DIVISION 27
Section 27 05 26

Technology Systems
Design and Installation Guidelines
for Architects and Engineers

Pinellas County
Business Technology Services

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SECTION 27 05 26 – GROUNDING AND BONDING FOR TELECOMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 PURPOSE OF THIS DOCUMENT

A. The purpose of this specification section is to indicate to A&E and designers of low voltage infrastructure, working in construction or renovation projects for Pinellas County Government, the design requirements by BTS when it comes to such infrastructure. This document will be a starting point for completing a set of construction documents but **SHALL NOT** be used unedited as a bid document.

1.2 RELATED DOCUMENTS

A. The Engineer for this project shall provide the complete requirements for a telecommunications grounding system. The details for this system are defined in the Division 26 and/or the Division 28 specifications. It is the responsibility of the Engineer to make sure both sets of documents are consistent and provide no overlap or divergent information.

B. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section.

1. 27 00 10 Technology General Provisions
2. 27 05 28 Raceways for Technology
3. 27 10 00 Structured Cabling System
4. 26 05 26 Grounding and Bonding for Electrical Systems

C. General: The bonding approach required herein is intended to work in concert with the cabling topology as specified in Specification Section 27 10 00 Structured Cabling System and installed in accordance with Specification Section 27 05 28 Raceways for Technology.

D. Reference Standards:

1. TIA-607-C
2. TIA-568.0-D
3. TIA-606-C
4. UL 1863 Communication Circuit Accessories
5. UL-50 & UL-514
6. NFPA 70 - National Electric Code
7. IEEE Std. 1100-1992, Powering and Grounding Sensitive Electronic Equipment
8. BICSI TDMM, Telecommunications Distribution Method Manual

9. UL 1449

1.3 MATERIALS ALTERNATES AND SUBSTITUTIONS

A. General: Substitutions are allowed for all components of the systems under this specification section if all requirements for substitutions indicated in Specification Section 27 00 10 Technology General Provisions are followed.

1.4 SHOP DRAWINGS AND SUBMITTALS

A. See additional requirements for shop drawings and submittals in Specification Section 27 00 10 Technology General Provisions.

B. The Installer of the Telecommunications Grounding systems shall provide the following information in the shop drawings phase of the project:

1. Manufacturer's cut sheets for all proposed equipment as described in Part 1 section 1.7 of this specification. Cut sheets shall bear the printed logo or trademark of the manufacturer for each type of product being provided. Mark each copy of the data sheets for the specific product being provided with an identifying mark, arrow, or highlighting.
2. A spreadsheet indicating telecommunications ground bar information selection for each telecommunications room indicated in the design drawings, including the following information:
    a. Room name or number
    b. Quantity of ground bars
    c. Height of each ground bar
    d. Length of each ground bar
    e. Number of holes in each ground bar
    f. Label for each ground bar
3. A drawing indicating the following information:
    a. Location of all telecommunications ground bars and routing of all telecommunications grounding backbones.
    b. Wire size charts for all telecommunications grounding backbones in the project.
    c. All labels to be used in telecommunications backbone cables, bonding conductors, and telecommunications ground bars.
4. A detailed drawing layout of the Mesh Common Bonding Network (MCBN) for all spaces with raised floor in the project.

1.5 ABBREVIATIONS

See **Appendix A - Abbreviations** in **Division 27 Appendices** document.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

A. General use: At least one TMGB shall be provided in the building MDF. The TMGB shall have the bond to the main grounding electrode in the building.

B. The TMGB serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The TMGB shall be located and provided in the Main Telecommunication Room in each building. The TMGB must also be listed by a Nationally Recognized Testing Laboratory (NRTL).

C. The TMGB shall have the following specifications:

1. Material: Copper with a thin platted finish
2. Thickness: 1/4 inch
3. Width: No less than four inches
4. Length: The Installer of the grounding system shall estimate the length of the bar to have enough pre-drilled holes for all BCs in the room. The bar shall be no less than 14 inches long. The Installer shall follow the following criteria in estimating the amount of pre-drilled holes required in the TMGB:
    a. Two holes required for each TBB termination
    b. Two holes for each cabinet or rack row in the room
    c. Two holes for each protector block in the room
    d. Two holes for each layer of ladder tray above the rack
    e. Two holes for each set of conduit sleeves entering the room
    f. 20% of spare capacity shall be available after all terminations are done
    g. If quantity of holes exceeds the maximum available by a manufacturer, multiple bars shall be provided as to match the criteria indicated above
5. Pre-drilled holes: All pre-drilled holes shall have a diameter of 5/16 of an inch
6. Hole spacing: All pre-drilled holes shall have a minimum spacing matching the spacing of the holes in the long barrel ground lugs

D. The TMGB shall be installed on the wall with stand offs and isolators. Isolators shall be rated at 600V.

E. Approved manufacturers: See Division 27 approved material list.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB) FOR INTERIOR USE

A. Intended use: At least one TGB shall be provided in each telecom room, entrance facility, Data Center, or any space where backbone cables are terminated. For rooms bigger than 200 sq. ft., consideration shall be given for additional ground bars. For rooms with multiple rack rows, one TGB shall be provided for each row of racks. Different from the TMGB, the TGB is not bonded directly to the main grounding electrode.

B. The TGB serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. The TGB shall be located and provided in each telecommunication room (except the main telecommunication room) in each building and any other additional locations as indicated in the drawings. The TGB must also be listed by a NRTL.

C. The TMGB shall have the following specifications:

1. Material: Copper with a thin platted finish
2. Thickness: 1/4 inch
3. Width: No less than four inches
4. Length: The Installer of the grounding system shall estimate the length of the bar to have enough pre-drilled holes for all BCs in the room. The bar shall be no less than 12 inches long. The Installer shall follow the following criteria in estimating the amount of pre-drilled holes required in the TMGB:
    a. Two holes required for each TBB termination
    b. Two holes for each cabinet or rack row in the room
    c. Two holes for each protector block in the room
    d. Two holes for each layer of ladder tray above the rack
    e. Two holes for each set of conduit sleeves entering the room
    f. 20% of spare capacity shall be available after all terminations are done
    g. If quantity of holes exceeds the maximum available by a manufacturer, multiple bars shall be provided as to match the criteria indicated above
5. Pre-drilled holes: All pre-drilled holes shall have a diameter of 5/16 of an inch
6. Hole spacing: All pre-drilled holes shall have a minimum spacing matching the spacing of the holes in the long barrel ground lugs

D. The TMGB shall be installed in the wall with stand offs and isolators. Isolators shall be rated at 600V.

E. Approved manufacturers: See Division 27 approved material list.

2.3 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB) FOR OUTDOOR USE

A. Intended use: Outdoor TGB shall be used to bond ground straps and other code required bonding conductors for cable going to a building roof for antennas or other services.

B. When TGB are located outdoors: All specs for indoor used TGB shall be followed except for the construction material. The TGB for outdoor use shall be made of galvanized steel.

2.4 FLEX CONDUCTOR, ONE-HOLE, LONG BARREL WITH WINDOW LUG

A. All BCs (different from TBB) shall be terminated in a flex conductor, one-hole, long barrel with window lug when a two-hole connector is not possible to be used because receiving equipment does not support the two holes. All lugs shall be selected to match the size of the conductor being used. Other types of terminations such as screw type connectors are not accepted.

B. The flex conductor, one-hole, long barrel with window lug shall have the following specification:

1. Finish: Thin plated
2. Cable types: Designed to work with Flexible, Extra-Flexible, and Code Stranded Copper Conductors
3. Stud hole size: 1/4 inch
4. Barrel type: Long barrel > one inch
5. Termination type: Crimp type
6. Angle: Straight or angled if installation space is limited
7. Listing: UL listed and tested to 35 KV and 90ºC

C. Approved manufacturers: See Division 27 approved material list.

2.5 FLEX CONDUCTOR, TWO HOLE, LONG BARREL WITH WINDOW LUG

A. Flex conductors, two-hole, long barrel with window shall be used with TBB and BCs to provide a good bond. All lugs shall be selected to match the size of the conductor being used. Other types of termination are not accepted.

B. The flex conductor, two-hole, long barrel with window lug shall have the following specification:

1. Finish: Thin plated
2. Cable types: Designed to work with Flexible, Extra-Flexible, and Code Stranded Copper Conductors
3. Stud hole size: 1/4 inch
4. Hole spacing: To match spacing of pre-drilled holes in ground bar or equipment.
5. Barrel length: Long barrel > one inch
6. Termination type: Crimp type
7. Angle: Straight or angled if installation space is limited
8. Listing: UL listed and tested to 35 KV and 90ºC

C. Flex conductors, two-hole, long barrel with window shall be used with BCs in the following cases:

1. Bonding two sections of pathways such as sections of tubular runways or cable trays
2. Bonding a BC or a TBB to a TGB or TMGB
3. Bonding to equipment that requires two holes for bonding

D. Approved Manufacturers: See Division 27 approved material list

2.6 HTAP CONNECTOR

A. When a Bonded Connector (BC) is required to be bonded to another BC of same or different size the only approved method of bonding is with HTAP style crimp connectors. Screw type connectors, wire nuts, or any other method are not acceptable. The specifications of the HTAP connectors are:

1. Finish: Thin plated
2. Cable types: Designed to work with Flexible, Extra-Flexible, and Code Stranded Copper Conductors
3. Tap grooves: Installer to select HTAP connector based on size of BCs and quantity of BCs to be bonded
4. Slots: The HTAP connector shall support the unit to the bonding conductors with nylon cable ties for initial support before crimping
5. Termination type: Crimp type
6. Listing: UL listed and tested to 600V

B. Approved manufacturers: See Division 27 approved material list.

2.7 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

A. Telecommunications Bonding Backbones shall be provided as indicated in the design documents. TBBs shall be insulated copper stranded conductors with a wire gauge dictated by the length of the cable. The TBB shall be sized at 2 Kcmil per linear foot (LF) of conductor length up to a maximum of 3/0 AWG. The following table shall be used to estimate the size of the TBBs:

TBB length LM (FT)	**TBB Size (AWG)**
Less than 4 (13)	6
g5- 6 (14 – 20)	4
6 – 8 (21 – 26)	3
8– 10 (27 – 33)	2
10– 13 (34 – 41)	1
13 – 16 (42 – 52)	1/0
16 – 20 (53 – 66)	2/0
Greater than 20 (66)	3/0

B. Once a TBB has been sized with a particular gauge, any extensions of such backbone shall not be done with a wire gauge smaller than the previous run regardless of distance.

2.8 BONDING CONDUCTOR (BC)

A. Bonding conductors shall be used to bond equipment and raceways to the telecommunications grounding infrastructure. The specifications of the BC are:

1. Conductor Size: Use the chart above for TBB to estimate the size of the bonding conductor. BC shall be no smaller than an AWG-6
2. Material: Copper stranded conductors
3. Insulation: Use non-insulated conductors only under raised floor spaces. Insulation color shall be green with a yellow stripe

B. Prefabricated BCs or field made BCs are acceptable

C. Both ends of a BC shall be terminated in long barrel lugs

2.9 RAISED FLOOR BONDING CLAMP

A. Raised floor bonding clamps shall be used to bond BCs under the raised floor to raise floor pedestals. The specifications of the raised floor bonding clamp shall be:

1. Construction: Solid metal device
2. Bonding of BCs: The device used to bond the BCs shall be a split screw copper bolt sized to match the size of the BCs being bonded
3. Bonding of raised floor pedestals: The device shall include an adjustable clamp to bond the pedestal. The Installer of this system is responsible for selecting the size of the clamp to match the size and shape of the pedestal provided for this project
4. Listing: UL listed

B. Approved manufacturers: see Division 27 approved material list.

2.10 MESH COMMON BONDING NETWORK (MCBN)

A. A Mesh Common Bonding Network (MCBN) shall be provided under all raised floor spaces in the project. The MCBN is basically a grid of non-insulated BCs running under the raised floor. The MCBN shall include a loop around the perimeter of the raised floor. The details of the construction of the MCBN shall be:

1. Size of Conductors: Conductors shall be sized using the table provided in this specification to size the TBB, but conductors shall not be larger than 1/0 AWG.
2. Spacing of the Grid: The grid of conductors shall have a spacing no longer than 10 feet below each row of cabinets, racks, or consoles there shall be a conductor part of this grid.
3. Continuous Conductors: Each grid line of conductors shall be a continuous conductor without any splices.
4. Aligning: All grid lines shall be adjacent to the raised floor pedestals to be able to bond the pedestals.
5. Elevation: All conductors part of the MCBN shall not be resting or touching the floor slab. They should be mounted around half of the height of the raised floor pedestals
6. Bonding: Bonding shall be provided to the MCBM at the following locations:

    a. Each pedestal with one or more BCs adjacent to it, shall be bonded using a raised floor bonding clamp.

b. All metal equipment under the raised floor shall be bonded to the MCBN such as cable trays or conduits.
c. All ground bars above the raised floor and inside the same room shall be bonded to the MCBN with a BC of equal size as the largest conductor in the MCBN.

7. Listing: All bonding equipment used for the MCBN shall be UL 467 listed.

B. Racks, cabinets, and consoles above the raised floor shall be individually bonded to the MCBN with a non-insulated BC, if space below raised floor is being used for air handling. An insulated BC shall be used if the space below the raised floor is not being used for air handling.

2.11 LABELS FOR TELECOMMUNICATIONS GROUNDING INFRASTRUCTURE

A. Installer shall follow labeling materials indicated in Specification Section 27 00 10 Technology General Provisions.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. General: All installation requirements indicated in Specification Section 27 00 10 Technology General Provisions shall be followed.

B. Pinellas County BTS requires the following elements to be bonded in projects:

1. All tubular runway
2. All cable tray sections
3. All conduit sleeves within 12 inches of a cable tray section
4. All racks and cabinets
5. All surge suppressors
6. All armored fiber cables
7. All patch panels for shielded twisted pair cables
8. Bond to building steel inside the telecom room

C. Protection: The TBBs and BCs shall be installed and protected from physical and mechanical damage.

D. Galvanic continuity: The TBBs and BCs shall be continuous and routed in the shortest possible straight-line path.

E. Crimping: All lugs shall be crimped with the proper die for the size of lug being used.

F. Paint Removal: Paint shall be removed before attaching any BC to equipment with painted surface, such as ladder trays and racks, if no ground lug is available in the equipment.

G. Routing Of TBB: Telecommunications grounding back bone shall be run in a way to minimize their distance. The shorter the distance the most effective the grounding system can be.

H. Splicing: The TBBs and BCs shall be installed without splices. Where splices are necessary, the number of splices should be a minimum, they shall be accessible, and located within telecommunications spaces. Joined segments of a TBB or BC shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.

I. Bonding to Electrical Panels: The TGB or TMGB shall be as close to the electrical power panel as is practical and shall be installed to maintain clearances required by applicable electrical codes. The electrical power panel bus or the panel enclosure feeding telecommunications equipment racks/cabinets shall be bonded to the TGB or TMGB.

J. Bonding to Building Steel: All connectors used for bonding to the metal frame of a building shall be listed for the intended purpose.

K. Lug Screws: All connections from lugs to ground bars or grounding equipment shall be done with metal screws with nuts and compression washers. Connections made with metal self-tapping screws will not be allowed.

L. Bonding Protector Blocks: All primary or secondary building entrance protector blocks shall be bonded to the nearest TMGB or TGB with a BC. A minimum of 1 ft. separation shall be maintained between this insulated conductor and any DC power cables, switchboard cable, or high frequency cables, even when placed in rigid metal conduit or EMT.

M. Bonding Outside Plant Cables: When the outside plant cables in the Telecommunications Entrance Facility room incorporate a cable metallic shield (armor) isolation gap, the cable metallic shield on the building side of the gap shall be bonded to the TMGB or TGB or the rack/cabinet or the rack's vertical ground bar (if available).

N. Bonding Backbone Cables: Where backbone cables (fiber or copper) incorporate a shield (armor) or metallic member, this shield or metallic member shall be bonded to the TMGB or TGB or rack/cabinet or the rack's vertical ground bar (if available).

O. Bonding Horizontal Cables: When shielded horizontal cable is used and terminated in patch panels, each patch panel needs to be bonded to the telecommunications grounding system. A BC shall be used between each patch panel and the rack rails of the rack/cabinet or the rack's vertical ground bar (if available).

P. Intended Use of TBB or BC: The TBB or BC is not intended to serve as the only conductor providing a ground fault current return path. The intended function of the TBB or BC is to equalize potential differences between telecommunications systems.

Q. Installation of TBBs Inside Telecommunications Spaces: When TBBs are run inside telecommunications spaces, they shall be protected from damage by running them inside conduit. Conduit to protect TBBs inside telecommunications spaces can be made of PVC and shall be sized and supported as required by NEC.

R. Installation of TBBs Outside Telecommunications Spaces: When TBBs are run outside of telecommunications spaces they shall be protected from damage by running them inside conduit. Conduit to protect TBBs outside telecommunications spaces shall be EMT or RMC. To avoid an electromagnetic choke effect in this conductor, each end of the conduit used to protect the TBB shall be bonded to the TMGB or TGB at each end. Conduit used for protection of TBBs shall be sized and supported as required by NEC.

S. Rack/Cabinet Bonding: All racks/cabinets in the project shall be bonded to the nearest TMGB or TGB inside the room. All rows of racks/cabinets shall be bonded together by a single AWG-2 conductor coming from the nearest TMGB or TGB inside the room. This bonding conductor shall be insulated and run above the racks on the side of the cable tray system, going above the racks, supported by a hanger external to the cable tray. At each rack, a bonding jumper (AWG-6) shall be provided and terminated to the rack manufacturer's recommended lug for bonding the rack/cabinet. The bonding jumper shall be connected to the AWG-2 conductor by means of a HTAP connector, protected with heat shrink material. This ground bar shall be the termination point for the bonding jumper for each rack and shall also bond the manufacturer's approved grounding lug in the rack/cabinet to the ground bar.

T. Rack/Cabinet Bonding Outside of Telecom Rooms: Racks/cabinets outside of telecom rooms shall be bonded to the nearest electrical ground with a BC.

U. LABELING: All labeling systems for telecommunications grounding infrastructure shall follow the ANSI/TIA/EIA-606-C standard. At a minimum, the following elements shall be labeled in the telecommunications grounding system:

1. All TMGB or TGB, with a unique identifier located on the wall near the unit, not on the ground bar.

2. All TBBs in the project with a unique identifier at each termination point of each TBB. The label on one side of the cable shall indicate the termination location of the other side of the cable.
3. BC for rows of racks with a unique identifier at both ends of the cable.
4. BC for surge protectors with a unique identifier at both ends of the cable.

V. Additional Labeling: All BCs bonding rows of racks/cabinets and TBBs shall have an additional identification marker comprised of a yellow printed wrap around tag installed close to the bonding point strap to the cable jacket with a flame-retardant cable tie. This tag shall have the following wording in green letters: “IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER".

3.2 AS-BUILT DOCUMENTS AND CLOSEOUT INFORMATION

A. See Specification Section 27 00 10 Technology General Provisions for these requirements.

END OF SECTION 27 05 26