What is Grounding and Bonding for Telecommunication Systems?

June 15, 2012

>> Why Do We Need Grounding and Bonding for Telecommunication Systems?

With the increasing demand for computer network installations, telecommunications grounding and bonding has become a growing opportunity for electrical contractors. Although similar grounding principles apply, understanding the telecommunications terminology and special considerations has been a challenge.

As with traditional electrical grounding, telecommunications networks and equipment should be grounded to the electrical service. However, simply grounding to structural steel isn’t enough when tackling telecommunications systems. The sensitivity of the electronic equipment requires that the telecommunications cabling and power be effectively equalized to prevent loops or transients that can damage the equipment. This means designing a complete grounding and bonding system that goes beyond the basic "green-wire" methodology.

>> What is Grounding?

The NEC article 100 defines ground as:

“A conducting connection, whether intentional or unintentional, between electrical circuits or equipment and the earth, or some conducting body that serves in place of the earth”.

Electrical systems and communication cabling systems that are required to be grounded must be connected to the earth. The grounding mechanism must provide a reliable means to safely conduct the voltages imposed by lightning, line surges, or unintentional contact with high voltage lines or equipment to ground.

>> What is Bonding?

The NEC article 100 and 250-70 defines bonding as:

“The permanent joining of the metallic conducting parts of equipment and conductor enclosures to assure and electrically conductive path between them that will ensure electrical continuity and have sufficient capacity to safely conduct any foreign current likely to be imposed to ground.”
Bonding is required because electrically conductive materials such as structural steel, metal cable trays, and metallic supporting structures may become energized in the event of making contact with: lightning, line surges, or unintentional contact with high voltage lines.

The practice of creating effective bonding is to create a reliable path for such fault currents to the electrical system ground. Effective bonding practices help to equalize potential caused by either lightning and electrical system faults that would otherwise damage equipment and harm individuals.

The NEC requires that metal raceways, cable trays, racks, enclosures, or metal cable armoring must be effectively bonded to ensure the capacity to conduct any fault current to ground.

The NEC Article 250-96 states:

“Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal noncurrent carrying parts that are able to serve as grounding conductors, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault currents likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings designed so as to make such removal unnecessary.”

**>> Electrical Exposure**

Communication cables have exposure to electrical currents. The NEC Article 800-2 defines a communication cable as “exposed” when

“The cable or circuit is in such a position that, in case of failure of supports or insulation, contact with another cable or circuit may result.”

All communication cables are considered exposed to electrical current because of where these cables are installed in a building or in a campus configuration. Communication cables are installed in very close proximity to electrical conductors on walls and above ceilings.

The degree of exposure is also determined by where the cable is installed. Exposure can be defined in the following two areas:

- Outside building exposure
- Inside building exposure

**1. Outside Building Exposure**

All copper communication cables, or any dielectric cables that have a conductive element, are conductors of electrical energy. When these types of cables are run between buildings, they are electrically exposed to lightning. These cables would carry a lightning strike along the cable and into any cables that are connected to these cables.
2. Inside Building Exposure

Communication cables are exposed to electrical hazards inside a building. Copper communication cables are installed in the same vicinity as electrical power conductors. These is the possibility of accidental contact with power conductors, which would cause power fault induction.

>> Telecommunications Grounding and Bonding Standard – ANSI/TIA/EIA-607

The ANSI/EIA/TIA-607 standard is the commercial building grounding and bonding requirements for telecommunications.

The primary objective of this standard is to provide guidance around the issue of bonding and grounding as it relates to building telecommunications infrastructure.

The ANSI/EIA/TIA-607 standard defines a telecommunications grounding and bonding system and the interconnections to the building electrical grounding system. The recommendations made in this standard do not supersede the bonding and grounding requirements of national and local electrical code.

Key Terms:

Bonding means permanent joining of metallic parts for the purpose of forming an electrically conductive path to ensure electrical continuity and capacity to safely conduct any current likely to be imposed.

Bonding conductor for telecommunications is a conductor used to interconnect the telecommunications bonding infrastructure to the service equipment (power) ground of the building.

Effectively grounded refers to an intentional connection to earth through a ground connection of sufficiently low impedance. It must have sufficient current-carrying capacity to be able to prevent the buildup of voltages that could potentially result in unnecessary hazard to connected equipment or persons.

Ground is an intentional or accidental conducting connection between an electrical circuit or equipment and earth or conducting body serving in place of earth.

Ground electrode conductor is a conductor used to connect the grounding electrode to:

- The equipment grounding conductor
- The grounded conductor of the circuit at the service equipment
- The source of a separate system.
Telecommunication Grounding System Components

The telecommunications grounding and bonding system starts with a physical connection to the building grounding electrode system and extends to every telecommunications room (TR) in the building (see the following figure).

In general, a telecommunications grounding system defined by the ANSI/TIA/TIA-607 standards contains the following components:

- Telecom bonding conductor
- Telecom main grounding busbar (TMGB)
- Telecom bonding backbone (TBB)
- Telecom grounding busbar (TGB)
- Telecom bonding backbone interconnecting bonding conductor (TBBIBC)

The system begins at the electrical service entrance, travels to the TMGB and continues through to each TGB located in individual telecommunications closets on each floor of the building structure, finally looping back around to the original TMGB.

1. Telecom Entrance Facility (TEF)
The telecommunications entrance facility (TEF) includes the entrance point at the telecommunications service and also the space where the inter- and intra-building backbone facilities join. Telecommunication-related antenna entrances and electronic equipment may be located in the TEF.

2. Telecom Bonding Conductor

![Diagram of Telecom Bonding Conductor]

The ANSI/EIA/TIA-607 standard requires that all communications bonding conductors be listed for the intended purpose and approved by a nationally recognized testing laboratory such as UL or ETL.

Bonding conductors must always be insulated wires. The standard also requires that bonding conductors be made of copper metal. Other metal types are not supported for use as a bonding conductor by the ANSI/EIA/TIA-607 standard. In addition, the minimum size of all bonding conductors must be at least a #6 AWG wire.

The ANSI/EIA-TIA-607 standard prohibits placing bonding conductors in a metallic conduit made of iron. This standard requires that if the bonding conductor must be placed in an iron conduit longer than 1m (3 ft.) in length, then bonding conductor must be bonded at each end of the conduit. The wires used for bonding the bonding conductor must be at least a #6 AWG wire.

3. Telecom Main Grounding Busbar (TMGB)
The TMGB is the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. Because it is the central attachment point for TBBs and equipment, the TMGB should provide easy access for telecommunications personnel.

The TMGB is predrilled copper busbar with standard NEMA bolt-hole sizing and spacing for the particular lug connection that will be used. It should be large enough to satisfy today’s applications and accommodate future growth. A minimum of 6-mm thickness and 100-mm width is required. Many varieties of ground bars are available, and some come as a kit and can be customized to meet the specific requirements of the application. Prewelded Cadweld pigtails are available in a variety of conductor sizes and lengths, insulated or bare, ready to be attached to the building ground.

For reduced resistance, electrotin plating is preferred. However, if not plated, the mating surfaces must be completely cleaned. Where telecommunications panelboards are located with the TMGB, they must have the alternating current equipment ground bus (or a metallic enclosure) bonded to the TMGB/TGB. All appropriate clearances should be maintained while locating TMGBs as close as possible to the panelboards.

Connections to the TMGB or lugs should be exothermic welds. Exothermic welds provide a connection that helps ensure the long-term integrity of the grounding system.

4. Telecom bonding backbone (TBB)
The TBB is a conductor that connects all TGBs with the TMGB. It reduces or equalizes potential differences between the telecommunications systems to which it is bonded. The TBB should not be the only conductor that provides a ground fault current return path.

Starting at the TMGB, the TBB loops throughout the building via telecommunications backbone pathways. It connects TGBs in every telecommunications closet and equipment room within the building. Multiple TBBs may be necessary, depending on the size of the structure and the number of TGBs in the building. Water pipes or metallic cable shield should not be used as telecommunications bonding backbone.

Each TBB should be an insulated copper conductor, a minimum of No. 6 AWG and possibly as large as 750 kc mil often used by telephone and communications companies. In a multi-story building where more than one TBB is used, the TBBs must be bonded together with a TBB interconnection bonding conductor (TBBIBC) located on the top floor and at least every third floor.

5. Telecom Grounding Busbar (TGB)
A TGB is a predrilled copper busbar with standard NEMA bolt hole sizing and centrally connected systems and equipment served by a telecommunications closet. It should be at least 6-mm thick by 50-mm wide. Just like the TMGB, the TGB should be electrotin-plated or cleaned prior to connecting the conductors to the busbar. The bonding conductor between the TBB and the TGB should be continuous and run in the most direct path possible.

Often, the TGB is installed to the side of the panelboard. When the building’s structural steel is effectively grounded, each TGB should be bonded to the steel within the same room with a No. 6 AWG conductor. Always use the shortest distance possible in the grounding system.

7. Telecom Bonding Backbone Interconnecting Bonding Conductor (TBBIBC)

TGBs can be located in the same TRs or TRs on the same floor.

The ANSI/EIA/TIA-607 standard requires that when two or more TBBs are installed vertically in the intrabuilding backbone pathway, the TBBs must be bonded together. The telecommunications bonding backbone interconnecting bonding conductor (TBBIBC) is the component used for this function (see the figure above).
The ANSI/EIA/TIA-607 standard requires that the TBBIBC be installed at the top floor and a minimum of every third floor. The minimum size of the TBBIBC must be no smaller than the TBB conductor size.

The TBBIBC would also be used to bond two or more TGBs installed in the same TR together. The TBBIBC is also used to bond the TGBs installed in different TRs that reside on the same floor of the building. This connection would follow the same requirements as bonding multiple TBBs at the top floor and a minimum of every third floor.

>> Summary

Telecommunications grounding and bonding is additional grounding and bonding installed specifically for telecommunications. This is not a replacement for grounding and bonding specified by the National Electrical Code (NEC) but typically is additional to address telecommunications system performance.

The NEC is a comprehensive set of codes related to both electrical and communication cabling. Communication cabling is covered in Chapter 8 of the NEC and is titled “Communication Systems.” Article 800 covers the installation of communication cables for telephone systems, telegraph systems, burglar alarm systems, and other central station systems.