Grounding Considerations for the Data Centre

The grounding system is not just an insurance policy against a lightning strike. It is an active, functioning system that provides protection for personnel and equipment. Proper grounding is essential for efficient system performance. Surges that are not properly dissipated by the grounding system introduce electrical noise on data cables. They cause faulty data signals and dropped packets, thus decreasing the throughput and overall efficiency of your network. According to insurance industry data, improper grounding of communication systems leads to $500 million per year in lightning damage to property and equipment. The Information Technology Industry Council states that grounding is the most important factor in reliable network equipment performance. The component cost of repairing damaged equipment is substantial for complex circuit boards, especially when labor and downtime are considered.

According to the IEEE, the typical AC third-prong ground is almost never sufficient to prevent damage to network equipment. Personal injury from electric shock due to improper grounding can cause immeasurable human suffering and significant expense. Potential fire hazards exist when heat is generated from electrical surges that find a high resistance path to ground.

Standards for Data Center Grounding

Data center grounding is governed by following documents:

- TIA-942, Telecommunications Infrastructure Standard for Data Centers—TIA-942 defines practical methods to ensure electrical continuity throughout the rack materials and proper grounding of racks and rack-mounted equipment. This is the only specification that addresses problems specific to data centers.

- J-STD-607-A-2002, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications — this standard focuses on grounding for telecommunications. It defines a system that begins at the
entrance facility, in the telecommunications main grounding bus bar (the TMGB), and ends at the local telecommunications grounding bus bars (TGBs) located in the telecommunications rooms.

- IEEE Std 1100 (IEEE Emerald Book), IEEE Recommended Practice for Powering and Grounding Electronic Equipment—IEEE provides further detail on how to design the grounding structure for a computer room environment through a Common Bonding Network (CBN). The CBN is the set of metallic components that are intentionally or incidentally interconnected to provide the principal bonding and grounding inside a telecommunications building. These components include structural steel or reinforcing rods, metallic plumbing, AC power conduit, cable racks, and bonding conductors. The CBN is connected to the exterior grounding electrode system.

**Characteristics of the Data Center Grounding System**

The purpose of the grounding system is to create a low-impedance path to earth ground for electrical surges and transient voltages. Lightning, fault currents, circuit switching (motors turning on and off), and electrostatic discharge are the common causes of these surges and transient voltages. An effective grounding system minimizes the detrimental effects of these surges. A properly designed grounding system has the following characteristics:

- It should be intentional; that is, each connection must be engineered properly. The grounding system is no more reliable than its weakest link.
- It should be visually verifiable.
- It should be adequately sized.
- It should direct damaging currents away from equipment.
- All metallic components in the data center should be bonded to the grounding system.
Along with these characteristics, all grounding conductors should be copper, components should be listed by an approved test lab such as UL, and local electrical codes must be adhered.

To ensure long-term integrity of the grounding system, always use compression connectors, not mechanical. A mechanical connector holds the conductor in place with a setscrew, and when exposed to vibration (e.g., nearby fans or humming equipment), the setscrew can back off and loosen. A loose connection is a high-resistance connection that can fail in a surge event. A compression connector is permanently deformed and does not come loose with vibration. There should be a logical flow as you follow the grounding structure, for example, from the equipment chassis to the rack, from the rack to the data center grounding infrastructure, then over to the local TGB, which feeds into the telecommunications bonding backbone (TBB) that runs back to the main TGB (TMGB), which is tied to earth ground.

**Routine Inspection of the Grounding System**

Mission-critical facilities should implement a plan to inspect all points along the grounding infrastructure on an annual or semiannual basis. An inspection that follows a line-by-line work order allows early detection of potential problems such as loosened or corroded connections, missing labels, conductors that have been damaged, cut, or removed, and new metallic elements that require connections to the CBN. To facilitate inspection, the grounding system should use connectors, bus bars, and conductors from end to end that allow visual verification of the bond.
# Key Points of Data Center Grounding

| Equipment chassis | • Third prong is never sufficient. • Always follow the grounding/earthing recommendations of the manufacturer when installing equipment. |
| Rack/cabinet continuity | • Hardware typically supplied with bolt-together racks is not designed for grounding/earthing purposes. • Racks should be assembled with paint-piercing grounding washers, under the head of the bolt and between the nut and rack, to provide electrical continuity. • A full-length rack grounding strip should be attached to the rear of the side rail with thread-forming screws to ensure metal-to-metal contact. |
| Rack/cabinet grounding | • Use a #6 AWG or larger bonding conductor to bond each rack or cabinet with the grounding strip to the data center grounding infrastructure. • Do not bond racks or cabinets serially. |
| Data center grounding infrastructure | • A common method for constructing the data center grounding infrastructure is to create a copper conductor grid on 0.6 to 3 m (2 to 10 ft) centers that covers the entire computer room space. |
| Telecommunications grounding bar | • Use a #1 AWG or larger conductor to bond the data center grounding infrastructure to the TGB. • Two-hole copper compression lugs are preferred because they are irreversible and resist loosening when twisted (bumped) or exposed to vibration. |
| Telecommunications bonding bar | • The TBB should be installed as a continuous conductor, avoiding splices where possible. • Avoid routing grounding/earthing conductors in metal conduits. • Although the building steel and metallic water piping must be bonded to the grounding/earthing system for safety reasons, neither may be substituted for the TBB. |
| Telecommunication main grounding bus bar | • The TMGB is bonded to the service equipment (power) ground, which connects to earth ground (the grounding electrode system). |