Because bonding and grounding systems within a building are intended to have one electrical potential, coordination between electrical and telecommunications bonding and grounding systems is essential during design and installation. One way to coordinate these efforts is to follow industry-established codes and standards. But how do you know which ones to follow? This article presents a brief history and overview of the relevant codes and standards you should be familiar with as well as discusses recent developments that affect all designers and installers.

Of course, the first relevant code is the National Electrical Code (NEC), which addresses bonding and grounding as minimum requirements for life safety. While ensuring public safety is the highest priority, the industry began to realize in the late 1980s and early 1990s that the electrical grounding requirements, while protecting end-users, were not protecting the end-user’s expensive electronic (IT) equipment.

The industry addressed this concern by developing standards. While similar to a code, which is adopted by local states and municipalities into law, the use of a standard is voluntary. However, it may become a requirement for any given project, if the owner or designer/engineer lists it as such in the construction documents.

One of the first standards to address bonding and grounding was IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems (the Green Book) when Chapter 5 was added in the 1991 edition – Electronic Equipment Grounding. This addition primarily featured improved bonding and grounding practices for the power systems serving information technology (IT) equipment.

The IEEE followed up with IEEE Standard 1100, Recommended Practice for Powering and Grounding Electronic Equipment (the Emerald Book) in 1992. IEEE 1100 expanded on the Green Book, explaining the issues with poor power quality, lightning, and other surges and different ground potentials on metallic data cabling.

In 1994, the Telecommunications Industry Association (TIA) and the Electronic Industries Association (EIA) published ANSI/TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications, which established the need for a dedicated telecommunications grounding and bonding system (see Main Components of a Telecommunications Grounding and Bonding System on page C27). This standard specified requirements for a ground reference (ground busbar) in each telecommunications space, including the telecommunications entrance room(s), telecommunications closets, and IT equipment rooms. It also established the bonding of telecommunications system pathways within the telecommunications spaces to the ground reference.

The ANSI/TIA/EIA standard was revised in 2002 to become ANSI-J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications. The standard was developed jointly by TIA/EIA Working Group 41.7.2 in close coordination with the Alliance for Telecommunications Industry Solutions (ATIS) T1E1.5 and T1E1.7. The term “earthing” was used as the internationally accepted term for “grounding.” The major changes from ANSI/TIA/EIA-607 were greater grounding busbar detail, the addition of tower and antenna bonding and grounding recommendations, work area and personal operator-type equipment position grounding and bonding recommendations, and harmonized international terminology (although terminology from the NEC was retained). Nevertheless, the standard only addressed the connections from the electrical ground to the busbar in each telecommunications space — the connection from the busbar to the equipment was still missing.

One of the glaring omissions from the standard was ensuring a quality installation. To address this issue, NECA and BICSI developed a joint standard, ANSI/NECA/BICSI-607, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings. Published in 2011, this standard provides limited planning information, but excels in eliciting installation requirements. For example, it clearly states how to ensure a bond to the busbar by using an antioxidant compound to the connection point using compression 2-hole lugs. From a planning perspective, the standard specifies bonding to a telecommunications rack and includes bonding and grounding information for data centers. However, one of the drawbacks is it was based upon ANSI-J-STD-607-A while the updated ANSI/TIA-607-B standard was in development and nearing publication.
ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises is by far the most encompassing telecommunications standard for bonding and grounding. Its requirements are for “generic” premises rather than for just a commercial building, and its purpose is to enable and encourage the planning, design, and installation of generic telecommunications bonding and grounding systems within premises. This is to address the basic grounding and bonding requirements without prior knowledge of the specific telecommunication or IT system that will be installed. While primarily intended to provide direction for the design of new buildings, this standard may be used for existing building renovations or retrofits. Design requirements and choices are provided to enable the designer to make informed design decisions.

The ANSI/TIA-607-B standard covers regulatory requirements, an overview of a bonding and grounding system, the components involved, and design requirements. Additionally, performance and test requirements are covered, although simplistically. The TR-42.16 Subcommittee recognized this shortfall, and is already developing an addendum to this standard on:

- soil resistivity testing using a 4-point method,
- grounding electrode system design,
- grounding electrode system resistance testing including the fall of potential method and use of the clamp-on test meter.

Through these updates, there have been many changes to the components of a telecommunications bonding and grounding system. Busbar requirements were modified to be made of copper or copper alloys having a minimum of 95% conductivity when annealed, as specified by the International Annealed Copper Standard (IACS). While some manufacturers are offering a less expensive product made of other metals, copper is still the preferred material. Regardless of the material, the busbars must still be listed, and the dimensions of the telecommunications main grounding busbar (TMGB) and the telecommunications grounding busbar (TGB) have not changed. As for the connectors to these busbars, the surface of all bonding and grounding connectors used on a TMGB and TGB shall be of a material that provides an electrochemical potential of less than 300mV between connector and grounding busbar. Essentially, with these requirements, the standard is ensuring a well-performing bonding and grounding system.

Conductor sizing is still 2kcmil per linear foot of conductor length, but the maximum size is now 750kcmil (Table). The previous edition of this standard sized the TBB conductor up to 3/0 AWG. The standard also states that the grounding conductors shall not decrease in size as the grounding path moves closer to earth, and the size of the conductor is not intended to account for the reduction or control of electromagnetic interference (EMI). The sizing of this conductor affects the:

- BCT (bonding conductor for telecommunications)
- TBB (telecommunications bonding backbone)
- GE (ground equalizer)
- Supplementary bonding network (found in computer rooms)
- TEB (telecommunications equipment bonding conductor)
- UBC (unit bonding conductor)

Design requirements for this standard include the entire system from the entrance point to the equipment in the rack within the telecommunications room. It also specifies that ANSI/NECA/BICSI-607 is to be used for bonding and grounding installation information. In order to limit the potential difference between telecommunications conduits or between telecommunications conduits and power conduits, the standard specifies that the telecommunications conduits shall be bonded to the TMGB/TGB.

Additionally, to achieve the objectives of potential equalization, ensure that cable runway/ladder sections are bonded together to the TMGB/TGB. When the electric panelboard serving that telecommunications room is located in the same room or space as the TMGB/TGB, that panelboard’s alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure shall be bonded to the TMGB/TGB. A qualified electrician should install this bond.

Informative annexes included with this standard have information on grounding electrodes, towers and antennas, telecommunications electrical protection, electrical protection for operator-type equipment positions, and a cross reference of more commonly used terms.
For a designer of telecommunications bonding and grounding systems, the ANSI/TIA-607-B standard is the most encompassing standard to follow for premises buildings. Although there are many other guides (see Resources at a Glance below), standards are developed so that a consensus must be reached among industry expert volunteers. Although best practices may have valuable information, they typically have not been vetted among a large subset of industry experts.

What does this mean for the electrical contractor? For anyone with a telecom division, it’s important to stay current on the telecommunications grounding standards. A well-designed system would include a telecommunications grounding detail and riser diagram (click here to see Figure), and specifications would list the most recent edition of the applicable standards.
For drawings and specifications that are silent — or that may reference outdated standards or conflicting guidelines — the contractor should ask the design team for clarification (during the bid window, if possible) as to what sizing to follow for the TBB, because a change in conductor size may greatly affect cost.

For electrical contractors subcontracting out the telecommunications work, the demarcation point for work between electrical and telecommunications contractors should be carefully coordinated. A recommended practice is for the electrical contractor to provide the grounding conductor and connection from the main electrical ground to the TMGB, as well as from an electrical panel in a telecommunications room to the grounding busbar in that room. The telecommunications contractor would then provide all of the grounding busbars and bonding conductors within and between the telecommunications rooms, as well as make all final connections to the TMGB, TGBs, and telecommunications infrastructure/equipment.

Peterworth works in the Information Technology Services - Networking & Telecommunications department at the University of Texas at Austin in Austin, Texas. He can be reached at: mpeterworth@austin.utexas.edu.

SIDEBAR: Main Components of a Telecommunication Grounding and Bonding System

The Telecommunications Main Grounding Busbar (TMGB) is typically located in the telecommunications entrance facility — where the telecommunications cables enter the building and need to transition to indoor-rated cables per Sec. 800.48 of the NEC, which limits unlisted cables to 50 ft or less. This busbar is pre-drilled and made of copper with a minimum of 4-in.-wide by ¼-in. -hick material of varying length. It is to be connected to the main electrical ground with an appropriately sized copper conductor. The entrance protectors from the outside cables and conduits are to be connected to this TMGB, as well as any other telecommunications equipment co-located in the entrance facility. (It is common practice for the entrance facility to also be the main network room for IT equipment.)

In all other telecommunications rooms, there is to be a telecommunications grounding busbar (TGB), to be made of copper with pre-drilled holes and minimum dimensions of 2-in.-wide by ¼-in.-thick material of varying length. These are to be connected back to the TMGB through appropriately sized copper conductors that form the telecommunications bonding backbone (TBB), as shown in the Figure (click here to see Figure).
In each telecommunications room, the ladder rack, equipment rack, entrance (lightning) protectors for the telecommunications lines, and even IT equipment are connected back to the TMGB or TGB with a bonding conductor. If either building steel or the electrical panel is available in the telecommunications room, they need to be connected back to the TMGB or TGB as well, with a minimum of 6 AWG copper conductor or larger.

SIDEBAR: Resources at a Glance

There are many standards and guidelines a designer may choose to specify. Here are a list of several that may be referenced for more specific project and installation applications:

- ANSI/ATIS-0600334, Electrical Protection of Communications Towers and Associated Structures
- ATIS 0600318, Electrical Protection Applied to Telecommunications Network Plant at Entrances to Customer Structures or Buildings
- ATIS 0600321, Telecommunications – Electrical Protection for Network Operator-Type Equipment Positions
- ATIS-0600313, Electrical Protection for Telecommunications Central Offices and Similar Type Facilities
- EN 50310, Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment
- MIL-HDBK-419A, Grounding, Bonding, and Shielding for Electronic Equipments and Facilities Basic Theory
- ANSI/IEEE 1100, 2005, Recommended Practice for Powering and Grounding Electronic Equipment
- ANSI/ATIS 0600333, Grounding and Bonding of Telecommunications Equipment
- ANSI/ATIS 0600334, 2008, Electrical Protection of Communications Towers and Associated Structures
- ITU-T K.27, 1996, Bonding Configuration and Earthing Inside a Telecommunication Building