

## **SECTION 16060**

### **GROUNDING AND BONDING**

#### **PART 1 – GENERAL**

##### **1.01 DESCRIPTION**

- A. Section includes requirements for an electrical grounding system, including electrodes, grounding rods, connectors, insulators, equipment grounding and bonding conductors, and wire and cable grounding conducts and joints.

##### **1.02 REFERENCE STANDARDS**

- A. American National Standards Institute (ANSI):
  - 1. J-STD-607 A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- B. American Society of Testing and Materials (ASTM International):
  - 1. B3 Standard Specification for Soft or Annealed Copper Wire
  - 2. B187 Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes
- C. California Code of Regulations (CCR):
  - 1. Title 24, Part 3, California Electrical Code
- D. National Fire Protection Association (NFPA):
  - 1. NFPA 70 National Electrical Code (NEC)
- E. Underwriters Laboratories Inc. (UL):
  - 1. UL 467 Grounding and Bonding Equipment

##### **1.03 SUBMITTALS**

- A. Refer to Section 16000, Basic Electrical Requirements, for additional submittals and submittal requirements.
- B. Submit shop drawings showing locations of ground rods, grounding connections, and embedded and buried grounding conductors.
- C. Submit product data including manufacturer's catalog cuts showing all specified items.
- D. Submit test procedures. Include description of method of measuring grounding resistance. Include plan showing locations of test points to measure grounding resistance items.

- E. Submit report of test results of grounding resistance.

## **PART 2 – PRODUCTS**

### **2.01 GROUNDING AND BONDING EQUIPMENT**

- A. Equipment: Conform to UL 467, with additional requirements as specified herein.

### **2.02 GROUNDING CONDUCTORS**

- A. Grounding conductors shall comply with NEC Articles 250.118, 250.119 and 250.122.

### **2.03 GROUND RODS**

- A. Material: ASTM B187, medium carbon steel core, copper-clad by the molten weld casting process.
- B. Size: 3/4 inch diameter; 10 feet long

### **2.04 MECHANICAL CONNECTORS**

- A. Material: Bronze

### **2.05 COMPRESSION CONNECTORS**

- A. Material: High conductivity electrolytic copper tubing, heavy wall
- B. Manufacturer: Burndy Electrical, Thomas & Betts, or Engineer approved equal

### **2.06 EXOTHERMIC CONNECTIONS**

- A. Manufacturer: Cadweld, Division of Erico, or Engineer approved equal.

### **2.07 WIRE**

- A. Material: ASTM B3, bare soft drawn stranded copper
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements and the requirements of Section 16100, Wiring Methods.
- C. Insulated general wiring: Type THHN/THWN for grounds routed in conduit with feeders. Size as noted on the Contract Drawings. Insulation: Green in color or taped ends as allowed by code.

### **2.08 BARE CONDUCTORS**

- A. Bare Conductors: ASTM B3, Class B stranded annealed copper conductor unless otherwise indicated.
- B. Bare Copper Cables for Direct Burial in Earth: No smaller than No. 2 AWG, having stranding no smaller than No. 12 AWG.

- C. Bare Copper Cables for Use for Concrete Encased Grounds: No smaller than No. 2 AWG, having stranding no smaller than No. 14 AWG.
- D. Flexible copper braid, minimum cross-sectional area 24,000 cir. Mils (No. 6 AWG), minimum strand size No. 30 AWG.
- E. Copper ground bus assembly, minimum 1/4 inch x 3 inches x 12 inches drilled and tapped every 2 inches on center for two-hole lugs.
- F. Bus bar insulators shall be fibrous glass reinforced polyester.
- G. Terminals, two-hole lug, compression type.
- H. Counterpoised Grounding Electrode Conductor: #4/0 AWG bare soft drawn stranded copper.

### **2.09 JUMPERS**

- A. Tin-plated copper, braided, flexible jumper.

### **2.10 SINGLE CONDUCTOR INSULATED WIRE**

- A. As specified in Section 16100, Wiring Methods.

## **PART 3 – EXECUTION**

### **3.01 GENERAL REQUIREMENTS**

- A. Install products as indicated on the Contract Drawings.
- B. Provide grounding and bonding to meet NEC and ANSI/J-STD-607 A requirements.
- C. Use continuous ground conductor without splices.
- D. Install counterpoised grounding electrode system for OCS (Overhead Catenary System) system and bond to platform reinforcement as indicated on the Contract Drawings.

### **3.02 GROUND CONNECTIONS**

- A. Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- B. For above ground connections, install compression type terminal lugs or mechanical bolted connectors.
- C. Exothermic weld buried and embedded ground connections: Make welds in accordance with manufacturer's requirements.
- D. Make connections to ground bus assembly in the following manner:

1. Bond cable to two-hole lug using exothermic welding process
2. Bolt two-hole lug to ground bus assembly

### **3.03 GROUND RODS**

- A. Install rod electrodes for electrical service panel and in handholes as indicated. Install and tie-in additional rods as required to achieve the resistance to ground specified under "Field Quality Control" in this Section.
- B. Verify that final grading has been completed before driving rod electrodes. Coordinate with the work performed under Section 02300, Earthwork.
- C. Bury ground rods vertically with rod top a minimum two feet below grade or with rod top exposed a minimum of 3 inches in handholes. Use ground rod for main grounding system. If extensive rock formation is encountered, relocate ground rods as approved by the Engineer.

### **3.04 SERVICE EQUIPMENT**

- A. Ground neutral bus to ground bus and ground bus to ground rod.
- B. Run insulated ground conductor in conduit with all feeder and branch circuits.

### **3.05 EQUIPMENT GROUNDING**

- A. Ground stationary equipment enclosures as required by the applicable codes.
- B. Ground metallic conduits, raceways, boxes, cabinets, cable trays, panelboards, disconnect switches, exposed expansion joints, receptacles, and lighting fixtures in accordance with NEC.
- C. Ground outdoor light poles as indicated on the Contract Drawings.
- D. Ground frames of motors by ground conductor carried in power conduit. Provide ground conductor sized in accordance with NEC.
- E. Bond all conduits that are used for parallel feeders.
- F. Feeders: Install ground conductor for the feeder rating in each conduit.
- G. All metallic structures, including station shelters, station lighting poles, metallic equipment cabinets, metal benches, railings, metal fences, and other metallic structures within a 10 ft distance to the centerline of an OCS line or supporting structure, shall be bonded to the OCS system counterpoise ground with a #2 AWG bare copper wire.

### **3.06 FIELD QUALITY CONTROL**

- A. Refer to Section 16000, Basic Electrical Requirements, for basic test procedures, as augmented by test procedures submitted under this Section.

- B. Perform tests in accordance with approved test procedures in coordination with the Field Engineer.
- C. In the presence of the Engineer, test the grounding system by the fall-of-potential method to demonstrate that total ground resistance does not exceed the value specified in the Contract Documents. If necessary, install additional ground rods to meet this resistance requirement.
- D. Test equipment enclosures, conduit, raceways and lighting fixtures for continuity to the ground system.
- E. Test counterpoise grounding electrode system resistance to remote ground using the 3-point fall of potential method. Counterpoise grounding electrode resistance shall not exceed 5 ohms.

**END OF SECTION**