

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

- A. Product Data
 - 1. For each type of ground rod, bar and connection type.

1.2 QUALITY ASSURANCE

- A. Provide Electrical Components, Devices, and Accessories listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Comply with UL 467 for grounding and bonding materials and equipment. Comply with ANSI/TIA/EIA-607, "Commercial Building Grounding and Bonding Requirements for Telecommunications. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Except as otherwise indicated, provide copper electrical grounding and bonding systems and materials with assembly of materials including but not limited to cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products that comply with NEC, UL, and IEEE requirements, and with established industry standards for those applications indicated. Utilize compatible metallic materials throughout system to eliminate galvanic action.
- B. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide conductors and connectors as specified in Section 260519. Subject to being equivalent and subject to compliance with requirements, provide other grounding related materials by Erico (as a standard of quality), or other equivalent available manufacturers where not otherwise specified in Division 26.

2.2 GROUNDING BUSBARS

- A. Electrical Service Entrance grounding busbar
 - 1. Electro-tin plated ¼" thick copper bar
 - 2. Insulated standoffs
 - 3. Hole pattern type "CC"
 - 4. 4 inches high x 24 inches wide

5. Standard of quality shall be equivalent to Erico Electrical Products # EGBA14424CC
- B. Satellite electrical room grounding busbar
1. Electro-tin plated ¼" thick copper bar
 2. Insulated standoffs
 3. Hole pattern type "CC"
 4. 4 inches high x 18 inches wide
 5. Standard of quality shall be equivalent to Erico Electrical Products # EGBA14418CC
- C. Telecommunications grounding busbar
1. Provide telecommunications grounding busbar(s) as specified in Division 27, Section 270526.00

2.3 CONDUCTORS AND CONNECTORS AND ELECTRODES

- A. For insulated conductors, provide copper or tinned-copper wire or cable insulated (green-colored) conductors, insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction. For bare copper conductors, provide: Solid Conductors, ASTM B 3; Stranded Conductors, ASTM B 8; Tinned Conductors, ASTM B 33.
- B. Provide connectors listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected. Provide copper or copper alloy bolted connectors for conductors and pipes, pressure type with at least two bolts. Provide clamp type pipe connectors, sized for pipe. Use exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Provide copper-bonded steel (copper molecularly bonded to nickel-sealed high-strength steel core) ground rods, 3/4 inch in diameter by 10 feet in length (sectional rods may be used when rods are longer than 10 feet). Provide sheet copper plate electrodes that are 20-gage by 36" by 36", made from high-conductivity sheet, with cable attachments (minimum quantity of 2), sized for cables as necessary to fulfill project grounding requirements, where ground rods cannot or should not be used.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Provide green-colored insulation, unless indicated otherwise. Provide solid conductors for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated. Provide bare copper conductors below grade, No. 2/0 AWG

minimum. Provide tinned conductors in corrosive areas. Where to be installed underground, bury at least 36 inches below grade.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors as required by NFPA 70 and as otherwise required. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70: all feeders; all branch circuits; expansion couplings; flexible raceway runs.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heaters: Install a separate insulated equipment grounding conductor to each water heater. Bond conductor to heater units, piping, connected equipment, and components.
- D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Terminate grounding conductors on grounding busses or cabinet grounding terminals as applicable.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. Install bonding so vibration is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Ground Rods: Drive rods until tops are at least 2 inches (50 mm) below finished floor or final grade unless otherwise indicated. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor. Use driving sleeves or couplings when driving ground rods into the earth.

- D. Ground Plates: Provide copper ground plates where ground rods cannot be used. Provide connections to ground electrodes at a point not less than 1 foot below grade level, and not less than 2 feet away from footings and foundations. Weld grounding conductors to underground grounding electrodes where mechanical connections cannot, or should not, be utilized. Interconnect ground plates with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- E. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except if otherwise indicated.
 3. Connections to Structural Steel: Welded connectors.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Gas Piping: Bond each above ground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Service Entrance Grounding Requirements
1. Provide a parity sized insulated grounded conductor (neutral) for each set of service entrance feeder phase/line conductors, terminated and bonded to service equipment (i.e. to each and every service disconnect where applicable). This applies whether or not downstream loads require a neutral conductor. Install these neutral conductors unspliced and unbroken.
 2. Ground and bond service entrance neutrals to room ground busbar, to effectively grounded structural steel member, to effectively grounded metallic water pipe, and to grounding electrode system as required per NFPA 70 and as applicable.
 3. Provide an enclosed single ground busbar at electrical service entrance locations, bonded to the enclosure, and bonded to service ground with full parity sized green insulated ground conductor (sized same as service ground conductor). Provide quantity and sizes of lugs on busbars as required to accommodate bonding to service grounding electrode system, service neutrals, structural steel, effectively

grounded metallic water pipe, and other grounding requirements set forth in project manual and in NFPA 70. Provide UL listed lugs for use with copper and aluminum conductors.

4. Connect grounding electrode conductors to 1-inch diameter, or greater, metallic cold-water pipe at service entrance using a suitably sized ground clamp. Provide connections to flanged piping at street side of flange. Ground electrical service system neutral at service entrance equipment to grounding electrodes. Install braided type bonding jumpers with code-sized ground clamps on water meter piping to electrically bypass water meters and water service entrance valves.
5. Contact AHJ electrical inspector in advance of installing service grounding work. Determine locally approved methods that must be used for re-bar grounding that the AHJ considers compliant with NFPA 70 Article 250.52.

I. Separately Derived System Grounding

1. Ground and bond each separately-derived system neutral to room ground busbar, to effectively grounded structural steel member, to effectively grounded metallic water pipe, and to separate grounding electrode system as required per NFPA 70 and as applicable.
2. Provide an enclosed single ground busbar at derived electrical system locations, bonded to the enclosure, and bonded to derived system ground with full parity sized green insulated ground conductor (sized same as derived system ground conductor). Provide quantity and sizes of lugs on these busbars as required to accommodate bonding to derived system ground and other grounding requirements set forth in project manual and in NFPA 70. Provide UL listed lugs for use with copper and aluminum conductors.

J. Grounding Requirements for Adjoining and Adjacent Structures

1. This subsection applies for any building structure of any kind that adjoins another in any way, including portions of common buildings that “adjoin” via expansion joints, as well as adjacent abutting structures.
2. Bond new concrete columns using minimum #3/0 AWG below-grade copper conductors. For steel construction, bond together every other steel perimeter column to those of adjacent and adjoining structures. Provide minimum surface contact area of eight square inches, welded securely to clean areas of the steel, for structural steel bonding plates (equivalent bolting methods are acceptable only if means and methods are in strict compliance with directives obtained from the project Structural Engineer). Provide minimum #3/0 AWG copper bonding jumper between bonding plates with sufficient slack to allow for building expansion and movement. Install this work above accessible ceilings or in other accessible non-public areas.
3. Provide an earth ground at every other new column in all directions. Adjacent columns may be earth-grounded at one of the columns instead of both, at column groups that are bonded together.

K. Telecommunications Grounding Requirements

1. At minimum, bond together telecommunications racks, cabinets, tray, ladder rack, and risers in each telecommunications equipment room (ER) and telecommunications wiring closet/room (TR) to the busbar in the respective room. Bond each TR busbar to the ER busbar. Bond the ER busbar to the to the grounding electrode system and the electrical grounding system at the main building ground point. Bond additional points where indicated in the drawings and where required by NFPA 70. Provide a common ground with the building's grounding electrode system for the Telecommunications Infrastructure components.
2. Bond the Main telecommunication service entrances to the electrical service equipment ground using the most direct route possible to minimize conductor length.
3. Provide copper grounding conductor from main building grounding electrode system at service entrance to ground bus at the Telecommunications Entrance Facility.
4. Provide copper bus bars on plywood backboard in each ER and TR. See Division 27, Section 270526.00 for bus bar specifications.
5. Provide copper grounding conductors, in conduit, from the electric service ground busbar to each ER and TR ground busbar.
6. Provide minimum #4 AWG bonding jumper (12 inches maximum) with appropriate lugs at each cable tray joint, or provide manufactured braided copper grounding jumper equal to B-Line #CAM-GJ, T&B #BD12, OZ/Gedney type "FB", or Mono-Systems equal.
7. Provide minimum #4 AWG insulated (green insulation) grounding conductor with appropriate lugs from side of cable trays to each ER and TR ground busbar. Drill and tap side of cable trays (for appropriate size bolt, 1/4 inch by 20 min.), and provide bolted connections making sure that bolts do not extend into wire management part of trays.
8. Provide isolation for grounding busbars from the structure support with a 2 inch minimum separation using manufacturer's recommended insulating stand-offs and hardware.

3.4 LABELING

- A. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed. The labels or text shall be green. Label Text: "GROUND SYSTEM - If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Inspect, test and adjust components, assemblies, and equipment installations, including connections. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test continuity of each conductor. Test completed grounding system at service disconnect enclosure grounding terminal/bar, and at each location where a maximum ground-resistance level is specified or as required to verify integrity of grounding electrode system. Make tests at ground rods before any conductors are connected.
4. Measure and report measured ground resistances that exceed 3 ohms. If resistance to ground exceeds specified values, notify Design Professional promptly and include recommendations to reduce ground resistance. After review and comment by Design Professional, take appropriate action to reduce resistance to specified values, by driving additional ground rods or installing additional ground plates or chemically treating adjacent soil, or providing chemical ground rods or combinations thereof. Then retest to demonstrate compliance.
5. Installed components will be considered defective if it does not pass tests and inspections. Correct malfunctioning work on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new work and retest. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 260526