

Table 1.11 Cross-sections for earthing conductors

Cross-section of outer conductor [mm ²]	Minimum cross-section of earthing conductor		
	in insulated cables [mm ²]	separately laid [mm ²]	flexible cables and wires [mm ²]
0,5 to 4	equal to cross-section of outer conductor	equal to cross-section of outer conductor but not less than 1,5 for stranded and 4 for solid earth conductor	equal to cross-section of outer conductor
> 4 to 16	equal to cross-section of outer conductor	equal to half the cross-section of outer conductor but not less than 4	
> 16 to 35	16		
>35 to < 120	equal to half the cross-section of outer conductor		
≥ 120	70	70	

3. Explosion protection

3.1 Hazardous areas

3.1.1 General

Hazardous areas are areas in which an explosive atmosphere in dangerous quantity (a dangerous explosive atmosphere) is liable to occur owing to local and operating conditions.

Hazardous areas are divided into zones depending on the probability that a dangerous explosive atmosphere may occur.

3.1.2 Subdivision into zones

Zone 0 comprises areas in which a dangerous explosive atmosphere is present either permanently or for long periods. Zone 1 comprises areas in which a dangerous explosive atmosphere is liable to occur occasionally. Zone 2 comprises areas in which a dangerous explosive atmosphere is liable to occur only rarely, and then only for a brief period (extended hazardous areas).

3.2 Hazardous areas, Zone 0

3.2.1 These areas include for instance the insides of tanks and piping with a combustible liquids having a flash point $\leq 60^\circ\text{C}$, or flammable gases, see also [3.9](#).

3.2.2 For electrical installations in these areas the permitted equipment that may be fitted is:

- intrinsically safe circuits Ex ia
- equipment specially approved for use in zone 0 by a test organisation recognised by GL

3.2.3 Cables for above mentioned equipment may be installed and shall be armoured or screened or run inside metal tubes.

3.3 Hazardous areas, Zone 1

3.3.1 These areas include areas like:

- paint rooms, kerosene lamp rooms, see also [3.5](#)
- acetylen and oxygen bottle rooms, see also [3.6](#)
- battery rooms, see also [3.7](#) and [Section 2, C.2](#)
- areas with machinery, tanks or piping for fuels having a flash point $\leq 60^\circ\text{C}$, or flammable gases, see also [3.8](#)
- ventilation ducts belonging to above mentioned areas
- insides of tanks, heaters, pipelines etc. for liquids or fuels having a flash point $> 60^\circ\text{C}$, if these liquids are heated to a temperature higher than 10°C below their flash point; see also [Chapter 2 – Machinery Installations, Section 10, B.5](#).
- see also [3.9](#) to [3.13](#)

3.3.2 The following electrical equipment or certified safe type equipment may be installed:

- equipment, permitted for zone 0, see [3.2.2](#)
- intrinsically safe circuits Ex i
- flameproof enclosure Ex d
- pressurized Ex p
- increased safety Ex e
- special type of protection Ex s
- oil immersion Ex o
- encapsulation Ex m
- sand filled Ex q
- hermetically enclosed echo-sounders

3.3.3 Cables for above mentioned equipment may be installed and shall be armoured or screened or run inside metal tubes, and cables for echo-sounders and cathodic protection systems, installed in thick-walled steel pipes with gastight joints up to above the main deck.

3.4 Extended hazardous areas, Zone 2

3.4.1 These areas include:

- Areas directly adjoining Zone 1 lacking gastight separation from one another are allocated to Zone 2 (Enclosed areas with access to zone 2-areas may be counted as safe areas under the following conditions, if the access door to the room is watertight and fitted with self-closing devices and without holding back arrangements and the area is ventilated from a safe area by an independent natural ventilation system and warning labels are fixed to the outside of the access door, drawing attention to the combustible liquids in this room)
- Areas on open deck 1m surrounding openings for natural ventilation or 3 m surrounding openings for forced ventilation for rooms, see [3.5](#), [3.6](#), [3.7](#), [3.8](#)
- see also [3.9](#) to [3.13](#)

3.4.2 The following electrical equipment may be installed:

- equipment permitted for zone 0, see [3.2.2](#),
- equipment permitted for zone 1, see [3.3.2](#),
- equipment of Ex n- type protection,
- facilities which in operation do not cause any sparks and whose surfaces, accessible to the open air, do not attain any unacceptable temperatures,
- equipment with a degree of protection of IP 55 at least and whose surfaces, accessible to the open air, do not attain any unacceptable temperatures.

3.5 Electrical equipment in paint and kerosene lamp rooms

3.5.1 In the above-mentioned rooms (Zone 1) and in ventilation ducts supplying and exhausting these areas, electrical equipment shall be of certified safe type and comply at least with II B, T3.

Switches, protective devices and motor switchgear for electrical equipment in these areas shall be of all-poles switchable type and shall preferably be fitted in the safe area.

3.5.2 On the open deck within a radius of 1 m (Zone 2) around natural ventilation openings (in- and outlets) or within a radius of 3 m around forced ventilation outlets (Zone 2) the requirements of 3.4 shall be

fulfilled. Care shall be taken to avoid exceeding temperature class T3 or 200 °C.

3.5.3 Enclosed areas with access to paint- and kerosene lamp rooms may be counted as safe areas under the following conditions; if

- the access door to the room is gastight and fitted with self-closing devices and without holding back arrangements. A watertight door may be considered as being gastight; and
- the area is ventilated from a safe area by an independent natural ventilation system; and
- warning labels are fixed to the outside of the access door, drawing attention to the combustible liquids in this room.

3.6 Electrical equipment in acetylene and oxygen bottle rooms

Electrical equipment in acetylene and oxygen bottle room shall be of certified safe type with explosion protection of IIC T2 at least.

3.7 Electrical equipment in battery rooms

Electrical equipment in battery rooms shall be of certified safe type with explosion protection of IIC T1 at least.

Arrangements and further requirements, see [Section 2, C](#).

3.8 Electrical equipment in fuel stores, flash point ≤ 60 °C

Electrical equipment in fuel stores shall be of certified safe type with explosion protection of IIA T3 at least.

3.9 Explosion protection on tankers

Regarding hazardous areas and approved electrical equipment on tankers see:

- IEC 60092-502
- [Section 15](#)
- [Chapter 6 - Liquefied Gas Tankers](#), see also IGC- Code of IMO
- [Chapter 7 - Chemical Tankers](#), see also IBC- Code of IMO

3.10 Explosion protection for ships for the carriage of motor vehicles

Regarding hazardous areas and approved electrical equipment on ships for the carriage of motor vehicles, see [Section 16](#).

3.11 Explosion protection for ships for the carriage of dangerous goods

Regarding hazardous areas and approved electrical equipment on ships for the carriage of dangerous goods, see [Section 17](#).

3.12 Explosion protection in areas, dangerous owing to ignitable dust

3.12.1 These areas include rooms and spaces e.g.:

- cargo holds, see also [Section 17, D.4.1](#) and [4.2](#)

3.12.2 The following electrical equipment may be installed:

- equipment of certified safe type for dust explosion protection
- equipment with a degree of protection of IP 55 at least and whose surfaces do not attain any unacceptable temperatures

In continuous service, the surface temperature of horizontal surfaces and surfaces inclined up to 60° to the horizontal shall be at least 75 K below the glow temperature of a 5 mm thick layer of the dust.

3.13 Explosion protection in pipe tunnels

All equipment and devices in pipe tunnels containing fuel lines or adjoining fuel tanks shall be permanently installed irrespective of the flash point of the fuels. Where pipe tunnels directly adjoin tanks containing combustible liquids with a flash point below 60 °C, e.g. in ore or oil carriers, or where pipes inside these tunnels convey combustible liquids with a flash point below 60 °C, all the equipment and devices in pipe tunnels shall be certified explosion-protected in accordance with [3.3.2](#) (zone 1).

3.14 Permitted electrical equipment

3.14.1 Electrical equipment shall not be installed in hazardous areas Zones 0, 1 and 2, unless it is necessary for ships operation or safety. All electrical equipment, necessary to install in hazardous areas zone 0 and 1 shall be either manufactured according to a recognised standard such as IEC 60079 and certified by an authority recognised by GL or of a simple type belonging to an intrinsically safe circuit. Certificates for electrical equipment installed in zone 2 may be requested by GL. Special conditions, mentioned in the certificates or in their instruction manuals have to be observed.

3.14.2 Where electrical equipment is liable to suffer damage due to characteristics of the cargo, measures shall be taken to protect such equipment.

3.15 Portable electrical equipment

Portable electrical equipment, important for aboard operation and used in hazardous areas or stipulated for such use by regulations shall be of a certified safe type.

3.16 Earthing/ Equipotential bonding/ Static electricity

3.16.1 All electrical equipment in hazardous areas shall be earthed regardless of the operating voltage.

3.16.2 To prevent static charges, all cargo tanks, processing plants, piping etc. shall be durably bonded by electrical conductors and/or connected to the hull, unless they are electrically connected to the hull by welds or bolting. Not permanently installed tanks, piping systems and equipment may be connected by bonding straps. Such straps shall be designed and located that they are protected against corrosion and mechanical damages. These connections shall be accessible for inspection and protected against mechanical damage and corrosion. The discharge resistance to the ship's hull be less than 1 MOhm.

3.17 Aerials / Electromagnetic radiation

3.17.1 Aerials and their riggings shall be placed outside hazardous areas.

3.17.2 If aerials shall be placed in hazardous areas owing important reasons of ship construction or radio technology, the level of radiated power or field strength shall be limited to safe values acceptable to the appropriate authority.

4. Electromagnetic compatibility (EMC)

4.1 Electrical and electronic equipment shall not be impaired in their function by electromagnetic energy. General measures are to extend with equal importance over:

- decoupling of the transmission path between source of interference and equipment prone to interference
- reduction of the causes of interference sources
- reduction of the susceptibility to interference

4.2 The IEC publications 60533 and 60945 for the bridge and deck zone are to be observed.

4.3 The requirements for electrical and electronic equipment subject to mandatory type approval regarding immunity and emissions of electromagnetic influence can be taken from [VI – Additional Rules and Guidelines, Part 7 – Guidelines for the Performance of Type Approvals, Chapter 2 – Test Requirements for Electrical / Electronic Equipment and Systems](#).

4.4 Electrical and electronic equipment on board ships, required neither by classification rules nor by international conventions, liable to cause electromagnetic disturbance shall be of a type which fulfils the test requirements of [VI – Additional Rules and Guidelines, Part 7 – Guidelines for the Performance of Type Approvals, Chapter 2 – Test Requirements for Electrical/Electronic Equipment and Systems, Section 3, B.21 and B.22](#).

5. Lightning protection

Reference is made to IEC publication 60092-401.