

SECTION 27 05 26
COMMUNICATIONS GROUNDING AND BONDING
Construction Specification

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Communications Grounding Backbone and bonding of communications infrastructure and equipment to Communications Grounding Backbone.
- B. Related Sections
Comply with the Related Sections requirements of Section 270000.

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In particular or addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. NFPA 70, "National Electrical Code", particularly the following Articles:
 - a. Article 250: Grounding
 - b. Article 770: Optical Fiber Cables and Raceways
 - c. Article 800: Communications Systems
 - d. Article 810: Radio and Television Equipment
 - e. Article 820: Community Antenna Television and Radio Distribution Systems
 - 2. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
 - 3. Electronic Industries Association/Telecommunication Industry Association:
 - a. ANSI-TIA-607-B, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
 - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 467, "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems"
 - b. IEEE P1100, "IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems"

1.3 DEFINITIONS

- A. Definitions as described in Section 270000 shall apply to this section.

- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
1. "BCT": Bonding Conductor for Telecommunications
 2. "CM" and "cmil": Circular Millionths of an inch
 3. "GE": Grounding Equalizer Conductor
 4. "MBRGB": Main Building Reference Grounding Busbar
 5. "TBB": Telecommunications Bonding Backbone
 6. "TBC": Telecommunications Bonding Conductor
 7. "TGB": Telecommunication Grounding Busbar
 8. "THHN": Thermoplastic High Heat-resistant Nylon-coated
 9. "TMGB": Telecommunication Main Grounding Busbar

1.4 SYSTEM DESCRIPTION

- A. Base Bid Work: The Work under this section includes furnishing materials, installation, and coordination through the General Contractor with other trades for a Communications Grounding Backbone and for bonding of telecommunications equipment and apparatus to the Communications Grounding Backbone.
- B. Communications Grounding Backbone System: The Communications Grounding Backbone System contains grounding busbars, grounding conductors, bonding conductors, and connecting devices (including but not limited to pressure connectors, lugs, clamps, or exothermic welds). These components, upon completion of installation and testing, shall provide the means of a low impedance path to earth for unintentional and/or stray voltages or spurious signals present on telecommunications media and equipment. The Communications Grounding Backbone System will consist of the following aspects (refer to Drawings for additional information)
1. TMGB: Locate the TMGB in the <MPOE><MDF><IDF> with the following connections:
 - a. MBRGB, via BCT (refer to Drawings for wire size)
 - b. Each TBB
 - c. Ground bushings installed on each entrance conduit opening within the space, via TBC
 - d. Overhead cable support within the space, via TBC
 - e. Dedicated power panel's ACEG within the space serving communication equipment, via TBC
 - f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC
 2. TBB: TBB(s) are the primary bonding conductor between the TMGB and other TGBs provided throughout a single building. The length of TBBs shall not exceed 500 feet. The TBB shall route from the MDF through each of the IDFs

bonding each of the TGBs to the TMGB. Maintain TBB continuity and do not break continuity in order to bond to a TGB.

3. GE: GE(s) are bonding conductors between TGBs (or other elements of the grounding backbone) on a common floor. The length of GEs shall not exceed 500 feet. One GE shall occur every three floors. Maintain GE continuity.
 4. TGB: Locate the TGB in each IDF with the following connections:
 - a. TBB
 - b. Building steel, via TBC
 - c. Each entrance conduit into the space, via TBC and ground bushings
 - d. Overhead cable support within the space, via TBC
 - e. Panelboard's ACEG within the space serving telecommunication equipment, via TBC
 - f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC
- C. Performance Criteria for the Grounding Backbone:
1. Resistance from any point of the communication grounding backbone system to the ground electrode and to earth shall not exceed 20 Ohms.
 2. Field test resistance and document, both electronically and printed, measured values.
- D. Bonding: Bonding consists of TBCs within telecommunications rooms from the TMGB and TGBs to the following components:
1. Rack bay / Cabinets
 2. Overhead cable support and vertical cable support
 3. Wall-mounted termination equipment
 4. Conduit ground bushings
 5. Exit pathways
 6. Bonding jumpers between basketway, cable runway, and cable tray joints & splices, and between basketway/cable runway/tray and equipment racks
- E. Conductor Gauge Criteria:
1. Size BCT as the greater of either 2,000 cmil per linear foot up to 3/0 AWG or the largest TBB.
 2. Size TBB, GE, and TBCs as 6 AWG minimum, then as 2,000 cmil per linear foot up to 3/0 AWG.

1.5 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.

- B. Submittal Requirements at Start Of Construction:
 - 1. Product Data Submittal
 - 2. Shop Drawing Submittal(s), if the Contractor's installation intent differs from the Contract Documents or the design intent
 - C. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.
 - D. Submittal Requirements at Closeout: Submit to the Owner at the time of project closeout the following and before certificate of final payment is issued.
 - 1. Test Report: Submit computer-generated test records of measured resistance values for inclusion into the Operation and Maintenance Manual.
 - 2. As-Built Drawings, consisting primarily of the Communications Grounding Backbone (not necessarily each bonded component or apparatus)
- 1.6 QUALITY ASSURANCE
- A. Comply with Quality Assurance requirements of Section 270000.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Comply with Delivery, Storage and Handling requirements of Section 270000.
- 1.8 WARRANTY
- A. Warrant Work to perform as described within this Section for a period of 5 years. Correct deficiencies within 24 hours of notification.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Application: Suitable for indoor installation as a BCT, TBB, GE, and/or TBC.
- B. Type: THHN (or THWN)
- C. Approvals:
 - 1. UL 83 as Type THHN
 - 2. Federal Specification A-A-59544, NEMA WC-5, UL-758
- D. Conductor: soft drawn annealed copper, stranded
- E. Gauge: Refer to System Description for conductor sizing criteria.
- F. Insulation: PVC, high-heat and moisture resistant
- G. Jacket: Nylon, abrasion, moisture, gasoline and oil resistant
- H. Color: green

- I. Flame Resistance: Meet the flame resistance requirements of IEEE 383, CSA FT-4 and UL VW-1.

2.2 CONNECTOR – “PARALLEL” TAP

- A. Application: H-type thick wall compression tap, for making conductor-to-conductor (e.g., TBB-to-TBC) permanent connection (pigtail, tapping, or splicing). Connectors shall be UL Listed.
- B. Manufacturers:
 1. Panduit
 - a. #HTCT2-2-1; “H-type” compression tap, run = #6-#2, tap = #2-#6.
 - b. #HTCT250-2-1; “H-type” compression tap, run = #2-250MCM, tap = #6-#2
 2. Or equal

2.3 CONNECTOR – “C” TAP

- A. Application: C-type copper thick wall compression tap, for making conductor-to-conductor (e.g., TBB-to-TBC) permanent connection (pigtail, tapping, or splicing). Connectors shall be UL Listed.
- B. Manufacturer:
 1. Panduit
 - a. #CTAPF4-12-C; CTAP for #6 AWG run –to– #6 AWG tap
 - b. #CTAPF2-12-C; CTAP for #2 AWG run –to– #6 AWG tap
 - c. #CTAPF1/0-12-L; CTAP for 1/0 AWG run –to– #6 AWG tap
 - d. #CTAPF2/0-12-Q; CTAP for 2/0 AWG run –to– #6 AWG tap
 - e. #CTAPF3/0-12-Q; CTAP for 3/0 AWG run –to– #6 AWG tap
 2. Or equal

2.4 GROUNDING BUSBAR - TINNED

- A. General: Busbar shall be UL listed.
- B. Standards: Compliant to ANSI-J-607-A
- C. Material: Solid copper, tinned cladding
- D. Holes: Predrilled, compatible with standard NEMA bolt hole sizing and spacing and with ANSI-J-607-A recommendations for 2-hole lugs.
- E. Mounting: Wall-mounted with standoffs. Standoffs shall insulate busbar from the mounting substrate.
- F. Manufacturer:
 1. Panduit

- a. # GB4B0624TPI-1; busbar, 20"L x 4"W x ¼"T, TMGB hole pattern
- b. # GB4B0612TPI-1; busbar, 12"L x 4"W x ¼"T, TMGB hole pattern
- c. # GB2B0312TPI-1; busbar, 20"L x 2"W x ¼"T, TGB hole pattern
- d. # GB2B0306TPI-1; busbar, 12"L x 2"W x ¼"T, TGB hole pattern
- e. #GB2B0304TPI-1; busbar, 10"L x 2"W x ¼"T, TGB hole pattern

2. Or equal

2.5 CONNECTION TO STRUCTURAL STEEL

A. Application: Exothermic welds shall be used for cable-to-cable, cable-to-ground rod, and cable-to-structural steel.

B. Manufacturers:

1. Cadweld

a. Each particular type of weld shall use a kit unique to that type of weld

2. Or equal

2.6 CONNECTOR – COMPRESSION LUG

A. Application: Conductor-to-busbar and/or –rack (or other flat surfaces) connection

B. Type: compression lug, standard or long barrel, two-hole (1/4 inch diameter 5/8 inch on center)

C. Manufacturers:

1. Panduit

a. #LCC6-14JAW-L; for 6 AWG conductor

b. #LCC4-14ADW-L; for 4 AWG conductor

c. #LCC2-14AW-Q; for 2 AWG conductor

d. #LCC1-14AW-E; for 1 AWG conductor

e. #LCC1/0-14AW-X; for 1/0 AWG conductor

f. #LCC2/0-14AW-X; for 2/0 AWG conductor

2. Or equal

2.7 CONNECTOR – SPLIT-BOLT, MECHANICAL TYPE

A. Application: Conductor-to-conductor (or other round component) connection

B. Type: split-bolt mechanical connector

C. Material: high-strength copper alloy

D. Manufacturers:

1. Cooper B-Line
 - a. #WB2GC; split bolt bonding clamp
2. Panduit
 - a. #SBC3-C; split bolt bonding clamp for #6 to #3 conductor
3. Or equal

2.8 GROUND BUSHING

A. Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

B. Manufacturers:

1. OZ/Gedney BLG
2. Thomas & Betts #TIGB series
3. Or equal.

2.9 BONDING STRAPS

A. Cable Runway Bonding Straps

1. Application: makes multiple sections of cable tray conductively continuous
2. Conductor: Flexible braided straps with factory terminated connectors.
3. Manufacturers:
 - a. Chatsworth Products Inc
 1. #12061-001
 - b. Cooper B-Line
 1. #SB6691x7¾
 - c. OZ/Gedney
 1. Type BJ
 - d. Thomas & Betts
 1. #3840 series
 - e. Or equal

B. Cable Tray Bonding Straps

1. Application: makes multiple sections of cable runway conductively continuous
2. Conductor: Flexible braided straps with factory terminated connectors.

3. Manufacturers:
 - a. Cooper B-Line
 1. #99-N1
 - b. Thomas & Betts
 1. #FB95
 - c. Or equal.

2.10 LABELS

A. Labels for Busbars

1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
2. Printable area should be approximately 2 inch wide x 0.5 inch high
3. Printable area color shall be white
4. Manufacturer:
 - a. Panduit
 1. #C200X100FJJ; laser/ink jet labels, white – for busbars
 - b. Or equal

B. Labels for Conductors

1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
2. Labels shall be adhesive-backed and have a self-laminating feature
3. Printable area should be 1 inch wide x 0.5 inch high, or larger
4. Printable area color shall be white
5. Manufacturer:
 - a. Panduit
 1. #S100X150YAJ; laser/ink jet labels, white – for #6 wires
 2. # S100X225YAJ; laser/ink jet labels, white – for #6 to #1/0 wires
 - b. Or equal

2.11 MISCELLANEOUS

A. Wire Clamp

1. Material: nylon, UV stabilized.
2. Color: black

3. Size: 0.25" holding diameter for 6 AWG; or size as required based on conductor size.
4. Manufacturer:
 - a. Richco Inc.
 1. #N4B-BLK
 - b. Or equal

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.
- B. Work shall comply with the International Building Code, International Fire Code, National Electrical Code, UL 467, and ANSI-J-607-A standards, as well as local codes that may specify additional grounding and/or bonding requirements. If discrepancies between codes and/or standards arise, codes shall prevail, and then the more stringent requirement shall prevail, and as directed by the AHJ.
- C. Install components to manufacturer's instructions and recommendations and as required per UL listing.
- D. Identify grounding and bonding conductors and components according to local codes.
- E. Terminations must be accessible for inspection and maintenance during the life of the system.

3.2 EXAMINATION AND PREPARATION

- A. Prior to the start of this section's work, examine pathways and communications rooms for completeness, compatibility with the work of this section, and readiness for connections with the work of this section.

3.3 INSTALLATION

- A. BCT, TBB, and GE Conductors
 1. Install BCT, TBB, and GE conductors in conduit and in a manner to protect them from physical damage.
 2. When routing BCT, TBB, or GE conductors through metallic conduit 3 feet or longer, bond the conductor to the conduit at both ends using a #6 AWG bonding conductor as a pigtail, an irreversible connection (preferably exothermic weld) for the conductor-to-pigtail connection, and insulated ground bushings at the conduit ends.
 3. Install the BCT, TBB, or GE conductor without splices.
 - a. In the event that a splice is necessary, notify the Owner's Representative in writing. Do not proceed with splicing work until the Owner's Representative has accepted in writing the installation of a splice.
 - b. Locate the splice in a telecommunications space and ensure accessibility.

- c. Perform the splice using an exothermic weld and an irreversible compression-type connector.
 4. Where shown on the drawings, connect grounding conductors to structural steel using exothermic welds. Each particular type of weld shall use a kit unique to that type of weld.
- B. TMGB and TGB Busbars
1. Mount busbars as noted on Drawings and using insulating standoffs. If not noted on drawings, install busbars onto wall at 84 inches AFF located within 5 feet of backbone pathways or rack bay.

C. Panelboard Bonding

1. Where a panelboard is located in the same communications room as a TMGB/TGB and serves that room, provide TBC between busbar and that panelboard's Alternating Current Equipment Ground (ACEG) bus (where equipped) or the enclosure.

D. Bonding

1. Provide TBC and appropriate grounding hardware between the nearest TMGB/TGB and the equipment racks / rack bay, overhead cable support, vertical cable support, telecommunication conduits, primary pathways that enter/exit the room (if applicable), and other metallic telecommunication infrastructure components. Refer to Drawings for additional information.
2. Minimum size: #6. If longer than 25 feet, size TBCs based on length using 2000 cmil per foot, up to 2/0 AWG.
3. Install TBCs in a manner that will protect them from physical and mechanical damage.
4. Routing:
 - a. Route TBCs in the shortest possible path, using right angles for turns and routed parallel to building lines. Route on outside edges of wall plywood. Do not cut across the middle of the plywood taking space away from other equipment or components.
 - b. Utilize a minimum 1-foot bend radius.
5. Connection to TMGB/TGBs:
 - a. Thoroughly clean busbars prior to attaching connectors to the busbar.
 - b. Fasten connectors (e.g., lugs) to the busbar using matching size bolt, flat washer Belleville washer, and nut. Torque hardware set.
6. Rack Bay Bonding
 - a. Refer to Drawings for detailed diagrammatic requirements for bonding the rack bay.
 - b. Bond equipment racks, frames, frame bays, cabinets, server racks, and other similar support systems located within the same room or space as the TMGB/TGB to the busbar.

- c. Use approved connectors for TBC-to-rack, -frame, and -cabinet connections.
 - d. Rack bays may be bonded in series using either of the following configurations:
 1. Series: Provide a TBC from the TGB to the rack closest to the busbar; then provide a TBC to the other racks in the rack bay in series using a common lug/connection per rack. The rack shall not be used as a 'conductor' in the series connection.
 2. String: Provide one 'main' TBC from the TGB along the length of the rack bay, and provide a pigtail from the 'main' TBC per rack. Use an irreversible connection (such as "C" tap) for the 'main'-to-pigtail connection.
7. Overhead and Vertical Cable Support Bonding
 - a. Bond overhead and vertical cable support located within the same room or space as the TMGB/TGB to the busbar.
 - b. Provide either UL listed connectors and splice plates or UL Listed bonding strap to bond sections of overhead cable support for ground continuity. This requirement applies to cable tray and runway sections and junctions within a single telecommunication room.
 8. Termination Field Bonding
 - a. Bond termination blocks to the TMGB/TGB within the same room or space. Termination blocks may be bonded in series, with the block closest to the TMGB/TGB bonded to the busbar. Refer to Drawings for detailed diagrammatic requirements for bonding the termination blocks.
 9. Metallic Surface Raceway Bonding
 - a. Bond metallic surface raceways for telecommunications cabling to approved electrical ground located within the same room or space as the surface raceway.

3.4 Labeling

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by the Owner's Representative before installation.
2. Permanently label TBCs. Affix label as close as practical to each end of the conductor.

B. Label Format

1. Provide permanent labels with machine-generated text; hand written labels will not be accepted.
2. Labels on TBCs shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

C. Identifier Assignment

1. Separate label fields of the identifier with a hyphen.
2. Assign identifiers according to current practice and as approved by the Owner's Representative before installation.
3. BCT and TBB
 - a. First field: "BCT" or "TBB" (the conductor type).
 - b. Second field: a unique sequential number, for example, "01".
 - c. Example: "TBB-01"
4. GE
 - a. First field: "GE" (the conductor type).
 - b. Second field: floor number, for example, "06".
 - c. Third field: a unique sequential number, for example, "01".
 - d. Example: "GE-06-01"
5. Ground Busbars
 - a. First field: "TMGB" or "TGB" (the busbar type)
 - b. Second field: the room's identity (TR identifier's suffix) where the busbar is installed; for example, "3A2.1".
 - c. Example: "TGB-3A2.1"
6. TBC:
 - a. First field: "TBC" (the bonding conductor type).
 - b. Second field: The room identity where TBC exists; for example: "A1.1".
 - c. Third field: A unique sequential number; for example: "01", "02", etc.
 - d. Fourth field: describe the device, equipment, component, or raceway being bonded.
 - e. Example: "TBC-A1.1-01 (RACK BAY)"

3.5 GROUNDING BACKBONE RESISTIVITY MEASUREMENT

- A. Measure ground resistance from each ground busbar to earth; record measurement. Provide additional grounding electrodes, bonding, and other elements as required to comply with resistance limits specified in this Section.
- B. Submit computer-generated records of measured resistance values to Owner's Representative for approval and for inclusion into the Operation and Maintenance Manual.

3.6 FINAL INSPECTION AND CERTIFICATION

- A. Punch the Work of this Section compliant to the requirements of Section 270000. Punching the Work of this Section may be combined with punching the rooms.
- B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION