

SECTION 16450

GROUNDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for providing a complete grounding system as specified and shown. Grounding includes but is not limited to: motor control centers, electric equipment enclosures, transformers, unit substations, switchgears, switchboards, ground grid systems with grounding rods, grounding conductors, bonding jumpers, grounded conductors, water pipe connections, and building and miscellaneous structure metal frames.
- B. Related Work Specified in Other Sections Includes:
 - 1. Section 16050 - Basic Electrical Materials and Methods
 - 2. Section 16110 - Electrical Raceway Systems
 - 3. Section 16120 - Wires and Cables - 600 Volts and Below
 - 4. Section 16670 - Lightning Protection Systems
 - 5. Section 16950 - Electrical Testing Requirements

1.2 REFERENCES

- A. Codes and Standards: The following codes and standards are referred to in this Section:
 - 1. NEC - National Electrical Code

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Product Data and Information: Provide manufacturer's catalog data for the following:
 - 1. Grounding and grounded conductors
 - 2. Grounding connectors, clamps and bushings
 - 3. Grounding rods
 - 4. Bonding jumpers
- C. Shop Drawings: Provide shop drawings showing the locations and length of grounding rods. Label the size and material used for grounding rods. Provide details pertaining to grounding electrode conductors, grounding and grounded conductors, grounding connections and the ground grid for buildings, structures, lighting units, manholes and handholes.

- D. Quality Control: Provide a field report of the system ground impedance test results.

1.4 QUALITY ASSURANCE

- A. Construct a complete grounding system in accordance with applicable ANSI, a IEEE standards and the NEC and local codes.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

- 1. Grounding and Grounded Conductors

- a. American Insulated Wire Corporation
- b. Rome Cable

- 2. Grounding Connectors, Clamps and Bushings

- a. Burndy Corporation
- b. O-Z/Gedner Company
- c. Ezico Products
- d. Thomas and Betts

- 3. Grounding Rods

- a. Harger Lightning Protection, Inc.
- b. Thomson Industries, Inc.
- c. Carolina Galvanizing Utility Products Division
- d. Erico International Corp.

2.2 MATERIALS

- A. General: Provide conductor sizes as shown or required.
- B. Materials: Use conductors in accordance with the requirements specified in Section 16120.
- C. Bare conductors: Use bare copper conductor where buried in earth, embedded in concrete or exposed.

- D. Insulated Conductors: Use copper conductor with green color insulation rated at 600 volts where installed in conduits or other enclosed raceways.

2.3 CONNECTORS

- A. Grounding Clamps and Bolted Connectors: Use grounding clamps and bolted connectors suitable for devices or cables being connected.
- B. Welding: Use the exothermic welding process for buried, concealed and accessible connections to structural members, ground rods, and case grounds. Clean and paint welds embedded in the ground or encased in concrete with asphalt base paint.
- C. Bolted Connectors: Use bolted connectors for grounding of ground buses and equipment.
- D. Pipe Grounding: Use copper, brass, or bronze grounding clamps for grounding pipes. Do not use strap type clamps for this purpose.
- E. Grounding Bushings: Provide grounding bushings for conduits where conduits are not effectively grounded by firm contact to the grounded enclosure.

2.4 GROUNDING RODS

- A. Length and Size: Provide grounding rods 3/4-inch in diameter and 10 feet long.
- B. Grounding Rod Material: Stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install conductors to preclude exposure to physical damage. Install connections firm and tight. Arrange conductors and connectors without placing strain on the connections. Bury equipment grounding conductors as shown, or at a minimum of 12 inches below grade. Bring loops or taps up for connection to equipment or other items to be grounded.
 1. Install an insulated grounding conductor in all conduits.
 2. When raceways are used to contain and protect grounding conductors, install in accordance with Section 16110 and NEC.

3. Where conductors are installed in nonmetallic raceway, install the grounding conductor in addition to the neutral wire, for system sized in accordance with NEC or as scheduled.
 4. Perform exothermic welding with properly sized molds.
- B. Grounding Rod Installation:
1. Install grounding rods as shown with the top of the rod a minimum of 12 inches below grade.
 2. Drive grounding rods into permanently moist soil.
 3. Provide additional ground rod sections as required to reach permanently moist soil.
 4. Install cast iron junction box without bottom for access to grounding rod and conductor where shown.
- C. Equipment Grounding: Ground each piece of electrical equipment using a conductor in the raceway feeding the equipment in accordance with NEC.
1. Unless specified otherwise, connect transformer enclosures and neutrals to the grounding system. Connect the neutral ground connection at the transformer terminal. Provide two separate, independent, diagonally opposite connections for power transformers so removal of one connection will not impair continuity of the other. Make the connection from the ground grid to the ground bus and enclosures of switchboards, switchgears and motor control centers, lighting and distribution panelboards, control, relay and instrumentation panels.
- D. Grounding Conductors: Connect the grounding conductor between the equipment and the grounding system. Where a ground bar is furnished with the panelboard, connect the grounding conductor to the bar.
- E. Miscellaneous Grounding: Provide grounding for the following:
1. Ground receptacles and switches and their metal plates through positive ground connection to the yoke/strap, outlet box and grounding system grounding wire installed in the conduit.
 2. Ground racks, supports, frames, covers and metal parts in manholes or handholes, controllers, motor frames, surge capacitors, arrestors, lighting fixtures, metal structures, exposed noncurrent carrying metal, mechanical equipment, hoist beams, cranes and similar items.

3.2 FIELD QUALITY CONTROL

- A. Tests: Conduct a witnessed test to determine the ground impedance for the entire system using a ground loop impedance tester. Provide a maximum impedance of 2 ohms at any point of the test. Add additional grounding rods if necessary to meet this requirement.

END OF SECTION

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