

GENERAL SPECIFICATION

STRUCTURAL

GS EP ELE 031

Design of earthing and bonding systems

03	10/2012	General Revision
02	10/2005	Modification of "instrument earthing" - Addition of "EP" root to GS identification
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1. Scope

The purpose of this specification is to specify the general requirements for the design of the earthing and equipotential bonding systems, in Company sites located either onshore or offshore.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

Design and engineering shall conform as a minimum requirement to the current edition of the following in preference order:

- Applicable laws, and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, the French laws and regulations shall be used
- Company Particular Specifications and data sheet (if any)
- Company General Specifications
- Applicable International Electro-technical Commission (IEC) Standards
- Applicable CENELEC Standards
- Applicable recognised standards and codes (e.g. UTE-NFC, BSI, VDE, etc.) where IEC publications have not yet been issued:

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
IEC 60079-14	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
IEC 60364 (Parts 4-44; 5-54)	Low voltage electrical Installations - Parts 4-44; 5-54
IEC 60479-1	Effects of current on human beings and livestock - Part 1: General aspects
IEC 61000-5-2	Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling
IEC 61892 (Parts 6; 7)	Mobile and fixed offshore units - Electrical installations - Parts 6; 7

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Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP ELE 051	Design and installation of lightning protection
GS EP ELE 364	Electrical installations
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP INS 107	Design and installation of instrumentation links

3. Study and installation conditions

The objective is to achieve earthing and equipotential bonding of all exposed conductive parts, as protection against the risks of contact by personnel with hazardous potential ([IEC 60479-1](#)) which could result of:

- Faults on electrical equipment and systems
- Accumulation of static electricity
- Stray currents, e.g. electromagnetic induction
- Lightning strikes.

Earthing arrangement shall comply with the requirements of the [IEC 60364-4-44](#).

In case of installation located in hazardous area, the requirements of [IEC 60079-14](#) shall also apply.

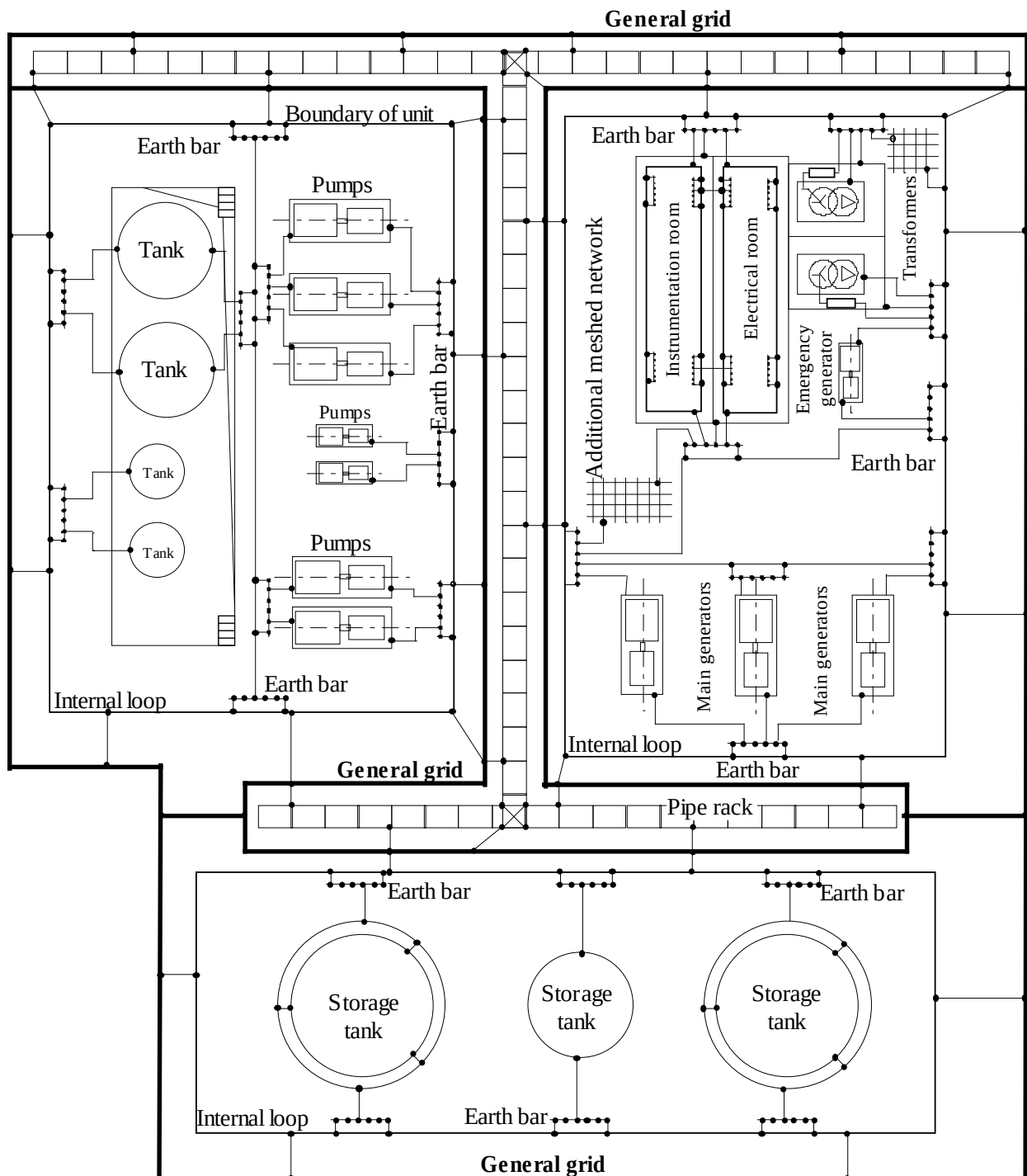
Earthing installation typical given in [GS EP ELE 364](#) appendix 1 shall be applied.

In case of lightning protection, [GS EP ELE 051](#) prevails on this specification.

4. Equipotential network

4.1 Equipotential network for an onshore installation

4.1.1 Diagram

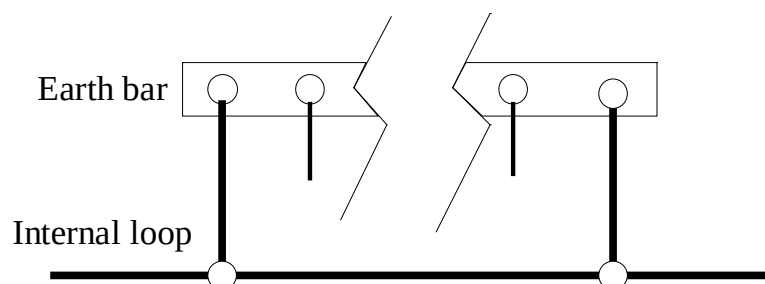


The equipotential earth bonding system shall comprise internal loops and a general earth grid, connected at least in two opposite points.

These links shall have the same cross-sectional area as that of the internal loop with which they are connected. The minimum equivalent cross-sectional area of these links shall be 70 mm² Cu.

The general earth grid and internal loops shall comprise class 2 bare copper conductors with a cross-sectional area calculated in accordance with section 543.1.1 of [IEC 60364-5-54](#).

The internal loops shall be connected at both ends of each earth bar as shown in the following figure.



When the general grid is laid in trenches, it shall be at a depth of 0.8 m, following the route of other electrical cables, pipes, etc.

When there is major risk of corrosion (soil or atmospheric), a special study shall be carried out.

4.1.2 Building reinforcements

For premises with a particular risk of electric shock (substations, power stations, pumping stations, etc.) having a reinforced concrete floor, the electrical continuity of the reinforcement shall be obtained by welds at the cross-points of the reinforcing rods (approximately one weld per square metre).

The reinforcement shall be bonded electrically to the conductor running around the building at two opposite points if the length of the building does not exceed 10 m and at two additional points for every additional 10 m of length.

4.2 Equipotential bonding system for offshore structures

The earthing and bonding arrangement shall comply with the requirements of the [IEC 61892-6](#) and [IEC 61892-7](#).

The entire welded metal structure shall form the equipotential bonding system of general earth grid and internal loops.

Unwelded structure elements shall be interconnected at two points by tinned copper braids. Stainless steel lugs with a cross-sectional area of 10 x 3 mm, and stainless steel terminals welded to the structure shall be used.

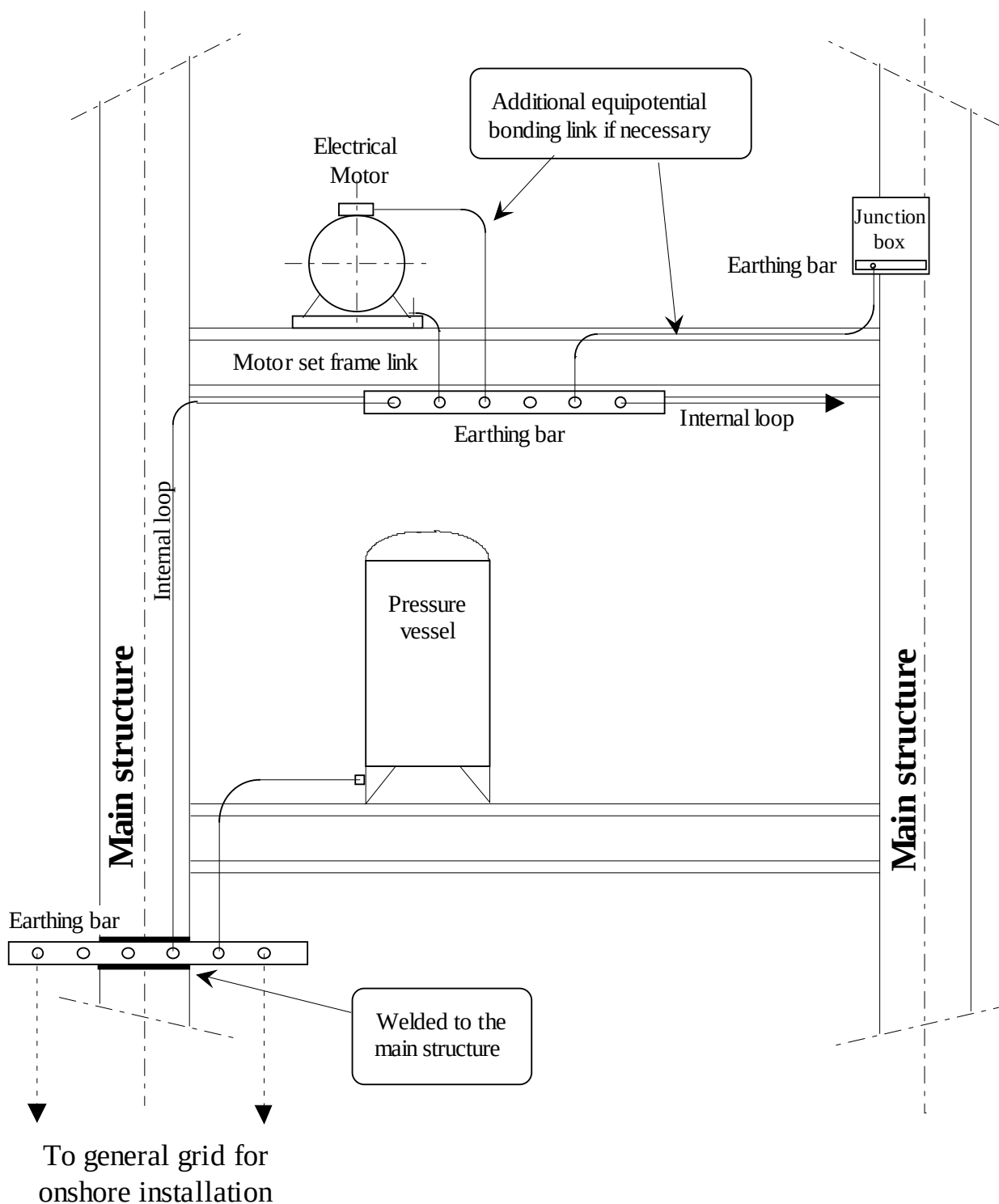
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4.3 Internal loops in structures



Packages, tanks and vessels that are welded to the structural steelwork do not require additional bonding except where anti-vibration measures isolate the equipment.

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Dedicated copper earth bars, locally insulated from the steelwork and having at least two separate connections (one at each end) for bolting to welded structural steelwork, shall be located in electrical equipment rooms, instrument control rooms and telecommunications rooms as required for the connection of individual items of equipment.

Each earth bar shall have a minimum size of 50 mm x 5 mm and shall be of hard drawn high conductivity tinned copper construction. The horizontal length of the bars will depend on the number of connections to be made but shall include 20% spare capacity.

4.4 Instrument earthing

Instrument earthing shall be in accordance with [GS EP INS 101](#) and [GS EP INS 107](#).

4.5 Protective conductors

Any electrical equipment that is not class II rated or is connected to a system operating at a voltage other than the safety extra low voltage shall be connected to the equipotential bonding system by its own earthing conductor.

On skid, electrical equipment shall be connected to the skid structure via a welded stainless steel boss.

On electrical equipment, the protective conductor shall be connected using a dedicated earth terminal.

The cross-sectional area of the protective conductor shall be sized in accordance with section 543.1.1 of [IEC 60364-5-54](#) or calculated according to short-circuit withstand and clearance time, material, permitted temperature rise and earth loop impedance values.

In TNS systems, the protective conductor shall be included in the multicore power supply cable and it may be separate from the power supply cable in other cases.

Metal ducting (cable tray, conduit, etc.) shall be connected to the equipotential bonding system at both ends and every 25 m. Full continuity shall be ensured. In case of short length elements (less than 3 m) one end only may be connected to the equipotential bonding system.

Use of metal ducting as earthing conductor is strictly prohibited.

4.6 Cable earthing

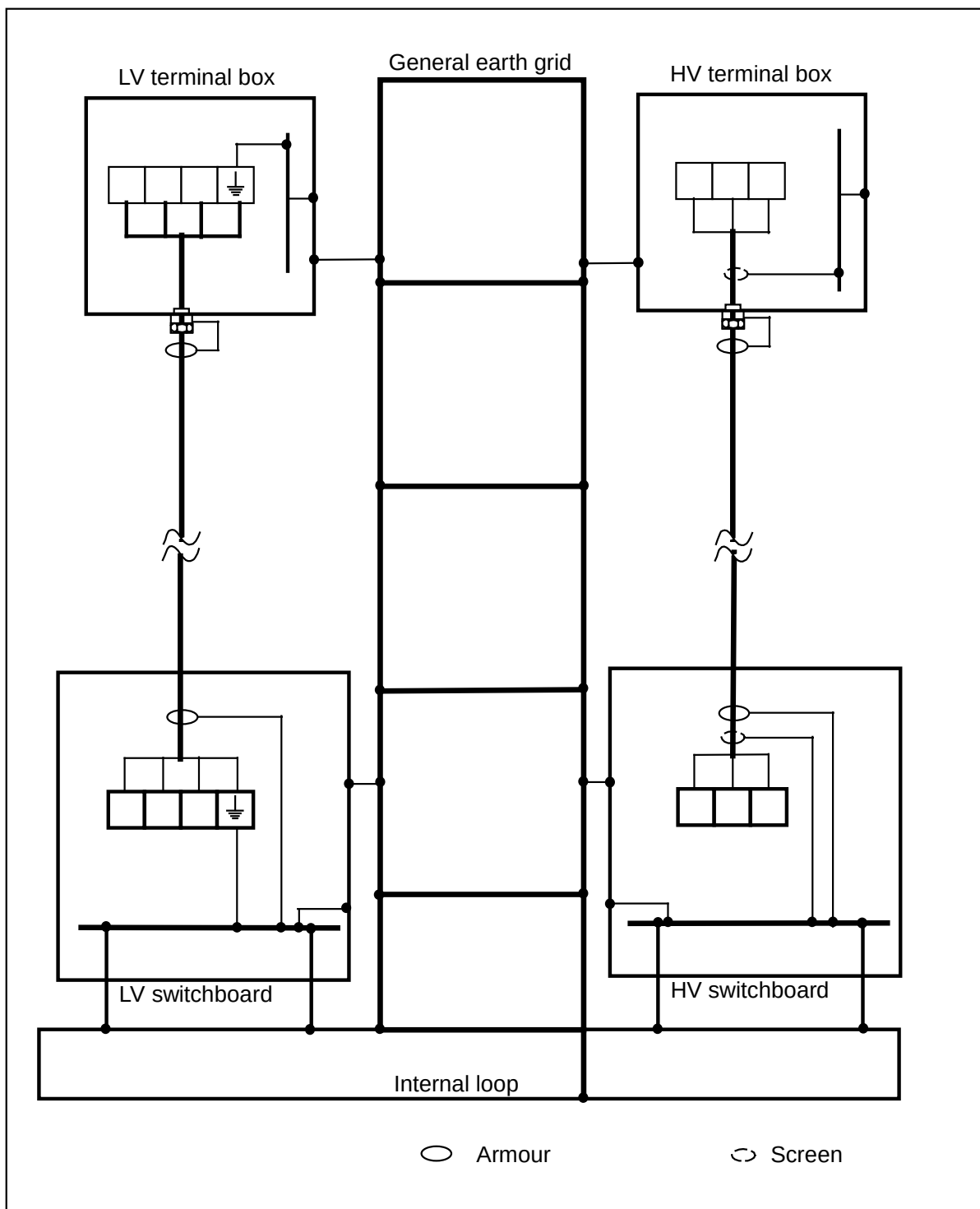
Cable armour and/or screen shall be earthed at both ends of the cable either by gland entry threads screwed into the enclosure or by earth tags where this is not applicable.

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Non-metallic enclosures, such as GRP junction boxes, push-button stations, etc, shall be fitted with internal brass metal inserts (connected to a common earth stud) to provide cable armour continuity (if any).

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5. Additional meshed network

When the global earth grid impedance value exceeds 10 Ohms, an additional meshed network shall be provided.

6. Earth electrodes

When earth electrodes are required, their depth shall consider soil drying and freezing which could increase the earth resistance (Generally the burying depth of earth is approximately 2 m).

Earth electrodes shall be connected to a main earthing terminal.

The minimum cross-sectional area of these copper conductors shall be calculated as per [IEC 60364-5-54](#) and not less than 35 mm².

7. Protection against corrosion

All necessary precautions shall be taken to avoid electrolytic corrosion, especially for connections.

Mechanical clamps are prohibited for buried connections. Crimped, aluminothermic process joints and any other equivalent joints may be used.

8. Cathodic protection by imposed current

For pipes installed with insulated joints between overhead and buried parts, the insulated joints shall be protected by surge protective device if they are located in lightning protection zones.

For Tanks or equivalent buried large structures, the earthing network shall be done in galvanised steel and connected to the cathodic protection network. No isolating device shall be installed between buried large structures and earthing network.

Cathodic protection shall be laid-out taking into account losses caused by earthing system (technical study to be performed).

9. Protection against static electricity

This protection concerns earthing of pipes, flares, tanks, columns and exchangers liable to generate static electricity.

These equipments shall be provided with welded lugs and connected to the nearest earth bar.

Storage tanks shall be fitted with at least two welded lugs, connected to the general earth grid or to an internal loop.

Metal pipes conveying products where friction generates static electricity shall be connected to the internal loop at least at each end.

Metal pipes and HVAC ducts shall be bonded to adjacent steel structures at all bulkhead penetrations if any. In addition, HVAC ducting shall be connected to earth at 25 metre intervals.

Where GRP pipes are used, all metal components of the system shall be bonded to the steelwork, e.g. valves, etc.

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10. Protection against stray currents

To channel stray currents to the equipotential bonding system, a copper conductor of 35 mm² cross-sectional area shall be used to connect all metal components and, in particular:

- Structural steelwork (a few points)
- Ladders (one point at the bottom)
- Rack supports (one point in every four supports)
- Piping shall be electrically bonded as follows:
 1. For piping which is in direct contact with structural steelwork no bonding connections are required between the pipe and the metallic structure. Nevertheless the electrical resistance between flanges and between pipes and earthing network shall be measured and found less than 0.5 ohms.
 2. GNL and gas piping shall be bonded to the earth at least at one end.

11. Loading - Offloading station

The structural steelwork of the station shall be connected to the equipotential bonding system at several points.

Pipes, loading arms, down-tubes, weighing systems, rails, shall be at all times electrically cross-bonded and connected to the equipotential bonding system by a copper conductor with a minimum cross-sectional area of 35 mm².

A removable device connected to the equipotential bonding system subject to the same conditions shall be used to connect tankers, road or rail tanks, during filling, emptying or refuelling (helicopters).

The loading/offloading station shall be equipped with an interlocking device to allow operation only when continuity of equipotential bonding is achieved.

12. EMC

In case of electromagnetic disturbances, at least provisions shall be taken in accordance with [IEC 61000-5-2](#) as regards the earthing systems.