SECTION 25 0533

Raceways and Boxes FOR BAS ELECTRICAL SYSTEMS

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LANL MASTER SPECIFICATION

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.

To seek a variance from requirements in the specifications that are applicable, contact the Engineering Standards Manual Chapter 8[POC](http://engstandards.lanl.gov/POCs.shtml#ic). 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.

NOTE: This specification overrides Division 26 electrical installation requirements for BAS systems only. If the designer wishes to use Division 26 installation requirements for specific portions of the BAS design, then these must be clearly noted on the drawings as a deviation from this specification requirement.

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1. GENERAL
   1. SECTION INCLUDES
      1. Conduits and fittings
      2. Outlet boxes
      3. Pull and junction boxes
      4. Surface metal raceways
      5. Wireway
   2. SUBMITTALS
      1. Submit the following per project submittal procedures:
         1. Catalog Data: Submit catalog data describing surface metal raceway. Include data substantiating that materials comply with specified requirements.
         2. Catalog Data: Submit catalog data describing wire way. Include data substantiating that materials comply with specified requirements.
   3. QUALITY ASSURANCE
      1. Comply with the *National Electrical Code* (NEC) for components and installation.
      2. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL).
   4. RECEIVING, STORING, AND PROTECTING
      1. Receive, store, and protect, and handle products according to NECA 1 – Standard *Practices for Good Workmanship in Electrical Construction*.
   5. Applicability
      1. Raceways and boxes used for low voltage (<100VDC and < 50VAC) building automation systems (BAS).
2. PRODUCTS
   1. product options and substitutions
      1. Alternate products may be accepted; follow Section 01 2500 – *Substitution Procedures*.
   2. Sizing
      1. When specific sizes for raceways, electrical j-boxes and enclosures are not specified in the design drawings, it is the installer’s responsibility to size such items to accommodate the required number of cables and wires to not exceed NEC maximum fill requirements.
      2. When placing cables in raceways, the outside dimension of the cable shall be used to determine fill cross sections.
      3. BAS control cables and wires are not considered current carrying conductors and thus are not subject to NEC Table 310.15(B)(3)(a) (*2014*) adjustment factors.
   3. COATINGS
      1. Provide products with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic that is suitable for the environment in which the product will be installed and used.
   4. INTERMEDIATE METAL CONDUIT AND FITTINGS (IMC)
      1. Furnish intermediate metal conduit (IMC) ,nipples, elbows and couplings that conform to UL1242 – *Intermediate Metal Conduit*, ANSI 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*.
   5. 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.
   6. 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. EMT conduit 1-inch trade size and smaller shall be blue in color to distinguish the conduit as BAS controls. Reused existing IMC conduit does not need to be replaced to meet this requirement.
      3. Furnish compression or set-screw type 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. 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 malleable iron 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.
   8. 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.
   9. INSULATING BUSHINGS
      1. Provide NRTL listed insulating bushings with 105 ºC rated insulation.
      2. Manufacturer: O-Z/Gedney, Type IB.
   10. GROUNDING BUSHINGS
       1. Provide NRTL listed, galvanized malleable iron, 150 ºC rated insulated throat grounding bushings with lay-in type ground cable lugs.
       2. Manufacturer: O-Z/Gedney, Type BLG.
   11. 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” or “700” series.
   12. 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 flush outlets in stud walls or above-grade cast-in-place concrete walls, use 4-inch square x 1-1/2 inch deep 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.
          2. 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.
          3. For surface outlet boxes in EMT raceway systems, use 4-inch x 2-1/8 inch deep 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 flush or surface wall-mounted outlets, use 4-11/16 square, 2-11/16 inch deep cast gray or malleable iron boxes with threaded hubs. Provide multiple gang boxes as required to fit devices. Provide gasketed cast gray or 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.
   13. PULL AND JUNCTION BOXES
       1. 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. Use boxes not less than 4 inches square x 1-1/2 inches deep with screw-secured covers. Provide larger boxes as required by the number and size of conduits and conductors.
       2. 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 conduits and conductors.
       3. For damp or wet, non-corrosive locations, in conduit runs up to 3/4 inch trade size, provide 4-11/16 inches square, 2-11/16 inches deep 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.
       4. For damp or wet, non-corrosive locations, in conduit runs 1 inch trade size and larger, provide galvanized sheet-steel pull and junction boxes and covers that comply with UL 50 Type 3R.
       5. Provide connection points for equipment grounding conductors in each box.
   14. 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.
   15. SEALING FITTINGS
       1. Furnish zinc-plated, malleable iron sealing fittings that meet the requirements of UL886 *Outlet Boxes and Fittings for Use in Hazardous 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.
   16. 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. EXECUTION
   1. Existing work
      1. Cap, plug, or seal remaining raceway openings to restore the original fire rating of floors, walls, and ceilings after electrical demolition.
      2. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
      3. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
      4. Clean and repair existing raceway and boxes to remain or to be reinstalled.
   2. 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.
   3. 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. Support raceways and boxes in accordance with the requirements the NEC, Section 26 0529 – Hangers *and Supports for Electrical Systems*, and Section 26 0548 – *Vibration and Seismic Controls for Electrical Systems*.
      6. Identify raceways and boxes as required in Section 25 0553 – *Identification for BAS Electrical Systems*.
      7. Arrange raceway and boxes to maintain headroom and present neat appearance.
      8. Install knockout closures in unused openings in boxes or raceways.
   4. CONDUIT INSTALLATION
      1. For BAS low-voltage wiring systems (less than 100 volts) use conduit materials according to the NEC and the following:
         1. Outdoors - underground:
            1. Direct buried: Use RNC, plastic-coated RMC, 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, plastic-coated RMC, RMC, or IMC for concrete encased underground work. Install with 24 inches minimum cover from top of encasement to finished grade or paving.
         2. Outdoors - exposed: Use RMC or IMC.
         3. Outdoor corrosive locations (including cooling towers): Use plastic-coated RMC 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 plastic-coated RMC 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 drywall partitions and above false ceilings: Use RMC, IMC, or EMT.
            2. Within masonry or cast-in-place concrete walls or floors: Use RMC or IMC.
            3. Direct-buried under building floor slabs on grade: Use RNC, plastic-coated RMC, 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.
            4. Concrete encased under building floor slabs on grade: Use RNC, plastic-coated RMC, 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.
         7. On Ductwork
            1. Short lengths of conduit, up to 1” in diameter, may be supported by ductwork provided the following are met:

* The conduit run supported on the ductwork is no longer than 10 feet in length.
* The conduit dead-ends at a device(s) associated with the supporting ductwork, e.g., sensor, damper actuator, valve actuator, etc.
* Any flex connector in the ductwork is bridged by a flex connection in the conduit.
* The conduit contains only Class 2 circuits.
  + - * 1. Existing Ductwork: Seal penetrations into the duct work per SMACNA HVAC Duct Construction Standards based on existing seal class installed.
        2. New Ductwork: Seal penetrations into the ductwork per ASHRAE 90.1 requirements.
        3. Do not install conduit on ductwork carrying particulate, corrosive fumes or flammable vapors.
      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 – *Vibration and Seismic Controls for Electrical Systems*.
         1. For raceway systems from 1/2 through 1-1/4 inches, install a minimum of 2 feet of flexible conduit, maximum length as determined by the NEC.
         2. For raceway systems from 1-1/2 through 2 inches, install a minimum of 3 feet of flexible conduit, maximum length as determined by the NEC.
         3. For raceway systems larger than 2 inches, install a minimum of 4 feet of flexible conduit, maximum length as determined by the NEC.
         4. Use liquid-tight flexible metal conduit outdoors, in wet, damp, or corrosive indoor locations. Use flexible metal conduit in dry indoor locations. Mechanical rooms are NOT considered wet locations unless expressly indicated on the design drawings.
         5. Install pull boxes as required to comply with the limits on conduit bends and distance between pull points in the CONDUIT INSTALLATION article of this Section; count each flexible conduit section described in this article as not less than a 90-degree bend.
      2. Connection to vibrating equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor‑driven equipment). Duct work is not considered vibrating equipment. - Use a minimum of 24 inches; maximum length as determined by the NEC:
         1. Outdoors: Use liquid-tight flexible metal conduit.
         2. Wet, damp, or corrosive indoor locations: Use liquid-tight flexible metal conduit. Mechanical rooms are NOT considered wet locations unless expressly indicated on the design drawings.
         3. Dry indoor locations: Use flexible metal conduit.
    1. Conceal conduits, unless otherwise indicated on the Drawings, with finished walls, floors and ceilings. Unless otherwise indicated on the Drawings, install concealed conduits with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions.
    2. Position parallel underground conduits with not less than 7-1/2 inches center-to-center separation.
    3. Install expansion fittings where embedded conduits cross building expansion joints.
    4. Use conduit hubs to fasten conduit to boxes in damp and wet locations.
    5. Install insulating bushings or connectors with an insulated throat to protect conductors or cables at conduit terminations.
    6. Install conduits 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.
    7. 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; 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.
  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. Thermostat and zone sensor outlets:
           1. Where user adjustable interfaces or displays are present on the device mount at 48” AFF.
           2. Where no adjustable interfaces or displays are present on the device mount at 54” AFF.
  3. 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 conduit bends and distance between pull points in the CONDUIT INSTALLATION article of this 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.
  4. WIREWAY INSTALLATION
     1. Install wireways at locations indicated on the Drawings.
     2. Mount plumb and level.
  5. SURFACE METAL RACEWAY INSTALLATION
     1. Install surface metal raceway at locations indicated on the Drawings or where existing conditions make it impracticable to install in concealed spaces (i.e. block wall construction, pored wall construction.
     2. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces.
     3. Mount plumb and level.
  6. 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.
  7. FIELD QUALITY CONTROL
     1. Provide final protection and maintain conditions to ensure that coatings and finishes are without damage or deterioration at final inspection.
     2. Hold and Witness Points –Subcontractor to 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.
        1. Underground conduits: After conduits have been installed but before concrete-encasement or trench backfilling commences. LANL inspection may include but is not limited to:
           1. Correct conduit material and size,
           2. Proper conduit spacing and supports,
           3. Correct conduit stub-up locations.
           4. Conduit 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 conduit spacing and supports,
           3. Raceway system connection integrity,
           4. Correct conduit stub-up locations.
           5. 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: Refer to Firestopping Section 07 8400 for required installation and proper inspection notification procedures.

END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWING REFERENCE IS FOR LANL USE ONLY

This project specification is based on LANL Specification 25 0533 Rev. 0, dated December 6, 2016.