

	GOLGOHAR STEEL PROJECT	
	Technical Specification For Earthing System of Weighing	
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Technical Specification For Earthing System of Weighing

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GENERAL

1.1 Introduction

This specification is prepared to cover the minimum requirement for designing Earthing System which located in loading, unloading & railway loading area project of Golgohar Mining & Industrial Co. Equipment and materials selection will be based on the utilization of modern proven technology that can be demonstrated as having operated successfully and reliably in an equally onerous environment.

1.2 Scope

This specification has been prepared to provide minimum requirement for design, erection and supply of earthing system regarding loading, unloading & railway loading area project of Golgohar Mining & Industrial Co.

In case of discrepancy between documents and this specification, the stringent shall be applied.

No deviation from this specification is allowed unless specificity agreed among OWNER and VENDOR.

1.3 Terms and Definitions

In construing this specification following words and expressions shall have the meanings as follows:

The **Owner / Purchaser** is **Golgohar Mining & Industrial Company**.

The **Manufacturer/Supplier/Vendor** is the organization to which the Purchase order has been awarded.

1.4 Document Priority

In case of conflict between documents, the order of precedence shall be:

- This specification,
- Earthing system calculation document,
- Drawings and other documents,
- Applicable laws, rules and regulations of the country,
- I.E.C. standards,
- Other standard and codes when I.E.C. publications have not yet been issued.

1.5 Conditions of Operation

All of the Electrical Equipment & Systems will be suitable for 24 hours, 7 days/week, and 365 days/year operation.

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2.0 Site Conditions

2.1 Plant Location

The Site is located at Gol-E-Gohar Iron Ore Complex, situated in Sirjan, Province of Kerman in southern part of Islamic Republic of IRAN, approximately 285 km southwest of Kerman city and 335 km north of Bandar Abbas port, in a semi-desertic high plateau terrain, 1750 m above sea level, and flanked by mountains over 2500 m high trending northwest to southwest.

2.2 Meteorological

Ambient Temperature

Max. Temperature:	+40 deg. C (Recorded)
	+50 deg. C (Design)
Min. temperature:	-12 deg. C (Recorded)
	-10 deg. C (Design)
Average temperature:	+15.9 deg. C (Design)
Wet bulb design temperature (summer):	+25 deg C
Relative Humidity:	Max. 70%

Wind Velocity

According to National Iranian Code (6th revision):

Basic speed data:	130 Km/h
Basic pressure data:	0.845 KN/m ²
Correction factor:	

0 - 10 m:	2
10 - 20 m:	2.2
20 - 100 m:	2.4

Rainfall

Yearly 120 mm (average)

Monthly rainfall 260mm (Max)

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Barometric Pressure

820 mbar

Geological Conditions

This data is belonging to the existing palletizing plant location. For the engineering the contractor shall be study geotechnical conditions for the essential location according to the project plan.

Altitude: About 1,750 m above mean sea level

Soil bearing: approx. 20t/m²

Ground water level: approx. 60 m below ground level

Earthquake Load

Equipment in plant will be dimensioned including a safety calculation against earthquake according to the “Iranian Code for Seismic Resistant Design of Buildings

– Publication No. S253-2nd edition, autumn 1999” (“Iranian Regulations 2800”) and “Minimum

Design Loads for Building and Structures” (Iranian Regulations 519).

- Design base acceleration: 0.3·g

- Classification of Buildings: Group 2

- Soil classification: soil type III-b

3.0 STANDARDS AND CODES

The systems will meet, as far as applicable the latest edition of the following recommendation:

IEC 60621-2	General Protection Requirements Second Edition
IEC 61000-5 Series	Earthing and Protection Requirements
BS 7430	Protective Earthing of Electrical Installations
IEEE 80	Safety in AC Substation Grounding
IEEE 142	Grounding of Industrial and Commercial Power Systems

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4.0 DEFINITIONS

4.1 Earth Electrode

Earth Electrode is a conductor or group of conductors in intimate contact with, and providing an electrical connection to earth.

4.2 Earth Conductor

Earth Conductor is a conductor that connects parts of the installation to the earth electrode, main earth conductor and connecting the main earth conductor to the earth electrode.

4.3 Main Earth Conductor

Main Earth Conductor is a conductor which makes a ring loop in a room or electrical room or process plant to which several earth conductors are connected.

4.4 Earthing System

Earthing System is a locally confined assemblage of earth electrodes or metal components and earth conductors, electrically connected together.

4.5 Exposed Conductive Part

Exposed conductive part is a conductive part of equipment which can be touched and which is not a live part but which may become live under fault condition.

4.6 Extraneous Conductive Part

Extraneous conductive part is a conductive part liable to introduce a potential, generally earth potential, and not forming part of the electrical installation.

Equipotential bonding:

Electrical connection maintaining various exposed conductive parts and extraneous conductive parts at substantially the same potential.

4.7 Neutral Conductor

Neutral conductor is a conductor connected to the neutral point of a system and capable of contributing to the transmission of electrical energy.

4.8 Earthing Voltage

Earthing Voltage is the voltage which occurs between an earthing installation and a reference earth.

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5.0 GENERAL INFORMATION OF EARTHING SYSTEM

5.1 General

Earthing system shall be provided for safety of personnel and equipment in case of electrical failure, lightning and static electricity.

The neutrals of MV system (33 kV) shall be resistance earthed and the neutrals of LV system (400 V System) shall be solidly earthed.

Major electrical equipment such as switchgears, transformers body, distribution panels, lighting towers or poles and metallic frameworks shall be directly connected to the plant earthing system via earth bar.

The star points of MV to LV transformers shall be connected to earth directly.

A common protective earthing system shall be provided for the whole site. Earthing system shall consist the following sub-systems:

- Site earth (dirty earth), PE
- Static earth
- Lightning earth
- Earth electrodes

Earthing connection to equipment will be via purpose designed termination studs.

Anchor bolts shall not be used for this propose.

Cable armours shall not be used as the protective earth conductor.

The process area plant earth ring system shall be carried out using a stranded round bare copper conductor and secondary interconnections and bonding of earthing system shall be carried out using a Green/Yellow coloured PVC sheath. Minimum sizes of protective earthing conductor shall be as follows:

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Table 1 – Minimum size of PE conductor

Application	Cross Section Area
Main plant, process earth ring	95 mm ² (Based on Calculation)
Earth Interconnections	50 mm ²
Structural columns, process towers, storage tanks, bonds to earth system or electrodes	50 mm ² (minimum 50mm ²)
Lightning protection systems	50 mm ²
Branch conductors for process plant	50 mm ²
Phase conductors ≥ 35 mm ²	0.5 cross sectional phase conductor area (maximum 70mm ²)
Phase conductors from 16 to 35 mm ²	16 mm ²
Phase conductors ≤ 16 mm ²	same cross sectional conductor phase area

5.2 Electrical Earthing System configuration

According to the following diagram (IEC Standard) the earthing system for Low Voltage switchgear is TN-CS system.

So, the switchgears bus No., are as follows:

MV Switchgear	3Ph+PE
LV Power Center/MCC	3Ph+N+PE
Lighting Center	3Ph+N+PE
Lighting Panel	3Ph+N+PE

The interconnecting cables are as follows:

MV Switchgear to Transformer	3Ph, 3-wire cable
Lighting Center to Lighting Panel	3Ph+N+PE, 4-wire cable
Lighting Panel to lighting and sockets	1Ph+N+PE, 3-wire cable, 3Ph+N+PE, 5- wire cable.

All the switchgears shall be earthed local also.

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5.3 Plant Earthing

The earthing system shall be designed on the ring principle with interconnecting conductors as necessary. This ring shall be connected to earth electrodes. There shall be a minimum of two interconnections between the Electrical Room earth ring and the process area site earth.

In general, earthing conductors shall be run on the same routes as power and other cable systems. Hence, generally, earthing cables to which equipment is connected shall run on cable rack/tray.

Earth conductor shall be laid in cable trenches as far as possible, when intending above grade they shall be run in a protective pipe. The pipe shall be impact resistant hot dipped galvanised steel and extend at least 500 mm above grade.

A main earth bar shall be provided within the electrical room and other rooms containing electrical equipment. The earth bar shall be connected to the site main earth ring.

The resistance of the common earthing system to the general mass of earth, measured at any point on the plant site, shall not normally exceed 2 ohms.

All transformer bays shall be provided with earth electrodes to ensure step, touch and transferable voltage levels are limited to a safe level.

The main earth conductor shall loop around the plant interconnected with a number of local equipment earth loops. Earth busbars shall provide connection points for earth electrodes, earth conductors and also provide the facility for earth loop testing.

Earth busbars shall be high conductivity hard drawn copper and shall be fixed to the inside wall of the electrical room. The earth bars of all other equipment and the metallic enclosures of all low voltage ancillary equipment (e.g. battery charger, lighting distribution board, etc.) shall be connected to these busbars.

The process area plant earth shall comprise earth electrodes driven into the ground connected together to form groups of electrodes and then connected to a main earth conductor buried in the ground.

All plant equipment items supplied as skid assembled units shall be connected to the common plant earthing system by a minimum of two separate bonding conductors.

All single phase lighting and small power circuits shall be wired in 3-core cables; the third core will be the earth conductor. For street lighting, earth lugs of street lighting poles shall be considered as earth bar. Heavy-duty general purpose or welding socket circuits shall be protected by residual current detection earth leakage protection.

5.4 Static Bonding and Equipment's Earthing

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The principle of equipment bonding is to give protection against the build-up of static charge and unequal potentials that could result in an electro-static discharge.

All equipment and parts of equipment, which are liable to accumulate static charges, shall be in effective metallic contact with adjacent metal and with earth. This equipment shall include but not limited to:

- Main and distribution transformers, switchboards / MCCs.
- Cable ladder racks and trays.
- Metallic sheaths of cables.
- Lighting Fixtures and Junction Boxes.
- Welding and Small power outlets.
- Marshalling Boxes and Distribution board frames.
- Non-current carrying parts of electrical equipment.
- Metal enclosures of all switching equipment and motors.
- All structural steelwork, including that of buildings, pipe racks, stairways and handrails.
- Wire fences.
- Towers, vessels exchangers and pipe work containing flammable liquids.
- PA system (loud speakers, etc.)
- All other equipment requiring a static or safety earth.

Internal earth bars shall be provided within MCCs, switchboards, distribution panels, etc. to which all noncurrent carrying metal parts shall be directly or indirectly attached.

Within Electrical Room, equipment earth bars shall be connected to a main earth bar and from these to the main site earthing system.

Flanges of metallic piping systems that have insulated linings shall be bonded to ensure electrical continuity. Flanged joints in other metallic piping systems shall be considered to be inherently electrically continuous.

The ends of cable tray, ladder rack and HVAC ductwork runs shall be bonded directly or indirectly to the earth system. In addition, rack, tray and duct shall be bonded at 50 meter intervals and at the boundaries of hazardous areas.

The resistance to earth from all parts of the fixed metal equipment shall not exceed 2 ohms.

Where a vessel has insulation and an outer metal cladding or wire reinforcement, the metal cladding or reinforcement shall be electrically continuous and bonded to the vessel.

The armouring of cables, which enter the vessel, shall be bonded to the shell at the point of entry.

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Equipment shall not be loop or series connected to earth in such a way that removal of the earth connection from one item would disconnect others from earth.

Where the measured resistance to earth across the connections in pipes and ducting approaches 1 mega-ohm, necessary steps (e.g. flexible bonding strap across the flanges) shall be taken to ensure that an electrical resistance lower than 1 mega-ohm is achieved across finally installed flanges.

A steel structure may be considered as a protective conductor provided it is connected to the process area plant earth system and there is a permanent metallic path for fault current via such steelwork and other earth conductors, back to the source of the power supply.

Where a vessel is mounted directly on and in metallic contact with an earthed steel structure, no further earthing is necessary other than that which may be necessary for lightning protection.

Where the mounting is insulated from steelwork by materials having poor conductivity such as concrete, rubber, etc. two earthing connections shall be taken from the vessel to the process area plant earth. Where the vessel is remote from the plant as to make connection to the plant earth impractical, two connections shall be taken from the vessel to separate earth electrodes, the combined resistance to earth of which shall not exceed 2 ohms.

The enclosures of all motors and distribution boards shall be individually bonded to the process area plant earth. A common busbar may be used for several items in the same area.

Where the driven machine is on a metallic bedplate separate from that for the driver motor then the bedplates shall be bonded together with a minimum of 35 mm² copper cables.

Metallic enclosures of the local distribution panel and any other associated electrical devices local to the motor shall be bonded to the motor enclosure or to that part of the process area plant earth to which the motor is connected.

Earth busbars shall be mounted at convenient locations through the plant to provide test facilities and connections points for the earth electrodes and earth conductors. The position of all earth connections shall be visible and easily accessible.

Where the earth conductor is run underground (Primary Earthing System) it shall be buried at depth of 1 m. All jointing in underground conductor shall be via Thermo-Welded Connections such as Cad Weld.

Connections and joints for aboveground conductors (Secondary Earthing System) shall generally be made at earth busbars.

All aboveground earth branch connections and terminations (Secondary Earthing System) shall be by means of compression type (crimped) connectors and lugs. All joints shall be wrapped with PVC tape or covered by other acceptable means so as to maintain insulation integrity and afford protection against corrosion.

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Metal security fences shall be connected to a system of earthing electrodes spaced at typically 100 meter intervals.

5.5 System Neutral Earthing

The neutrals of the secondary windings of MV/LV transformers shall be directly (solidly) connected to earth. Current transformers for earth fault protection relays shall be located in the star point of transformers.

5.6 Earth Electrodes

Rod type earth electrodes shall be installed in the ground close to Electrical Room and around the plant and steel bars in armoured concrete of foundations shall be used as earth electrodes.

Calculations (considering fault current, electrode current density, soil resistivity level, etc) shall be carried out to determine quantity and driven depth of electrodes. The quantity/depth of the electrodes shall be such as to achieve a combined resistance to earth design figure of 2 ohms or less.

Acidic/alkaline soil contents shall dictate the specification of materials to be used. Earth rods shall be copper/zinc coated steel suitable for the application and ground conditions.

Each earth rod electrode shall be terminated in a small inspection pit to enable periodic visual inspection and testing to be carried out. Generally, earth terminals shall be protected against corrosion.

Horizontal spacing between earth electrodes shall not be less than the combined buried length of two electrodes. At least one more than the required minimum number of electrodes shall be installed. By this means each electrode can be disconnected one at a time for testing without affecting the integrity of the power earthing/grounding system.

Earth electrodes as part of the respective system shall be inter-connected between themselves.

5.7 Cable Terminations

The armouring and metallic sheath (if provided) of all multicore cables terminating in the switchboard/MCC shall, unless specified otherwise, be bonded to the switchboard earth bar, via the gland and gland plate.

Plastic enclosures (e.g. motor control stations, junction boxes) shall incorporate an internal metal gland plate to maintain continuity to the earth system.

Equipment having metallic enclosures shall be connected to the earth system via the cable armouring provided the complete system earth loop impedance permits operation of the circuit protective device.

6.0 GENERAL CONCEPTION OF EARTHING SYSTEM

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6.1 Earth Rod

3-meter copper rod, as a vertical earth electrode will be installed for auxiliary earth electrode when achieving to the lower resistivity via a surface earth electrode and earth well is not available. Also where earth electrodes are remote vertical copper rod is installed for fence earthing. Minimum distance between each two earth rods should be the depth of installation.

Each earth rod electrode shall be terminated in a small inspection pit to enable periodic visual inspection and testing to be carried out. Generally, earth terminals shall be protected against corrosion.

Horizontal spacing between earth electrodes shall not be less than the combined buried length of two electrodes. At least one more than the required minimum number of electrodes shall be installed. By this means each electrode can be disconnected one at a time for testing without affecting the integrity of the earth system.

6.2 Earth Well/Pit

To achieve reliable 2 ohm earth resistivity for each individual sub-system an earth well for connecting of each transformer neutral point should be considered. Earth well shall be consist of a 0.7 * 0.7 square meter copper plate (thickness=3mm) which should beset vertically underground in depth of earth (to receive permanent wet soil). Two 70mm² stranded bare copper conductor should be welded to the plate and should be set vertically up to an earth bar above ground near the transformer. Where the soil resistivity is not enough, soil treatment around the plate with suitable infill should be considered. Minimum distance between each two earth wells should be the depth of installation.

6.3 Earth Bar

A copper earth bar shall be installed wherever various earthing conductors should be connected to each other (earth electrode to the main earthing conductor or neutral conductor...)

Earth/ground bars should be sized respective of minimum sizes prescribed in standards.

6.4 Earth Conductor

Above ground earthing conductor shall be insulated stranded copper conductor.

Earthing/bonding conductors should be sized respective of minimum sizes prescribed in standards.

6.5 Equipment to be Earthed

- All crane runways shall be earthed on both ends.
- All switchgears should be earthed.

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- Steel structures (welded or screwed) should be interconnected to each other (e.g. staircases with railings) and common earthed. The minimum size of earth bridges is 50 mm² stranded copper conductor.
- All LV equipment like MCC panels or distribution boxes with metallic covers, doors or walls shall be connected to earth.
- The fixing bolts of the apparatus and structures may not be used for the fixing of earthing wire. If there are no earthing screws, the connection of earthing wire has to be done by means of a hexagonal screw of minimum size M10 welded or screwed.
- To avoid spark discharges due to either electrostatic charge inside the system or lightning stroke, special attention must be paid to the earthing of steel structures and equipment's piping.
- All motor frames and their local control box with metallic covers shall be earthed by earthing conductors.
- Vertical beams around structures with height up to 20m shall be earthed at maximum intervals of 20m. For higher structures, maximum interval is 10m.
- The steel structure of all cable trays and ladders installed in the plant should be earthed in the cable rooms of electrical rooms. The cable ladders shall form a continuous electrically conductive part. Where necessary, the cable ladders must be electrically conductive bridged.
- All the tanks shall be earthed and bonded as a common earth.
- The fence shall be earthed at maximum intervals of 100m (where earth electrodes are remote, an earth rod shall be installed for earthing of fence).