANSI/NEMA FB1 – *Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*. Furnish insulated-throat connectors.
	7. INSULATING BUSHINGS
		1. Provide NRTL-listed, insulating bushings with 105-deg C-rated insulation.
		2. Manufacturer: O-Z/Gedney, Type IB.
	8. GROUNDING BUSHINGS
		1. Provide NRTL listed, 150-deg C-rated insulated-throat grounding bushings with lay-in type ground cable lugs

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Edit the following articles to match Project requirements: delete if not applicable.

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* 1. EXPANSION FITTINGS
		1. Furnish NRTL listed expansion fittings with hot dipped galvanized malleable iron body, factory installed packing and a bonding jumper.
		2. Manufacturer: O-Z/Gedney, Type AX, TX or EXE with Type BJ bonding jumper.

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* 1. RACEWAY SEALS
		1. Duct Sealant
			1. Furnish a two-part, foam-based, duct sealing system.
			2. Provide sealing compound specifically listed for use with the foam damming materials.
			3. Provide sealing compound that is identified for use with the conductor or cable insulation.
			4. Manufacturer: Polywater FST-250.
		2. Sealing Fittings for Use in Hazardous-Classified Locations
			1. Furnish zinc-plated, malleable iron sealing fittings that meet the requirements of UL1203 Explosion-Proof and Dust-Ignition-Poof Electrical Equipment for Use in Hazardous (Classified) Locations.
			2. Select each sealing fitting so the cross-sectional area of conductors passing through the seal is not more than 25 percent of the cross-sectional area of a rigid metal conduit of the same trade size unless the fitting is specifically identified for a higher percentage of fill.
			3. Provide sealing compound specifically listed for use with the sealing fitting.
			4. Manufacturer: Crouse-Hinds Type EYS, EYSX, EYD.
	2. CORROSION PROTECTION TAPE
		1. Furnish pressure-sensitive, 10 mil thick. PVC based tape for corrosion protection of metal conduit and fittings.
		2. Manufacturer: 3M, Type 50.
	3. RACEWAY MEASURING TAPE
		1. Furnish raceway measuring tape with permanently printed measurements in one-foot increments and minimum 1200 lb average breaking strength.
		2. Manufacturer: Greenlee “39243”.

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* 1. SURFACE METAL RACEWAY
		1. Furnish surface metal raceway that meets the requirements of UL5 – *Surface Metal Electrical Raceways and Fittings*.
		2. Furnish surface metal raceway fabricated from cold rolled galvanized steel with a thickness of not less than 0.040 inches and coated with a baked enamel finish.
		3. Furnish fittings required for a complete installation.
		4. Manufacturer: Wiremold “500,” “700,” or “4000” series.

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* 1. POWER AND COMMUNICATIONS SURFACE METAL RACEWAY
		1. Furnish power and communications surface metal raceway that meets the requirements of UL5 – *Surface Metal Electrical Raceways and Fittings*.

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Select B, C, or D to match Project requirements. Gray is a standard finish; it should be used in utilitarian spaces, where it will match or accent architectural finishes, or where the raceway will be field painted. Ivory should be used where it will match or accent architectural finishes. Stainless steel should be used only in laboratory spaces where there is the possibility of corrosion.

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* + 1. [Furnish power and communications surface metal raceway fabricated from cold rolled galvanized steel with a thickness of not less than 0.04 inches and coated with a gray, baked-enamel finish.]
		2. [Furnish power and communications surface metal raceway fabricated from cold rolled galvanized steel with a thickness of not less than 0.04 inches and coated with a polyester topcoat over an ivory colored base.]
		3. [Furnish power and communications surface metal raceway fabricated from Type 304 stainless steel with a thickness of not less than 0.04 inches.]
		4. Raceway shall consist of a metal base and a snap-on metal cover.
		5. Nominal dimensions of the assembled raceway shall be 4-3/4 inches wide by 1‑3/4 inches high.
		6. Furnish fittings required for a complete installation to include a full-length partition separating the power wiring from the communications cables. [Provide suitable internal fittings to accommodate bending radii for fiber optic cables.]

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* + 1. Provide a plastic snap-in plate for each 36 inches of the power and communications surface metal raceway. Each snap-in plate shall include one isolated ground duplex receptacle and one connector faceplate for two RJ11/RJ45 telecommunications connectors.
		2. Manufacturer: Wiremold “4000” or “6000”.

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* 1. WIREWAY
		1. Provide NRTL listed, [general purpose] [oil-tight and dust-tight] [rain-tight] type wireway with covers, elbows, tees, and fittings required for a complete system.
		2. Supply wireway [with manufacturer's standard] [without] [with bottom only] knockouts.
		3. [Provide 45 degree angle and tee fittings to accommodate bending radii for fiber optic cables.]
		4. Manufacturer: Hoffman
	2. OUTLET BOXES
		1. Provide outlet boxes selected for specific installations using the guidance in NEMA OS 3, *Selection and Installation Guidelines for Electrical Outlet Boxes*, and the requirements of this Section.
		2. For dry locations provide galvanized steel outlet boxes that comply with UL Standard 514-A *– Metallic Outlet Boxes* and ANSI/NEMA OS1 *– Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports*.
			1. For fire detection and alarm device outlets use boxes specified in Section 28 4600.
			2. For flush outlets in stud walls or above-grade cast-in-place concrete walls use 4-inch square or 4-11/16 square boxes; provide deeper boxes or multiple gang boxes as required to fit devices. Provide raised device covers that match the thickness of the wallboard and the number of devices. Provide supplemental box supports to prevent movement of the box.
			3. For flush outlets in above-grade masonry walls use masonry boxes with conduit knockouts. Provide boxes with depth suitable for the masonry unit size. Provide multiple gang boxes as required by the number of devices.
			4. For surface outlet boxes in EMT raceway systems, use 4 inch or 4 11/16 inch square boxes. Provide deeper boxes or multiple gang boxes as required to fit devices. Provide square surface covers that match the installed device and have not less than two holes for securing the device to the cover.
		3. For damp or wet locations and for surface-mounted RMC or IMC raceway systems, provide outlet boxes that comply with UL Standard 498 and 514, ANSI/NEMA FB1.
			1. For lighting fixture outlets use 4-inch, round, cast gray or malleable iron boxes with threaded hubs, or as required by the manufacturer.
			2. For flush or surface wall-mounted outlet boxes, use cast gray or malleable iron boxes with threaded hubs. Provide multiple gang boxes as required to fit devices. Provide gasketed cast gray, malleable-iron, or cast copper-free aluminum covers that match the installed device and have not less than two holes for securing the device to the cover.

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* 1. RECESSED FLOOR BOXES
		1. Provide recessed floor boxes with threaded conduit entrances for use in floor slabs on grade or below grade. Floor boxes in suspended floor slabs may be the formed steel type.
		2. Provide fully adjustable floor boxes as follows:
			1. External means to adjust the height of the box before concrete is placed.
			2. Internal means to adjust the cover to be flush and level with the finished floor after the flooring material is placed.
		3. Provide floor boxes with brass covers as required for the system or device to be installed in the box.
		4. Provide carpet flanges or covers with integral carpet flanges for floor boxes in carpeted areas.
		5. Manufacturer: Hubbell

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* 1. MULTI-SERVICE RECESSED FLOOR BOXES
		1. Provide fully adjustable multi-service recessed floor boxes for use in floor slabs on grade or below grade. Multi-service floor boxes in suspended floor slabs may be the formed steel type.
		2. Provide multi-chamber floor boxes with provisions for routing wires between chambers.
		3. Provide service plates as required for the systems or devices to be installed in the floor box.
		4. Provide flush covers with integral carpet flange and cable doors.
		5. Manufacturer: Hubbell
	2. PULL AND JUNCTION BOXES
		1. For pull and junction boxes, the NEC size requirements must be met:
			1. For conductors 6 AWG and smaller, the conditions of 314.16 must be met
			2. For conductors 4 AWG and larger, the conditions of 314.28 must be met
		2. For dry locations in clean, non-contamination environments use galvanized sheet steel pull and junction boxes that comply with UL Standard 50 Type 1 and the NEC as to size and construction.
		3. Conduit bodies are acceptable so long as the NEC requirements, in paragraph A above, are met.
		4. For dry locations in dusty or possible contamination (e.g. beryllium, explosives, or uranium) environments use galvanized steel pull and junction boxes that comply with UL Standard 50 Type 12 and the NEC as to size and construction. Use boxes not less than 6 inches square x 4 inches deep with gasketed covers. Provide larger boxes as required by the number and size of raceways and conductors.
		5. For damp or wet, non-corrosive locations, in raceway runs up to trade size 3/4, provide cast gray or malleable iron pull and junction boxes with threaded hubs and gasketed cast gray or malleable iron or cast copper-free aluminum covers.
		6. For damp or wet, non-corrosive locations, in conduit runs trade size 1 and larger, provide galvanized sheet-steel pull and junction boxes and covers that comply with UL 50 Type 3R.

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* + 1. For damp or wet, non-corrosive locations that are subject to hose-directed water, provide pull and junction boxes and covers that comply with UL 50 Type 4.

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* + 1. For damp or wet, corrosive locations provide pull and junction boxes and covers that comply with UL 50 Type 4X.

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* + 1. For locations subject to occasional submersion, provide pull and junction boxes and covers that comply with UL 50 Type 6.

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* + 1. For in-ground flush-mounted cast metal boxes, provide UL 50 Type 6 boxes with flanged, recessed cover.
			1. Material: Galvanized cast iron or galvanized gray or malleable iron.
			2. Cover: Non-skid cover with neoprene gasket and stainless steel screws.
			3. Identification: Permanent mark or logo on cover prominently identifying the function of the enclosure in accordance with NEC requirements.

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* + 1. For in-ground, non-metallic, open-bottom handholes, use products that are NRTL-listed to ANSI/SCTE 77, *Specification for Underground Enclosure Integrity*.
			1. Material: Polymer concrete.
			2. Minimum ANSI/SCTE 77 load rating:
				1. Located in sidewalks: Tier 8.
				2. Located in driveways, parking lots, and off-roadway locations: Tier 15.
			3. Size: Up to 30” x 48”
			4. Cover: Non-skid cover with stainless steel cover bolts.
			5. Identification: Permanent mark or logo on cover prominently identifying the function of the enclosure in accordance with NEC requirements.
			6. Manufacturer: Quazite “Style PC, PG, or PT”
		2. Provide connection points for equipment grounding conductors in each box.
1. EXECUTION

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For raceways, or boxes, that are not exempt from seismic, 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

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* + 1. Cap, plug, or seal remaining raceway openings to restore the original fire rating [and acoustical STC rating] of floors, walls, and ceilings after electrical demolition. Patch surfaces to match existing.
		2. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

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Edit the following paragraph to match Project requirements.

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* + 1. Extend existing raceway and box installations using materials and methods [compatible with existing electrical installations, or] as specified.
		2. Clean and repair existing raceway and boxes to remain or to be reinstalled, as a part of the job scope.
	1. EXAMINATION
		1. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.
	2. GENERAL
		1. Install complete systems of raceways and boxes for wiring systems.
		2. Install raceways and boxes according to NECA 1 – *Standard Practices for Good Workmanship in Electrical Construction*, NECA 101 – *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*, NECA 111 – *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)*, the NEC, the manufacturer’s instructions, and requirements in this Section.
		3. Raceway termination points and box locations shown on the Drawings are in approximate locations unless dimensioned. Verify locations before rough‑in.
		4. Raceway routing is shown on the Drawings in approximate locations unless dimensioned. Coordinate routing with structure and with work of other trades. Route as required for a complete wiring system.
		5. Ground and bond raceways and boxes as required in Section 26 0526, *Grounding and Bonding for Electrical Systems*.

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Edit the following article to match project requirements; coordinate with Section 26 0548.16.

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* + 1. Support raceways and boxes in accordance with the requirements the National Electrical Code; Section 26 0529, *Hangers and Supports for Electrical Systems*; and Section 26 0548.16, *Seismic Controls for Electrical Systems*.
		2. Identify raceways and boxes as required in Section 26 0553, *Identification for Electrical Systems*.
		3. Arrange raceway and boxes to maintain headroom and present neat appearance.
		4. Install knockout closures in unused openings in boxes or raceways.
	1. RACEWAY INSTALLATION
		1. For low-voltage wiring systems (less than 1000 volts) use raceway materials according to the NEC and the following:
			1. Outdoors–Underground:
				1. Direct buried: Use RNC, tape-wrapped RMC, or tape-wrapped IMC. Do not use RNC where subject to physical damage. Install with 24 inches minimum cover from top of conduit to finished grade or top of paving.
				2. Concrete encased: Use RNC, RMC, or IMC for concrete encased underground work. Install with 24 inches minimum cover from top of encasement to finished grade or paving.
				3. Align and support ducts to prevent trapping moisture at any point.
			2. Outdoors–Exposed: Use RMC or IMC.
			3. Outdoor corrosive locations (including cooling towers): Use corrosive-resistant raceways and fittings.
			4. Outdoors–Concealed: Use RMC or IMC for concealed outdoor work. Do not use bare RMC or IMC in direct contact with earth. EMT may be used for concealed outdoor work where not in contact with earth, not encased in concrete, and where not exposed to deteriorating agents.
			5. Indoors–Exposed outside of designated electrical rooms or telecommunications rooms:
				1. Exposed to severe physical damage during or after installation: Use RMC or IMC.
				2. Exposed to moisture: Use RMC or IMC.
				3. Exposed to corrosives: Use corrosive resistant raceways and fittings.
				4. Not exposed to deteriorating agents and not subject to severe physical damage during or after installation: Use RMC, IMC, or EMT.
			6. Indoors–Concealed:
				1. Within masonry or cast-in-place concrete walls or floors: Use RMC or IMC.
				2. Direct-buried under building floor slabs on grade: Use RNC, tape-wrapped RMC, or tape-wrapped IMC. Locate top of conduits not less than 12 inches below the bottom of the concrete slab. Install warning tape approximately 6 inches above the conduits; install multiple warning tapes above parallel conduit runs wider than 18 inches.
				3. Concrete encased under building floor slabs on grade: Use RNC, RMC, or IMC. Locate top of concrete encasement not less than 12 inches below the bottom of the concrete slab. Install warning tape approximately 6 inches above the concrete encasement; install multiple warning tapes above concrete encasements wider than 24 inches.

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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).

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 determined by the NEC.
				*Note: Raceways that are Trade Size 2 ½, or less are considered flexible for the sake of seismic requirements.*

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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.

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* + - * 1. Arrange the flexible conduit sections to accommodate 4 inches of movement in all directions.
				2. Use liquidtight flexible metal conduit outdoors, in wet, damp, or corrosive indoor locations, and in mechanical rooms. Use flexible metal conduit in dry indoor locations.
				3. Install pull boxes as required to comply with the limits on raceway bends and distance between pull points in the RACEWAY INSTALLATION article.
			1. Connection to vibrating equipment (including hydraulic, pneumatic, or electric solenoid or motor‑driven equipment): Use a minimum of 24 inches; maximum length as determined by the NEC:
				1. Outdoors: Use liquidtight flexible metal conduit.
				2. In mechanical rooms: Use liquidtight flexible metal conduit.
				3. Wet, damp, or corrosive indoor locations: Use liquidtight flexible metal conduit.
				4. Dry indoor locations: Use flexible metal conduit.
			2. Connections to luminaires: Use flexible metal conduit, metal-clad cable, or manufacturer’s whips, for conductors to luminaires above suspended ceilings.

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Edit the following to match Project requirements: delete if not applicable.

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* + 1. For medium-voltage wiring systems (1 kV or greater but less than 100 kV) use raceway materials according to the NEC and the following:
			1. Underground, both outside and inside the perimeter of the building, red concrete encased: Use RNC, RMC, or IMC for concrete encased underground work. Install with 24-inches-minimum cover from top of encasement to finished grade, paving, or building slab.
			2. Indoors or outdoors, concealed or exposed: Use RMC or IMC.
		2. Use trade size 3/4 or larger raceways to enclose multiple conductors larger than 12 AWG.
		3. Use raceways to enclose fire alarm wiring. See Section 28 4600 for size and type of raceways to be used to enclose fire alarm wiring.
		4. Conceal raceways, unless otherwise indicated on the Drawings, with finished walls, floors and ceilings. Unless otherwise indicated on the Drawings, install concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions.
		5. Install expansion fittings where embedded raceways cross building expansion joints, or where needed for thermal expansion and contraction
			1. For calculating where thermal expansion fittings are needed, use a 100 deg F temperature difference with 0 degrees as the minimum and 100 degrees as the maximum. The gap must be set on the day of installation, based on the temperature at the time of installation.
		6. Use sealing locknuts, hubs, or similar water-resistant fittings on raceways entering the top of switchgear, switchboards, motor control centers, panelboards, cabinets, pull boxes, and similar enclosures that are in damp and/or wet locations.
		7. Install insulating bushings or connectors with an insulated throat to protect conductors or cables at raceway terminations.
		8. Install raceways as shown on the Drawings or with the following limits of bends and distance between pull points:
			1. Less than 50 ft., follow the NEC.
			2. 50 ft. to 100 ft., a maximum of 3 equivalent 90 degree bends.
			3. 100 ft. to 150 ft., a maximum of 2 equivalent 90 degree bends.
			4. 150 ft. to 200 ft., a maximum of with 1 equivalent 90 degree bend.
			5. Over 200 ft., a straight run with no bend.
		9. Stub‑Up Connections:
			1. Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor or equipment pad.
			2. Extend conductors to equipment with rigid steel conduit, or intermediate steel conduit. Flexible metal conduit may be used 6 inches above the floor.
			3. Where equipment connections are not made under this Subcontract, install threaded insert plugs set flush with the floor.

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Edit the following article to match Project requirements; delete if not applicable.

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* + 1. Raceway Sealing:
			1. Sealing is required in the following locations. A sealing fitting is not required, but may be used. The sealing compound must be identified for use with the conductor or cable insulation.
				1. Raceways pass from exterior locations to interior locations.
				2. Raceways pass from warm locations to cold locations, such as the boundaries of refrigerated and air‑conditioned spaces.
				3. Raceways enter or leave radiological "controlled areas.”
				4. Raceways go between areas where air pressure differential must be maintained.
				5. Raceways enter an enclosure protected by a clean-agent, total-flooding fire suppression system.
				6. Otherwise required by the NEC.
			2. Locate conduit fittings or boxes at suitable, approved, accessible locations to provide access to the interior of the conduit to be filled with duct sealant.
			3. Install sealant in accordance with the manufacturer’s written instructions.
		2. Sealing Fittings
			1. Where conduits enter or leave NEC Class I hazardous locations.
				1. Install conduit sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with NRTL‑listed conduit sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

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Edit the following article to match Project requirements: delete if not applicable.

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* + 1. Join nonmetallic raceways using cement as recommended by manufacturer. Wipe nonmetallic raceways dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, or for the manufacturer’s recommended time period.
		2. Do not use RNC 90 degree elbows larger than trade size 2; use tape-wrapped RMC, or tape-wrapped IMC for trade size 2.5 and larger 90 degree elbows.
		3. Maintain the following minimum clearances between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C):
			1. 6 inches at perpendicular crossings.
			2. 12 inches between parallel runs.
		4. For above ground installations, avoid moisture traps in raceway systems; provide boxes with drain fittings at low points in raceway systems.
		5. Install corrosion protection tape on metal raceways and fittings that are in contact with soil using half-lapped wrappings.
		6. Install grounding bushings at the following locations:
			1. On metallic raceways entering enclosures through concentric, eccentric or oversize knockouts.
			2. On metallic raceways that terminate to a metallic enclosure without effective electrical connection such as locknuts or threaded bushings.
		7. Install conduit measuring tape in empty raceways. Leave not less than 12 inches of slack at each end of the tape. Secure each end of tape.

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Edit the following article to match Project requirements: delete if not applicable.

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* 1. CONCRETE ENCASEMENT
		1. Concrete-encase underground low-voltage (less than 1000 volts) electrical service and feeder raceways outside the perimeter of the building foundation, if indicated on drawings
		2. Concrete-encase underground medium-voltage (1 kV or greater but less than 100 kV) electrical service and feeder raceways outside and inside the perimeter of the building foundation. Use red-colored concrete.
		3. Concrete-encase underground electrical branch circuit, communications, and alarm raceways, if indicated on the Drawings.
		4. Provide not less than 3 inches of concrete coverage on all sides of raceways.
		5. Refer to Section 03 3053, *Miscellaneous Cast-in-Place Concrete* for basic material and installation requirements. Concrete finishing is not required for this application.
			1. Use a pre-approved concrete mix design that is suitable for exterior use exposed to freezing and thawing.
			2. Use un-colored concrete to encase raceways for low-voltage wiring systems
			3. Use red-colored concrete to encase raceways for medium voltage cables.
				1. Use 2.0 lb. of pigment per 94 lb. sack of cement.
				2. Manufacturer: Rockwood Industries/Davis Colors, No. 1117.
		6. Refer to Section 33 7119, *Electrical Underground Ducts and Manholes* for requirements pertaining to underground ducts for medium-voltage power, telecommunications, and secure communications.

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Edit the following article to match Project requirements: delete if not applicable.

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* 1. Fire-stopping
		1. Install an NRTL-approved fire-stop system at each electrical penetration in a fire-rated wall, floor, or partition.
		2. Refer to Section 07 8400, *Firestopping* for materials and installation requirements.
	2. OUTLET BOX INSTALLATION
		1. Install outlet boxes with centers at the following heights unless noted otherwise on the Drawings:
			1. Receptacle, telephone, and data outlets:
				1. Common Areas (such as conference and break rooms): 18 inches above finished floor.
				2. Offices and Workstations: 7 inches above finished floor.
			2. Receptacle, telephone and data outlets at lab benches and counters -- use mounting heights specified in Section 27 3000.
			3. Light switches: top of outlet box not more than 48 inches above finished floor and within 6 inches of door frame.
			4. Thermostats: top of outlet box not more than 48 inches above finished floor.
			5. Wall mounted emergency lights: 80 inches above finished floor or 12 inches below the ceiling; whichever is lower.
			6. Fire alarm audible/visible alarm devices and pull stations: use mounting heights specified in Section 28 4600
		2. Coordinate outlet box locations with modular furniture and associated hangers.
		3. Where the Drawings show outlets as adjacent, align outlet boxes with each other and group them symmetrically.
		4. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726, *Wiring Devices*.
		5. Install a multi-gang box where more than one device is mounted together. Do not use sectional type boxes.
		6. Install box with plaster ring for single or multiple device outlets.
		7. Use flush mounted outlet boxes in finished areas.
			1. Install flush outlet boxes and fittings in walls and ceilings so that front edge is flush with the finished surface. Repair broken wall or ceiling surfaces so no gaps or open spaces exceed 1/8 inch at the edge of boxes or fittings.
			2. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
			3. Do not install flush mounting boxes back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
			4. Secure flush mounting boxes to interior wall and partition studs. Accurately position to allow for surface finish thickness.
			5. Install stamped steel bridges to fasten multiple flush mounting outlet boxes between studs.
			6. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
		8. Install adjustable steel channel fasteners for hung ceiling outlet box.
		9. Install partitions in boxes as follows:
			1. Between 277 volt devices
			2. Between 277 volt devices and 120 volt devices.
			3. Between low voltage control switches and both 120 volt and 277 volt devices.
		10. Install a blank cover plate on each outlet box in which no device is installed.

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Edit the following section to match Project requirements: delete if not applicable.

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* 1. FLOOR BOX INSTALLATION
		1. Install floor boxes at locations indicated on the Drawings:
		2. Set height of boxes, before concrete is placed, so cover will be flush with the finished floor surface.
			1. Determine the type and thickness of flooring materials and set height of boxes accordingly.
			2. In setting box heights, take into account structural deflection that will occur when concrete is placed.
		3. Install devices, covers, and carpet flanges after flooring materials are installed; adjust boxes so covers are level and flush with flooring material.
	2. PULL AND JUNCTION BOX INSTALLATION
		1. Install pull and junction boxes as shown on the Drawings and as required for splices, taps, wire pulling, and compliance with regulatory requirements.
		2. Install pull boxes as required to comply with limits on raceway bends and distance between pull points in the RACEWAY INSTALLATION section.
		3. Install indoor pull and junction boxes in accessible locations above accessible ceilings and in unfinished spaces. Position boxes so covers can be removed. Place boxes to maintain headroom.

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Edit the following paragraph to match Project requirements: delete if not applicable.

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* + 1. Install a concrete collar around handholes not placed in sidewalks or pavement.

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Edit the following paragraph to match Project requirements: delete if not applicable.

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* 1. WIREWAY INSTALLATION
		1. Install wireways at locations indicated on the Drawings.

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Edit the following article to match Project requirements: delete if not applicable.

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* 1. SURFACE METAL RACEWAY INSTALLATION
		1. Install surface metal raceway at locations indicated on the Drawings.
		2. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces.
	2. CLEANING
		1. Clean interior of boxes to remove dust, debris, and other material.
		2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
		3. Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.
	3. FIELD QUALITY CONTROL
		1. Provide final protection and maintain conditions to ensure that coatings and finishes are without damage or deterioration at final inspection.

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Edit the following paragraph to match Project requirements: delete inspection points that are not applicable to the Project.

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* + 1. Inspection Points – Provide not less than 2 working days advance notice to the LANL STR for the following LANL inspection points. In the notice identify the particular areas of the Project for which LANL inspection is requested. Correct deficiencies identified during inspections. If the requested LANL inspection does not occur within 1 working day of the LANL inspection point, work may proceed.
			1. Underground raceways: After raceways have been installed but before concrete-encasement or trench backfilling commences. LANL inspection may include but is not limited to:
				1. Correct raceway material and size,
				2. Proper raceway spacing and supports,
				3. Correct raceway stub-up locations.
				4. Raceway connection and coupling integrity.
			2. Raceway systems in concrete walls, floors, slabs, and equipment pads: After raceways and boxes have been installed but before concrete placement commences. LANL inspection may include but is not limited to:
				1. Correct raceway system materials and sizes,
				2. Proper raceway spacing and supports,
				3. Raceway system connection integrity,
				4. Correct raceway stub-up locations.
				5. Correct floor box locations and proper height setting,
				6. Correct outlet box locations.
			3. Raceway systems in drywall partitions: After raceways and boxes have been installed but before drywall installation that would cover the raceway system commences. LANL inspection may include but is not limited to:
				1. Correct raceway system materials and sizes,
				2. Proper supports for raceways and boxes,
				3. Raceway system connection integrity,
				4. Correct outlet box locations and proper depth setting.
			4. Raceway systems above ceilings: After raceways and boxes have been installed but before ceiling system installation commences. LANL inspection may include but is not limited to:
				1. Correct raceway system materials and sizes,
				2. Proper supports for raceways and boxes,
				3. Raceway system connection integrity,
				4. Correct outlet box locations and proper depth setting.
			5. Fire-stop installation: After fire-stop system has been installed but before covering the installation (e.g., with gypsum board) commences. LANL inspection may include but is not limited to:
				1. Proper selection and installation of fire stop system.

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 Section 26 0533 Rev. 8, dated December 19, 2018.