UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025
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DIVISION 27 - COMMUNICATIONS

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

11/25

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USACE / NAVFAC / AFCEC **UFGS-27 05 26 (November 2025)**

Preparing Activity: USACE **New**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025

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SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
11/25

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NOTE: This guide specification covers requirements for building telecommunications grounding and bonding infrastructure and its interconnection to electrical systems and telecommunications systems.

Coordinate telecommunications grounding and bonding requirements with electrical grounding requirements. Coordinate all requirements with the proponent Technical Authority.

Adhere to UFC 1-300-02 United Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions, and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: UFC 3-580-01, "Information and Communications Technology Infrastructure Planning and Design," provides requirements for grounding, bonding, and static protection of telecommunications systems for DoD.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS 0600334	(2024) Electrical Protection of Communications Towers and Associated Structures

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2023) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

BICSI International Standards Program (BICSI)

ANSI/BICSI N1	(2019) Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure
ANSI/BICSI N3	(2020) Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure
BICSI TDMM	(2024; 15th Edition) Telecommunications Distribution Methods Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2026) National Electrical Code
NFPA 780	(2026) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

ANSI/TIA-606	(2021d) Administration Standard for Telecommunications Infrastructure
ANSI/TIA-607	(2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-419	(1987; Rev A) Grounding, Bonding, and Shielding for Electronic Equipments and Facilities Volumes 1 of 2 Basic Theory
UFC 3-580-01	(2024) Information and Communications Technology Infrastructure Planning and Design

UL SOLUTIONS (UL)

UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2025) UL Standard for Safety Wire Connectors
UL 969	(2025) UL Standard for Safety Marking and Labeling Systems

1.2 RELATED REQUIREMENTS

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NOTE: Ensure that design grounding and bonding system meets UFC 3-580-01 as a minimum requirement.

The telecommunications grounding and bonding system must support the Information Technology (IT) and Operational Technology (OT) requirements of the end user.
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Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, and Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP) apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification must be as defined in ANSI/TIA-607, BICSI TDMM, UFC 3-580-01, 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM, and

herein.

1.3.1 Activity Specific Telecommunications Manager

Throughout this document, the term "Telecommunications Manager" or "Information Communications Technology (ICT) Manager refers to the following:

Army - the Network Enterprise Center (NEC) or the Information Officer (G6, S6, J6)

Navy - the Base Communications Officer (BCO) or the Naval Computer and Telecommunications Area Mater Station (NCTAMS) Regional Coordinator (RC)

Marine Corps - the Installation Communications-G6

Air Force - the Base/Installation Communications Squadron-A6.

1.3.2 Alternating Current Equipment Ground (ACEG) Bonding Conductor

A conductor installed from the alternating current equipment ground inside an electrical panel to a secondary bonding busbar or primary bonding busbar.

1.3.3 Backbone Bonding Conductor (BBC)

A telecommunication bonding connection which interconnects telecommunications bonding backbones (formerly known as the grounding equalizer)

1.3.4 Bonding Network (BN)

A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.

1.3.5 Electromagnetic Impulse (EMI)

Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

1.3.6 Mesh Bonding Network (mesh-BN)

A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to multiple points on the common bonding network (formerly known as the signal reference grid).

1.3.7 Mesh-Isolated Bonding Network (mesh-IBN)

A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to a single point on the common bonding network (formerly known as the isolated signal reference grid).

1.3.8 Primary Bonding Busbar (PBB)

A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the buildings service equipment (power) ground (formerly known as the telecommunications main grounding busbar).

1.3.9 Rack Bonding Busbar (RBB)

A busbar within a cabinet, frame, or rack.

[1.3.10 Rack Bonding Conductor (RBC)

Bonding conductor from the rack bonding busbar to the telecommunications equipment bonding conductor.

]1.3.11 Secondary Bonding Busbar (SBB)

A common point of connection for telecommunications system and equipment bonding to ground and located in satellite telecommunications rooms (formerly known as the telecommunications grounding busbar).

1.3.12 Secondary Bonding Conductor (SBC)

Bonding conductor from the secondary bonding busbar to the telecommunications bonding backbone.

1.3.13 Telecommunications Bonding Backbone (TBB)

A conductor that interconnects the primary bonding busbar to the secondary bonding busbar.

1.3.14 Telecommunications Bonding Conductor (TBC)

A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground (formerly known as the bonding conductor for telecommunications).

1.3.15 Telecommunications Drawings - T3

Drawings in accordance with ANSI/TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, ladder racks, and conduit), mechanical/electrical layout, and[cabinet,][rack,][backboard,][and] wall elevations. Drawings must show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces, and cabinet/racks. Drawings must include a complete list of equipment and material, equipment rack details to include conduit and cable tray data, proposed layout and bonding of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

1.3.16 Telecommunications Drawings - T4

Detailed drawings of symbols and typical details such as labeling, bonding, installation procedures, detail racking, and raceways.

1.3.17 Telecommunications Drawings - T6

Drawings to include grounding riser diagrams

1.3.18 Telecommunications Equipment Bonding Conductor (TEBC)

A conductor that connects the primary bonding busbar, secondary bonding busbar or supplementary bonding network to equipment racks or cabinets, rack bonding busbars or rack bonding conductors.

1.3.19 Unit Bonding Conductor (UBC)

A bonding conductor from equipment or a patch panel to a rack bonding busbar.

1.4 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Bonding Busbar; G, [_____]

Bonding Conductors; G, [_____]

Bonding Components; G, [_____]

SD-06 Test Reports

Grounding and Bonding System Test; G, [_____]

SD-07 Certificates

Contractor Qualifications; G, [_____]

Key Personnel Qualifications; G, [_____]

Manufacturer Qualifications; G, [_____]

Report Of Prior Installations

SD-10 Operation and Maintenance Data

Telecommunications Grounding and Bonding System; G, [_____]

SD-11 Closeout Submittals

Record Documentation; G, [_____]

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

****

NOTE: The critical bond between the ACEG and the PBB or SBB must be installed by a licensed electrician. Once the TBC or ACEG Bonding Conductor is bonded, a telecommunications installer may install the remainder of the telecommunications grounding and bonding system. It is preferred that a licensed electrician install the entirety of the telecommunications grounding and bonding system.

****

Work and equipment installation under this section must be performed by and provided by approved contractor(s) and key personnel. Qualifications must be provided for: the telecommunications grounding and bonding contractor, the telecommunications grounding and bonding installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience, and certifications of the contractor and all key personnel.

1.5.1.1 Contractor Qualifications

The contractor must be a firm which is regularly and professionally engaged in the business of the implementation, installation, and testing of the specified telecommunications grounding and bonding systems and equipment. The contractor must demonstrate experience in providing successful telecommunications grounding and bonding systems within the past three years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunications grounding and bonding system installations for the contractor.

1.5.1.2 Key Personnel Qualifications

****

NOTE: For complex installations or critical applications, delete the bracketed option for

alternative qualification.
****

Provide key personnel who are regularly and professionally engaged in the business of providing implementation, installation, and testing of the specified telecommunications grounding and bonding systems and equipment. There may be one key person, or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel must demonstrate experience in providing successful telecommunications grounding and bonding systems within the past 5 years. Submit documentation for a minimum of three and a maximum of five successful telecommunications grounding and bonding system installations for the submitted key personnel. The initial bond between the ACEG busbar and the PBB/SBB must be installed by a licensed electrician. Supervisors, installers, and testers assigned to the installation of subsequent work of this system or any of its components must be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current electrician's license and BICSI certification for each of the key personnel.[In lieu of BICSI certification, supervisors and installers assigned to the installation and testing of this system or any of its components must have a minimum of [5][_____] years' experience in the installation of the specified grounding and bonding components and training that is deemed equivalent by the COR. These must include factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.] Documentation for each key person must include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications grounding and bonding system proposed for this solicitation. Include specific experience in installing and testing telecommunications grounding and bonding systems and provide the names and locations of at least two project installations successfully completed using telecommunications grounding and bonding systems.

All the existing telecommunications grounding and bonding system installations offered by the key persons as successful experience must have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity. Indicate that all key persons are currently employed by the [electrical contractor][or][telecommunications contractor] or have a commitment to the [electrical contractor][or][telecommunications contractor] to work on this project. Note that only the key personnel identified in the approved submittals of the successful proposal, and approved by the Contracting Officer, are permitted to do work on this telecommunications grounding and bonding system. Key personnel must function in the same roles in the contract, as they functioned in the successful experience offered. Any substitutions for the telecommunications contractor's key personnel requires the resubmission of the qualifications and new approval from the Contracting Officer.

1.5.1.3 Minimum Manufacturer Qualifications

Cabling and equipment manufacturers must have a minimum of [3][_____]

year[s] experience in the manufacturing, assembly, and factory testing of components which comply with ANSI/TIA-607

1.6 REGULATORY REQUIREMENTS

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "must" had been substituted for "shall" or "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.7 STANDARD PRODUCTS

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for [2][_____] year[s] prior to bid opening. The [2][_____]-year period must include applications for equipment and materials under similar circumstances and of comparable size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

[

1.7.1 Alternative Qualifications

Products having less than a [1][2][_____]-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, excluding the manufacturer's factory or laboratory tests, is provided.

]1.7.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site must not be used, unless specified otherwise. Products must not be delivered to site earlier than 6 months prior to installation.

1.8 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage. Visual inspection, for damage, of all material must be performed prior to installation.

1.9 MAINTENANCE

[

1.9.1 Telecommunications Grounding and Bonding System

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for telecommunications grounding and bonding system that provide basic data relating to the design, operation, and maintenance of the telecommunications grounding and bonding system for the building. Include the following:

a. Riser diagram of the "as-built" building telecommunications grounding and bonding system.

b. Manufacturers' maintenance manuals on grounding and bonding hardware, bonding features of material, and installation requirements.

]1.9.2 Record Documentation

****

NOTE: ANSI/TIA-606 describes the necessary data fields and reports for hard copy, spreadsheet, and electronic media as well as cable management software requirements. Check with activity ICT Manager to determine if cable management software is currently employed at the activity and provide necessary data input to the existing system to include information associated with project installation in the coordinated/approved/proper format.

****

Provide T3, T4, and T6 drawings including documentation on cables and termination hardware in accordance with UFC 3-580-01. Drawings must include enlarged floor plans, details, and grounding riser diagrams to show information for grounding and bonding locations and interconnection of grounding systems. Drawings must be provided [in hard copy format][on electronic media using Windows based computer cable management software].[A licensed copy of the cable management software including documentation, must be provided.]

1.10 WARRANTY

The equipment items must be supported by service organizations which are reasonably convenient to the equipment installation to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract and as required in Section 01 78 00 CLOSEOUT SUBMITTALS.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of ANSI/TIA-607, NFPA 70, and NFPA 780 for all materials, equipment, and devices.

2.2 COMPONENTS

Components must be UL, or third party certified by a nationally recognized testing laboratory (NRTL). Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate must state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference

standard. Provide a complete system of telecommunications grounding and bonding conductors and hardware. Provide support structures and pathways, complete with conductors, connecting hardware, and grounding busbars.

Conductors and interconnecting hardware and components for telecommunications grounding and bonding systems must be UL listed, or third-party independent testing laboratory certified and must comply with NFPA 70, ANSI/TIA-607, and conform to the requirements specified herein.

2.3 BONDING PRODUCTS

****

NOTE: Indicate bonding components and conductor sizes on drawings.

****

Provide in accordance with UL 467, ANSI/TIA-607, and NFPA 70. Components must be labeled as required by ANSI/TIA-606 and as indicated. Conductor sizes shown are based on copper, unless indicated otherwise.

2.3.1 Bonding Conductors

****

NOTE: A TBB is required between the PBB and all SBBs and a BBC is employed to interconnect multiple TBBs through the associated busbars on the same floor in a multi-story building. A TBB, a BBC, or both are not required for installation when: 1) Only a single PBB is installed; or
2) Structural steel in the building is electrically continuous and bonded to the electrical grounding electrode system (GES) and available in the TR; and 3) when an ACEG busbar is available in the TR per UFC 3-580-01.
Before utilizing structural metal in place of a TBB, building plans (including as-builts as applicable) and specifications must be reviewed to ensure the structural metal is electrically continuous or can be made so. Additionally, a two point continuity test must be performed on the structural metal to verify electrical continuity and acceptable resistance along the paths used as bonding conductors. Concrete reinforcing steel must not be used as a TBB.
Improved bonding performance at high frequencies can be achieved by using structural metal in place of or in addition to a TBB.
A TBC is required between the PBB and the building grounding electrode system. The sizing requirements of the TBC are not listed in UFC 3-580-01, and ANSI/TIA-607 states that as a minimum, the TBC must be the same size as the largest TBB. BICSI TDMM provides IAEI calculations for determining the size of the TBC. Size the TBC per IAEI calculations unless a larger TBB or BBC is installed.

Sizing of the TBB and BBC	
TBB/BBC linear length ft	Conductor Size (AWG)
less than 4 13	6
4 - 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
20 - 26 67 - 84	3/0
26 - 32 85 - 105	4/0
32 - 38 106 - 125	250 kcmil
38 - 46 126 - 150	300 kcmil
46 - 53 151 - 175	350 kcmil
53 - 76 176 - 250	500 kcmil
76 - 91 251 - 300	600 kcmil
Greater than 91 301	750 kcmil

Choose the second bracketed options where a lightning protection system is provided in the solicitation and specified in other sections. Choose insulated TBB when pathway is a dissimilar metal than copper. See ANSI/TIA-607 E Section 6 for further information.

Choose BBC bracketed conductor when two or more stacks of TR's are required.

When a tower or antenna is installed, the installation must meet the grounding and bonding requirements of ATIS 0600334. See annex B of ANSI/TIA-607 for information regarding grounding and bonding of towers and antennas.

****

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors must be installed using two-hole compression type lugs in accordance with ANSI/TIA-607 and UL 486A-486B.

2.3.1.1 Telecommunications Bonding Conductor (TBC)

Provide a copper TBC in accordance with ANSI/TIA-607 and BICSI TDMM. [The TBC must be sized using IAEI calculations as described in BICSI TDMM Chapter 9 but must not be smaller than the largest TBB.][The TBC must be sized at 2 kcmil per 30 cm linear foot with a minimum size of No. 6 AWG and a maximum size of 750 kcmil.][Provide TBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.]

[2.3.1.2 Telecommunications Bonding Backbone (TBB)

Provide a copper TBB in accordance with ANSI/TIA-607. The TBB must be sized at 2 kcmil per 30 cm linear foot with a minimum size of No. 6 AWG and a maximum size of 750 kcmil. Determine linear length as the shortest practical route between the PBB and the furthest SBB.[Provide TBB with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.]

][2.3.1.3 Backbone Bonding Conductor (BBC)

Provide a copper BBC in accordance with ANSI/TIA-607. The BBC must be sized at 2 kcmil per 30 cm linear foot with a minimum size of No. 6 AWG but must not be smaller than the largest TBB to which it is connected.[Provide BBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.]

]2.3.1.4 Alternating Current Equipment Ground (ACEG) Bonding Conductor

Provide a copper ACEG Bonding Conductor in accordance with ANSI/TIA-607 and BICSI TDMM.[The ACEG Bonding Conductor must be sized using IAEI calculations as described in BICSI TDMM Chapter 9, but must not be smaller than the largest TBB.][The ACEG Bonding Conductor must be sized at 2 kcmil per 30 cm linear foot with a minimum size of No. 6 AWG and no smaller than the largest TBB.] Provide ACEG Bonding Conductor with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION and meeting the fire ratings of its pathway.

[2.3.1.5 Rack Bonding Conductor (RBC)

****

NOTE: If telecommunications racks/cabinets are provided by the contractor as a part of the scope, retain this paragraph.

ANSI/TIA-607 Figure 8, Example "A" is not allowed for DOD installations. Coordinate design drawing to implement Example "B" or Example "C" only.

****

Provide a copper Rack Bonding Conductor (RBC) in accordance with ANSI/TIA-607. Provide RBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. RBC must be at a minimum No. 6 AWG.ANSI/TIA-607 Figure 8, Example "A" is not allowed and an RBC must not be substituted for an Rack Bonding Busbar (RBB) in any location.

][2.3.1.6 Secondary Bonding Conductor (SBC)

****

NOTE: A Secondary Bonding Conductor (SBC) is used only when the SBB is not bonded directly to the TBB. Projects that require a PBB only, or a single SBB will not have an SBC.

****

Provide a copper Secondary Bonding Conductor (SBC) in accordance with ANSI/TIA-607. Provide SBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. At a minimum, the SBC must be the greater of No. 6 AWG or the largest conductor bonded to the associated SBB.

]2.3.1.7 Telecommunications Equipment Bonding Conductor (TEBC)

Provide a copper TEBC in accordance with ANSI/TIA-607. Provide TEBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION. The TEBC must be continuous and sized not less than a No. 6 AWG or as the largest size equipment grounding conductor in the branch power circuit(s) serving the rack/cabinet lineup. Cable shields, metal conduit, cable runway or ladder, or any other metallic cable pathway do not satisfy the requirements for a TEBC.

2.3.1.8 Unit Bonding Conductor (UBC)

Provide a copper UBC in accordance with ANSI/TIA-607 for appliances that have manufacturer bonding connections available. Provide UBC with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION.[Size UBC per telecommunications equipment manufacturer recommendations.][UBC must be at a minimum No. 12 AWG.] Bonding per Example "A" of ANSI/TIA-607 is not permitted.

[2.3.1.9 Structural Metal Bonding Conductor

****

NOTE: Structural metal bonding conductors are typically provided as bare copper wires and are exothermically welded to structural steel. Delete bracketed option unless required otherwise by ICT Manager.

****

Provide a copper structural metal bonding conductor in accordance with ANSI/TIA-607.[Provide structural metal bonding conductor with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION.] The structural metal bonding conductor must be sized at 2 kcmil per 30 cm linear foot with a minimum size of No. 6 AWG and a maximum size of 750 kcmil.

]2.3.1.10 Cable Tray Bonding Jumper

****

NOTE: The bonding of cable tray sections can be accomplished with the use of approved mechanical bonds that provide a maximum bonding resistance of 100 micro-ohms.

****

Bonding jumpers or mechanical bonds supplied by the cable tray manufacturer must provide a maximum bonding resistance of 1 milliohm. If not supplied by the cable tray manufacturer or if unable to meet the maximum bonding resistance requirements, provide a copper bonding jumper across connection points in accordance with ANSI/TIA-607.[Provide cable tray bonding jumper with insulation as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM paragraph INSULATION.] Provide cable tray bonding jumpers not smaller than [10 AWG][6 AWG] and not longer than 300 mm 12 in. If jumper is wire, it must be terminated with lugs having [one hole and standard barrel for one crimp][two holes and long barrel for two crimps]. If jumper is flexible braid, it must be terminated with [one- or two-hole ferrule][one-hole ferrule]. Attach with bonding screw or connector provided by cable tray manufacturer.

2.3.2 Bonding Busbar

****

NOTE: ANSI/TIA-607 lists theminimum width for the PBB as 100 mm 4 in and for the SBB as 50 mm 2 in. However, to allow for future expansion and mitigate the need for replacement of the SBB, the minimum width for the SBB is 100 mm 4 in. Telecommunications bonding busbar provides bonding termination for all metallic elements in the telecommunications systems. Choose the bracketed option for SBB when there are more than one telecommunications rooms or telecommunications equipment rooms included in the project.

****

Provide isolated, corrosion-resistant bonding busbar suitable for [indoor][outdoor] installation in accordance with ANSI/TIA-607. Busbars: plated for reduced contact resistance. Provide a Primary bonding busbar (PBB) in the telecommunications entrance facility [and a Secondary bonding busbar (SBB) in all other telecommunications rooms and equipment rooms]. The PBB[and the SBB]: sized in accordance with the immediate application requirements and with consideration of future growth.[Provide[vertical][horizontal] Rack Bonding Busbar (RBB) in each[rack][cabinet].] Provide bonding busbars with the following:

a. Predrilled copper busbar provided with holes for use with standard sized two-hole lugs.

b. Minimum dimensions of 6 mm 0.25 in thick by 100 mm 4 in wide for the PBB[and SBBs] with length [as required for the number of terminations plus 50 percent with a minimum length of 300 mm 12 in][as indicated][and[6 mm 0.25 in thick by[762 mm 30 in][648 mm 25.5 in][_____] for a vertical RBBs][or][[483 mm][19 in][_____] for horizontal RBBs.]]

c. Minimum stand-off distance of [50 mm][2 in][100 mm][4 in] for the PBB[and [50 mm][2 in][100 mm][4 in] for the SBB][and 19 mm 0.75 in for the RBB]. The PBB[,[and][SBBs]][[,][and RBBs]] must be insulated from supports using insulators that are listed for the purpose.

d. Listed by a nationally recognized testing laboratory.

2.3.3 Bonding Components

2.3.3.1 Exothermic Weld

Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

2.3.3.2 Irreversible Compression-Type Connectors

Make irreversible compression type connections using a hydraulic or electric compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed.

[2.3.4 Mesh Bonding Network (mesh-BN)

****

NOTE: Mesh-BNs serve two purposes: (1) they approximate an equipotential plane for communication signals; and (2) they help mitigate damage to electronic equipment from lightning electromagnetic pulses imposed on the grounding conductors. The grid pattern provides adequate performance for frequencies with wavelengths larger than half the spacing of the grid. A 1200 mm 4 ft spacing performs well up to about 500 MHz. A 10 mm 4 in spacing performs well up to about 6 GHz. Also, the closer the spacing, the smaller the size of conductor needed. At each crossing of the grid, the lightning pulse splits to follow all paths; so, the magnitude of the pulse current drops rapidly when the spacing of the grid is small. See IEEE Std 142 and MIL-HDBK-419A for technical discussion and recommended guidelines for mesh-BNs.

****

Provide a mesh-BN in accordance with MIL-HDBK-419 and as specified herein.

[2.3.4.1 Access Floor mesh-BN

****

NOTE: ANSI/TIA-607 recommends No. 6 AWG minimum mesh-BN conductor size. The mesh-BN must be bonded together no further than every 3.7 m 12 ft (approximately 6 pedestals) in each direction using listed pedestal ground clamps, but is recommended at least every 2.4 m 8 ft (approximately 4 pedestals) in each direction.

****

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-BN by installing [No. 6 AWG][_____] bonding conductors in a grid pattern under the floor. Bond the mesh-BN conductors every[3.7 m 12 ft][2.4 m 8 ft] in each direction using listed pedestal ground clamps.

][2.3.4.2 mesh-BN - Wire Mesh

****
NOTE: Retain mesh-BN - Wire Mesh for higher frequency performance and installation in concrete.
****

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-BN by installing wire mesh [in concrete floor slab][above ceiling] with [No. 10 AWG][No. 8 AWG][No. 6 AWG][No. 4 AWG][No. 2 AWG].

][2.3.4.3 mesh-BN - Grid Tape

****
NOTE: Retain mesh-BN - Grid Tape for installation under floor finishes. Be aware that tape mesh usually becomes visible through the floor finish and causes wear patterns.
****

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-BN by installing tape mesh under floor finish 50 mm by 16 mm 2 in by 16 mil solid copper.

]][2.3.5 Mesh-Isolated Bonding Network (mesh-IBN)

****
NOTE: Mesh-IBNs serve two purposes: (1) they approximate an equipotential plane for communication signals; and (2) they help mitigate damage to electronic equipment from lightning electromagnetic pulses imposed on the grounding conductors. The grid pattern provides adequate performance for frequencies with wavelengths larger than half the spacing of the grid. A 1200 mm 4 ft spacing performs well up to about 500 MHz. A 10 mm 4 in spacing performs well up to about 6 GHz. Also, the closer the spacing, the smaller the size of conductor needed. At each crossing of the grid, the lightning pulse splits to follow all paths; so, the magnitude of the pulse current drops rapidly when the spacing of the grid is small. The mesh_IBN is typically limited to a restricted area within a building such as in a computer room. The primary benefit is the blocking of building currents, such as lightning and power faults from entering into the IBN. See IEEE Std 142 and MIL-HDBK-419A for technical discussion and recommended guidelines for mesh-IBNs.
****

Provide a mesh-IBN in accordance with MIL-HDBK-419 and as specified herein.

[2.3.5.1 Access Floor mesh-IBN

****
NOTE: ANSI/TIA-607 recommends No. 6 AWG minimum mesh-IBN conductor size. The mesh-BN must be bonded together no further than every 3.7 m 12 ft

(approximately 6 pedestals) in each direction using listed pedestal ground clamps, but is recommended at least every 2.4 m 8 ft (approximately 4 pedestals) in each direction.

****

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-IBN by installing [No. 6 AWG][_____] bonding conductors in a grid pattern under the floor. Bond the mesh-IBN conductors every[3.7 m 12 ft][2.4 m 8 ft] in each direction using listed pedestal ground clamps.

][2.3.5.2 mesh-IBN - Wire Mesh

****

NOTE: Retain mesh-IBN - Wire Mesh for higher frequency performance and installation in concrete.

****

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-IBN by installing wire mesh [in concrete floor slab][above ceiling] with [No. 10 AWG][No. 8 AWG][No. 6 AWG][No. 4 AWG][No. 2 AWG].

][2.3.5.3 mesh-IBN - Grid Tape

****

NOTE: Retain mesh-IBN - Grid Tape for installation under floor finishes. Be aware that tape mesh usually becomes visible through the floor finish and causes wear patterns.

****

Provide low-impedance path between telecommunications cabinets, equipment racks, and mesh-IBN by installing tape mesh under floor finish 50 mm by 16 mm 2 in by 16 mil solid copper.

]]2.4 LABELS

Comply with ANSI/TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

a. Brass Tag: Pre-pressed, 38 mm 1-1/2 inch diameter brass label with the words "DO NOT DISCONNECT".

[b. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

][c. Snap-Around Labels: Slit, pretensioned flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

][d. Self-Adhesive Wraparound Labels: Preprinted, 0.08 mm 3 mil thick, [polyester][vinyl] flexible labels with acrylic pressure-sensitive adhesive.

(1) Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating protective shields over the legend. Labels sized

such that the clear shield overlaps the entire printed legend.

(2) Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.

][e. Self-Adhesive Labels: [Polyester][Vinyl], thermal, transfer-printed, 0.08 mm 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

(1) Minimum Nominal Size:

(a) 37 by 150 mm 1-1/2 by 6 inches for raceway and conductors.

(b) 76 by 127 mm 3-1/2 by 5 inches for busbars.

]

2.5 FIRESTOPPING MATERIAL

****
NOTE: Firestopping material requirements are specified in Section 07 84 00 FIRESTOPPING.
****

Provide as specified in Section 07 84 00 FIRESTOPPING. Ends of conduit stubs must be treated as part of the overall assembly.

PART 3 EXECUTION

3.1 EXAMINATION

****
NOTE: Minimum requirement is for 25 ohm resistance. Only require a resistance of 5 ohms or less for critical facilities or as directed by the Telecommunications Manager.
****

a. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for [25 ohm][5 ohm] maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

b. Inspect test results of grounding system measured at point of TBC connection.

c. Prepare written report of prior installations, endorsed by Installer, listing conditions detrimental to performance of the Work.

d. Proceed with connection of TBC only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Grounding through the equipment Alternating Current (AC) power cord does not meet the intent of this specification. Information technology equipment must be provided with a supplementary and specific ground path for the equipment over and above the required alternating current or direct current power ground path. Install all grounding and bonding conductors in accordance with ANSI/BICSI N3, ANSI/TIA-607, and

manufacturer's published instructions.

3.2.1 Bonding Conductors

Bonding conductors must not be placed in ferrous metallic conduit unless otherwise required by NFPA 70. If it is necessary to place bonding conductors in ferrous metallic conduit, bond the conductors to each end of the conduit using a grounding bushing where the bonding jumper is the same size or larger than the bonding conductor. Outside of telecommunications spaces, install conductors in metric designator 21 trade size 3/4 conduit in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Bonding conductors routed through ferrous metallic enclosures must be bonded to the enclosure with a grounding bushing where the bonding jumper is the same size or larger than the bonding conductor.

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NOTE: For new construction, delete the allowance for stacked bonding conductors. For renovations where existing bonding space is limited, stacking of conductors is permitted utilizing listed hardware.

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[Stacking of conductors under a single bolt must utilize hardware listed for the application.][Stacking of conductors under a single bolt is not permitted.] Assemble wire connector to conductor, complying with manufacturer's published instructions and as follows: Use crimping tool and die specific to the connector, pre-twist the conductor, and apply antioxidant compound to bolted and compression connections.

Install all bonding conductors to the maximum extent possible without splices and routed in the shortest possible straight-line path. Where splices are necessary, the number of splices are to be minimized as much as possible. Make necessary splices accessible and located in telecommunications spaces. Make necessary splices using exothermic welding or irreversible compression-type connectors. Install all joints to be adequately supported and protected from damage. Support conductors at not more than 900 mm 36 in intervals.

Bends of bonding conductors terminating at the Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] must have a minimum inside bend radius of 200 mm 8 in. At other locations, make bends in bonding conductors with the greatest practical inside bend radius. A minimum bend radius of 10 times the bonding conductor diameter is recommended. A minimum included angle of 90 degrees must be used.

3.2.1.1 Telecommunications Bonding Conductor (TBC)

Install a TBC between the PBB and service equipment power ground.

[3.2.1.2 Telecommunications Bonding Backbone (TBB)

****

NOTE: The type of building construction, building size, general telecommunications requirements, and the configuration of the telecommunications pathways and spaces should be considered when designing the TBB.
A TBB is not required for installation when:

1) Only a single PBB is installed; or
2) Structural steel in the building is electrically continuous and bonded to the electrical grounding electrode system (GES) and available in the TR; and
3) when an ACEG bus is available in the TR per UFC 3-580-01.
Before utilizing structural metal in place of a TBB, building plans (including as-builts as applicable) and specifications must be reviewed to ensure the structural metal is electrically continuous or can be made so. Additionally, a two point continuity test must be performed on the structural metal to verify electrical continuity and acceptable resistance along the paths used as bonding conductors. Concrete reinforcing steel must not be used as a TBB.
Improved bonding performance at high frequencies can be achieved by using structural metal in place of or in addition to a TBB.

****

The TBB must: be connected to the PBB, be consistent with the design of the telecommunications backbone cabling system, permit multiple TBBs as necessary, be continuous from the PBB to the furthest SBB to which it is connected, and minimize, to the extent practical, the lengths of the TBB(s). The TBB conductors must be protected from physical and mechanical damage. Metallic cable shield(s) or any metal pathway for cable must not be used as a TBB nor water piping systems be used as a TBB.

][3.2.1.3 Bonding Backbone Conductor (BBC)

****

NOTE: When there are multiple TBBs, the BBC is employed to interconnect them through the associated busbars on the same floor in a multi-story building.
A BBC is not required for installation when:
1) Only a single TBB is installed; or
2) Structural steel in the building is electrically continuous and bonded to the electrical grounding electrode system (GES) and available in the TR; and
3) when an ACEG bus is available in the TR per UFC 3-580-01.
Before utilizing structural metal in place of a BBC, building plans (including as-builts as applicable) and specifications must be reviewed to ensure the structural metal is electrically continuous or can be made so. Additionally, a two point continuity test must be performed on the structural metal to verify electrical continuity and acceptable resistance along the paths used as bonding conductors. Concrete reinforcing steel must not be used as a BBC.

****

Provide a Bonding Backbone Conductor (BBC) between all TBBs in a multistory building at the top floor, and at a minimum of every third floor in between to the lowest floor level. The BBC must be bonded to the associated SBB utilizing exothermic welding, listed compression two-hole

lugs, or listed exothermic two-hole lugs.

]3.2.1.4 Bonding Conductors for Connections to the [mesh-BN or]RBB

Bonding conductors used to bond components to the [mesh-BN or]RBB must: be stranded copper conductors, be neatly routed and no longer than practical to bond the component to the[mesh-BN or] RBB, be secured at no greater than 1 m 3 ft intervals, not be routed so as to create a tripping hazard or impair access to equipment, not be attached with any method that could damage the conductors, be listed as suitable for bonding applications, and be available for use in the space in which they will be placed. [Where uninsulated conductors are utilized, they must be supported by standoff insulators at intervals no greater than 60 cm 2 ft or be contained in electrical non-metallic tubing (ENT). Uninsulated bonding conductors must not be in contact with metallic surfaces or other conductors that are not part of the telecommunications grounding and bonding system.]

3.2.1.5 Telecommunications Equipment Bonding Conductor (TEBC)

Install a TEBC between the Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] and the equipment Rack Bonding Busbar (RBB).[Provide a separate TEBC per rack or cabinet.][The TEBC must be continuous from the PBB[or SBB] and the furthest RBB. Connections to the TEBC must be made with listed compression connections, suitable for multiple conductors, and with the Rack Bonding Conductors (RBCs) routed toward the PBB[or SBB].] Cable shields, metal conduit, cable runway or ladder, or any other metallic cable pathway do not satisfy the requirements for a TEBC. The TEBC may be routed within cable trays, on the outside of ladder rack tray supported at no greater than 1 m 3 ft intervals, or along equipment platforms. The TEBC must be separated a minimum of 50 mm 2 in from conductors of other cable groups, except when conductors are grouped together to enter or exit an enclosure, and ferrous material. In locations where TEBC cannot meet separation requirements from ferrous material, bond the TEBC to the ferrous material.

3.2.1.6 Unit Bonding Conductor (UBC)

Install a UBC between the Rack Bonding Busbar (RBB) and the cabinet/rack mounted equipment. The UBC must be connected to the RBB using a listed compression connection and to the grounding post of the cabinet/rack mounted equipment per manufacturer's instructions. Only bond equiment that has manufacturer bonding connections available.

3.2.2 Bonding Busbar

****

NOTE: The vertical location of the PBB and SBB should be determined by considering whether the bonding conductors are routed in an access floor or overhead cable support. Its placement should provide for the shortest and straightest practical routing of the TBC and the primary protector grounding conductor if installed.

Modern building construction techniques will bond structural metal to the main alternating current power entrance or another grounding source. Ensure that when working in existing buildings that the

structural metal is bonded to a suitable ground source.

****

3.2.2.1 Primary Bonding Busbar (PBB)

Install a Primary Bonding Busbar (PBB) as close as practical to the panelboard serving the Telecommunications Entrance Facility (TEF) and located within the TEF while providing the shortest and straightest practical routing of the Telecommunications Bonding Conductor (TBC). Maintain clearances as required by NFPA 70. Mount the PBB[[460 mm 18 in][2 m 6.5 ft][_____] above finished floor.][as indicated.] The PBB and the electrical service ground, where the grounding electrode conductors are bonded together, serve separate purposes and must be two separate busbars even when both are located in the same room or area.

Bonds to the PBB:

a. Panelboard: Bond all panelboard Alternating Equipment Ground (ACEG) busbars[or panelboard enclosures] serving the TEF equipment to the PBB using an ACEG Bonding Conductor.

[b. Primary Protector: Bond the primary protector grounding conductor to the PBB. A minimum of 30 cm 1 ft separation must be maintained between this conductor and any direct current power cables, switchboard cable, or high frequency cables, even when placed in metal conduit.

][c. Outside Plant Cables: Bond the cable shield on the building side of the cable shield isolation gap to the PBB.

] d. Structural Metal: Where structural metal is accessible and in the same room as the PBB, bond the structural metal to the PBB using a structural metal bonding conductor. When practical, because of shorter distances and where horizontal steel members are permanently electrically bonded to vertical column members, the PBB may be bonded to horizontal members in lieu of vertical column members. When the structural metal is external to the room, but readily accessible, bond the structural metal to the PBB using a structural metal bonding conductor.

e. Metallic Pathways: Bond all metallic telecommunications pathways 1 m 3 ft or greater to the PBB with a minimum [No. 6 AWG][_____] in accordance with ANSI/BICSI N3. For metallic pathways containing bonding conductors where the pathway is bonded to the bonding conductor, no additional bond is required.

f. Cable Tray: Bond cable tray or runway to the PBB with a cable tray equipment grounding conductor.

g. Electrical Service Ground: Provide a TBC between the PBB and readily accessible grounding connection of the electrical service in accordance with ANSI/TIA-607, BICSI TDMM, and NFPA 70 Section 250.94.

****

NOTE: A TBB is used when two or more telecommunications bonding busbars are installed. The TBB is installed between the PBB and the furthest SBB with an SBC used to bond any additional

SBBs to the TBB. If only one bonding busbar is installed as part of the project, delete this paragraph.
A TBB is not required for installation when:
1) Only a single PBB is installed; or
2) Structural steel in the building is electrically continuous and bonded to the electrical grounding electrode system (GES) and available in the TR; and
3) when an ACEG bus is available in the TR per UFC 3-580-01.
Before utilizing structural metal in place of a TBB, building plans (including as-builts as applicable) and specifications must be reviewed to ensure the structural metal is electrically continuous or can be made so. Additionally, a two point continuity test must be performed on the structural metal to verify electrical continuity and acceptable resistance along the paths used as bonding conductors. Concrete reinforcing steel must not be used as a TBB.
Improved bonding performance at high frequencies can be achieved by using structural metal in place of or in addition to a TBB.
****

[h. Telecommunications Bonding Backbone (TBB): Provide a TBB between the PBB and the furthest Secondary Bonding Busbar (SBB) in accordance with ANSI/TIA-607.

] i. Telecommunications Equipment Bonding Conductor (TEBC): Provide a TEBC between the PBB and [each Rack Bonding Busbar (RBB)][the farthest Rack Bonding Busbar (RBB)].

j. Electronic Security System (ESS): Bond all ESS equipment located within the TEF to the PBB.

The connection of conductors for bonding telecommunications equipment and pathways to the PBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.

[3.2.2.2 Secondary Bonding Busbar (SBB)

Install a minimum of one Secondary Bonding Busbar (SBB) in all other telecommunications spaces. Multiple SBBs may be installed within the same telecommunications space to aid in minimizing bonding conductor lengths and minimizing terminating space. Locate the SBB as close as practical to the panelboard serving the telecommunications space and located within the telecommunications space. Maintain clearances as required by NFPA 70. Mount the PBB[[460 mm 18 in][2 m 6.5 ft][_____] above finished floor.][as indicated.]

Bonds to the SBB:

a. Panelboard: Bond all panelboard Alternating Equipment Ground (ACEG) busses[or panelboard enclosures] serving the telecommunications space equipment to the SBB using an ACEG Bonding Conductor.

b. Telecommunications Bonding Backbone (TBB): At SBB(s) located furthest from the PBB, bond the TBB to the SBB(s).

c. Secondary Bonding Conductor (SBC): Where the SBB is not directly bonded to the TBB, install an SBC between the TBB and the SBB. The SBC must be continuous and routed in the shortest practical straight-line path.

[d. Other SBBs: All SBBs located within the same telecommunications space must be bonded together with [a conductor the same size as the TBB.][splice bars.]

] e. Structural Metal: Where structural metal is accessible and in the same room as the SBB, bond the structural metal to the SBB using a structural metal bonding conductor. When practical, because of shorter distances and where horizontal steel members are permanently electrically bonded to vertical column members, the SBB may be bonded to horizontal members in lieu of vertical column members. When the structural metal is external to the room, but readily accessible, bond the structural metal to the SBB using a structural metal bonding conductor.

f. Metallic Pathways: Bond all metallic telecommunications pathways 1 m 3 ft or greater to the SBB with a minimum [No. 6 AWG][_____] in accordance with ANSI/BICSI N3. For metallic pathways containing bonding conductors where the pathway is bonded to the bonding conductor, no additional bond is required.

g. Cable Tray: Bond cable tray or runway to the SBB with a cable tray equipment grounding conductor

h. Telecommunications Equipment Bonding Conductor (TEBC): Provide a TEBC between the SBB and [each Rack Bonding Busbar (RBB)][the farthest Rack Bonding Busbar (RBB)].

i. Electronic Security System (ESS): Bond all ESS equipment located within the telecommunications space to the SBB.

The connection of conductors for bonding telecommunications equipment and pathways to the SBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.

]3.2.2.3 Rack Bonding Busbar (RBB)

****

NOTE: A RBB is recommended for all telecommunications equipment enclosures. Delete requirement only when directed by the Telecommunications Manager.

TIA 607 Figure 8, Examples "B" and "C" are the only approved methods for equipment enclosure bonding.

****

Install a [vertical][horizontal] Rack Bonding Busbar (RBB) in each telecommunications cabinet or rack.

Bonds to the RBB:

a. Telecommunications Equipment Bonding Conductor (TEBC): Bond a TEBC to [each RBB using exothermic welding, listed compression two-hole lugs,

or listed exothermic two-hole lugs][the farthest RBB in the telecommunications space. For all other RBBs within the space, bond the RBB to the TEBC with a Rack Bonding Conductor (RBC). The connection of the TEBC or RBC to the RBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs].

b. Cabinet and Rack: Bond the cabinet or rack to its associated RBB using a Rack Bonding Conductor (RBC). The connection of the RBC to the RBB must utilize exothermic welding, listed compression two-hole lugs, or listed exothermic two-hole lugs.

c. Cabinet and Rack Mounted Equipment: Equipment containing metallic parts and patch panels for shielded cabling within cabinets and racks must be bonded to the RBB using a Unit Bonding Conductor (UBC). The UBC must be connected to the RBB using a listed compression connection and to the grounding post of the telecommunications equipment if provided. Only bond equipment that has manufacturer bonding connections available.

3.2.3 Telecommunications Cabling

[Metallic sheaths of OSP cables must be bonded to the Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] as close as practical to the point of entrance in accordance with ANSI/TIA-607 and manufacturer's instructions.

][Telecommunications backbone cabling incorporating a shield or metallic member must have the shield or metallic member bonded to the Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] where the cables are terminated or where pairs are "broken out" from the cable sheath in accordance with ANSI/TIA-607 and manufacturer's instructions.

][The secondary protector grounding conductor or terminal must be connected to the nearest Primary Bonding Busbar (PBB)[or Secondary Bonding Busbar (SBB)] using the shortest practical path in accordance with ANSI/TIA-607 and manufacturer's instructions.
]
[3.2.4 Mesh Bonding Network (mesh-BN)

3.2.4.1 Access Floor mesh-BN

a. [Provide access floor with integral means to bond the flooring grid as part of the structure][Install grid bonding conductors] on[3.7 m 12 ft][2.4 m 8 ft] centers, to permit bonding of every [sixth][forth] pedestal using listed pedestal ground clamps. Connect grid conductors together where they cross each other.

b. Bond PBB[or SBBs] in room to two or more bonding conductors of reference grid with TEBCs.

c. Bond equipment to nearest PBB[or SBB] and to mesh-BN with TEBCs.

d. Bond conduits and piping entering equipment room with TEBCs to nearest PBB[or SBB] and to grid conductor nearest entry into room.

3.2.4.2 mesh-BN - Wire Mesh

a. Install grid bonding conductors on[50 mm 2 in][75 mm3 in][100 mm 4 in

][150 mm 6 in][300 mm 12 in][610 mm 24 in] centers. Connect grid conductors together where they cross each other.

b. Bond PBB[or SBBs] in room to two or more bonding conductors of reference grid with TEBCs.

c. Bond equipment to nearest PBB[or SBB] and to mesh-BN with TEBCs.

d. Bond conduits and piping entering equipment room with TEBCs to nearest PBB[or SBB] and to grid conductor nearest entry into room.

3.2.4.3 mesh-BN - Grid Tape

a. Install mesh tape on[300 mm 12 in][610 mm 24 in] centers. Connect mesh tape together where they cross each other.

b. Bond PBB[or SBBs] in room to two or more bonding conductors of reference grid with TEBCs.

c. Bond equipment to nearest PBB[or SBB] and to mesh-BN with TEBCs.

d. Bond conduits and piping entering equipment room with TEBCs to nearest PBB[or SBB] and to grid conductor nearest entry into room.

][3.2.5 Mesh-Isolated Bonding Network (mesh-IBN)

3.2.5.1 Access Floor mesh-IBN

a. [Provide access floor with integral means to bond the flooring grid as part of the structure][Install grid bonding conductors on[3.7 m 12 ft][2.4 m 8 ft] centers, to permit bonding of every [sixth][forth] pedestal using listed pedestal ground clamps. Connect grid conductors together where they cross each other.]

b. Bond PBB[or SBBs] in room to a single bonding conductor of reference grid with TEBC.

c. Bond equipment to mesh-IBN with TEBCs.

d. Bond conduits and piping entering equipment room with TEBCs to grid conductor nearest entry into room.

3.2.5.2 mesh-IBN - Wire Mesh

a. Install grid bonding conductors on[50 mm 2 in][75 mm3 in][100 mm 4 in][150 mm 6 in][300 mm 12 in][610 mm 24 in] centers. Connect grid conductors together where they cross each other.

b. Bond PBB[or SBBs] in room to a single bonding conductor of reference grid with TEBC.

c. Bond equipment to mesh-IBN with TEBC.

d. Bond conduits and piping entering equipment room with TEBCs to grid conductor nearest entry into room.

3.2.5.3 mesh-IBN - Grid Tape

a. Install mesh tape on[300 mm 12 in][610 mm 24 in] centers. Connect

mesh tape together where they cross each other.

b. Bond PBB[or SBBs] in room to a single bonding conductor of reference grid with TEBC.

c. Bond equipment to mesh-IBN with TEBCs.

d. Bond conduits and piping entering equipment room with TEBCs to grid conductor nearest entry into room.

]3.2.6 Cabinets and Racks

Metallic enclosures, including telecommunications cabinets and racks, must be bonded to the [mesh-BN][mesh-IBN][,][or][PBB][, or][SBB] using a minimum sized [No. 6 AWG][_____]. Cabinets, racks, and other enclosures must not be bonded serially; each must have its own dedicated bonding conductor to the [mesh-BN][,][or][PBB][,][or][SBB][, or][TEBC]. Equipment containing metallic parts and patch panels for shielded cabling in cabinets and racks must be bonded to the telecommunications bonding system [in accordance with ANSI/TIA-607 and manufacturer's instructions.][a minimum [No. 12 AWG][_____] conductor.] For bolted cabinets and racks, bonding hardware must be specifically designed to accomplish integral bonding of the cabinet and rack assembly, frame, and support, and tested to meet applicable third-party nationally recognized testing laboratory requirements. All detachable, metallic parts of equipment cabinets and racks must be bonded, either directly by means of bonding jumpers or through the cabinet frame, to the connection point on the cabinet where the cabinet bonding conductor connects to the cabinet. When a detachable, metallic part of an equipment cabinet or rack is connected by a bonding jumper, the bonding jumper must be a minimum No. 12 AWG stranded, high strand count, insulated copper conductor with green or green with yellow stripe jacket. The bonding jumper must have an easily visible quick connect to facilitate detaching and attaching the panel or door.

3.2.7 Cable Tray Connections

Provide cable tray bonding with mechanical bonds supplied by the cable tray manufacturer or a bondingjumper between connected sections of cable tray or runway.Test bonding connections to ensure a maximum bonding resistance of 1 milliohm.

3.2.8 Grounding and Bonding for Towers and Antennas

****
NOTE: Refer to ANSI/TIA-607 Annex B for information regarding grounding and bonding of towers and antennas. Refer to ATIS 0600334 for additional requirements.
****

The installation must meet the grounding and bonding requirements of ATIS 0600334.

3.2.8.1 Ring Electrode

Install a minimum 760 mm 30 in below grade and a minimum 610 mm 24 in from base of tower or mounting. Bond each tower base and metallic frame of dish to ring electrode, buried a minimum 460 mm 18 in below grade. Bond

ring electrode and antenna bonding conductors to equipment room PBB[or SBB], buried a minimum 760 mm 30 in below grade. Bond metal fences located within 2 m 6 ft of towers and antennas to ring electrode, buried a minimum 460 mm 18 in.

3.2.8.2 Roof-Mounted Towers

Provide a roof ring that meets the requirements for ring electrode except conductors must comply with NFPA 780. Bond tower base footings steel, PBB[or SBB] in equipment room, and antenna support guys to roof ring. Connect roof ring to perimeter conductors of lightning protection system.

3.2.8.3 Waveguides and Coaxial Cable

Bond cable shields at point of entry into building to the external grounding system using at minimum No. 2 AWG bonding conductors. Once cable is inside building, connect cable shields to building interior grounding system using a minimum No. 6 AWG bonding conductor. Metallic entrance plates must be bonded to cables using a minimum No. 2 AWG bonding conductor for exterior of building, and No. 6 AWG for interior of building. Bond coaxial cable surge arrester to ring electrode or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.3 IDENTIFICATION

****

NOTE: Install and label medical facilities in accordance with Defense Health Agency LAN/WLAN Installation Manual. Label other projects in accordance with ANSI/TIA-606 using a mechanical device for printing. Labeling schemes are required to be detailed in design drawings and approved by the Telecommunications Manager. Labeling must be IAW the architectural wayfinding and not construction space number/naming conventions.

****

3.3.1 Labels

Provide labeling in accordance with ANSI/TIA-606, UFC 3-580-01, and as designed. Handwritten labeling is unacceptable. Stenciled lettering for grounding must be provided using [thermal ink transfer process][laser printer][_____].

3.3.2 Cable

Cables must be labeled with To/From information on opposing ends with identifiers as provided in design drawings and in accordance with ANSI/TIA-606.

Cables terminated on the PBB[and SBBs] must have "DO NOT DISCONNECT" brass tags installed at the termination point.

3.3.3 Termination Hardware

Bonding busbars must be labeled using yellow labels with verbiage/identifiers as approved by Telecommunications Manager in accordance with ANSI/TIA-606, UFC 3-580-01, and as designed.

3.4 FIELD QUALITY CONTROL

Provide test equipment and personnel and submit written copies of test results. Technicians who have successfully completed a training program for the test equipment and hold a current certificate as proof thereof must execute the tests. Give Contracting Officer [5][_____] working days notice prior to [each][_____] test[s]. Test grounding and bonding system in accordance with ANSI/TIA-607.

3.4.1 Inspection

Prior to performing testing, a visual inspection must be performed to verify all components are installed in accordance with ANSI/TIA-607, NFPA 70,[and] ANSI/BICSI N3[,[and] NFPA 780][,[and] ATIS 0600334][, and MIL-HDBK-419]. Verify tightness of accessible, bolted electrical connections with calibrated torque wrench according to manufacturer's published instructions.

3.4.2 Grounding and Bonding System Test

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NOTE: Minimum requirement is for 25 ohm resistance. Only require a resistance of 5 ohms or less for critical facilities or as directed by the Telecommunications Manager.

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a. Test structural metal using a two-point test in accordance with ANSI/TIA-607to verify its conductivity to the building's electrical grounding electrode system before making connection of structural metal bonding conductors.

b. Test the electrical grounding electrode system using a three-point fall-of-potential method in accordance with ANSI/TIA-607 before making connection of TBC. The electrical grounding system must not exceed [25 ohms][5 ohms] resistance. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Document and submit test results in accordance with paragraph SUBMITTALS.

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NOTE: The recommended maximum value for resistance between any point in the telecommunications bonding system and the building's electrical grounding electrode system is 100 milliohms. Only require a resistance of 50 milliohms or less for critical facilities or as directed by the Telecommunications Manager.

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c. Bonding system testing is required to determine if an acceptable level of resistance is provided between the telecommunications bonding system and the electrical grounding electrode system. Perform bonding testing on all segments of the bonding system using a two-point test in accordance with ANSI/TIA-607 and ANSI/BICSI N1. Testing must be performed prior to the installation of any telecommunications equipment. A maximum value of resistance between any two points in the telecommunications bonding system must be less than 100 micro-ohms and to the buildings electrical grounding electrode system must be

less than [100][50] milliohms. Document and submit test results in accordance with paragraph SUBMITTALS.

d. Test for ground loop currents using digital clamp-on ammeter, with full scale not more than 10 amperes, displaying current in increments of 0.01 ampere accuracy of plus or minus 2.0 percent. With grounding infrastructure completed and communications system electronics operating, measure current in bonding conductors connected to the PBB[and SBB[s]]. Maximum acceptable alternating current level is 1 ampere. Document and submit test results in accordance with paragraph SUBMITTALS.

e. Test for stray direct current voltages using direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. With grounding infrastructure completed and communications system electronics operating, measure voltage in bonding conductors connected to the PBB[and SBB[s]]. Maximum acceptable direct current voltage level is 3 millivolts.

Final labeling must be verified as part of testing and certified as accurate per record documentation.

Telecommunications grounding and bonding will be considered defective if it does not pass tests and inspections. Remove and replace defective units and retest.

3.5 PROTECTION

After installation, protect busbars and conductors from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance.

-- End of Section --