

## **SECTION 27 05 26**

### **GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding labeling.
- B. Related Sections:
  - 1. For additional requirements relating to work in this section refer to Section 260526 - Grounding and Bonding for Electrical Systems.

##### **1.3 DEFINITIONS**

- A. TBC: Telecommunications Bonding Conductor.
- B. TEBC: Telecommunications Equipment Bonding Conductor.
- C. TGB: Telecommunications Grounding Busbar.

##### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans showing locations and sizes of grounding and bonding infrastructure, including the following:
  - 1. TBC, TGB, and TEBC, including routing of the bonding conductors.

### **1.5 AS-BUILT SUBMITTALS**

- A. Updated versions of all Action Submittals, updated to indicate as-built products/conditions.

### **1.6 CLOSEOUT SUBMITTALS**

- A. As-Built Submittal documents.
- B. Warranty documentation.

### **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Refer to Section 270000 "Common Work Results for Communications", which identifies general quality assurance requirements for the project.
  - 2. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when work of this section is performed at Project site.
  - 3. Field Inspector: Currently registered by BICSI as a Registered Communications Distribution Designer (RCDD) to perform the on-site inspection.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All bonding conductors and connectors shall be listed for the purpose intended and approved by a National Recognized Testing Laboratory (NRTL).

### **2.2 SYSTEM COMPONENTS**

- A. Comply with standard TIA-607-C.

### **2.3 CONDUCTORS**

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be a minimum of a No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

- C. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
  4. Bonding Cable: 28 kcmils, 14 strand of No. 17 AWG conductor, and 14 inch in diameter.
  5. Bonding Conductor: No.4 or No. 6 AWG stranded conductor.
  6. Bonding jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules, 1-5/8 inches wide and 1/16 inch thick.

## **2.4 CONNECTORS**

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
1. Electroplated tinned copper, C and H shaped.
- C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## **2.5 GROUNDING BUSBARS**

- A. TGB: Predrilled rectangular bars of hard-drawn solid copper, ¼ inch by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-C.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
  4. Manufacturer: Chatsworth
    - a. Part No. 40153-012
- B. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying

with UL 467, and complying with TIA-607-C. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet. Minimum cross sectional area equal to a 6 AWG wire.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack. Minimum cross sectional area equal to a 6 AWG wire.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack. Minimum cross sectional area equal to a 6 AWG wire.
4. Ground Terminal Block: Designed for attaching ground wires to racks or cabinets. Include extruded, high-strength aluminum two mounting hole ground terminal block with stainless steel set screws.

## **2.6 COMPRESSION LUGS**

- A. Meets TIA-607-C requirements for network systems grounding applications.
  1. Tested by Telcordia – meets NEBS Level 3 with AWG conductor.
- B. UL Listed and CSA Certified with AWG conductor for use up to 35 KV and temperature rated 90°C when crimped with Panduit and specified manufacturers' crimping tools and dies.
- C. Have an "inspection window" over tongue to visually assure full conductor insertion.
- D. Tin-plated to inhibit corrosion.
- E. Available with NEMA and BICSI hole size and spacing.
- F. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- G. Compression Type
- H. Two holes with various hole spacing to fit the busbar.
- I. Long barrel that will allow a minimum of two crimps with standard industry colors.
- J. Crimped according to manufacturer's recommendation.
- K. Size:
  1. #2/0 AWG
  2. #6 AWG
  3. Material: copper or alloy copper.

## **2.7 LABELING**

- A. Comply with TIA/EIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the TBC only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-C.

### **3.3 APPLICATION**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.
- C. Conductor Support:
1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- D. Grounding and Bonding Conductors:
1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than ten times the diameter of the conductor. No one bend may exceed 90 degrees.
  2. Install without splices.
  3. Support at not more than 36-inch intervals.
  4. Install grounding and bonding conductors without conduit. Where installation in conduit is required, install in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
    - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to each end of the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems."

### **3.4 GROUNDING ELECTRODE SYSTEM**

- A. The TBC between the TGB and the ac service equipment ground shall not be smaller than the size of the TBB. Minimum size No. 6 AWG.

### **3.5 GROUNDING BUSBARS**

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

### **3.6 CONNECTIONS**

- A. Bond metallic equipment in a telecommunications room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  - 1. Use crimping tool and the die specific to the connector.
  - 2. Pre-twist the conductor.
  - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install rack grounding busbar or terminal block as indicated on the drawings unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar or terminal block to the TGB with a TEBC with a minimum size of a No. 6 AWG conductor.
- E. Structural Steel: Bond each TGB to the vertical steel of the building frame.
- F. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- G. Access Floors: Bond all metal parts of access floors to the TGB.
- H. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
  - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
  - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
  - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

### **3.7 CABLE TRAYS**

- A. Bonding jumpers shall be installed at all cable tray splices and connection points unless the cable tray has labeling that identifies it as suitable for use as a grounding (earthing) conductor and it meets the requirements of NFPA 70-2005, Article 392.7(B). Cable trays shall have bolted splices and the connection points use splined shoulder bolts which bite into the side rail of the cable tray to ensure a positive bond between sections. All bolts must be properly installed at each splice in the cable tray system per the manufacturer's instructions. Care must be taken to ensure a continuous electrical path. Bonding jumpers must be used where discontinuities such as expansion splice plates and hinged splice plates exist.

- B. Cable trays shall not be utilized as a ground bus conductor for equipment or ancillary support apparatus.

### **3.8 IDENTIFICATION**

- A. Labels shall be preprinted or computer-printed type.
  - 1. Label TGB(s) with "fs-SBB," where "fs" is the telecommunications space identifier for the space containing the SBB.
  - 2. Label each TBC conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER"

### **3.9 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
    - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the TBC exceeds 5 ohms, notify Engineer promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION**