22 EARTHING AND BONDING

22.1 GENERAL

22.1.1 Scope

1 This Part specifies the requirements for earthing and bonding.

2 Related Parts and Sections are as follows:

This Section
Part 1..... General Provisions for Electrical Installations
Part 2..... HV and MV Factory Built Assemblies (FBA's)
Part 6..... Cables and Small Wiring
Part 7..... Conduit
Part 8..... Trunking
Part 9..... Cable Trays

22.1.2 References

BS 7430.....Code of practice for protective earthing of electrical installations

22.1.3 Quality Assurance

1 Design Criteria: the earthing system shall be in accordance with QGEWC (KARAMAA) Rules and Regulations.

22.1.4 Submittals

1 Shop Drawing and product data per Part 1.

(a) submit full technical details and conductor size calculations of each type of cable or wire proposed.

(b) submit exact route of each cable or wire proposed.

22.2 PRODUCTS

22.2.1 Materials

1 Generally:

(a) products used in the earthing system shall be copper or an approved copper alloy, unless otherwise specified, and specifically manufactured for the purpose.

2 Earth Continuity Conductors:

(a) sizes shall be as specified by QGEWC, unless otherwise indicated, but in no case shall size be less than half that of the associated phase conductors

(b) insulation shall be of the same material as insulation in associated sub-circuits.

3 Main Earth Loops:

(a) 25 x 3 mm tinned copper tape, unless otherwise indicated.

4 Rod Electrodes:

(a) shall be of the earth rod type

(b) earth rod electrodes: 16 mm diameter steel core copper jacketed type, comprising a high strength steel alloy core with a molten welded copper covering

(c) Length as required, in 1.2 m sections coupled by strong bronze couplers.

5 Earth Connectors:

(a) Connection of rod electrodes: shall be bolted type.

(b) All connection of earth electrodes with conductor/tape in earth pit shall be provided with clamps. Two connection clamps shall be provided for each individual connection.

6 Removable Earth Links:

(a) to comprise a bolted copper link fixed on porcelain insulators and complete with studs, nuts and washers to take the earth tape and a bolted lug adequately sized for the final connection of the earth electrode.

7 Bolts, Washers And Nuts In Bolted Connections:

(a) high copper alloy or silicone bronze. Ferrous hardware is not acceptable.

8 Earth Pit Cover

(a) shall be of heavy duty construction

(b) shall have a recessed lifting hook

(c) shall have a brass plate, engraved “Electrical Earth Below No.XXX”. Including identification No. as per the approved drawings.

22.3 INSTALLATION

22.3.1 Installation

1 Circuit Wiring

(a) shall have a green/yellow coloured insulated earth continuity cable connecting the earth bus or earth terminal in switchboards, switchgears, motor control centres and panel boards to the motor, equipment, outlet and other device by earthing lugs. All hand rails and other metal works within 2 m of a potentially live metal surface shall be earthed.

2 Main Earth Loops

(a) Fix in mechanical equipment rooms and other areas indicated on the drawings, in convenient locations, allowing two return paths to earth

(b) Fix copper tape to structure with copper or brass saddles and/or screws. Make tees and straight joints by riveting and seating

(c) Make branch connections between main loop and major equipment, such as switchboards, switchgears, motor control centres and large motors, with copper tape of same size as main loop tape

(d) Make other branch connections to equipment with copper conductors of size not less than half that of the relative phase conductor.

3 Removable Earth Links

(a) Fix in every main earth lead to enable the electrode system to be disconnected for testing

(b) Install in an accessible position, above ground as close as possible to the earth electrode.

4 Exposed Earth Cables

(a) Install and locate in a manner to provide maximum mechanical protection, utilising ceiling corners, suspended ceiling and webs of beams as much as possible.

5 Bolted Connections:

(a) Multiple bolt type

(b) Where bare copper is bolted in connections contact surfaces shall be silver/tin electroplated.

6 Brazed Connections:

(a) where earthing terminal connections are to be brazed to equipment, thoroughly clean

(b) metal prior to brazing and repaint impaired surfaces to prevent corrosion.

7 Connections Between Dissimilar Metals:

(a) protect by:

(i) painting with a moisture resistant bituminous paint or compound, or

(ii) wrapping with protective tape to exclude moisture.

8 Equipment Earthing:

(a) connect all non-current carrying metallic parts of the electrical/mechanical installation to the earthing system

(b) non-current carrying metallic parts of the electrical installation include:

(i) metal conduit, cable armour, raceways, outlet boxes, cabinets, and the like

(ii) exposed metal parts of apparatus

(iii) enclosures, doors, grills, barriers and the like protecting or shielding electrical equipment from direct access

(c) series earthing of one piece of equipment to another is not acceptable. Each item shall be individually connected to earth system

9 Fire Fighting Equipment:

(a) earth on a separate ring system.

10 Motors Earthing:

(a) connect the motor terminal box to the relative earth loop. The terminal must be mechanically connected to the frame or, where this is not feasible

(b) extend the earthing conductor through an insulated bushed opening in the connection box and connect to the frame.

11 Main Switchboards, Switchgears and Motor Control Centres Earthing:

(a) connect the special earthing lug or busbars inside the cabinet to the main earth copper tape.

(b) connect all parts of the switchboards, switchgears and motor control centres other than “live” parts, to the earth bar in the board in an approved manner.

(c) The MV /MCC panel shall be connected at both end of the MV/MCC to a two separate Earthing pits, (directly or through intermediary Earthing bar installed in MV/MCC basement) or as approved by the Engineer. The earthing cable calculation shall be performed with approved professional international recognised licensed software, Subject to the Engineer’s approval.

12 Distribution Boards Earthing:

(a) connect an earthing conductor from the main distribution earth busbar to an earth connector welded to the cabinet and earthing bushings on the incoming and outgoing feeder conduits.

13 Bus-Duct Feeders Earthing:

(a) connect the green/yellow coded earth busbar directly to the earth bus-bar in main switchboard with earth copper tape

14 Cable Armour Earthing:

(a) Connect steel armour to the earthing system Coordinate with QGEWC regarding any specific earthing requirements for the EHV cable sheaths.

15 Earth Rod Electrodes:

(a) extensible rods of the same diameter shall be installed in holes drilled into the ground. If ground conditions permit, rods may be driven into the ground either manually or mechanically. The earth electrode shall be installed at such a depth that it penetrates the summer water table by a minimum of 2 metres.

(b) bolt earth connectors to the top of the rods, in sufficient number to make connection with all incoming cables.

16 Earth Pit:

(a) Provide a concrete/PVC pit complete with a heavy duty concrete, cast iron or PVC cover with recessed lifting hook to the Engineers written approval, at the head of the earth rod, to protect the rod and allow access to connections for testing.

17 Transformer and MCC/MV Panel Earthing:

(a) Transformer Earthing Terminals are to be connected to MV main earthing bar by bare copper earthing conductor not less than 30 mm^2 per 100 kVA of transformer rating, with a minimum of 120 mm^2.

(b) Transformer Neutral (Star Point) is to be connected by insulated conductor (colour black) to MV/MCC panel as per QGEWC rules and regulations.

(c) MV/MCC panel earthing conductor to earthing bar and earthing pit , is to be sized for maximum earth fault current for 5 seconds with final conductor temperature not exceeding 160 °C or sized not less than 20 mm² per 100 kVA of transformer rating, and with a minimum of 95 mm².

22.3.2 Testing

1 Testing earthing systems shall be done by the earth megger test. The electrical resistance value of the earthing system shall not exceed 1 ohm, unless approved otherwise by QGEWC

2 The resistance of any point in the earth continuity system to the main earth electrode shall not exceed 1 ohm, unless approved otherwise by QGEWC.

3 Install additional earth electrodes if these figures are not met.

END OF PART