PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Facilities Management Design and Construction Guide, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical and telecommunications systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Ground rods.
2. Ground bars.
3. Connectors.

B. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 DEFINITIONS

A. ACEG: Alternating Current Equipment Ground
B. EK: Equipment Bonding Conductor
C. GEC: Grounding Electrode Conductors (Bonds earth sources to MGW)
D. MGW: Main Grounding Window (Electrical Service Ground Bar)
E. TBB: Telecommunications Bonding Backbone (Bonds TMGB to TGB’s)
F. TBC: Telecommunications Bonding Conductor (Bonds MGW to TMGB)
G. TGB: Telecommunications Grounding Busbar
H. TMGB: Telecommunications Main Grounding Busbar
1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   
   1. Comply with UL 467.

B. Comply with NFPA 70.

C. Comply with TIA/EIA-607 for telecommunications grounding.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Grounding Electrode Conductors: Stranded cable.

D. Underground Conductors: Bare, tinned, stranded annealed.

E. Bare Copper Conductors: Comply with the following:
   

F. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators. EIA/TIA TMGB and TGB hole patterns are required on all telecommunications ground bars.

2.2 CONNECTOR PRODUCTS

A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

D. High-Pressure Compression Connectors: Burndy Hyground System.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   
   1. Size: 5/8" diameter by 120 inches long.
PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections or High-Pressure Compression Connections: Use for connections to structural steel.

D. High-Pressure Compression Connections: Use for underground connections.


F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

G. High-Pressure Compression Connections: Use for connections to electrical system ground bus (MGW) and for underground connections.

3.2 APPLICATION FOR TELECOMMUNICATIONS SYSTEMS

A. High-Pressure Compression Connections: Use for all grounding conductors which interconnect grounding busbars and at ground rods.

B. Compression Type Bolted Connections: Use for grounding conductors between telecommunications enclosures, including racks and cabinets, and grounding busbars. For #4 AWG and larger, use two-hole lugs. For #6 AWG and smaller, use one-hole lugs.

C. Connection at Grounding Conductor Including Connections at TBC and TBB: High-pressure compression type connectors. Grounding conductor shall not be spliced or broken.

D. Connection at Cable Tray: Bolted-pressure type mechanical connectors.

E. All Other Connections: Compression type connectors.

3.3 EQUIPMENT GROUNDING CONDUCTORS FOR ELECTRICAL SYSTEMS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and branch circuits.

C. Wiring Devices: Install an insulated bonding jumper from the ground terminal of each wiring device to its respective outlet box.
3.4 INSTALLATION

A. Ground Rods: Install rods spaced as indicated on drawings.
   1. Drive ground rods until tops are 2 inches below finished floor or final grade.
   2. Interconnect ground rods with grounding electrode conductors. Use high-pressure compression connections. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or high-pressure compression connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use compression-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing or at a nonmetallic housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. High-Pressure Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other
standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 TELECOMMUNICATIONS GROUNDING SYSTEM TESTING AND DOCUMENTATION

A. Purpose: Perform tests described below and document results to insure proper grounding of the telecommunications system. Tests are based on TIA/EIA-607, “Commercial Building Grounding and Bonding Requirements for Telecommunications” and require the following steps:

1. Equipment set-up and reference test.
2. Ground electrode resistance testing.
3. Grounding system continuity test.
4. Test result documentation.

B. Test Equipment:

1. Furnish necessary testing equipment.
2. Acceptable ground testers:
   a. Biddle Instruments DET 2/2.
   b. AEMC.

3.7 TELECOMMUNICATIONS GROUNDING

A. Install exterior grounding electrode conductors with a minimum bending radius of 12 inches.

B. Install interior grounding conductors with a minimum bending radius of 8 inches.

C. Install TBC and TBB grounding conductors in conduit unless otherwise indicated. For metallic conduit, bond each end of the conduit to the grounding conductor using an appropriate grounding bushing.

D. When present, bond the following to the TMGB or TGB:

1. Metallic equipment racks.
2. Cable shields.
3. Metal raceways and cable trays for telecommunications cabling extending from the same room or space where the TMGB or TGB is located.
4. Telecommunications panelboards: ACEG.
5. Metallic equipment racks.
7. Building entrance protectors.

E. Labeling:

1. Clean all surfaces prior to attachment of any label.
2. Follow manufacturer’s recommendations for cleaning and affixing labels.
3. TMGB:
   a. Label Location: Upper left-hand corner of the busbar.
   b. Label Information: The letters TMGB. The TMGB is unique to the building. The identifier information is identified on drawings.

d. Format: All capital letters. Font shall be as large as possible to fill the label space with the information. The font shall be Helvetica, or equal, and bold. One line format. Letters shall be at least 1 inch tall for readability.

e. Example: TMGB

4. TBC:
   a. Label Location: On the conductor at each end where it terminates.
   b. Label Information: The letters TBC followed by the telecommunications room designation.
   d. Format: All capital letters. Font shall be as large as possible to fill the label space with the information. The font shall be Helvetica, or equal, and bold. One line format.
   e. Example: TBC1A

5. TBB:
   a. Label Location: On the conductor at each end and at each break in the insulation (for connection to another conductor or a busbar). Place the label near the end busbar or the break in the insulation, whichever applies.
   b. Label Information: The letters TBB followed by the sequence number (one numeric character). The sequence number shall be unique to the building. The identifier information is identified on drawings.
   d. Format: All capital letters. Font shall be as large as possible to fill the label space with the information. The font shall be Helvetica, or equal, and bold. One line format.
   e. Example: TBB1

6. EK:
   a. Label Location: On the conductor at each end and at each break in the insulation (for connection to another conductor or a busbar). Place the label near the end busbar or the break in the insulation, whichever applies.
   b. Label Information: The letters EK followed by the sequence number (three numerical characters). The sequence number shall be unique to the building. The identifier information is identified on the drawings.
   d. Format: All capital letters. Font shall be as large as possible to fill the label space with the information. The font shall be Helvetica, or equal, and bold. One line format.
   e. Example: EK001

END OF SECTION 16060