Shaft sinking and drifting are particular operations where lightning is a recognized hazard. With these operations all work associated with electrical blasting should be suspended and persons withdrawn to a safe distance when an electrical storm is approaching.

A conservative approach would require that the precautions applied to shaft sinking and drifting be applied to all underground operations.

6.6.4 Surface workings

6.6.4.1 *General*

The following recommendations apply to surface mining operations where any type of explosive is used in the mining operation.

6.6.4.2 *Equipment*

For many surface workings involving blasting operations, action need only be taken in the immediate vicinity of the area where blasting takes place. This is because no interconnection by metallic structures, such as air/water/electricity services, exists with distant structures or earth. Where these services exist the recommendations for underground working, of Clauses 6.6.3.3 to 6.6.3.5 apply and, where practicable, the bonding recommendations of Clause 6.6.3.7 should also apply. Where electric detonators are used, electric detonators of the type described in Clause 6.6.3.2 should be used.

6.6.4.3 *On-site precautions*

All work associated with blasting operations should be suspended and persons should be withdrawn to a safe distance from explosives when an electric storm is approaching.

High equipment, such as drilling rigs, shovels and draglines, that may increase lightning locality concentration, should be moved to a safe distance from the area where blasting is to take place prior to explosives being brought to the site.

6.6.5 Lightning detector

Specially designed lightning detectors should be provided to warn of approaching electrical storms so that the precautions set out in Clauses 6.6.3.8 and 6.6.4.3 may be taken.

6.7 PROTECTION OF BOATS

6.7.1 General

A boat should be considered to be at risk both because of its method of construction (except for metal-hulled boats) and because it forms a marked protrusion above the surrounding water surfaces. Overseas statistics show that in excess of 10 percent of fatalities occurring on cruising sailing boats are due to lightning.

While the principles to be applied will not differ from those for land-based structures, the methods employed will depend on the form of construction and the type of boat to be protected.

NOTE: For further detail on the protection of boats against lightning refer to ISO 10134 and Paragraph G2, Ref 7.

6.7.2 Elements of the protection system

6.7.2.1 *Air terminal*

A metal mast or the metal fitting on a timber mast will act as an adequate air terminal.

6.7.2.2 *Downconductors*

The mast, if metallic or if provided with a metal track, and stays will both act as downconductors and each should be connected to an earth termination.

Stays as small as 3 mm diameter steel wire will serve as effective downconductors, but may be damaged under severe lightning discharges.

6.7.2.3 *Earthing*

Any metal surface that is normally submerged in the water will provide adequate earthing. Propellers, metal rudder surfaces and metal keels may be used. The earth plate for the radio transmitter may also be used, providing that it is constructed of solid material and not of the porous type. A metal or a ferro-cement hull also constitutes an adequate earth.

6.7.2.4 *Metallic objects*

Metallic objects that are permanent parts of the boat and whose function would not seriously be affected by earthing should be made part of the LPS by interconnection with it.

NOTE: The purpose of interconnecting the metal parts of a boat with a downconductor is to prevent side-flashes to metal objects that could form part of an alternative path to earth or which could bridge out a substantial length of the downconductor.

A general rule is, that if the non-conducting part of the alternative path through such object is less than one-eighth of the length of downconductor bridged out, then that object should be electrically interconnected with the downconductor.

6.7.2.5 *Radio transceivers*

A whip antenna consisting of a fine wire embedded in a glass fibre tube cannot be considered a satisfactory lightning conductor and should be folded down during a lightning storm.

All radio equipment or other navigational equipment with exposed transducers such as radar, wind speed/direction indicators, and the like, should be fitted with effectively-earthed spark gaps or SPDs. Alternatively, input cabling should be disconnected from the equipment if there appears to be imminent danger of the boat being struck by lightning.

6.7.2.6 *Corrosion*

Care should be taken that the design of the LPS does not promote the occurrence of electrolytic or galvanic corrosion. Bonding of dissimilar metals and interconnection of the earth terminals of different pieces of electrical equipment should not be undertaken without expert knowledge of the possible problems involved (see also Clause 4.7.2).

6.7.3 Installation recommendations

6.7.3.1 *Protection of boats with masts*

Sailing or power boats that have a mast or masts of sufficient height to give an adequate zone of protection in accordance with Clause 4.4 may be protected by earthing the lower ends of the standing rigging and the base of a metallic mast, or the lower end of a continuous metal sail track on a timber mast.

Where the mast of a boat is stepped on deck, particular care should be taken to ensure that the conductor from the base of the mast follows a direct route if it passes through the accommodation section of the boat, otherwise a situation analogous to that shown in Figure 4.8 may occur.

A typical small sailing boat with aluminium mast stepped on deck, glass fibre hull with the metal ballast encapsulated in the glass fibre (or unballasted and with a non-metallic centreboard) and with chainplates moulded into the hull provides something of a problem. In such cases, it is suggested that some protection be sought when necessary by temporarily connecting the mast and stays together at deck level by a length of chain or other flexible conductor and allowing a short length of chain or the conductor to hang in the water at each chainplate.

6.7.3.2 *Protection of boats without masts*

Boats without masts do not constitute as high a risk as boats with masts. However, where the size of the boat is such as to cause a marked protrusion above the surrounding water surfaces, such boats should be fitted with air terminals that will give at least the protection recommended in Section 4 for land-based structures.

6.7.4 Precautions for persons and maintenance suggestions

To the extent consistent with safe handling and navigation of the boat during a lightning storm, persons should remain inside a closed boat and avoid contact with metallic items such as gear levers or spotlight control handles. Persons should stay as far as practicable from any parts of the standing rigging or other items forming part of a downconductor. No person should be in the water or dangle arms or legs in the water.

If a boat has been struck by lightning, compasses and navigation instruments should be checked for calibration. Protective coatings on steel hulls and glass fibre sheathing over ballast keels should also be checked for damage. All standing and running rigging and associated fittings should be checked in detail.

6.7.5 Bonding the lightning protection system to the vessel's electrical wiring system earth

The interworking and bonding of the LPS on a boat should recognize that the electrical wiring system on a boat is commonly only a final subcircuit. As such, the wiring will be very light, and neither the live conductors (whether or not energized) nor the earthing arrangements, are capable of carrying lightning discharge current. Even with a larger vessel, where the wiring is for a submain or a complete installation with a generator, this will often still be the case, though larger wire sizes would be in use.

As a consequence, the LPS should be designed initially as a self-contained unit, even as far as selecting and arranging the most appropriate below water level earthing electrode, in accordance with Clause 6.7.2.3.

The wiring systems likely to be encountered (see AS/NZS 3004) are—

(a) a conventional AS/NZS 3000 arrangement with an inlet socket; or

(b) a conventional arrangement, but with the shore earth broken (for voltages less than about 2 V) by a galvanic isolator. The galvanic isolator may be located either on board, or on shore; or

(c) a system where the need for an onboard earthing system is removed by either an onboard or a shore-mounted isolation transformer.

Items (b) and (c) above are to avoid galvanic or electrolytic corrosion of metallic skin fittings below the water line from interaction with shore earthing. It should be noted that Item (c) is not intended to give effect to the usual function of isolation transformers, which is to avoid earth path electric shock. The ship installation may have common fed accessories off the isolation transformer secondary, and all systems may incorporate RCD protection. One side of the isolation transformer secondary may be a pseudo 'neutral' with ship earthing.

In such cases, a ship earth or ship bonding of one side of the isolation transformer secondary would be expected to be provided. Ships wired to earlier standards or overseas standards may vary from the above.

When the LPS is completed, the earthing conductor at its final point connection to its chosen earth termination network should be bonded to the ship earth or ship bonding point at its termination. Where the bonding conductor on the electrical wiring is not actually terminated on 'earth', the bond from the LPS should be connected to its lowest (height) control point by a conductor of not less than twice the cross-sectional area of the electrical wiring system.

6.8 FENCES

If an extended length of metal fence is struck it is raised momentarily to a high potential relative to earth. Persons or livestock in close proximity to, or in contact with, such fencing at the time of a lightning discharge to the fencing may therefore be exposed to danger. Fences that give rise to the most risk are those constructed with posts of poor conducting material, such as wood or concrete. Fences built with metal posts set in earth are less hazardous, especially if the electrical continuity is broken. Breaking the electrical continuity prevents a lightning stroke from affecting the entire length of a fence, as it can if the stroke is direct and the fence continuous, even though earthed.

Thus it is desirable to limit the length of fencing so affected by the provision of gaps, and also to provide several earthing electrodes in each section so as to facilitate the discharge to earth of the lightning current. In addition, persons or livestock can be endangered by potential differences in the ground in the proximity of fences (see Figure 6.1). The risk is greatest on rocky ground.

No value can be given for the earth termination resistance, since this must be largely governed by the physical conditions encountered, but the lower the resistance to earth the less risk will result to persons and livestock. In this connection, it should be borne in mind that because of large body spans and bare contact areas many types of livestock are more susceptible to electric shock than humans.

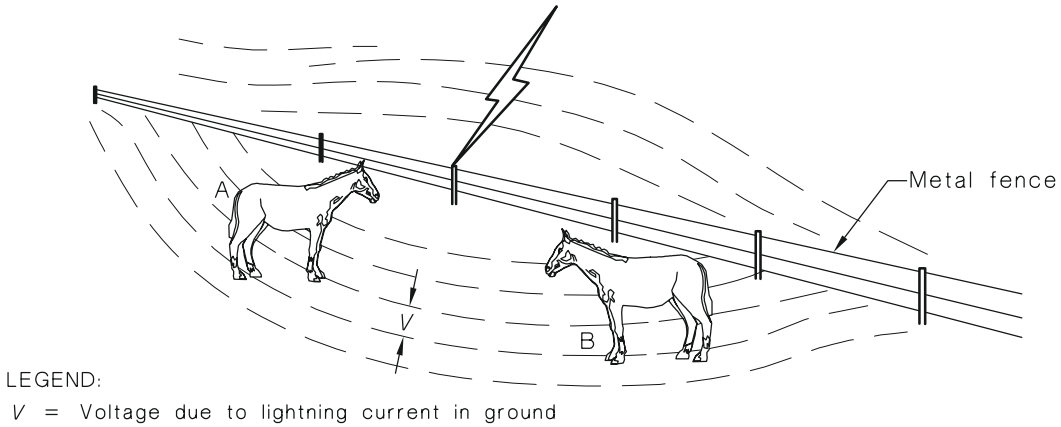

FIGURE 6.1 EQUIPOTENTIAL LINES NEAR METAL FENCE CAUSED BY LIGHTNING DISCHARGE TO FENCE

6.9 MISCELLANEOUS STRUCTURES

6.9.1 Shelters, shade structures and rotundas in the public domain

Structures of this nature, which have metallic roofs supported on wood or other electrically non-conductive materials, shall have the metallic roof earthed by a minimum of two standard downconductors at intervals not exceeding 20 m of the roof perimeter. These downconductors should be arranged outside the structure away from exits and entrances and to reduce the hazard of touch potential, should be installed in a suitable heavy duty electrical conduit to the AS/NZS 2053 series. Where the metallic roof is in contact with, and supported by, metallic supports, no additional downconductors are required.

In the case of structures of this nature with a non-conductive roof, air terminations and downconductors shall be installed as per Section 4, with earthing as described below.

Each specially provided downconductor shall be suitably earthed. Where doubt exists as to the effective earthing of metallic supports being used as downconductors, they should also be suitably earthed.

In addition to these minimum requirements, further protection may be afforded to the occupants of the shelter by installation of a ring earth.

6.9.2 Large tents and marquees

Where large temporary structures of this type are used for such purposes as exhibitions and entertainments involving large numbers of people, consideration should be given to their protection against lightning. In general such structures are manufactured from non-metallic materials and the simplest form of protection will usually consist of one or more horizontal air terminals suspended above them and connected solidly to earth. A non-metallic extension of the vertical supports provided for such structures may, if convenient and practicable, be used for supporting a network of horizontal air terminals but a clearance of not less than 1.5 m should be maintained between the conductor and the fabric of the enclosure. Downconductors should be arranged outside the structure away from exits and entrances and be connected to earthing rods that, in turn, should be connected to a ring conductor in such a manner as to be inaccessible to the general public. Those types of tented structure that have metal frameworks should have these efficiently bonded to earth at intervals of not more than 20 m of perimeter.

6.9.3 Small tents

For small tents, no specific recommendations can be given.

6.9.4 Metal scaffolding and similar structures, including overbridges

Where metal scaffolding is readily accessible to the general public, particularly when it is erected over and on part of the common highway or may be used in the construction of public seating accommodation, it should be efficiently bonded to earth. A simple method of bonding such structures consists of running a strip of metal other than aluminium, 20 mm × 3 mm size, underneath and in contact with the base plates carrying the vertical members of the scaffolding and earthing it at intervals not exceeding 20 m. With public seating accommodation only the peripheral members of the structure need bonding to earth. Other steel structures, such as those used for pedestrian bridges over main trunk roads, are frequently sited in isolated situations where they may be prone to lightning strikes and should therefore be bonded to earth, particularly at the approach points.

6.9.5 Tall metal masts, towers, cranes and revolving and travelling structures

Masts and their guy-wires, floodlighting towers and other similar structures of metallic construction, particularly those to which the general public have access, should be earthed in accordance with this Standard.

Cranes and other tall lifting appliances used for building construction purposes, shipyards and port installations should also be bonded to earth. For cranes or revolving structures mounted on rails, efficient earthing of the rails, preferably at more than one point, will usually provide adequate lightning protection.

In special cases, where concern is felt regarding possible damage by lightning to bearings, additional measures may be justified.

Mobile towers, portable cranes and similar structures mounted on vehicles with pneumatic tyres can be given a limited degree of protection against lightning damage by drag chains or tyres of conducting rubber such as are provided for dissipating static electricity.

6.10 PROTECTION OF HOUSES AND SMALL BUILDINGS

6.10.1 General considerations

The application of this Clause is intended to be restricted to relatively small buildings, such as houses or similar buildings, of a smaller size than those envisaged in Section 4 of this Standard.

Lightning protection for a house or small building in complete accordance with the recommendations of Section 4 may be difficult to justify on economic grounds. However, there may be a need to provide some degree of protection against lightning damage.

Houses and small buildings vary greatly in the degree to which their construction provides inherent lightning protection. Small buildings with mainly non-metallic materials offer little or no inherent protection against lightning, whereas a building with a metallic roof, metallic gutters, and metallic downpipes leading into the ground has a high degree of inherent protection, since the main elements of an LPS are already present.

If lightning strikes a house with little or no inherent lightning protection, the lightning is likely to penetrate the roof and attach to electrical wiring in the roof area. This will usually result in damage to electrical equipment in the house, and in some cases, may result in a fire, or in hazard to persons within the house.

The objective in protecting small buildings should be to provide conductors to intercept the lightning, to provide a low-resistance path to earth, and to provide at least two earth stakes or equivalent earthing electrodes for conveying the lightning current into the earth.

6.10.2 Air terminal network for the building

If the building roof consists mainly of metallic materials, then it will serve as the air terminal network. It is necessary to ensure that there is electrical continuity between the various parts of the roof. Adequate continuity will often be provided by the way in which the metallic parts are overlapped and fastened.

If the building roof consists mainly of non-metallic materials, then an air terminal network should be provided. Suitable materials are listed in Clause 4.7. Copper wire and copper strip are recommended for their durability. At least one conductor should be run along the highest parts of the roof, for example, the highest ridge of the building. If the roof has a complicated shape, it may be necessary to run additional conductors along the highest parts of each section of the roof. All conductors should be joined together.

To be in accordance with this Standard, the cross-sectional area of the conductors should be not less than 35 mm^2, achieved, for example, by copper strip 25 mm × 1.5 mm. However, it should be realized that much thinner conductors are able to carry most lightning currents without damage. Even if the conductor were to melt, it would have carried out its function for that one strike, as the lightning current would flow through the path of the molten metal, rather than penetrate below the roof of the house.

For a large, more-or-less flat roof of non-conducting material, the simplest form of air terminal network may be a series of vertical metallic rods above the roof level, all connected together. The zone of protection provided by a vertical rod may be estimated using the information in Clause 4.4.

Metallic gutters may become a strike attachment point. If there are metallic gutters around the roof, these should be connected to the air terminal network. With metallic roofs, these connections may already exist in the fastenings of the guttering to the roof. With non-metallic roofs, the guttering should be connected to the air terminal network at no less than two points.

6.10.3 Provision of downconductors for the building

There should be at least two low-resistance paths to convey the current from any lightning strike to the roof to earth. Metallic downpipes from metallic gutters may be used for this purpose, provided that they afford a direct electrically continuous path for the lightning current. In the absence of any low-resistance path from roof to earth, at least two conductors should be provided to serve as downconductors. These may be continuations of the conductors forming part of the air terminal network, and the same recommendations apply as in Clause 6.10.2.

6.10.4 Provision of earthing electrodes

A path to earth for the lightning current should be provided at no less than two well separated points, for example, at opposite ends of the house. Preference should be given to areas that are usually damp, such as gardens. A metallic water pipe buried in the ground would be a satisfactory earthing electrode provided that the water pipe is also connected to the electricity supply service earth.

Each downconductor should be connected to an earthing electrode by the shortest possible route, with the proviso that downconductors and earthing electrodes should not be placed close to entry doors, or places where persons are likely to stay for long periods. For example, earthing electrodes should not be placed close to swimming pools.

Earthing electrodes and their connected conductors should be examined periodically to ensure that they are intact, and not suffering corrosion or mechanical damage.

6.11 PROTECTION OF METALLIC PIPELINES

Recommendations for the protection of metallic pipelines are given in AS/NZS 4853.

SECTION 7 PROTECTION OF STRUCTURES WITH EXPLOSIVE OR HIGHLY-FLAMMABLE CONTENTS

7.1 SCOPE OF SECTION

This Section provides a guide to the protection of structures containing explosives, or highly-flammable solids, liquids, gases, vapours or dusts, from lightning or induced discharges, and indicates ways of protecting those structures that are not inherently self-protecting. Reference should be made to the AS/NZS 2430 series for information on areas that are likely to have an explosive atmosphere. Reference should also be made to AS/NZS 1020 for information on the control of static discharges.

7.2 GENERAL CONSIDERATIONS

7.2.1 Risk assessment

The approach for the assessment and management of risk due to lightning detailed in Section 2 may be applied to structures with explosive or highly-flammable contents.

In some cases, the risk to life and property may be so obvious that the provision of every means possible for protection from the consequences of a lightning discharge is essential. Similarly, the owner of such a facility may decide that there should be no avoidable risk and specify that every means possible for protection from the consequences of a lightning discharge be installed.

Alternatively, the risk may be assessed as acceptable where the quantity of dangerous material is strictly limited, as in a laboratory or small store, or where the structure is specifically designed and situated to restrict the effects of a catastrophe. Also, lightning protection may not be necessary in some circumstances where the dangerous materials are not exposed but are completely encased in metal of an adequate thickness.

7.2.2 Protection required

Unless the risk assessment considerations in Clause 7.2.1 indicate that protection is not required, the recommendations in this section should be followed for structures in which explosives or highly-flammable solids, liquids, gases, vapours or dusts may accumulate, i.e. in those areas that may be classified as hazardous.

Due to the increased risk, protection level I as defined in Section 4 should be applied to these structures (e.g. a rolling sphere of 20 m radius when using the RSM).

7.2.3 Electrostatic shielding

The electrostatic induced voltage on isolated objects in the field of a storm cloud may cause sparks to earth when a lightning discharge occurs to some adjacent object. Isolated objects within a structure that is adequately shielded will themselves be electrostatically shielded. If the structure is not shielded or is only partly shielded, then the isolated objects should be earthed to prevent electrostatic sparks. For further discussion on the earthing of isolated internal objects, see Section 5.

7.3 AREAS OF APPLICATION

Protection should, in all cases, be provided for the following structures:

(a) Tanks and vessels containing flammable solids, liquids, vapours or gases, or highly-flammable or explosive dusts.

(b) All metallic pipes and electricity supply and telecommunications service lines at the point where they enter or leave a hazardous area.

Piping that is not in electrical contact with its associated tank or vessel, such as an open discharge line into a water tank, should be bonded to the tank or vessel by a flexible conductor, and earthed. Cathodic protection may justify the insertion of an insulating flange that will interrupt the electrical continuity of the total length of line. Cathodic protection usually has its converter and monitoring equipment outside the hazardous area, with ELV d.c. leads feeding into the latter. This may require separate protection to each part of the circuit.

Where flexible connections between pipelines and tanks do not incorporate an earth-continuity conductor, a separate conductor for earthing should be provided. No pipeline should be used for earth-continuity purposes as a substitute for the recommended earthing conductor.

(c) Buildings that may contain explosive or large quantities of highly-flammable materials, or nominated buildings that may, in an emergency, be used for the storage of explosives.

(d) Buildings that may contain small quantities of highly-flammable material or a large quantity of combustible material if sited within 50 m of a building specified in Item (c).

(e) Any structure sited within 30 m of a building containing explosives, which thus constitutes a projectile hazard to this building in the event of dislodgment of masonry and the like by lightning.

(f) Any structure sited within 30 m of a building containing explosives that, if struck by lightning, might constitute a subsequent fire hazard.

7.4 EQUIPMENT APPLICATION

7.4.1 Earth bonding points

Earth bonding points should be designed and installed to provide permanent, electrically sound connections between the tank, plant or structure and the earthing system.

The bonding points can be bosses tapped to receive a bolt up to 50 mm long, a tag (minimum 50 × 50 × 10 mm) or a 50 mm threaded stud. The points should be fabricated to provide or accept a minimum of M10 (10 mm diameter) bolt, lug or fixing.

Earth bonding points should be fabricated from the same (or compatible) metal as the structure it is being welded to. Pressure vessels should be provided by the manufacturer with a suitable bonding point to take the earth connection.

In order to avoid corrosion, earth bonding points should be installed not less than 500 mm above ground level. In addition, all earth connections to the points should be protected with a suitable corrosion inhibiting compound or paint.

7.4.2 Bonding conductors

Where various items of process plant or a number of vessels are mounted on an extensive concrete plinth that elevates the equipment above ground level, bonding conductors should be provided to form a common earth connection for all the downconductors from the plant.

Copper strip should be installed along two opposite sides of the plinth, fastened to the walls not less than 500 mm above ground level to avoid corrosion. Tee-joints may be used between down and bonding conductor. Diagonally opposite ends of the base conductor should be provided with a test link from which connection is made to the earth termination network, preferably to earth busbars that provide alternative earth connections.

Where one bonding conductor only is installed, test links and earth connections should be provided at each end.

7.4.3 Sizes of copper strips

Sizes of copper strips should be in accordance with Table 4.6. For common earthing systems, larger sizes may be needed depending on the fault current. These should be selected in accordance with AS/NZS 3000.

7.4.4 Downconductors (see Clause 4.12)

All high salient structures within a process area should be provided with at least two downconductors unless they are of welded construction or electrically continuous down to base level.

Wherever possible, downconductors should be installed remote from stairs and operational walkways and ladders.

Downconductors should preferably be installed at diagonally opposite corners of the structure in positions that provide the shortest possible path for connection to the earth termination network. They should be installed on the outside of the structure and should not pass through it.

Copper strip should be used for downconductors and while, wherever possible, it should be in a continuous length, test links may be attached for connection of down or base conductors at various levels.

Where structural steelwork or columns do not require the installation of an air terminal, the downconductor should extend from above the highest point of the structure.

Provision should be made for thermal expansion of the earthing conductor and associated structure.

A test link should be installed in the downconductor in accordance with Clause 4.13, not less than 500 mm above ground level.

Each downconductor from the highest point or points within the process area should take the shortest possible path direct to earth and should be equipped with its own set of earthing electrodes to provide a path of minimum impedance for a lightning discharge. The earthing electrodes should be interconnected below ground level with the bonding conductor(s) belonging to other earthing systems.

7.4.5 Air terminals (see Clause 4.11)

All high salient structures that are not electrically continuous and that are not within the zone of protection of an adjacent protected structure should be equipped with air terminals in accordance with the recommendations of this Standard.

Where two or more air terminals are employed they should be interconnected by roof conductors for connection to at least two downconductors as follows:

(a) *Roof conductors* Copper strips should take the shortest salient route between the various air terminals, with fasteners spaced as for downconductors.

(b) *Air terminal network* Buildings that are protected by an air terminal network should be provided with at least two downconductors, that should be directly connected to the most widely-spaced parts of the air terminal network.

7.5 SPECIFIC OCCUPANCIES

7.5.1 Protection of steel tanks

7.5.1.1 *General precautions*

The following precautions should be taken to minimize the effects of lightning discharge on tanks containing petroleum products, including tanks with fixed roofs and tanks with floating roofs:

(a) The shells of all tanks intended for the storage of highly-flammable liquids that can produce an explosive gas atmosphere should be permanently and effectively earthed. Other tanks, such as water tanks, if located in a hazardous area should also be permanently and effectively earthed.

The combined earth resistance of permanent earth connections to the tank should not exceed 10 Ω.

The recommended method of earthing is by means of earthing electrodes as detailed in Clause 4.15, but in some installations soil conditions and the earth resistance of the tank when isolated from associated pipelines may in themselves constitute permanent and effective earthing. In such cases, the necessity for tank earthing electrodes should be considered with particular reference to site measurements of earth resistance.

(b) The minimum number of individual earthing electrodes on storage tanks will depend upon the diameter and soil condition, and should be in accordance with the following schedule for single tanks:

Diameter of tank m	Minimum number of independent earthing electrodes
≤ 30	2
> 30	3

For a group of small tanks, earthing electrodes common to the group may be installed, provided that each tank has two independent paths to earth. One of these paths may be through the pipeline earthing system.

NOTE: The reason for the minimum of two earthing electrodes is that during testing of one electrode the tank will remain earthed by the other electrode.

Earthing electrodes for a tank may be interconnected around the periphery of the tank, and where two or more connections are used they should be spaced symmetrically round the tank.

(c) Each earthing conductor should be terminated and attached by means of a bolted connection to a steel boss welded to the tank body. The steel boss should be tapped to receive a bolt or stud, preferably 10 mm diameter. Lock washers should be used on the connecting assembly. Soldered connections should be avoided. It is suggested that the boss be welded on the tank at a minimum height of 500 mm above the bottom of the tank.

(d) When a pipe or rod earthing electrode is driven into the ground, mechanical protection should be given to the head of the electrode.

NOTE: It is the practice of some organizations to enclose all earth stake heads in a pit, where they are associated with ‘special’ earthing, such as lightning protection or static earthing.