

Australian Standard™

**Electrical installations—Surface mines
and associated processing plant**

Part 2: General protection requirements



This Australian Standard was prepared by Committee EL-033, Electrical Installations for Outdoor Sites Under Heavy Conditions. It was approved on behalf of the Council of Standards Australia on 28 July 2004.
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Construction and Mining Equipment Association of Australia
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Department of Natural Resources and Mines (Qld)
Minerals Council of Australia
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Australian Standard™

**Electrical installations—Surface mines
and associated processing plant**

Part 2: General protection requirements

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PREFACE

This Standard was prepared by Standards Australia Committee EL-033, Electrical Installations for Outdoor Sites Under Heavy Conditions, to supersede AS 3007.2—1987 which was based on IEC 60621-2:1987, *Electrical installations for outdoor sites under heavy conditions (including open-cast mines and quarries)*, Part 2: *General protection requirements*.

This Standard was produced from AS 3007.2—1987. Even though much of the technical content is sourced from IEC 60621-2, this Standard is not equivalent to IEC 60621-2. It has been updated to align with Standards Australia style including the following:

- (a) Numbering of all clauses.
- (b) The addition of lists of referenced Standards.
- (c) Updating of references to other Standards.

This Standard is Part Two of a series that includes the following:

AS

3007	Electrical installations—Surface mines and associated processing plant
3007.1	Part 1: Scope and definitions
3007.2	Part 2: General protection requirements (this Standard)
3007.3	Part 3: General requirements for equipment and ancillaries
3007.4	Part 4: Additional requirements for specific applications
3007.5	Part 5: Operating requirements

The object of the AS 3007 series is to specify requirements for the installation and operation of electrical apparatus and systems in open-cut mines, quarries, stockpiles and similar installations to provide for the safety of persons, livestock and property.

AS 3007.1 outlines the scope of the AS 3007 series and provides definitions for some of the terms used. AS 3007.2 (this Standard) specifies measures which are required for protection against electric shock in normal service from direct contact with live parts, for protection against electric shock from parts which may become live in the event of a fault (indirect contact), and for protection against the effects of overcurrent resulting from overload or short-circuit conditions. AS 3007.3 prescribes general requirements for equipment and ancillaries associated with the electrical installation. AS 3007.4 sets out the requirements which are specific to particular installations, together with exemptions from the general requirements of AS 3007.2 and 3, which apply for such installations. AS 3007.5 sets out the normal operating procedures which should be carried out to ensure the safety of personnel.

The AS 3007 series recognizes several types of power supply system and specifies the protective measures which are necessary for each system. Requirements for protection of persons from indirect contact are based on the concept of permissible voltage versus time limits, which take into account the pathophysiological effects of electric current passing through the human body, typical industry conditions, and the probability of persons being in contact with the plant.

The terms ‘normative’ and ‘informative’ are used to define the application of the appendix to which they apply. A normative appendix is an integral part of a standard, whereas an informative appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

Electrical installations—Surface mines and associated processing plant**Part 2: General protection requirements**

SECTION 1 SCOPE AND REFERENCED DOCUMENTS

1.1 SCOPE

This Standard prescribes general protection requirements for electrical installations within the scope of AS 3007.1. It outlines the measures which are required for protection against electric shock in normal service from direct contact with live parts; for protection against electric shock from parts which may become live in the event of a fault (indirect contact); and for protection against the effects of overcurrent resulting from overload or short-circuit conditions.

1.2 REFERENCED DOCUMENTS

The following standards are referred to in this Standard:

AS

- | | |
|---------|---|
| 1243 | Voltage transformers for measurement and protection |
| 1824 | Insulation co-ordination |
| 1824.1 | Part 1: Definitions, principles and rules |
| 1824.2 | Part 2: Application guide |
| 3007 | Electrical installations—Surface mines and associated processing plant |
| 3007.1 | Part 1: Scope and definitions |
| 3007.4 | Part 4: Additional requirements for specific applications |
| 4436 | Guide for the selection of insulators in respect of polluted conditions |
| 60044 | Instrument transformers |
| 60044.1 | Part 1: Current transformers |
| 60529 | Degrees of protection provided by enclosures (IP Code) equipment |

AS/NZS

- | | |
|-----------|---|
| 60269 | Low-voltage fuses |
| 60269.2.0 | Part 2.0: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) |
| 60269.2.1 | Part 2.1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)—Sections I to V: Examples of types of standardized fuses |

IEC

- | | |
|------------|--|
| 60364 | Electrical installations of buildings |
| 60364-1 | Part 1: Fundamental principles, assessment of general characteristics, definitions |
| 60364-4-41 | Part 4-41: Protection for safety—Protection against electric shock |

SECTION 2 PROTECTION AGAINST DIRECT CONTACT

2.1 INTRODUCTION

In this Section, the requirements for protection against direct contact (protection against electric shock in normal service) are described for all installations with voltages up to and including 1000 V and with those above 1000 V. The requirements for installations for voltages up to 1000 V are taken over essentially from IEC 60364, as applicable.

2.2 GENERAL REQUIREMENTS

2.2.1 General

Except as provided in Clause 2.2.2, protection against direct contact shall be provided by compliance with the requirements contained in Clause 2.7 and in one of the Clauses 2.3, 2.4, 2.5 or 2.6.

2.2.2 Exceptions to the general requirements

- (a) *Limitation of voltage* Protection against direct contact is deemed to be ensured where SELV or FELV is used in accordance with the requirements of IEC 60364-4-41.
- (b) *Limitation of discharge of energy* Protection against direct contact is deemed to be ensured where the energy available from the supply source is limited to a safe value.
- (c) *Neutral and protective conductors* Protection against direct contact for neutral and protective conductors is deemed to be ensured when such conductors are installed in accordance with the applicable clauses (see Clauses 3.2.1, 3.4.6, 3.5.2 and 3.6.3).

2.3 COMPLETE PROTECTION BY MEANS OF BARRIERS OR ENCLOSURES

2.3.1 General

Barriers or enclosures are intended to prevent contact of persons or livestock with live parts of the electrical installation.

The minimum clearance distances in air between field-installed bare conductors and between such conductors and earthed parts (such as barriers and enclosures) shall be in accordance with Table 1. The clearance distances specified need not apply within electrical apparatus, wiring devices or manufactured assemblies.

The clearance distances in Table 1 have been derived from Appendix D of AS 1824.2 based on the most unfavourable conditions, viz. 'rod-structure' electrode configuration and highest category of impulse withstand voltage. Smaller clearance distances than those specified in Table 1 may be adopted—

- (a) where it is known that the lightning exposure level is low; or
- (b) where surge protection limits impulse voltages to lower values than specified in Appendix D of AS 1824.2.

Appropriate guidance may be obtained by reference to AS 1824.1 and AS 1824.2.

For equipment with a designed impulse withstand voltage, equipment dimensions may result in clearances of less than those in Table 1 at the conductor terminations; consequently, conductors in the connection zone may need to be insulated.

Where the conductor under consideration is immediately adjacent to a conductor of a higher voltage, the clearance distance applicable to the higher voltage shall apply between the conductors.

Constructional or environmental conditions such as conductor swing due to wind or short circuit, construction tolerances, the likelihood of snow or ice, may necessitate the use of clearance distances in excess of those specified in Table 1.

The creepage distances between field-installed live conductors and earthed parts, such as barriers and enclosures, shall be not less than the value specified in Table 2 appropriate to the degree of pollution expected.

The creepage distances given in Table 2 shall be multiplied by the ratio U phase-to-phase/ U phase-to-earth ($\sqrt{3}$ for a three-phase system) for the following cases:

- (i) Where IT systems are used.
- (ii) Where insulators are used between phases, e.g. phase spacers.

TABLE 1
MINIMUM CLEARANCES BETWEEN FIELD
INSTALLED BARE CONDUCTORS AND
BETWEEN SUCH CONDUCTORS AND EARTHED PARTS

System voltage		Minimum clearance distance
Nominal voltage kV, r.m.s.	Highest voltage kV, r.m.s.	
1.1	1.2	40
3.3	3.6	60
6.6	7.2	90
11	12	120
22	24	220
33	36	320
66	72.5	630
110	123	1100
150	170	1500
220	245	2100

2.3.2 Protection from live parts

All live parts shall be inside enclosures or behind barriers providing at least the degrees of protection in accordance with Table 3.

2.3.3 Strength and stability of barriers and enclosures

Barriers and enclosures shall be firmly secured in place. Taking into account their nature, size and arrangement, they shall have sufficient stability and durability to resist the strains and stresses likely to occur in normal service.

TABLE 2
RELATION BETWEEN DEGREES OF POLLUTION
AND CREEPAGE DISTANCES

Pollution degree	Significant characteristics (see Notes 1, 2 and 3)	Minimum specific nominal creepage distance between phase and earth (see Notes 4 and 5) mm/phase-to-phase kV
I Light	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.	16
II Medium	Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.	20
III Heavy	Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation.	25
IV Very heavy	The pollution generates persistent conductivity caused, for instance, by conductive dust or by rain or snow.	31

NOTES:

- 1 It should be realized that any tabulation of pollution characteristics cannot cover the complete range of pollution possible and hence it may be necessary, in particular cases, to increase creepage distances for the special pollution encountered. Consideration should also be given to the possibility of varying pollution levels due to seasonal changes and exceptional climatic conditions.
- 2 Except for Pollution degree I, condensation of water must always be considered arising from either—
 - (a) the temperature of the insulation surface falling below the dew-point of the surrounding air; or
 - (b) hygroscopic dust or salt contamination causing moisture to deposit at low relative humidity.
- 3 Conductive dusts may originate from the environment (e.g. material being mined or processed), or from within an enclosure (e.g. dust from carbon or metallic brushes).
- 4 The creepage distances in Table 2 have been derived from test data for normal porcelain and glass insulators. For more detailed guidance on the selection of insulators, see AS 4436.
- 5 The voltage corresponds to the system highest voltage (phase-to-phase).

2.3.4 Access to installation

Where it is necessary to make provision for the removal of barriers, the opening of enclosures, or the withdrawal of parts of enclosures (doors, casings, lids, covers and the like), this shall be in accordance with one of the following items:

- (a) *Key or tool* Removal, opening or withdrawal shall necessitate the use of a key or tool.
- (b) *Interlocking device* An interlocking device shall be provided so that removal, opening or withdrawal without the use of a key or tool necessitates previous switching off of all live parts behind the barrier or enclosure which might be touched accidentally. Restoration of supply shall be possible only after replacement or reclosure of the barriers or enclosures.

Provision shall be made for the discharge of stored energy in capacitors or cable systems where they are likely to give rise to the risk of electric shock.

- (c) *Automatic disconnection* Removal, opening or withdrawal without the use of a key or tool shall initiate automatic switching off before live parts behind the barrier or enclosure can be touched accidentally. Restoration of supply shall be possible only after replacement or reclosure of the barriers or enclosures.

- (d) *Internal interposing screen* An internal interposing screen shall be positioned so that none of the live parts can be touched while the barrier or enclosure is removed. The screen shall meet the requirements in Clause 2.3.2 (except as provided in Item (e) below) and Clause 2.3.3; it may be either firmly secured in place or slid into place at the moment the barrier or enclosure is removed. It shall not be removable except by means of a tool or key.

Such a screen may be a protective shutter which, in the case of a disconnectable assembly, slides into place in front of the feed line contacts.

- (e) *Access to fuses or lamps* Where any parts behind the barrier or enclosure need occasional handling (such as the replacement of a lamp or of a fuse-link) the removal, opening or withdrawal without the use of a key or tool and without switching off shall be possible only if the following conditions are simultaneously fulfilled:

- (i) A second barrier shall be provided inside that barrier or enclosure so as to prevent persons from coming accidentally into contact with live parts not protected by another protective measure.

However, this second barrier need not prevent persons from coming intentionally into contact with live parts by bypassing it with the hand. Nevertheless, it shall not be possible to remove the second barrier except through the use of a key or tool.

- (ii) The voltage of all live parts behind the second barrier shall not exceed 1000 V.

2.4 COMPLETE PROTECTION BY INSULATION OF LIVE PARTS

2.4.1 General

The insulation is intended to prevent any contact of persons or livestock with live parts of the electrical installation.

2.4.2 Degree of insulation

Live parts shall be completely covered with insulation which can be removed only by destruction.

2.4.3 Type of insulation

The insulation shall comply with the relevant requirements for the electrical equipment.

2.5 PARTIAL PROTECTION BY PLACING LIVE PARTS OUT OF REACH

Placing out of reach is designed to prevent unintentional contact with live parts (see Table 3).

Protection against shock in normal service by placing live parts so as to be out of reach from all directions is considered to be ensured if no simultaneously accessible live parts are at distances less than the minimum stated in Table 4, for the appropriate voltage.

If the extent of locations normally occupied by persons is limited by an obstacle which affords a degree of protection less than IP2X (see AS 60529), the distance specified shall extend from this obstacle.

Examples of such obstacles are handrails, open mesh screens and partial protective barriers.

2.6 PARTIAL PROTECTION BY THE PROVISION OF OBSTACLES

Partial protection by the interposition of obstacles is designed to prevent unintentional contact with live parts, but not intentional contact such as may result when a person deliberately tries to circumvent the obstacles with his hand (see Table 3).

Protection against electric shock in normal service by the provision of obstacles is considered to be ensured if such obstacles prevent either—

- (a) an unintentional bodily approach to live parts, this being achieved by, for example, protective barriers, handrails or similar partitions; or
- (b) an unintentional contact with live parts when live equipment is handled during operation, for example, by the provision of screens or by protective handles on fuses.

The obstacle may be removable without the use of a tool or key, but it shall be secured in place in such a manner as to prevent involuntary removal.

2.7 MINIMUM DISTANCES TO BE OBSERVED IN OPERATING AND MAINTENANCE GANGWAYS FOR INDOOR INSTALLATIONS

2.7.1 General

Minimum distances are intended to provide protection against direct contact while permitting access to and from gangways for operating and maintenance purposes.

2.7.2 Minimum distances

The minimum distances to be observed in operating and maintenance gangways shall be in accordance with Table 4. (Sec also Clause 2.7.3.)

2.7.3 Minimum width

If it is not practicable to achieve the specified clearances, values less than the widths shown in Table 4 may be used provided the degree of protection is equal to or greater than IP4X. In such cases the minimum width may be reduced to 375 mm for restricted gangways for lengths up to 2 m.

2.7.4 Access

Access to and from maintenance and operating gangways shall be in accordance with the following:

- (a) *For voltages up to and including 1000 V* For installations having a nominal voltage of not more than 1000 V, operating and maintenance gangways of a length exceeding 20 m shall be accessible from both ends. For gangways shorter than 20 m but exceeding 6 m, access from both ends is recommended.
- (b) *For voltages above 1000 V* For installations having a nominal voltage greater than 1000 V, operating and maintenance gangways of a length exceeding 6 m shall be accessible from both ends.

For very long gangways, additional access ways are recommended.

- (c) *Access doors* It is recommended that access doors to gangways should—
 - (i) swing outwards; and
 - (ii) open without the use of hands; and
 - (iii) have a free space outside the door of at least 1.5 m² with width and length of approximately equal dimensions.

NOTE: Pressurized rooms and other special rooms may require doors to swing inwards.

2.8 MINIMUM CLEARANCES FOR OUTDOOR INSTALLATIONS

2.8.1 Application

This clause specifies minimum clearances for outdoor installations from field-installed bare live parts to—

- (a) boundary fences enclosing such live parts (see Clause 2.8.2); and

- (b) areas within the boundary fence to which persons normally have access (see Clause 2.8.3); and
- (c) barriers installed within the boundary fence to restrict the access of persons to the live parts (see Clause 2.8.4).

The minimum clearances are based on persons with a reach of 2440 mm from ground and may not prevent a person from reaching into the flashover area.

Where the live parts consist of overhead lines precautions shall be taken to ensure that minimum clearance distances are not reduced by conductor sag, wind forces, short-circuit forces, or insulator rupture when using multiple parallel insulator strings.

2.8.2 Minimum clearances to boundary fences

Boundary fences enclosing bare live parts shall be of a height of not less than 1800 mm. The boundary fence shall be so located that the live parts are outside the zone prescribed by Figure 1 and Table 5, taking into account the type of fencing used.

NOTE: The minimum height of the boundary fence and the minimum clearances from live parts are based on considerations of protection against direct contact. Additional measures may be necessary to restrict access.

2.8.3 Minimum clearances from accessible areas

Within areas that are accessible to persons such as permanent walkways, platforms or other surfaces on which persons may normally stand, bare live conductors shall be installed either—

- (a) at a height above the area concerned of not less than the appropriate value specified in Column 3 of Table 5, or
- (b) behind barriers which restrict access of persons to the live parts in accordance with Clause 2.8.4.

In areas where heavy snow is experienced, the clearances required by (a) shall be increased by the expected compacted depth of snow accumulation.

NOTE: See Figure 2 for an illustration of the requirement of (a) above.

2.8.4 Minimum clearances to barriers

Where bare live parts within the boundary fence are at a height which is less than the minimum value required by Clause 2.8.3 (a), barriers shall be installed to restrict the access of persons to such live parts. The type, height and location of the barrier shall be such that the live parts are outside the relevant zone prescribed in Figures 3 or 4 and Table 5. The height of the barrier shall in any event be not less than 1100 mm.

TABLE 3
MINIMUM PROTECTION AGAINST DIRECT CONTACT
BY BARRIERS OR ENCLOSURES
(APPLICABLE TO LIVE PARTS ONLY)

Voltage band (a.c.)	Within operating areas	Within electrical operating areas	Within closed electrical operating areas
$50 < U \leq 1000 \text{ V}$	Complete protection IP2X or IP4X for top surfaces or barriers or enclosures which are readily accessible. This applies in particular to those parts of enclosures which might serve as a standing surface. The use of floor plug and socket connectors is not precluded but such sockets shall be covered when not in use.	Partial protection IP1X if $U \leq 600 \text{ V}$ or no simultaneously accessible parts at different voltages are situated within arm's reach. No protection IP0X if live parts are placed out of reach or obstacles, e.g. protective barriers or handrails, are interposed (see Clauses 2.5 and 2.6) Complete protection IP2X if $U < 600 \text{ V}$ or IP4X if $U > 600 \text{ V}$ for top surfaces or barriers or enclosures which are readily accessible. This applies in particular to those parts of enclosures which might serve as a standing surface. The use of floor plug and socket connectors is not precluded but such sockets shall be covered when not in use.	No protection IP0X if— (a) $U \leq 600 \text{ V}$, or (b) live parts are placed out of reach or obstacles, e.g. protective barriers or handrails, are interposed (see Clauses 2.5 and 2.6) Partial protection IP1X if $U > 600 \text{ V}$ or no simultaneously accessible parts at different voltages are situated within arm's reach. The use of floor plug and socket connectors is not precluded but such sockets shall be covered when not in use.
$U > 1000 \text{ V}$	Complete protection IP5X within arm's reach. Partial protection IP2X beyond arm's reach.	Complete protection IP5X within arm's reach. Partial protection IP1X beyond arm's reach. No protection IP0X if live parts are placed out of reach or obstacles, e.g. protective barriers or handrails, are interposed (see Clauses 2.5 and 2.6).	Partial protection IP1X. No protection IP0X if live parts are placed out of reach or obstacles, e.g. protective barriers or handrails, are interposed (see Clauses 2.5 and 2.6).

U = the nominal voltage of the installation between lines.

NOTES:

- See AS 60529 for details of the IP classifications. The IP classifications specified in Table 3 are only intended to specify the degree of protection required against contact with live parts. Additional protection may be required for protection from contact with moving parts or to prevent ingress of solid foreign bodies, such as dust.
- For d.c. voltages, the voltage bands in Table 3 may be increased in the ratio of 1:1.5, namely up to 1500 V and above.

TABLE 4

MINIMUM DISTANCES TO BE OBSERVED IN OPERATING AND MAINTENANCE GANGWAYS FOR INDOOR INSTALLATIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
System voltage		Minimum distances, mm														
		Complete protection as required in Table 3					Partial protection as required in Table 3									
Nominal voltage	Highest voltage	Height below barriers or enclosures	Width between obstacles or switch handles and wall		Width between obstacles or switch handles		Live parts on one side with IP1X protection					Live parts on both sides with IP1X protection				
			Maint.	Opn	Maint.	Opn	Height of live parts above floor level*	Width between wall and live parts		Free passage in front of controls		Height of live parts above floor level*	Width between live parts and conductors on both sides		Free passage between controls	
kV, r.m.s.	kV, r.m.s.							Maint.	Opn	Maint.	Opn		Maint.	Opn	Maint.	Opn
1.1	1.2	2000	700	700	700	700	2300	1000	1000	700	700	2300	1000	1200	900	1100
3.3	3.6	2000	800	1000	1000	1200	2500	1000	1165	800	1000	2500	1330	1530	1000	1200
6.6	7.2	2000	800	1000	1000	1200	2500	1000	1190	800	1000	2500	1380	1580	1000	1200
11	12	2000	800	1000	1000	1200	2500	1015	1215	800	1000	2500	1430	1630	1000	1200
22	24	2000	800	1000	1000	1200	2500	1115	1315	800	1000	2500	1630	1830	1000	1200
33	36	2000	800	1000	1000	1200	2500	1225	1425	800	1000	2500	1850	2050	1000	1200
66	72.5	2000	800	1000	1000	1200	2800	1600	1800	800	1000	2800	2600	2800	1000	1200
110	123	2000	800	1000	1000	1200	3250	2000	2200	800	1000	3250	3400	3600	1000	1200

* Where live parts are installed at or above the minimum height specified, no additional protection is required.

NOTE: Minimum distances for voltages above 110 kV are under consideration.

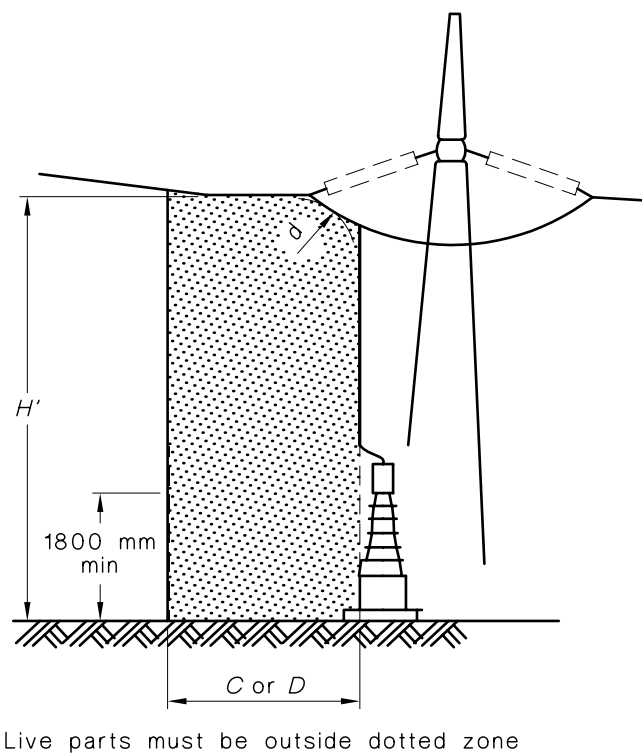
Maint. = maintenance.

Opn = operation.

TABLE 5
MINIMUM CLEARANCES FOR FIELD-INSTALLED BARE LIVE PARTS IN OUTDOOR INSTALLATIONS

1	2	3	4	5	6	7
System voltage		<i>H</i> Minimum height of live parts above accessible areas (Figures 2, 3 and 4) <i>H</i> = <i>d</i> + 2440 mm	Horizontal clearances from live parts to barriers within the installation (Figures 3 and 4)		Horizontal clearances from live parts to outer fencing (Figure 1)	
Nominal voltage kV, r.m.s	Highest voltage kV, r.m.s		<i>A</i> For solid barriers* with a minimum height of 1800 mm <i>A</i> = <i>d</i> mm	<i>B</i> For wire mesh or screen barriers with a minimum height of 1800 mm <i>B</i> = <i>d</i> + 100 mm	<i>C</i> For solid fences* with a minimum height of 1800 mm <i>C</i> = <i>d</i> + 1000 mm	<i>D</i> For wire mesh or screen fences with a minimum height of 1800 mm <i>D</i> = <i>d</i> + 1500 mm
3.3	3.6	2500	60	160	1060	1560
6.6	7.2	2530	90	190	1090	1590
11	12	2560	120	220	1120	1620
22	24	2660	220	320	1220	1720
33	36	2760	320	420	1320	1820
66	72.5	3070	630	730	1630	2130
110	123	3540	1100	1200	2100	2600
150	170	3740	1300	1400	2300	2800
220	245	4540	2100	2200	3100	3600

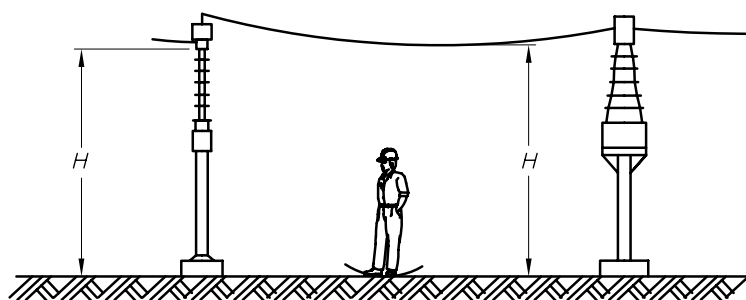
* For solid barriers and fences, the horizontal clearances shall be measured from the face nearest to the live parts.
d = The applicable minimum clearance distance specified in Table 1.
NOTE: The minimum clearances specified in Table 5 assume the lightning impulse withstand voltages given in Tables 4.1 and 5.1 of AS 1824.2.



LEGEND:

- H' = minimum clearance for overhead power lines
 C, D = minimum clearance required by Columns 6 and 7 respectively in Table 5
 d = minimum clearance specified in Table 1

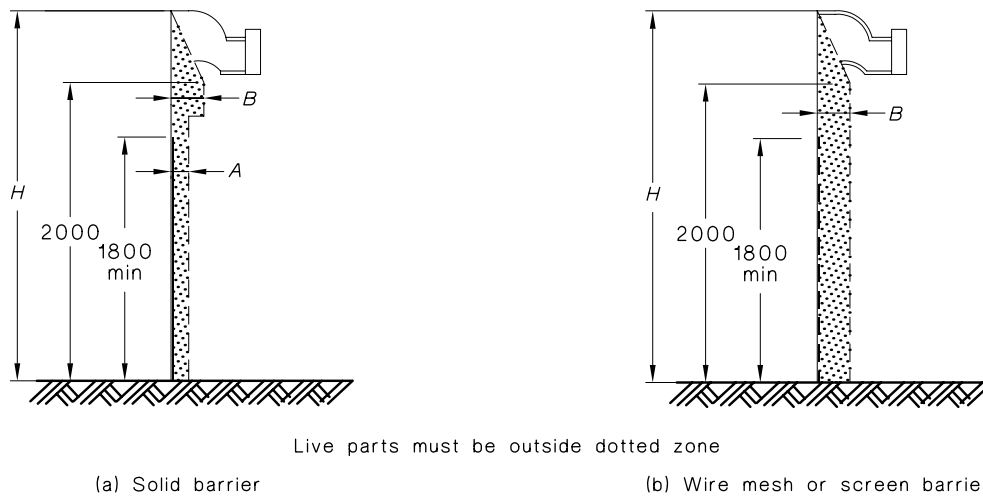
FIGURE 1 CLEARANCES FROM LIVE PARTS AT THE OUTER BOUNDARY FENCE



LEGEND:

- H = minimum clearance of live parts above accessible areas required by Column 3 of Table 5. The clearance may need to be increased to take into account the conditions referred to in Clauses 2.8.1 and 2.8.3

FIGURE 2 MINIMUM HEIGHT OF LIVE PARTS ABOVE ACCESSIBLE AREAS IN OUTDOOR INSTALLATIONS



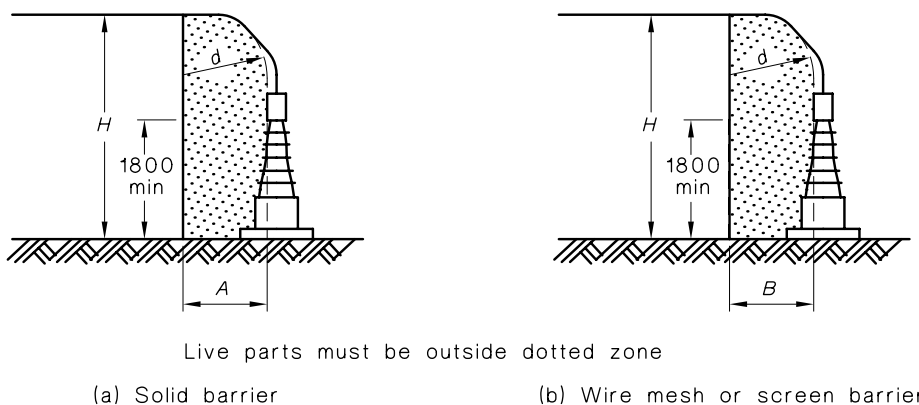
LEGEND:

H = minimum clearance of live parts above accessible areas required by Column 3 of Table 5. The clearance may need to be increased to take into account the conditions referred to in Clauses 2.8.1 and 2.8.3

A & B = minimum clearances required by Columns 4 and 5 respectively in Table 5

DIMENSIONS IN MILLIMETRES

FIGURE 3 CLEARANCES FROM LIVE PARTS FOR OUTDOOR INSTALLATIONS WITH VOLTAGES UP TO AND INCLUDING 30 kV



LEGEND:

H = minimum clearance of live parts above accessible areas required by Column 3 of Table 5. The clearance may need to be increased to take into account the conditions referred to in Clauses 2.8.1 and 2.8.3

A & B = minimum clearances required by Columns 4 and 5 respectively in Table 5

d = minimum clearance specified in Table 1

DIMENSIONS IN MILLIMETRES

FIGURE 4 CLEARANCES FROM LIVE PARTS FOR OUTDOOR INSTALLATIONS WITH VOLTAGE ABOVE 30 kV

SECTION 3 PROTECTION AGAINST INDIRECT CONTACT — A . C .

3.1 INTRODUCTION

The protective measures specified are intended to prevent a touch voltage from persisting for such a length of time after the occurrence of a fault that danger to persons or livestock could arise. The measures have been developed from experience and from consideration of the probability of persons or livestock being in an indirect contact situation and of the nature of the plant involved in the fault situation.

Protection shall be afforded in the case of an earth fault by either automatic disconnection of supply within specified conditions of voltage and time, or limitation of indirect contact voltage below the conventional voltage limit at which disconnection of the supply is not required.

In this Section, the protective measures against indirect contact with a protective conductor for all installations with voltages up to and including 1000 V and those above 1000 V are described. The requirements for installations for voltages up to and including 1000 V are taken over essentially from IEC 60364 as applicable.

3.2 GENERAL

3.2.1 Use of protective conductors

All exposed conductive parts shall be connected to a protective conductor except—

- (a) where any of the protective measures described in Clause 3.2.4 are used, or
- (b) where specifically exempted in Clause 3.2.8.

The earthable point of the power system, if earthed, shall be connected to an earth electrode near the respective power transformer or generator.

Where a protective conductor is required to be separately earthed, the connection to earth shall be made remote from the power system earth electrode. If good earthing facilities or points are available, the protective conductor shall preferably be connected to them at as many places as possible. Multiple earthing at points distributed as evenly as possible may be necessary in order to ensure that the potential of the protective conductor remains as close as possible to the earth potential in case of fault.

The protective conductor may be a bare conductor, that is, without a covering of insulating material.

3.2.2 Automatic disconnection of supply

A protective device shall automatically disconnect the supply to that part of the electrical installation protected by the device, if, following a fault in that part, the touch voltage cannot be maintained at any point of the installation at a value equal to or less than the conventional voltage limit U_L , where $U_L = 50$ V (r.m.s.).*

NOTE: In certain configurations of IT systems (see Clause 3.6), automatic disconnection may not be required on the occurrence of a first fault.

* It may be necessary to specify lower values for certain applications or locations, for example, wet and conductive environments.