

SECTION 16660

EARTHING AND EARTH FAULT PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work to be performed includes, but is not necessarily limited to, all work involved with the construction and assembly of a complete electrical earthing and bonding system as specified herein.

1.02 QUALITY ASSURANCE

- A. The Contractor is responsible for the quality of all its purchased items and as such, must develop and submit a supplier quality inspection plan to review. The inspection plan is to cover those items intended for shop inspection and the procedures for carrying out same.
- B. Manufacturer: Components of earthing and earth fault protection shall be the standard products of a manufacturer regularly engaged in manufacture of components of types and sizes required and complying with the requirements of the listed standards and whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Codes and Standards: Comply with requirements of the following codes and standards except as herein modified:
 - 1. BSI - British Standard Institution
 - BS 7430 Code of Practice for Earthing.
 - BS 7671 Requirements for Electrical Installations.
 - 2. IEC - International Electrotechnical Commission
 - IEC 60364-5-54 Earthing arrangements and protective conductors.

1.03 TESTS AND ACCEPTANCE CRITERIA

- A. Earthing system shall be tested to assure mechanical and electrical continuity and compliance with the requirement of the standards. The overall resistance between any point on the earth installation and the general mass of the earth shall be less than 2.0 ohms.
- B. Material Test: Unless requirement is waived, materials shall be tested and manufacturer's test reports certifying that materials meet the requirement of the listed standards shall be submitted.

1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data including specifications, and dimensions for equipment and materials.
- B. Shop Drawings: Submit the following:
 - 1. Submit dimension and layout of the exact routing of all main earth loops with indication of cable, busbar and connector cross-sections.
 - 2. Details of all connectors and mounting details.
 - 3. Details of earthing of switchboards, motor control centers, final distribution boards, motors and various types of equipment.
 - 4. Details of earthing pit.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Every means of earthing and every protective conductor shall be selected and erected to satisfy the requirements of the listed standard.
- B. All switchboards, motor control centers, motor starter panels, and final distribution boards shall have a copper earth bar to which shall be connected the earth conductor of the equipment.
- C. Main equipotential bonding conductors shall connect to the main earthing terminal for that installation extraneous conductive parts including: main water pipes, main gas pipes, other devices pipes and ducting, risers of air conditioning systems, and metallic parts of the building structures.
- D. Local supplementary bonding connections shall be made to metal parts where those parts are extraneous conductive parts and are simultaneously accessible with exposed conductive parts or other extraneous parts and where local equipotential bonding is provided Metalwork which may be required to be bonded includes baths, metal pipes, switches and taps.
- E. A circuit protective conductor of minimum cross-sectional area 2.5 sq.mm. stranded copper PVC insulated shall be drawn in with every circuit installed in conduit or trunking. The protective conductor and any trunking or tray system, together with the metallic sheathing of all cables, shall be electrically and mechanically solidly bonded with the earthed metal of switchgear, conduit boxes, distribution boards, motors and all other electrical apparatus, fixed/or connected by the Contractor.
- F. All apparatus or part thereof not solidly connected to the conduit and cable

system shall be connected in an approved manner by solid copper conductor secured by substantial bonding clamps.

- G. The Contractor shall test every complete earth loop circuit comprising cables or cable sheaths and core conductors and these shall comply with the maximum values specified in the standards.

2.02 EARTH ELECTRODES

- A. The earth electrode shall be copperweld rod of 20 mm diameter and extensive type. It shall have a spike at one end and driving head at the other. The sectional rods shall be coupled with strong bronze couplers. The coupler shall be threaded to fit the rod section. For driving the rod into the ground threaded steel stud shall be used. A brass clamp of suitable size shall be provided for clamping the earth conductor to the earth rod. The top of earth electrode shall be enclosed in a concrete or brick lined pit with removable concrete or metal cover. Earth electrode shall be connected to its associated earth conductor through a link, which will be mounted above ground in an accessible position and as close as possible to the earth electrode. Each link shall confirm a bolted copper link studs, nuts and washers to take earth conductor and bolted lug for the cable connection to the electrode. The length of the electrode shall not be less than 3 m.

- B. A loop type, low impedance, earthing system shall be installed in mechanical rooms, switchboards rooms, interconnecting all non-domestic equipment such that at least two earthing connections are provided for each major equipment.

The loop shall consist of 4 x 25 mm copper tape fixed by brass spacing saddles and brass countersunk screws at 600 mm centers, all through joints being trimmed and riveted. Two opposite points of the loop shall be connected to two separate earth electrodes.

- C. The earthing system shall be earthed by sets of earth electrodes. The earth resistance of each electrode shall be measured separately and if not 2 ohms or less, a longer electrode, or sectional electrodes shall be used to obtain approximately double length.

If a 2-ohm resistance is still unobtainable, another similar set of electrodes shall be installed, except that not over six separate electrodes need be installed at one location. Each earth electrode shall be enclosed in a concrete pit covered with an appropriate inspection cover.

The earth resistance shall be measured in normally dry conditions, and not less than 48 hours after rainfall.

- D. Switchboards, motor control centers and similar large items of enclosed electrical equipment shall be connected so that the earth bus contained in each item is connected at each end to a different point in the earthing system. The earth bus then becomes a part of the earthing system.

- E. An earthing conductor shall be connected between the distribution board and the earthing system. The earthing conductor shall be connected to the earthing bus. The bus shall contain screw terminals to which the earthing conductor of each branch circuit shall be connected.
- F. Each branch circuit from a distribution board or other distribution equipment shall contain an insulated earthing conductor which shall be connected to the earthing bus in the distribution equipment, and to the receptacle, fixture, motor or other device, served by the branch circuit. The size of the earthing conductor shall be as required by the applicable standard.
- G. Where items require the use of 4 core XLPE/SWA/PVC, or PVC/SWA/PVC cables. The cable armour shall be used as the earth continuity conductor. Earthing system shall be of the radial type.
- H. Where cables supply 3 phase A.C. motors they shall be 4 core with the fourth used as the earthing lead and suitably colour coded at each end.
- I. On motor control centres or switchboards a copper earthing bar having a cross section of 50 x 10 mm will be fitted along the entire length of the board, and this earth bar will be solidly bonded to sub-station earth bar. All outgoing cables from a control centre shall be installed such that the earth continuity conductor or associated earth cable is effectively bonded to this main earth bar.
- J. Where thermoplastic or PVC conduits or PVC trunking is installed a separate earth protective conductor shall be run inside the enclosure to ensure complete earth continuity throughout the system.
- K. Where the protective earth conductor is formed by galvanized steel conduit, trunking or metal ducting, then the earthing arrangements shall be carried out in accordance with EDD/R-1.
- L. An instrumentation earth shall be provided adjacent to the main earth bar and connected to it by a removable link.

2.04 ELECTRICAL EARTHING CONDUCTORS:

- A. All earthing conductors shall be copper conductor materials only. Materials shall be in conformity with the codes and standards and those specified elsewhere herein for electrical systems. Earthing conductors shall be as follows:
 - 1. Copper tape of minimum size 25 x 4 mm.
 - 2. Soft drawn copper stranded conductors, PVC covered.
 - 3. Insulated copper conductors run in conduits.

2.05 EARTHING CONNECTORS AND DEVICES

- A. Connectors and devices used in the earthing systems shall be of copper or bronze materials, and applicable for the use whether specified by manufacturers or otherwise required. All connectors and devices shall be compatible with the surfaces being bonded or shall be suitably surfaced or coated and comply with EDD/R-1.
- B. Where steel conduits are not effectively earthed by firm contact with an earthed enclosure, earthing bushings shall be used on at least one end of the conduit run. The bushings shall be designed to screw onto the end of the conduit and have a separate screw type connector for the earthing wire.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All non-current carrying metal parts of electrical equipment and switchboard shall be solidly earthed and complete earth continuity shall be maintained in all parts of the installation conforming to the regulations of the applicable codes.

** END OF SECTION *