

PART 1 - GENERAL

1.1 GENERAL  
REQUIREMENTS

- .1 Grounding conductors for all distribution grounding to be insulated copper, uninsulated where in contact with earth. Copper conductors shall be used in the following areas:  
grounding of transformer neutrals, service entrance switch ground of neutral, pad mount transformer grounding, ground rider conductors from main ground station to sub-closets, telephone and data system grounds.

1.2 MEASUREMENT AND  
PAYMENT

- .1 Payment for provision of all items specified in this Section shall be by Lot Price. No separate payment will be made for work specified in the Contract Documents. All costs incurred by Contractor in meeting with the requirements of this Section shall be included in the bid price for the Work.

1.3 WORK INCLUDED

- .1 Provide a complete grounding system including surge protection system as specified.
- .2 Provide grounding and bonding for all equipment.
- .3 Provide a ground bus in the switchgear and enclosures.
- .4 Provide ground for instrument control panels and metering unit.

1.4 RELATED  
SECTIONS

- .1 Section 26 05 00: Common Work Requirement - Electrical.

1.5 SUBMITTALS

- .1 Submittals, product data and shop drawings shall be in accordance with Specification Sections 01 33 00 and 26 05 00.

1.5 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
  - .1 ANSI/IEEE 837-2002, Qualifying Permanent Connections Used in Substation Grounding.

1.5 REFERENCES  
(Cont'd)

- .2 Canadian Standards Association, (CSA)
  - .1 CAN/CSA-Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities, where applicable.
  - .2 CSA C22.2 No. 41-07, Grounding and Bonding Equipment (Bi-national Standard, with UL467).

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as indicated or as required by CSA 22.2 No. 41.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- .3 Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- .4 Plate electrodes: copper, surface area 0.2 m<sup>2</sup>, 1.6 mm thick.
- .5 Grounding conductors: bare stranded copper, size as indicated.
- .6 Insulated grounding conductors: green.
- .7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .8 Make buried connections to building counterpoise network, water mains (where metallic), etc. using permanent mechanical connectors.
- .9 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 INSTALLATION  
GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run insulated copper ground wire in conduit.
  - .2 Install connectors in accordance with Manufacturer's written instructions.
  - .3 Protect exposed grounding conductors from mechanical injury.
  - .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
  - .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
  - .6 Soldered joints not permitted.
  - .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
  - .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
  - .9 Install separate ground conductor to outdoor lighting standards.
  - .10 Connect building structural steel and metal siding to ground by welding copper to steel.
  - .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
  - .12 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.
  - .13 Ground secondary service pedestals.
  - .14 Provide all excavation and backfill for grounding and bonding as required.
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### 3.2 MANHOLES

- .1 Install conveniently located grounding electrode and size 3/0 stranded copper conductor in each manhole.
- .2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

### 3.3 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4 Install rod, plate electrodes and make grounding connections.
- .5 Bond separate, multiple electrodes together.
- .6 Use size 2/0, 3/0 or 4/0 AWG copper conductors for connections to electrodes as required by code.
- .7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

### 3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 208 V system.

### 3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

### 3.6 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

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| 3.6 GROUNDING BUS<br>(Cont'd) | .2 | Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size as required by code. |
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| 3.7 BONDING | .1 | Bond non-current carrying metal parts together with size 3/0 AWG copper equipotential conductor. Run conductor from separate lug or service neutral bar to, but not necessarily limited to, following indoor systems and equipment: <ul style="list-style-type: none"><li>.1 Hot water heating system.</li><li>.2 Main water pipe.</li><li>.3 Main building drain.</li><li>.4 Oil line.</li><li>.5 Telephone, security equipment, emergency and fire alarm lead-in or service conduits, near panels.</li><li>.6 Make connections to pipes on building side of main valves and tanks. Connect jumpers across boilers to supply and return hot water heating pipes.</li></ul> |
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| 3.8 TESTING AND<br>COMMISSIONING | .1 | Engage an approved testing company to perform grounding tests.  |
|                                  | .2 | For resistance to ground measurements use a ground resistance test set with an accuracy of 10 milliohms.  |
|                                  | .3 | For measuring resistance to ground use the fall of potential method as outlined in IEEE Standard No.81. After selecting the distance for the current probe take resistance measurements at a minimum of six voltage probe locations. Ensure that three of the voltage probe locations have resistance values such that the difference between any two is 0.5 ohm or less. If this is not the case repeat and retest with a larger distance for the current probe until this condition is satisfied. |
|                                  | .4 | Perform testing under average weather condition, allow three days after the last rain before conducting test.   |
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3.8 TESTING AND  
COMMISSIONING  
(Cont'd)

- .5 Test the integrity of the connections between the various components of the total grounding system. Test separately the continuity of the building perimeter loop and the connections between the pad mount transformer ground grid and the building grounding system, between the building grounding system and grounding triangles and between the computer room floor grid and the small grid below it.
- .6 For continuity measurements use a bridge or similar type test meter designed for the purpose with an accuracy of 1 milliohm.
- .7 Where readings are not acceptable to Electrical Inspection and Departmental Representative provide additional ground conductors, ground rods, connections, as necessary to satisfy the requirements of both.
- .8 Prepare and submit a Test Report, signed by the Test Engineer, and where witnessed, by Departmental Representative.

3.9 FIELD QUALITY  
CONTROL  
                    

- .1 Perform tests in accordance with Section 26 05 00 and Section 01 91 13.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.