SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

SPEC WRITER NOTES.
1. Use this section only for NCA projects. Delete text between // _____ // not applicable to project. Edit remaining text to suit project.
2. Contact Department of Veterans Affairs' (VA) AHJ, Spectrum Management and COMSEC Service (SMCS), Special Communications Team (SMCS 07A2), Telephone (202-461-5301/5311), for technical assistance.
3. When using this section, always include Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS in project specifications.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General grounding and bonding requirements of // telecommunication // and // electronic safety and security // installations for equipment operations.

B. See Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS for requirements governing work of this section.

1.2 DEFINITIONS

A. Grounding electrode system" means electrodes required by NFPA 70 and made, supplementary, telecommunications system grounding electrodes.

B. Grounding electrode conductor means earth grounding electrode that is connected to a separate circulating communications grounding conductor, to the equipment grounding conductor at the source of a separately derived system.

C. The terms "connect" and "bond" are used interchangeably in this specification and have same meaning.

1.3 RELATED REQUIREMENTS

A. Communications General Requirements: Section 27 05 00, COMMON WORK RESULTS FOR COMMUNICATIONS.

1.4 APPLICABLE PUBLICATIONS

A. ASTM International (ASTM):

1. B1-13 - Hard-Drawn Copper Wire.

2. B8-11 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. 81-2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

C. National Fire Protection Association (NFPA):

1. 70-17 - National Electrical Code (NEC).

D. Telecommunications Industry Association (TIA):

1. 607-2015 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

E. UL LLC (UL):

1. 83-14 - Thermoplastic-Insulated Wires and Cables.
2. 467-13 - Grounding and Bonding Equipment.

F. United States Department of Veterans Affairs (VA):

1. VA Construction and Facilities Management (CFM):

a. DM Telecom - Telecommunications & Special Telecommunications Systems Design Manual, 2016.

1.5 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.6 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

A. Provide each product type by a single manufacturer.

2.2 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductors: UL 83 insulated stranded copper, except solid copper for sizes 6 sq. mm (10 AWG) and smaller. Continuous green insulation color for equipment grounding conductors, except wire sizes 25 sq. mm (4 AWG) and larger may be identified according to NFPA 70.

B. Bonding Conductors: ASTM B8 bare stranded copper, except ASTM B1 solid bare copper at sizes 6 sq. mm (10 AWG) and smaller.

C. Isolated Power System: Type XHHW-2 insulation with 3.5 or less dielectric constant.

D. Telecom System Grounding Riser Conductor: TIA 607, minimum 50 sq. mm (1/0 AWG) insulated stranded copper grounding conductor, unless otherwise indicated.

2.3 GROUND RODS

A. Copper Clad Steel: UL 467, 19 mm (3/4 inch) diameter by 3000 mm (10 feet) long.

B. Provide quantity required to obtain specified ground resistance.

2.4 SPLICES AND TERMINATION COMPONENTS

A. Splices and Termination Components: Meet or exceed UL 467, clearly marked with manufacturer, catalog number, and permitted conductor sizes.

2.5 TELECOMMUNICATION SYSTEM GROUND BUSBARS

A. Busbar: Solid copper, pre-drilled from two-hole lug connections, minimum 6 mm (1/4 inch) thick for wall and backboard mounting using standard insulators sized as follows:

1. Room Signal Grounding: 300 mm by 100 mm (12 inches by 4 inches).
2. Master Signal Ground: 600 mm by 100 mm (24 inches by 4 inches).

2.6 GROUND CONNECTIONS

A. Below Grade: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: One-hole compression-type lugs using zinc-plated or copper alloy fasteners.

C. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

2.7 GROUND TERMINAL BLOCKS

A. Terminal Blocks: Provide screw lug-type at equipment mounting locations, such as backboards and hinged cover enclosures, where rack-type ground bars cannot be mounted.

2.8 SPLICE CASE GROUND ACCESSORIES

A. Splice Case Grounding and Bonding Accessories: Supplied by splice case manufacturer or 16 sq. mm (6 AWG) insulated ground wire with shield bonding connectors.

2.9 COMPUTER ROOM AND ENTRANCE ROOM GROUND

A. Computer Room and Entrance Room Ground: 50 sq. mm (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form equipotential grounding grid in 600 mm (24 inch) mesh pattern. Bond grid to each access floor pedestal.

PART 3 - EXECUTION

3.1 GROUNDING - GENERAL

A. Ground according to NFPA 70, TDM Chapter 4, as shown on drawings, and as specified.

B. Grounding:

1. Ground equipment to eliminate shock hazard and minimize, to maximum extent possible, ground loops, common mode returns, noise pickup, and cross-talk.
2. System:
   a. Ground CFE and identified GFE to earth ground, via approved electrical ground with wires run inside building, to eliminate shock hazards. Provide minimum number of ground connections. Ground resistance to be 0.1 Ohm or less.
   b. Use of AC neutral for system control, subcarrier or audio reference ground, either in power panel or receptacle outlet, is not acceptable.
   c. Conduit, signal duct, or cable trays may not be used as system or electrical ground. These items are acceptable only for dissipation of internally generated system static charges, not to be confused with externally generated lightning, that may be applied or generated outside mechanical and physical confines of system to earth ground. Discovery of improper system grounding

is ground to declare system unacceptable and termination of system acceptance testing.

3. Cabinet Bus: Extend minimum 6 sq. mm (10 AWG) solid copper wire common ground bus throughout each equipment cabinet. Home-run common ground bus from each equipment cabinet to system ground.
4. Equipment: Bond equipment to cabinet ground bus with copper braid equivalent to minimum 2 sq. mm (14 AWG).
   a. Acceptable Alternatives: Self-grounding equipment enclosures, racks or cabinets, providing OEM certified functional ground connections through physical contact with installed equipment.
5. Cable Shields: Bond cable shields to cabinet ground buss with minimum 2 sq. mm (14 AWG) stranded copper wire at one end of cable run. Insulate cable shields from each other, face-plates, equipment racks, consoles, enclosures or cabinets, except at system common ground point. Provide one ground connection at source for coaxial and audio cables, if possible, with minimum number of cable shield ground connections.

C. System Grounding:
1. Secondary Service Neutrals: Ground at supply side of secondary disconnecting means and at related transformers.
2. Separately Derived Systems (Transformers Downstream from Service Entrance): Ground secondary neutral.
3. Do not system ground isolation transformers and isolated power systems.

D. Equipment Grounding: Bond and ground metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity to electrical circuits.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Inaccessible Grounding Connections: Exothermically weld buried or otherwise normally inaccessible grounding connections, except connections for which periodic testing access is required.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond secondary service neutral to ground bus in service equipment.

B. Metallic Piping, Building Steel, and Supplemental Electrodes:

1. Provide grounding electrode conductor sized according to NFPA 70 between service equipment ground bus and metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in metallic piping. Make connections to electrodes with fittings according to UL 467.
2. Provide supplemental ground electrode and bond to grounding electrode system.

C. Conduit Systems:
1. Ground metallic conduit systems. Provide metallic conduit systems with equipment grounding conductor.
2. Provide equipment grounding conductor for non-metallic conduit systems, except for non-metallic feeder conduits carrying grounded conductor from exterior transformers to interior or building-mounted service entrance equipment.
3. Bond conduit containing only grounding conductor, provided for mechanical protection of conductor at entrance and exit from conduit.

D. Feeders and Branch Circuits: Install equipment grounding conductors with feeders and power and lighting branch circuits.

E. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which conductor passes.
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to housing, with sufficient lugs to terminate equipment grounding conductors.

F. Do not ground receptacles through their mounting screws, ground with jumper from receptacle green ground terminal to device box ground screw and branch circuit equipment grounding conductor.

G. Raised Floors: Provide bonding of raised floor components. // See details on drawings. //

3.4 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting connection between metals used.

3.5 CONDUCTIVE PIPING

A. Bond conductive piping systems, interior and exterior, to building to grounding electrode system. Make bonding connections as close as practical to equipment ground bus.

3.6 TELECOMMUNICATIONS SYSTEM

A. Bond telecommunications system grounding equipment to facility main electrical grounding electrode system at source point.

B. Provide wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to ground source.

C. Provide continuous ground bonding jumpers without splices. Use shortest possible bonding jumper length.

D. Provide permanent and continuous ground paths with maximum 1 ohm resistance from raceway, cable tray, and equipment connections to building grounding electrode. Resistance across individual bonding connections to be maximum 10 milli ohms.

E. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file point of contact to bare metal surface. Use exothermic welding cartridges and molds according to manufacturer’s instructions. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint area. Notify Contracting Officer's Representative (COR) before backfilling any ground connections.

F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose entire contact surface by grinding where necessary, thoroughly clean connector, plate and other contact surfaces, and apply appropriate corrosion inhibitor to surfaces before joining.

G. Bonding Jumpers:

1. Provide insulated ground wire of size and type shown on Drawings or use minimum 16 sq. mm (6 AWG) insulated copper wire.
2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
3. Provide compression connectors of proper size for conductors specified. Use connector manufacturer’s compression tool.

H. Bonding Jumper Fasteners:

1. Conduit: Fasten bonding jumpers with screw lugs on grounding bushings or conduit strut clamps, or clamp pads on push-type conduit fasteners. When screw lug connection to conduit strut clamp is not

possible, fasten plain end of bonding jumper wire by slipping plain end under conduit strut clamp pad and firmly tighten clamp screw. Where appropriate, use zinc-plated external tooth lockwashers.

2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, for example, zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Provide tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
4. Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers. Contact AHJ 07A2 for specific instructions.

3.7 COMMUNICATION ROOM GROUNDING

A. Telecommunications Ground Busbars:
   1. Provide communications room telecommunications ground busbar hardware, minimum size as described in TDM Chapter 4 at locations indicated on Drawings.
   2. Connect telecommunications room ground busbars to other room grounding busbars as indicated on drawings.

B. Telephone-Type Cable Rack Systems: An aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room. Make ground connections by installing the following bonding jumpers:
   1. 16 sq. mm (6 AWG) bonding between telecommunications ground busbar and nearest access to aluminum pan installed on cable rack.
   2. Provide 16 sq. mm (6 AWG) bonding jumpers across aluminum pan junctions.

C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
   1. When ground bars are provided at rear of lineup of bolted together equipment racks, bond copper ground bars together using solid copper splice plates furnished by ground bar manufacturer.
   2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 sq. mm (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.

3. Provide 16 sq. mm (6 AWG) bonding jumper between rack or cabinet ground busbar and overhead cable tray aluminum pan or raised floor stringer as required.

D. Backboards: Provide screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to telephone-type cable tray aluminum pan using insulated 16 sq. mm (16 AWG) bonding jumper.

E. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray pan or telecommunications ground busbar, whichever is closer, using insulated 16 sq. mm (6 AWG) ground wire bonding jumpers.

3.8 COMPUTER ROOM GROUNDING

A. Conduit: Ground and bond metallic conduit systems as follows:

1. Ground metallic service conduit and any pipes entering or being routed within computer room at each end using 16 sq.mm (6 AWG) bonding jumpers.
2. Bond at intermediate metallic enclosures and across joints using 16 sq. mm (6 AWG) bonding jumpers.

3.9 COMMUNICATIONS CABLE GROUNDING

A. Bond metallic cable sheaths in multipair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.

1. At terminal points, install cable shield bonding connector to provide screw stud connection for ground wire. Use bonding jumper to connect cable shield connector to appropriate ground source, such as rack or cabinet ground bar.
2. Bond metallic cable shields together within splice closures using cable shield bonding connectors or splice case grounding and bonding accessories furnished by splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to approved ground source and other metallic components and equipment at that location.

3.10 COMMUNICATIONS CABLE TRAY SYSTEMS

A. Bond metallic structures of one cable tray in each tray run following same path to provide 100 percent electrical continuity throughout cable tray systems as follows:

1. Splice plates furnished by cable tray manufacturer is acceptable for ground bonding connection between cable tray sections when resistance across bolted connection is maximum 10 milliohms. Verify loss by testing across one slice plate connection.
2. Install 16 sq. mm (6 AWG) bonding jumper across each cable tray splice or junction where splice plates cannot be used.
3. At cable tray terminations to cable rack, install 16 sq. mm (6 AWG) bonding jumper between cable tray and cable rank pan.

3.11 COMMUNICATIONS RACEWAY GROUNDING

A. Conduit: Provide insulated 16 sq. mm (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at intermediate metallic enclosures.

B. Wireway: Provide insulated 16 sq. mm (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at intermediate metallic enclosures and across section junctions.

C. Cable Tray Systems: Provide insulated 16 sq. mm (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 m (50 ft.).

3.12 GROUND RESISTANCE

A. Grounding System Resistance: Maximum 5.0 ohms to ground. Make necessary modifications or additions to grounding electrode system for compliance at no additional cost to Government. Perform tests to ensure requirement is met.

B. Measure grounding electrode system resistance using four-terminal fall-of-potential method according to IEEE 81. Make ground resistance measurements before electrical distribution system is energized in normally dry conditions minimum 48 hours after last rainfall. Make resistance measurements of separate grounding electrode systems before systems are bonded together below grade. Combined resistance of separate systems is acceptable to meet required resistance, but specified number of electrodes must still be provided.

C. Comply with utility company ground resistance requirements for services at utility company interface points.

D. COR will inspect below-grade connections before backfilling. Notify COR and AHJ SMCS 07A2 24 hours before connections are ready for inspection.

E. Provide Communications Circulating Ground System certification certificate, accomplished by an approved commercial certified grounding professional, which is additionally signed and stamped by the Project's BICSI RCDD Certified design professional, to the COR for inclusion in the project official documents after approved by AHJ SMCS 07A2.

3.13 GROUND ROD INSTALLATION

A. Drive each rod vertically into earth, minimum 3000 mm (10 feet) deep.

B. Where permanently concealed ground connections are required, make connections by exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents driving vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve specified resistance.

3.14 GROUNDING FOR RF/EMI CONTROL

A. See DM Telecom, Paragraph 9.1.(d) for minimum requirements.

B. Install bonding jumpers to bond conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers consist of 100 mm (4 inches) wide copper strip or two 6 sq. mm (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Provide 16 sq. mm (6 AWG) copper where exposed and subject to damage.

C. Comply with the following when shielded cable is used for data circuits:

1. Shields to be continuous throughout each circuit.
2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
3. Do not connect shields from different circuits together.
4. Connect shield only at one end. Connect shield to signal reference at circuit origin. Consult equipment manufacturer to determine signal reference.

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