COMMUNICATIONS
ALLIANCE LTD

AUSTRALIAN STANDARD

AS/CA S009:2013

Installation requirements for customer cabling (Wiring rules)

Australian Standard – *Installation requirements for customer cabling (Wiring Rules)*

This Standard was issued in draft form for public comment as DR AS/CA S009:2012

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FOREWORD

General

This Standard was prepared by the CECRP/WC18 : *Cabling Standards* Working Committee and most recently revised by the WC35 : *Customer Cabling Installation Revision* Working Committee. It is one of a series of Telecommunication Standards developed under the Memorandum of Understanding between the Australian Communications Authority (ACA) and the Australian Communications Industry Forum (ACIF).

Note: On 1 July 2005 the ACA became the Australian Communications and Media Authority (ACMA) and the Memorandum of Understanding continues in effect as if the reference to the ACA were a reference to the ACMA.

Communications Alliance was formed in 2006 and continues the functions previously fulfilled by ACIF.

This Standard is a revision of AS/ACIF S009:2006 *Installation requirements for customer cabling (Wiring Rules)*.

This Standard is the result of a consensus among representatives on the Communications Alliance Working Committee to produce it as an Australian Standard.

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The Project Manager
Customer Equipment and Cable Reference Panel
Communications Alliance
PO Box 444
Milsons Point NSW 1565

Regulatory notice

Attention is drawn to the fact that cabling work must be performed or supervised by a person with the appropriate cabling provider registration. This requirement is determined by legislation and subordinate regulatory instruments administered by the Australian Communications and Media Authority (ACMA).

This Standard comes into force as at 1 July 2013. Until that date AS/ACIF S009:2006 remains in force.

The ACMA is a Commonwealth Authority with statutory powers to impose requirements on cabling providers concerning customer cabling.

Details on cabling regulations can be obtained from the ACMA website at www.acma.gov.au or by contacting the ACMA at:

Australian Communications and Media Authority
PO Box 13112
Law Courts PO
Melbourne VIC 8010
Australia

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Introduction

This introduction for the AS/CA S009:2013 ***Installation requirements for customer cabling (Wiring Rules)*** Standard is not an authoritative section of this Standard and is only provided as guidance for the user of the Standard to outline its objectives, the factors that have been taken into account in its development and to list the principal differences between the new and the previous edition.

The reader is directed to the Clauses of this Standard for the specific requirements and to the Australian Communications and Media Authority (ACMA) for the applicable Cabling Provider Rules arrangements.

Note: The Cabling Provider Rules can be obtained from the Australian Communications and Media Authority (ACMA) website at www.acma.gov.au.

The objective of this Standard is to set out minimal requirements that may ensure the safety and integrity of a cabling installation and of the telecommunications network to which it is, or will be, connected, and to provide additional guidance for compliance with these requirements.

The objective of this revision is to update requirements to accommodate regulatory and technological changes and feedback from industry.

The principal differences between this edition of AS/CA S009 and the previous edition are:

(a) Scope (Clause 1.1) amended to exclude radio and TV antenna cabling and any cabling on the carrier's side of the network boundary, e.g. lead-in cabling. All references to 'cable TV' or 'pay TV' deleted

(b) References (Section 2) updated to the current editions

(c) Some definitions and abbreviations (section 3) added, some amended

(d) Assemblies of sockets used for connection of no more than 6 telecommunications outlet cables has been excluded from the 'distributor' and 'patch panel' definitions to allow basic NBN installations to be done by 'Restricted' cabling providers.

(e) Standards listed in Clause 4.5 relocated to Clause 5.5.2 and new standards added to the list

(f) Clause 4.6 rephrased and competency standards that will be mandatory from 1 July 2014 removed from the list

(g) Manufacturer's instructions (Clause 5.2) expanded to include equipment instructions

(h) Cabling jointing methods (Clause 5.8.1) amended for improved clarity

(i) Clause 5.15 added prohibiting connection of plugs to fixed or concealed cabling except in certain circumstances

(j) Requirements for hazardous areas (explosive atmosphere) expanded (Clause 7.1)

(k) Requirements for separation from non-electrical hazardous services (Clause 9.2.2) amended, Table 2 added

(l) Optical fibre systems requirements expanded (Clause 11.1) to include optical interface cleaning/inspection and labelling of panels, enclosures and outlets

(m) Clarification added that an MDF should be located in the same building as the end-user (Clause 13.3)

(n) Reference to a telecommunications outlet (TO) changed to 'socket' where appropriate (Section 15, Appendix C and Appendix J)

(o) Clause 17.3 expanded to specifically address cabling between buildings

(p) Clause 17.6 on external antennas added

(q) Clause 18.1.4 expanded to include conduit and cable entry to pits or access holes and drainage of pits and access holes

(r) Clause 18.3.5 on conduit integrity added, including a new Table 3

(s) Editorial error in Figure I1 corrected

(t) Appendix J expanded to include previous omissions in respect of the relevant legislation and additional explanatory diagrams

(u) Alignment of LV a.c. mains power voltages with AS/NZS 3000, i.e. references to 240 V changed to 230 V and references to 415 V changed to 400 V

(v) a new Figure D4 added for access clearances for floor-mounted MDFs

(w) Appendix L on guidance for domestic installations added

(x) Appendix M on aerial cabling requirements added

(y) General correction of various editorial errors, omissions and ambiguities

WARNING

This Standard includes requirements intended to ensure the safety of customers, cabling providers, carrier staff, and the general public. However, cabling providers are reminded that metallic telecommunications conductors, earth connections, metallic parts, etc. may, at any given time, be at a voltage that exceeds the Telecommunications Network Voltage (TNV) rating of AS/NZS 60950.1. Examples of an overvoltage condition may include:

- **contact with AC mains power through customer equipment failure or cabling faults;**
- **power feeding;**
- **surge currents and induced voltages through power system faults.**

Accordingly, cabling providers working on customer cabling are warned to treat the metallic parts of a telecommunications installation as potentially harmful.

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1 SCOPE

1.1 Application

This Standard applies to the installation and maintenance of fixed or concealed cabling or equipment that is connected, or is intended to be connected, to a telecommunications network, including any cord or cordage, or that part of any cord or cordage, that is connected as fixed or concealed cabling.

This Standard does not apply to—

(a) any electrical power cabling whose primary function is the distribution of AC mains supply, and which is connected to an AC mains supply, but which may also carry telecommunications signals as a secondary function as long as the telecommunications signals originate from the power network or are injected into the power cabling via a compliant interface device;

(b) any cabling used for the connection or distribution of broadcasting services, as defined in the *Broadcasting Services Act 1992*, that are supplied to the end-user by means of transmission through free air to a receiving radio, television or satellite antenna whether or not such cabling is connected to receiving equipment that is connected to a carrier's or carriage service provider's telecommunications network (e.g. via an Ethernet port); and

(c) any cabling on the carrier's side of the network boundary whether or not such cabling is located in customer premises, e.g. lead-in cabling.

Note 1: Cabling described in Item (a) is subject to AS/NZS 3000.

Note 2: Cabling described in Item (b) is effectively exempted from technical regulation under the *Telecommunications Act 1997* and is therefore out of the scope of AS/CA S009.

1.2 Date of effect

This Standard comes into force as at 1 July 2013. Until that date AS/ACIF S009:2006 remains in force.

1.3 Limitations

The requirements in this Standard are generally limited to—

(a) protecting the health and safety of persons; and

(b) protecting the integrity of a telecommunications network or a facility.

However, additional information is provided for guidance.

1.4 Basic aims

This Standard covers design and construction practice sufficient to ensure that—

(a) the installation or normal use of the cabling does not expose carrier personnel, cabling providers, customers or other persons to any danger; and

(b) the installation or normal use of the cabling does not adversely affect the integrity (proper end-to-end functioning) of a telecommunications network.

1.5 Topics

In achievement of its basic aims, this Standard addresses the following matters:

(a) Connection of the installation to the telecommunications network (network boundary).

(b) Protection of the installation from foreseeable physical damage (e.g. impact, weathering, corrosion) or interference from other circuits (e.g. crosstalk, noise).

(c) Mitigation against the effects of earth potential rise and low frequency induction.

(d) Protection of end-users from exposure to hazardous voltages, telecommunications network voltages, radiation hazards or the ingress of dangerous fluids or gases to the building.

(e) Prevention of injury to any person due to the improper installation of such things as catenary supports, pits, access holes or enclosures.

(f) Installation of cabling in hazardous areas (explosive atmospheres).

(g) Protection of carrier personnel, cabling providers and other workers from exposure to site hazards or contact with hazardous services.

(h) Prevention of fire caused by improper installation or use of the cabling, and compliance with the Building Code and Occupational Health and Safety (OH&S) requirements.

(i) Identification of lines and services to minimise the risk of accidental interference, improper use or disconnection of telecommunications network services.

(j) Protection of persons from exposure to earthed cables, equipment or objects (including ground) that may be at a different electric potential.

(k) Protection of end-users from overvoltages caused by atmospheric discharges (e.g. lightning) or power system faults.

(l) Prevention of damage to the earthing system of the electrical installation due to electrolytic corrosion caused by DC Currents in the telecommunications earthing system.

Note: This Standard should be read in conjunction with AS/CA S008 which specifies the requirements for cabling products intended for connection to the customer side of the boundary of a telecommunications network.

2 REFERENCES

2.1 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies.

In the event of a discrepancy between this document and a referenced document, this document takes precedence.

Publication	Title
Australian Standards	
AS 1735.2–2001	Lifts, escalators and moving walks - Passenger and goods lifts - Electric
AS/NZS 1768:2007	Lightning protection
AS/NZS 2053.1:2001	Conduits and fittings for electrical installations - General requirements
AS/NZS 2648.1:1995	Underground marking tape - Non-detectable tape
AS/NZS 3000:2007	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3835.1:2006	Earth potential rise - Protection of telecommunications network users, personnel and plant - Code of practice
AS/NZS 4117:1999	Surge protective devices for telecommunication applications
AS 4262	Telecommunication overvoltages
AS 4262.1–1995	Part 1: Protection of persons
AS 4262.2–1999	Part 2: Protection of equipment
AS 60529-2004	Degrees of protection provided by enclosures (IP Code)
AS/NZS IEC 60825.1:2011	Safety of laser products - Equipment classification and requirements
AS/NZS IEC 60825.2:2011	Safety of laser products - Safety of optical fibre communication systems (OFCS)
AS/NZS 60079.14:2009	Explosive atmospheres - Electrical installations design, selection and erection
AS/NZS 60950.1:2011	Information technology equipment - Safety - General requirements
Communications Alliance Standards	
AS/ACIF S006:2008	Requirements for Customer Equipment, operating in the voiceband, for connection to the non-switched Telecommunications Network
AS/CA S008:2010	Requirements for customer cabling products

Publication	Title
AS/ACIF S043	Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network
AS/ACIF S043.1:2003	Part 1: General
AS/ACIF S043.2:2008	Part 2: Broadband
AS/ACIF S043.3:2008	Part 3: DC, low frequency AC and voiceband
Other references	
HB 101–1997 (CJC 5)	Coordination of power and telecommunications – Low Frequency Induction (LFI): Code of practice for the mitigation of hazardous voltages induced into telecommunication lines
HB 102–1997 (CJC 6)	Coordination of power and telecommunications – Low Frequency Induction (LFI) Note: Application Guide to the LFI Code

2.2 Informative references

The following documents are referred to in this document for guidance.

Publication	Title
Australian Standards	
AS ISO 1000–1998	The international system of units (SI) and its application
AS/NZS 1367:2007	Coaxial cable and optical fibre systems for the RF distribution of analog and digital television and sound signals in single and multiple dwelling installations
AS/NZS 1477:2006	PVC pipes and fittings for pressure applications
AS/NZS 2967:2010	Optical fibre communication cabling systems safety
AS/NZS 3013:2005	Electrical installations – Classification of the fire and mechanical performance of wiring system elements
AS/NZS 3015:2004	Electrical installations – Extra-low voltage d.c. power supplies and service earthing within public telecommunications networks
AS/NZS 3080:2013	Telecommunications installations – Generic cabling for commercial premises (ISO/IEC 11801:2011, MOD)

Publication	Title
AS/NZS 3084:2003	Telecommunications installations – Telecommunications pathways and spaces for commercial buildings (ISO/IEC 18010:2002, MOD)
AS/NZS 3085.1:2004	Telecommunications installations – Administration of communications cabling systems – Basic requirements
AS 3818.11-2009	Timber - Heavy structural products - Visually graded - Utility poles
AS 3996-2006	Access covers and grates
AS/NZS 4065:2010	Concrete utility services poles
AS/NZS 4676:2000	Structural design requirements for utility services poles
AS/NZS 4677:2010	Steel utility services poles
AS/NZS ISO/IEC 14763.2:2013	Telecommunications Installations – Implementation of Customer Premises Cabling - Part 2: Planning and Installation
AS/NZS ISO/IEC 15018:2005	Information technology — Generic cabling for homes
AS/NZS ISO/IEC 24702:2007	Telecommunications installations - Generic cabling - Industrial premises –
AS/NZS ISO/IEC 24764:2012	Generic cabling systems for data centres
AS/NZS 60079.10.1:2009	Explosive atmospheres - Classification of areas - Explosive gas atmospheres
AS/NZS 60079.10.2:2011	Explosive atmospheres - Classification of areas - Combustible dust atmospheres
Communications Alliance Standards	
AS/CA S003:2010	Requirements for Customer Access Equipment for connection to a Telecommunications Network Part 1: General Part 2: Analogue and TDM based technologies Part 3: Packet and cell based technologies
Communications Alliance Industry Codes	
ACIF C524:2004	External Telecommunication Cable Networks
C559.1:2012	Unconditioned Local Loop Service (ULLS) Network Deployment– Part 1: ULLS Performance Requirements

Publication	Title
ITU-T Recommendations	
K.21 (11/2011)	Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents
Other references	
HB 100–2000 (CJC 4)	Coordination of Power and Telecommunications — Manual for the establishment of safe work practices and the minimization of operational interference between power systems and paired cable telecommunications systems

3 DEFINITIONS AND ABBREVIATIONS

For the purposes of this document, the following terms and definitions apply.

If there is any conflict between the definitions used in this document and the definitions used in the *Telecommunications Act 1997* (the *Act*), the *Act* takes precedence.

3.1 Definitions

3.1.1 AC mains supply

an AC power distribution system external to the equipment for supplying power to AC powered equipment.

Note 1: Power sources may include public or private utilities and equivalent sources such as motor-driven generators and uninterruptible power supplies.

Note 2: Adapted from AS/NZS 60950.1.

3.1.2 aerial cabling

cabling that is suspended between poles, buildings or other supporting structures external to a building.

Note: Cabling that is supported along its length by a fixed, solid support such as a beam or girder between buildings is treated as outdoor surface cabling.

3.1.3 bearer

a wire or strengthener that is moulded or bound to the sheath of an aerial cable to provide mechanical support for the cable when suspended between two points.

Note: The bearer may also be known as a 'messenger'.

3.1.4 building

building includes a structure, a caravan and a mobile home.

Note: A structure includes any substantial construction intended to protect persons, animals, vehicles, machinery, tools or equipment from the weather but does not include such things as—

(a) a pole, tower, mast, antenna, fence, retaining wall; or

(b) any freestanding enclosure with a total enclosed volume less than 0.4 cubic metres.

3.1.5 Building Code

the Building Code of Australia (BCA), as varied and enacted in the relevant State or Territory.

3.1.6 building entry point

a point at which a line that is used to provide a carriage service to an end-user in a building meets the outer surface of that building, immediately before entering the building. [*Telecommunications Act 1997*]

3.1.7 cable

an assembly of one or more cable units (e.g. pairs, quads, coaxial tubes, fibres, etc.) in an overall sheath.

Note: The assembly may include such things as a shield, moisture barrier, filling compound, strengthener or bearer.

3.1.8 cable lug

a cable terminal designed to be fastened to the connection point by a threaded screw, bolt or nut and which can only be disconnected by complete removal of the threaded screw, bolt or nut, as applicable.

3.1.9 cabling

cable or cables and any associated works or parts, e.g. pits, poles, conduits, trays, connecting devices, jumpers.

3.1.10 cabling product

a passive device (including any cable or connecting hardware) that is intended for use on the customer side of the network boundary.

3.1.11 cabling provider

a person who performs or supervises cabling work.

3.1.12 Cabling Provider Rules

the *Telecommunications Cabling Provider Rules 2000*, as amended from time to time.

3.1.13 cabling work

(a) the installation of customer cabling for connection to a telecommunications network or to a facility; or

(b) the connection of customer cabling to a telecommunications network or to a facility; or

(c) the maintenance of customer cabling connected to a telecommunications network or to a facility.

[*Telecommunications Act 1997*]

Note: The installation of cord or cordage as fixed or concealed cabling is cabling work and is subject to the requirements of this Standard. Refer to Clause 1.1.

3.1.14 carriage service

a service for carrying communications by means of guided and/or unguided electromagnetic energy. [*Telecommunications Act 1997*]

3.1.15 carriage service provider

a person who supplies, or proposes to supply, a listed carriage service to the public using—

(a) a network unit owned by one or more carriers; or

(b) a network unit in relation to which a nominated carrier declaration is in force

[*Telecommunications Act 1997*]

3.1.16 carrier

the holder of a carrier licence. [*Telecommunications Act 1997*]

3.1.17 catenary support system

a suspension system, typically a wire rope, between two points to provide support for one or more cables or conduits.

3.1.18 Certified Components List (CCL)

a list that was established by AUSTEL and that is published by the ACMA on its website.

Note 1: AUSTEL and the Spectrum Management Agency merged in the creation of the Australian Communications Authority (ACA) on 1 July 1997. The ACA and the Australian Broadcasting Authority (ABA) merged in the creation of the Australian Communications and Media Authority (ACMA) on 1 July 2005.

Note 2: The maintenance of the CCL was discontinued on 1 July 1997, but the CCL remains in force in accordance with ACA TS 102–1998 *Telecommunications Technical Standard (Customer Equipment and Customer Cabling)*.

3.1.19 Communications Earth System (CES)

a system of earthing using common elements to provide for earthing of electrical and communications equipment within a premises.

Note: A CES may be used for protective and functional earthing for telecommunications purposes.

3.1.20 Communications Earth Terminal (CET)

a terminal provided for the purpose of equipotential bonding of the CES or the TRC to the main earthing bar, main earthing conductor or sub-main earthing conductor of the electrical installation.

Note: The CET provides a demarcation between the electrical earthing system and the telecommunications earthing system and was formerly known as a ‘bonding terminal’.

3.1.21 compliant

labelled in accordance with the *Telecommunications Labelling Notice*.

3.1.22 conductive pole or structure

a pole or structure that has a low electrical resistance.

Note: Any metallic, reinforced concrete or fibre-cement pole or structure is deemed to be conductive.

3.1.23 conduit

a tube or pipe that physically accommodates cables.

Note: In this Standard, conduit and pipe have the same meaning (see also 'duct' and 'trunking').

3.1.24 connected

in relation to—

(a) a telecommunications network; or

(b) a facility; or

(c) customer cabling; or

(d) customer equipment;

includes connection otherwise than by means of physical contact, for example, a connection by means of radiocommunication. [*Telecommunications Act 1997*]

3.1.25 cord

a flexible cable with a minimum of one termination (e.g. on a plug).

Note: Cords are used for connection of moveable customer equipment or to afford flexibility, e.g. includes patch cords, fly leads and pigtails.

3.1.26 cordage

a flexible cable that is not fitted with connectors, which may be used in the assembly of cords.

3.1.27 cross-connection

a method of providing for flexible interconnection of cables or cable elements, by means of jumpers or patch cords.

3.1.28 customer

a legal person, including a natural person, a corporation or an organisation, that subscribes to (pays for) the supply of a carriage service.

3.1.29 Customer Access Equipment (CAE)

customer equipment with multiple ports (local or network) that provides access (gateway functions) to a telecommunications network and is capable of switching, storage, processing, conversion, integration, line isolation/coupling or multiplexing of analogue or digital voice or voice equivalent communication. [AS/CA S003]

Note 1: Examples of CAE include, but are not limited to, PABX or key systems, line isolators, ISDN terminal adapters, echo cancellers, interactive voice response systems, voice/packet gateway, integrated access devices and voice messaging systems.

Note 2: CAE is a type of customer equipment but, for the purposes of this Standard, is not considered to be 'terminal equipment'. An operator console, telephone handset or any other peripheral device connected to CAE that may be regularly handled by an end-user is 'terminal equipment'.

Note 3: CAE was formerly referred to as a CSS (customer switching system).

3.1.30 customer cabling

a line that is used, installed ready for use or intended for use on the customer side of the boundary of a telecommunications network. [*Telecommunications Act 1997*]

3.1.31 customer equipment

(a) any equipment, apparatus, tower, mast, antenna or other structure or thing that is used, installed ready for use or intended for use on the customer side of the boundary of a telecommunications network; or

(b) any system (whether software-based or otherwise) that is used, installed ready for use or intended for use on the customer side of the boundary of a telecommunications network;

but not including a line. [*Telecommunications Act 1997*]

Note: See also 'terminal equipment'.

3.1.32 damp location

a location that is continuously or frequently exposed to splashing, spraying, hosing, ice, steam or water condensation but does not include a location exposed to the weather.

Note 1: An example of a damp location may include, but is not limited to, a room or area within a building used for hosing down operations or containing a bath, shower, washing tub, washing basin, spa, swimming pool, sauna, urinal, fountain, water feature or refrigeration.

Note 2: A damp location does not include a domestic kitchen, a domestic WC, a building cavity (including any wall cavity, roof, ceiling space or underfloor space) or floor duct.

3.1.33 designated distributor

a distributor, near the main or first electrical switchboard in the building, designated by the cabling provider as the most appropriate distributor for distribution of a TRC system.

Note 1: The designated distributor may or may not be an MDF.

Note 2: The designated distributor was formerly called the 'nominated distributor'.

3.1.34 differential earth clamp

a device that electrically connects two earthing systems under transient overvoltage conditions, but remains electrically disconnected under normal operating conditions.

Note: A differential earth clamp may also be known as a potential equalisation clamp or PEC.

3.1.35 distributor

a collection of components used to terminate cables which—

(a) provides for cross-connection of cables or cable elements; and

(b) excludes an assembly of sockets used for connection, using cords, of no more than six telecommunications outlet cables to other cables or equipment.

Note 1: Any cable termination equipment used to connect two or more cables or cable elements together without cross-connection (e.g. a cable joint) is not regarded as a distributor for the purposes of this Standard.

Note 2: An assembly of sockets that is not deemed to be a distributor is to be treated as multiple telecommunications outlets for the purposes of this Standard.

3.1.36 duct

a closed passage for housing and protecting cables and conductors.

Note 1: A duct may consist of a conduit, rectangular tubing or construction materials, e.g. a channel formed in concrete with a permanent concrete, metal or plastic covering.

Note 2: See also 'conduit' and 'trunking'.

3.1.37 Earth Potential Rise (EPR)

a rise in voltage of an earthing system and the surrounding soil with respect to a distant earth.

Note 1: EPR is caused primarily when an earth fault on an HV power system produces a current flow through the earthing system of an HV site.

Note 2: See Appendix H for more information about EPR.

3.1.38 electrically conductive element

any internal or external electrically conductive material associated with cable, including, but not limited to, a metallic cable pair, connector, shield, pair separator, bearer, or metallic or carbon fibre strengthener.

3.1.39 enclosure

a housing or covering for cables or equipment providing an appropriate degree of protection against external influences or end-user contact with hazardous voltages, ELV or TNV.

3.1.40 end-user

the customer or any other person that may use a carriage service, e.g. a family member or an employee of the customer.

3.1.41 EPR hazard zone

the area around an earthing system bounded by a contour joining all points of EPR equal to the maximum acceptable voltage below which no special precautions need to be taken to protect telecommunication services, cabling providers and end-users.

Note: See Appendix H for more information.

3.1.42 equipotential bonding

electrical connections intended to bring exposed conductive parts or extraneous conductive parts to the same or approximately the same potential, but not intended to carry current in normal service. [AS/NZS 3000]

Note: In this Standard, the conductor used for equipotential bonding of a telecommunications earthing system to the electrical earthing system is called a 'communications bonding conductor' or 'Telecommunications Bonding Conductor'.

3.1.43 Extra-Low Voltage (ELV)

a voltage not exceeding 42.4 V peak or 60 V d.c. [AS/NZS 60950.1]

Note: This definition differs from the ELV definition contained in AS/NZS 3000, which is more closely aligned to the TNV limits described in Clause 3.1.88, i.e. 120 V d.c. or 70.7 V a.c. peak (50 V a.c. r.m.s.).

3.1.44 ELV circuit

a secondary circuit with voltages between any two conductors of the circuit, and between any one such conductor and earth, not exceeding ELV limits under normal operating conditions, which is separated from hazardous voltage by basic insulation, and which neither meets all of the requirements for an SELV circuit nor meets all of the requirements for a limited current circuit. [AS/NZS 60950.1]

Note 1: Under normal conditions, an ELV circuit is the same as an SELV circuit but without the additional protection provided by SELV under fault conditions.

Note 2: ELV circuits as defined above should not be encountered unless there is a situation where the electric power is not subject to the usual laws and regulations that regulate the supply of electricity (e.g. self-generated power).

3.1.45 facility

(a) any part of the infrastructure of a telecommunications network; or

(b) any line, equipment, apparatus, tower, mast, antenna, tunnel, duct, hole, pit, pole or other structure or thing used, or for use, in or in connection with a telecommunications network. [*Telecommunications Act 1997*]

3.1.46 first socket

the socket of a telecommunications outlet within a customer's building which terminates a carrier's lead-in cabling, i.e. the carrier's lead-in cable does not terminate on an MDF or NTD.

Note 1: The first socket is a defined network boundary point. Refer to Appendix J for more information about the first socket and the network boundary.

Note 2: There may be more than one 'first socket' within a building.

3.1.47 functional earth

the earthing of a point in equipment or in a system which is necessary for a purpose other than safety. [AS/NZS 60950.1]

3.1.48 hazardous area (explosive atmosphere)

an area in which an explosive gas atmosphere or dust/air mixture is present, or may be expected to be present, in dangerous quantities so as to require special precautions for the selection, installation and use of cabling and equipment. Explosive gas atmospheres include flammable vapours (from liquids).

Note 1: Hazardous areas are classified in accordance with AS/NZS 60079.10.1 and AS/NZS 60079.10.2, or in accordance with industry-specific Standards or Codes (e.g. mines or premises where explosives are processed or manufactured).

Note 2: The responsibility for classification of hazardous areas rests with the owner or occupant of the premises.

3.1.49 hazardous service

a service that may cause injury to any person or permanent mechanical or electrical damage to telecommunications plant.

Note: Such services include, but are not limited to, the following—

(a) a pipe containing corrosive or flammable liquid or gas, or any liquid or gas under high pressure;

(b) a pipe of a temperature in excess of 60° C (this does not include a water pipe at a temperature below 60° C);

(c) an LV or HV power cable or HV circuit;

(d) a lightning down-conductor from an air termination; and

(e) any telecommunications cable that carries a hazardous voltage (such cables are normally special application cables).

3.1.50 hazardous voltage

a voltage exceeding ELV limits existing in a circuit which does not meet the requirements for either a limited current circuit or a TNV circuit. [AS/NZS 60950.1]

3.1.51 High Voltage (HV)

a voltage exceeding LV limits. [AS/NZS 3000]

3.1.52 HV circuit

any circuit, whether a primary circuit or a secondary circuit, in which the voltages may exceed LV limits under normal operating conditions.

Note: HV power is also an HV circuit.

3.1.53 HV power

a primary circuit connecting HV AC mains supply to a building, structure or electrical equipment.

Note: An example of HV power is an 11 kV a.c. (or higher) mains power cable feeding a large commercial or multi-residential building.

3.1.54 HV site

any part of an HV power system where power system fault current may flow into the surrounding soil or local earthing system.

Note: Refer to Appendix H for more information about HV power systems.

3.1.55 indoor cabling

customer cabling that is installed inside a building but not underground or exposed to the elements.

Note: Cabling installed within a sheltered structure between buildings, such as a service tunnel, covered walkway or above-ground trunking system, is treated as indoor cabling for certain requirements of this Standard (e.g. cable properties, separation from other services).

3.1.56 isolation device

a device that isolates each of the conductors of a telecommunications service to prevent the transfer of hazardous voltages but allows the service to operate normally.

3.1.57 jumper

a cable unit or cable element without connectors, typically one to four twisted pairs, either unsheathed or sheathed, used to make a cross-connection within a distributor.

3.1.58 lead-in cabling

a carrier's telecommunications network cabling from the carrier's distribution point to the network boundary.

3.1.59 limited current circuit

a circuit which is so designed and protected that, under both normal operating conditions and single fault conditions, the current which can be drawn is not hazardous. [AS/NZS 60950.1]

Note 1: For frequencies not exceeding 1 kHz, the steady-state current drawn through a non-inductive resistor of 2000 Ω ±10% connected between any two parts of a limited current circuit, or between any such part and earth, should not exceed 0.7 mA peak or 2 mA d.c.

Note 2: For frequencies above 1 kHz, the limit of 0.7 mA is multiplied by the value of the frequency in kHz but should not exceed 70 mA peak.

3.1.60 line

a wire, cable, optical fibre, tube, conduit, waveguide or other physical medium used, or for use, as a continuous artificial guide for or in connection with carrying communications by means of guided electromagnetic energy. [*Telecommunications Act 1997*]

3.1.61 Low Frequency Induction (LFI)

the generation of currents in a telecommunications line due to inductive coupling with a power line carrying large unbalanced currents, e.g. during a fault condition on an HV power system.

Note: See Appendix H for more information about LFI.

3.1.62 Low Voltage (LV)

a voltage exceeding ELV limits but not exceeding 1000 V a.c. or 1500 V d.c. [AS/NZS 3000]

3.1.63 LV power

a primary circuit connecting LV AC mains supply to a building, structure or electrical appliance.

Note: An example of LV power is a 230 V a.c. mains power cable within a building.

3.1.64 LV telecommunications circuit

a secondary circuit used for telecommunications purposes whose voltages under normal operating conditions or single fault conditions exceed TNV limits but do not exceed LV limits, and which does not meet the requirements for a limited current circuit.

Note 1: An example of an LV telecommunications circuit is a cable of an emergency warning and intercommunication system (EWIS) typically operating at 100 V a.c.

Note 2: An LV telecommunications circuit is a hazardous service and is required to be separated from other telecommunications circuits, LV power and HV circuits in accordance with this Standard.

3.1.65 Main Distribution Frame (MDF)

a distributor that provides, or is intended to provide, an electrical termination point for a carrier's twisted pair lead-in cabling.

Note 1: The MDF is a defined network boundary point. Refer to Appendix J for more information about the MDF and the network boundary.

Note 2: There may be more than one MDF within a building.

3.1.66 network boundary

the point which is deemed to be the boundary of a carrier's telecommunications network for determining whether cabling or equipment is 'customer cabling' or 'customer equipment' for the purpose of technical regulation under Part 21 of the *Telecommunications Act 1997* (the *Act)*.

Note 1: In accordance with Part 21 of the *Act*, customer cabling and customer equipment is required to comply with the *Telecommunications Labelling Notice* and cabling work is to be performed by a cabling provider.

Note 2: Refer to Appendix J for more information about the network boundary.

3.1.67 Network Termination Device (NTD)

a device meeting the carrier's requirements that is provided by the carrier to establish a demarcation point between the carrier's telecommunications network and customer cabling or customer equipment.

Note 1: An NTD is permanently marked at manufacture with the words 'Network Termination Device' or the letters 'NTD'. Any device that is not so marked is not an NTD.

Note 2: The NTD is a defined network boundary point. Refer to Appendix J for more information about the NTD and the network boundary.

3.1.68 outdoor cabling

customer cabling that is installed external to a building, either underground or exposed to the elements.

Note: Cabling installed within a sheltered structure between buildings, such as a service tunnel, covered walkway or above-ground trunking system, is treated as indoor cabling for certain requirements of this Standard (e.g. cable properties, separation from other services).

3.1.69 patch cord

a flexible cable unit or cable element with connector(s) typically used to establish connections on a patch panel.

3.1.70 patch panel

a distributor designed to accommodate the use of patch cords.

Note 1: An assembly of sockets used for connection of no more than six telecommunications outlet cables is not regarded as a patch panel (or a distributor) for the purposes of this Standard. Refer to 3.1.35.

Note 2: An assembly of sockets that is not deemed to be a patch panel is to be treated as multiple telecommunications outlets for the purposes of this Standard.

3.1.71 plug

a connecting device designed to be inserted in a mating socket.

Note: Plugs are typically used on connecting cords (otherwise known as ‘line cords’ or ‘fly leads’) or patch cords.

3.1.72 port

a socket, adaptor or terminal in equipment for the connection of cabling or other equipment.

3.1.73 power feeding

the transfer of electrical power (usually DC) over a telecommunications line for telecommunications purposes to operate a powered device.

3.1.74 premises

premises includes—

(a) land; and

(b) a group of buildings that is located in the same vicinity.

Note: The premises may contain a building or buildings on a single parcel of land under a single title deed or on two or more parcels of land under a community title deed or separate title deeds.

3.1.75 primary circuit

a circuit which is directly connected to the AC mains supply and includes, for example, the means for connection to the AC mains supply, the primary windings of transformers, motors and other loading devices. [AS/NZS 60950.1]

3.1.76 protective earth

the earthing of a point in equipment or in a system which is necessary for safety purposes.

Note: A protective earth may be provided by means of a protective earthing conductor, an equipotential bonding conductor to the electrical earthing system, a connection to a CES or via bonding of metallic parts to a protective earth connection.

3.1.77 protective earthing conductor

a conductor, other than a main earthing conductor, connecting any portion of the electrical earthing system to the portion of the electrical installation or electrical equipment required to be earthed, or to any other portion of the electrical earthing system. [AS/NZS 3000]

Note: A protective earthing conductor is part of the electrical installation and usually needs to be installed by a licensed electrical worker.

3.1.78 readily accessible

capable of being reached quickly and without climbing over or removing obstructions, mounting upon a chair, or using a movable ladder, and in any case not more than 2 m above the ground, floor or platform. [AS/NZS 3000]

3.1.79 restricted access location

a locked room or enclosure where appropriate signage is used to ensure accidental access is not obtained by persons who are not qualified or authorised to gain access.

3.1.80 Safety Extra-Low Voltage (SELV) circuit

a secondary circuit which is so designed and protected that—

(a) under normal operating conditions, its voltages do not exceed ELV limits at any time; and

(b) under single fault conditions, its voltages do not exceed ELV limits for longer than 200 ms and, in any case, do not exceed 71 V peak or 120 V d.c. at any time.

Note 1: An example of an SELV circuit is a power feed from a battery or a double insulated ‘plug pack’.

Note 2: Adapted from AS/NZS 60950.1.

Note 3: A circuit that meets the above requirements, but which is subject to overvoltages from a telecommunications network or a cable distribution system, is classified as a TNV circuit.

3.1.81 secondary circuit

a circuit which has no direct connection to a primary circuit and derives its power from a transformer, converter or equivalent isolation device, or from a battery. [AS/NZS 60950.1]

3.1.82 socket

a connecting device designed to accept a mating plug.

Note 1: Sockets are typically used in telecommunications outlets and patch panels for connection of equipment cords or patch cords.

Note 2: A socket is sometimes also described as a 'jack'.

3.1.83 Special application cable

a cable that—

(a) is intended to carry steady-state or change-of-state DC signals or AC signals less than 300 Hz between devices;

(b) is a cable intended to carry an industrial data signalling protocol, e.g. RS232 or RS485;

(c) is intended for multidiscipline use; or

(d) is a hybrid cable.

Note: A special application cable may include, but is not limited to—

(a) a cable used for connection of telecommunications power (usually SELV) and associated status and alarm circuits;

(b) a MIMS, EWIS or other fire detection or fire warning system cable;

(c) a security or control system cable; or

(d) a travelling lift or hoist cable.

3.1.84 sub-duct

a conduit installed within a larger conduit, duct or trunking.

Note: Sub-ducting is used to provide physical or electrical separation between a cable installed within the sub-duct and any service installed within the larger conduit, duct or trunking.

3.1.85 Telecommunications Functional Earth Electrode (TFEE)

an electrode that provides a connection to the general mass of earth for functional earthing of telecommunications equipment and cabling.

3.1.86 Telecommunications Labelling Notice

the *Telecommunications Labelling (Customer Equipment and Cabling) Notice 2001*, as amended from time to time, or a notice made in substitution for that notice.

3.1.87 telecommunications network

a system, or series of systems that is operated by a carrier or carriage service provider and which carries, or is capable of carrying, communications by means of guided and/or unguided electromagnetic energy. [*Telecommunications Act 1997*]

3.1.88 Telecommunications Network Voltage (TNV)

a voltage not exceeding—

(a) when telephone ringing signals are not present—

(i) 71 V a.c. peak or 120 V d.c.; or

(ii) if a combination of AC voltage and DC voltage is present, voltages such that the sum of the AC peak voltage divided by 71 and the DC voltage divided by 120 does not exceed 1; and

(b) when telephone ringing signals are present, voltages such that the signal complies with the criteria of either Clause M.2 or Clause M.3 of AS/NZS 60950.1 (the signal is required to be current limited and cadenced).

Note: Adapted from AS/NZS 60950.1.

3.1.89 Telecommunications Network Voltage (TNV) circuit

a secondary circuit to which the accessible area of contact is limited and that is so designed and protected that—

(a) under normal operating conditions, the voltages do not exceed TNV limits; and

(b) under single fault conditions, the voltages do not exceed TNV limits for longer than 200 ms and, in any case, do not exceed 1500 V peak at any time.

Note 1: An example of a TNV circuit is a standard telephone line.

Note 2: Adapted from AS/NZS 60950.1.

Note 3: AS/NZS 60950.1 further classifies TNV circuits as TNV-1, TNV-2 and TNV-3 in accordance with the table below.

Overvoltages from telecommunications networks possible?	Overvoltages from cable distribution systems possible?	Normal operating voltages	
		Within SELV circuit limits	Exceeding SELV circuit limits but within TNV circuit limits
Yes	Yes	TNV-1 circuit	TNV-3 circuit
No	No	SELV circuit	TNV-2 circuit

3.1.90 Telecommunications Outlet (TO)

a fixed connecting device to which an end-user may connect terminal equipment to telecommunications cabling.

Note 1: A telecommunications outlet typically comprises a wall plate, housing or other mounting device containing a socket or sockets.

Note 2: For the purposes of this Standard, a telecommunications outlet includes a device referred to as a 'broadcast outlet' (BO) or 'control outlet' (CO) in any other telecommunications Standard.

3.1.91 Telecommunications Reference Conductor (TRC)

a low noise earthing system providing a zero voltage reference point for telecommunications signalling and other functional purposes which may include equipment reliability.

3.1.92 terminal equipment

peripheral equipment operated by the end-user to access a telecommunications service.

Note 1: An example of terminal equipment is a telephone instrument, headset, fax machine, modem or other equipment that may be handled by the customer.

Note 2: Terminal equipment is a type of customer equipment. Equipment such as a distributor or CAE is also customer equipment but is not terminal equipment.

3.1.93 trunking

a tray or trough system with removable cover(s) along its length for housing and protecting cables.

Note: See also 'conduit' and 'duct'.

3.1.94 underground cabling

cabling that is installed below ground level external to a building.

Note: Cabling installed within an underground structure such as a service tunnel or mine is treated as indoor cabling for certain requirements of this Standard (e.g. cable properties, separation from other services.

3.1.95 wall plate

a face plate normally used on a cavity wall or on a mounting block, to which one or more discrete telecommunications sockets may be fitted for connection of cords by end-users.

3.2 Voltage classifications

The voltage classifications are reproduced below from the Definitions clause for easier comparison.

3.2.1 Extra-Low Voltage (ELV)

a voltage not exceeding 42.4 V peak or 60 V d.c. [AS/NZS 60950.1]

Note: This definition differs from the ELV definition contained in AS/NZS 3000, which is more closely aligned to the TNV limits described in Clause 3.2.2, i.e. 120 V d.c. or 70.7 V a.c. peak (50 V a.c. r.m.s.).

3.2.2 Telecommunications Network Voltage (TNV)

a voltage not exceeding—

(a) when telephone ringing signals are not present—

(i) 71 V a.c. peak or 120 V d.c.; or

(ii) if a combination of AC voltage and DC voltage is present, voltages such that the sum of the AC peak voltage divided by 71 and the DC voltage divided by 120 does not exceed 1; and

(b) when telephone ringing signals are present, voltages such that the signal complies with the criteria of either Clause M.2 or Clause M.3 of AS/NZS 60950.1 (the signal is required to be current limited and cadenced).

Note: Adapted from AS/NZS 60950.1.

3.2.3 Low Voltage (LV)

a voltage exceeding ELV limits but not exceeding 1000 V a.c. or 1500 V d.c. [AS/NZS 3000]

3.2.4 High Voltage (HV)

a voltage exceeding LV limits. [AS/NZS 3000]

3.2.5 hazardous voltage

a voltage exceeding ELV limits existing in a circuit which does not meet the requirements for either a limited current circuit or a TNV circuit. [AS/NZS 60950.1]

3.3 Service classifications

The service classifications are reproduced below from the Definitions clause for easier comparison.

3.3.1 primary circuit

a circuit which is directly connected to the AC mains supply and includes, for example, the means for connection to the AC mains supply, the primary windings of transformers, motors and other loading devices. [AS/NZS 60950.1]

3.3.2 secondary circuit

a circuit which has no direct connection to a primary circuit and derives its power from a transformer, converter or equivalent isolation device, or from a battery. [AS/NZS 60950.1]

3.3.3 Safety Extra-Low Voltage (SELV) circuit

a secondary circuit which is so designed and protected that—

(a) under normal operating conditions, its voltages do not exceed ELV limits at any time; and

(b) under single fault conditions, its voltages do not exceed ELV limits for longer than 200 ms and, in any case, do not exceed 71 V peak or 120 V d.c. at any time.

Note 1: An example of an SELV circuit is a power feed from a battery or a double insulated 'plug pack'.

Note 2: Adapted from AS/NZS 60950.1.

Note 3: A circuit that meets the above requirements, but which is subject to overvoltages from a telecommunications network or a cable distribution system, is classified as a TNV circuit.

3.3.4 ELV circuit

a secondary circuit with voltages between any two conductors of the circuit, and between any one such conductor and earth, not exceeding ELV limits under normal operating conditions, which is separated from hazardous voltage by basic insulation, and which neither meets all of the requirements for an SELV circuit nor meets all of the requirements for a limited current circuit. [AS/NZS 60950.1]

Note 1: Under normal conditions, an ELV circuit is the same as an SELV circuit but without the additional protection provided by SELV under fault conditions.

Note 2: ELV circuits as defined above should not be encountered unless there is a situation where the electric power is not subject to the usual laws and regulations that regulate the supply of electricity (e.g. self-generated power).

3.3.5 TNV circuit

a secondary circuit to which the accessible area of contact is limited and that is so designed and protected that—

(a) under normal operating conditions, the voltages do not exceed TNV limits; and

(b) under single fault conditions, the voltages do not exceed TNV limits for longer than 200 ms and, in any case, do not exceed 1500 V peak at any time.

Note 1: An example of a TNV circuit is a standard telephone line.

Note 2: Adapted from AS/NZS 60950.1.

Note 3: AS/NZS 60950.1 further classifies TNV circuits as TNV-1, TNV-2 and TNV-3 in accordance with the table below.

Overvoltages from telecommunications networks possible?	**Overvoltages from cable distribution systems possible?**	**Normal operating voltages**	
		Within SELV circuit limits	**Exceeding SELV circuit limits but within TNV circuit limits**
Yes	Yes	TNV-1 circuit	TNV-3 circuit
No	No	SELV circuit	TNV-2 circuit

3.3.6 limited current circuit

a circuit which is so designed and protected that, under both normal operating conditions and single fault conditions, the current which can be drawn is not hazardous. [AS/NZS 60950.1]

Note 1: For frequencies not exceeding 1 kHz, the steady-state current drawn through a non-inductive resistor of 2000 Ω ±10% connected between any two parts of a limited current circuit, or between any such part and earth, should not exceed 0.7 mA peak or 2 mA d.c.

Note 2: For frequencies above 1 kHz, the limit of 0.7 mA is multiplied by the value of the frequency in kHz but should not exceed 70 mA peak.

3.3.7 LV telecommunications circuit

a secondary circuit used for telecommunications purposes whose voltages under normal operating conditions or single fault conditions exceed TNV limits but do not exceed LV limits, and which does not meet the requirements for a limited current circuit.

Note 1: An example of an LV telecommunications circuit is a cable of an emergency warning and intercommunication system (EWIS) typically operating at 100 V a.c.

Note 2: An LV telecommunications circuit is a hazardous service and is required to be separated from other telecommunications circuits, LV power and HV circuits in accordance with this Standard.

3.3.8 LV power

a primary circuit connecting LV AC mains supply to a building, structure or electrical appliance.

Note: An example of LV power is a 230 V a.c. mains power cable within a building.

3.3.9 HV power

a primary circuit connecting HV AC mains supply to a building, structure or electrical equipment.

Note: An example of HV power is an 11 kV a.c. (or higher) mains power cable feeding a large commercial or multi-residential building.

3.3.10 HV circuit

any circuit, whether a primary circuit or a secondary circuit, in which the voltages may exceed LV limits under normal operating conditions.

Note: HV power is also an HV circuit.

3.3.11 hazardous service

a service that may cause injury to any person or permanent mechanical or electrical damage to telecommunications plant.

Note: Such services include, but are not limited to, the following:

(a) a pipe containing corrosive or flammable liquid or gas, or any liquid or gas under high pressure;

(b) a pipe of a temperature in excess of 60° C (this does not include a water pipe at a temperature below 60° C);

(c) an LV or HV power cable or HV circuit;

(d) a lightning down-conductor from an air termination; and

(e) any telecommunications cable that carries a hazardous voltage (such cables are normally special application cables).

3.4 Abbreviations

For the purposes of this document, the following abbreviated terms apply.

AC (or a.c.)	Alternating Current (in r.m.s. value unless stated otherwise)
ACIF	Australian Communications Industry Forum
ACMA	Australian Communications and Media Authority
AS	Australian Standard
CA	Communications Alliance
CAE	Customer Access Equipment
CES	Communications Earth System
CET	Communications Earth Terminal
DC (or d.c.)	Direct Current
ELV	Extra-Low Voltage
EPR	Earth Potential Rise
ESAA	Electricity Supply Association of Australia Limited
EWIS	Emergency Warning and Intercommunication System
FTTP	Fibre To The Premises
HV	High Voltage
IEC	International Electrotechnical Commission
IP	International Protection (rating) — sometimes also referred to as 'ingress protection'
IPXn	rated for protection against ingress of water only (n = 0 to 8, according to the degree of protection specified)
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU–T	International Telecommunication Union–Telecommunications Standardization Sector
LFI	Low Frequency Induction
LPG	Liquid Petroleum Gas
LV	Low Voltage
MDF	Main Distribution Frame
MIMS	Mineral Insulated Metal Sheath
NTD	Network Termination Device
NZS	New Zealand Standard
OH&S	Occupational Health and Safety
PABX	Private Automatic Branch eXchange
PVC	PolyVinyl Chloride
SELV	Safety Extra-Low Voltage
SWA	Steel Wire Armouring
SWER	Single Wire Earth Return
TFEE	Telecommunications Functional Earth Electrode

TNV	Telecommunications Network Voltage
TO	Telecommunications Outlet
TRC	Telecommunications Reference Conductor
ULLS	Unconditioned Local Loop Service
UPVC	Unplasticised Poly Vinyl Chloride
UV	UltraViolet (radiation/light), e.g. direct sunlight

4 GENERAL PRINCIPLES

4.1 Objective

The basic objective of this Standard is to—

(a) protect the health and safety of any person who may—

(i) operate;

(ii) work on;

(iii) use services supplied by means of; or

(iv) be otherwise reasonably likely to be affected by the operation of;

a telecommunications network or a facility; and

(b) protect the integrity (proper end-to-end functioning) of a telecommunications network or a facility.

Note: A carrier may disconnect customer equipment or customer cabling that is, or is likely to be, a threat to the health or safety of any person or the integrity of a telecommunications network or a facility.

4.2 Categories of requirements

This Standard contains normative and informative elements. Normative elements (mandatory requirements) are indicated by the words '**shall**' or '**shall not'**.

All other elements are informative.

4.3 Units and symbols

In this Standard the International System (SI) of units and symbols is used in accordance with Australian Standard AS ISO 1000.

4.4 Safety of the Installation

In the performance of any cabling work, in general the cabling provider should ensure that—

(a) end-users are protected from personal electrical contact with any voltage/service other than SELV and from any exposure to laser radiation;

(b) cabling providers are protected from accidental personal electrical contact with LV telecommunications circuits, LV power and HV circuits or accidental exposure to hazardous laser radiation;

(c) cabling providers who are required to access, install or maintain LV telecommunications circuits, are protected from accidental personal electrical contact with LV power and HV circuits;

(d) licensed electrical workers are protected from accidental personal electrical contact with any telecommunications circuits or accidental exposure to hazardous laser radiation; and

(e) the creation of any general safety hazard is avoided, e.g. tripping, falling or bodily impact with a protruding object.

Note 1: End-users are all persons other than persons performing cabling work, including persons who do not actually use the telecommunications service (e.g. casual visitors, cleaners). End-user contact with SELV circuits should be prevented where practicable.

Note 2: Provision is made in this Standard for cabling providers who are suitably qualified or licensed to access LV telecommunications circuits, LV power or HV circuits.

4.5 Network integrity

To ensure electromagnetic compatibility (EMC) and interoperability of the customer cabling with telecommunications networks, and to minimise the risk of crosstalk between telecommunications circuits, in addition to the requirements of this Standard customer cabling should be installed as per Clause 5.5.2.

4.6 Other industry standards or codes

In addition to the mandatory requirements of this Standard, the cabling provider may need to meet the requirements of other standards or codes for the installation or repair of certain types of customer cabling including, but not limited to, the following categories:

(a) Fire detection and alarm systems.

(b) Lifts, escalators and moving walks.

(c) Intruder alarm systems.

(d) Building control and automation systems.

Note: Although compliance with the Standards applicable to Items (a) to (d) is not a requirement of this Standard, regulatory authorities may require compliance and may have additional requirements of national building codes.

5 GENERAL REQUIREMENTS

5.1 Safe and sound practice

Customer cabling **shall** be installed in accordance with principles of safe and sound practice.

Note: An example of practices that are not considered to be safe and sound are those that may inevitably lead to the injury of a cabling provider or any other person, such as—

(a) visible markings that are misleading, e.g. the use of conduit, trunking or ducting marked 'ELECTRICAL' for enclosure of telecommunications cable;

(b) physical protrusions in trafficable areas that a person may bump into or trip over (e.g. due to their location or low visibility);

(c) non-compliance with another industry Standard or Code; or

(d) the improper installation of cabling product that makes it unfit for purpose.

5.2 Manufacturer's instructions

Cable and equipment installed for connection to a carrier's telecommunications network **shall** be installed—

(a) in accordance with the manufacturer's instructions, including, in the case of cable, such things as cable bend radius, tension, cable tie pressure, colour code, etc.; and

(b) in accordance with the instructions of the manufacturer or supplier of any equipment to which the cable or equipment is to be connected.

5.3 Compliance labelling

A cabling provider **shall not** install any customer cabling or customer equipment that is subject to a standard under the *Telecommunications Act 1997* unless it is labelled in accordance with the *Telecommunications Labelling Notice*.

Note: Earthing and telecommunications power distribution components (e.g. earthing/power conductors, earthing bars, busbars, earthing/power terminals, line tap devices, earth electrodes and associated fittings, batteries, fuses and circuit breakers) are not required to comply with the *Telecommunications Labelling Notice*.

5.4 Protection against damage

All parts of an installation **shall** be adequately protected against damage which might reasonably be expected to result from mechanical injury, exposure to weather, water or excessive dampness, corrosive fumes, accumulation of dust, steam, oil, high temperature, or any other circumstance to which they will be exposed under the conditions of their use.

5.5 Proper use

5.5.1 Fit for purpose

A cabling product **shall** be fit for purpose for its intended use.

5.5.2 Other cabling Standards

In addition to the requirements of this Standard, customer cabling should be installed in accordance with the following Standards, where relevant:

(a) Generic cabling for commercial premises — AS/NZS 3080

(b) Pathways and spaces for commercial buildings — AS/NZS 3084

(c) Generic cabling for homes — AS/NZS ISO/IEC 15018

(d) Optical fibre cabling — AS/NZS 60825.1, AS/NZS 60825.2 and AS/NZS 3080

(e) Coaxial cabling — AS/NZS 1367

(f) Telecommunications Installations – Implementation of Customer Premises Cabling - Part 2: Planning and Installation AS/NZS ISO/IEC 14763.2

(g) Generic cabling systems for data centres – AS/NZS ISO/IEC 24764

(h) Telecommunications installations - Generic cabling - Industrial premises – AS/NZS ISO/IEC 24702

Note 1: A carrier's specific requirements may also need to be taken into account, for example—

(a) at the network interface (network boundary);

(b) for coaxial cabling used to supply broadband data services;

(c) for fibre-to-the-premises (FTTP) cabling: or

(d) for the supply of telecommunications network services via satellite or terrestrial radio communications.

Note 2: Refer to Appendix L for guidance on the minimum recommendations for cabling of domestic premises.

5.6 Cables used for LV telecommunications circuits

Any cable used for an LV telecommunications circuit **shall** be—

(a) clearly identifiable at any access point; and

(b) separated from other services and telecommunications circuits in accordance with Section 9.

5.7 Cable with red sheath

Cable with a red sheath should only be used for cabling associated with a fire detection and fire alarm system.

Note: Before altering or disconnecting any cable with a red sheath, the cabling provider should check whether it is associated with a fire detection and fire alarm system and treat it accordingly.

5.8 Cable joints

5.8.1 Jointing method

A joint in a cable **shall** be made by one of the following means:

(a) For all types of cables, using suitable connectors, joiners, compression fittings or other compliant devices.

(b) For twisted pair cable, by one of the methods described in Item (a) or by twisting and soldering of conductors.

(c) For optical fibre cable, by one of the methods described in Item (a) or by fusion or mechanical splicing.

Note 1: Joints in cables may reduce the performance of the cabling system.

Note 2: A joint in cabling of any type may be referred to as a 'splice' in some Standards.

5.8.2 Physical protection of the joint

The cable joint **shall** be suitably constructed, enclosed, positioned, and supported to prevent accidental disturbance and the ingress of dust or moisture.

5.9 Cable terminations

5.9.1 Access to cable terminations

All telecommunications terminations **shall** be enclosed or located to prevent unintentional contact with ELV, TNV, limited current or LV telecommunications circuits by a person who is not doing cabling work.

Note 1: It is permissible to allow end-users (e.g. customers) to come into personal contact with SELV circuits although this should be prevented where practicable.

Note 2: LV telecommunications circuits should only be accessible by suitably qualified persons.

5.9.2 Separation from other services

All telecommunications terminations **shall** be separated from the cable terminations of other services in accordance with Section 9.

5.10 Hazardous voltages

Customer cabling **shall not** be used to carry a hazardous voltage except where otherwise allowed in this Standard.

Note: 'Hazardous voltage' is defined in Section 3.

5.11 Interference to other circuits

Any communications or power feeding circuit carried in customer cabling with any carriage service **shall** comply with the requirements of AS/ACIF S006 or AS/ACIF S043, whichever is applicable, whether or not the communications or power feeding circuit is connected to a telecommunications network.

5.12 Alterations and additions

Every addition to, or alteration of, an existing installation **shall** comply with the relevant requirements of this Standard.

5.13 Tampering or interference with a carrier facility

A carrier's lead-in cabling or network boundary facilities **shall not** be moved, removed or altered without the prior written authorisation of the carrier.

Note: If a carrier publishes a document authorising cabling providers to alter its facilities, for the purpose of this clause such a document will be taken to be the prior written authorisation of the carrier as long as any terms and conditions set out in the document are adhered to by the cabling provider.

5.14 Defective customer cabling or customer equipment not to be reconnected

A cabling provider **shall not** reconnect any cabling, equipment or line that has been disconnected by the carrier pursuant to section 446 or section 447 of the *Telecommunications Act 1997* (the *Act*).

Note: Sections 446 and 447 of the *Act* empower a carrier to disconnect customer cabling or customer equipment if the carrier has an honest belief that the cabling or equipment is, or is likely to be, a threat to the health or safety of persons or to the integrity of the carrier's telecommunications network or a facility.

5.15 Connection of customer equipment

Fixed or concealed cabling **shall not** be terminated on a plug for connection of customer equipment unless—

(a) the customer equipment will only be connected by a cabling provider and connection of the customer equipment by a person who is not a cabling provider is prevented by effective means; or

(b) the plug is an integral part of a device that is fastened to a wall, floor or ceiling or other permanent building element.

Note: Plugging a cable or cord into a socket is 'cabling work' as defined in section 418 of the *Telecommunications Act 1997*, for which cabling provider registration would normally be required. However, end-users (customers) are exempted from the need to be registered cablers to plug properly manufactured and compliance-labelled cords into wall sockets or patch panels by virtue of the *Telecommunications (Types of Cabling Work) Declaration 1997*, which declares that the connection by an end-user of a compliance-labelled (e.g. A-ticked), pre-terminated patch cord, pre-terminated patch lead, adaptor or pre-terminated telephone extension cord, is a type of cabling work that is exempt from the cabling provider registration requirements.

6 HAZARDOUS CONDITIONS ASSOCIATED WITH HV POWER

6.1 Earth potential rise (EPR)

6.1.1 General

Customer equipment, distributors and other connecting hardware, earthed surge suppression devices, telecommunications electrodes, pits, access holes, or cable joints that are associated with any cable that contains electrically conductive elements, **shall not** be placed in a location where the EPR may exceed 430 V a.c. under power system fault conditions, except as part of an engineered solution in accordance with Clause 6.1.3.

Note 1: If a building is only supplied by 230 V a.c. single phase power or 400 V a.c. three phase power, there will be no need to consider EPR unless the proposed installation is within the EPR hazard zone of an HV site, as determined in the document described in Clause 6.1.3.

Note 2: Appendix H provides more information about EPR including recommended minimum clearances from certain HV equipment.

6.1.2 HV sites of particular concern

The cabling provider **shall** check with the power utility as to the extent of the EPR hazard zone at an HV site where customer cabling or customer equipment is to be installed—

(a) in or near a power generating station or power substation;

(b) near an HV transformer or SWER transformer; or

(c) in or near any HV site located in an area of high soil resistivity (e.g. rocky or dry, sandy terrain).

6.1.3 Engineered installation

Where an installation cannot be placed in a location where the EPR hazard is less than 430 V a.c., the installation **shall not** proceed unless on the basis of a design certified by a qualified electrical engineer as complying with the principles of AS/NZS 3835.1.

Note: A useful reference is HB 100 (CJC 4).

6.1.4 Carrier notification

The relevant carrier **shall** be notified in writing of an installation proposed under the conditions of Clause 6.1.3 before the installation proceeds.

6.2 Low frequency induction (LFI)

6.2.1 General

Customer cables that contain electrically conductive elements **shall not** be installed in the vicinity of an HV power line where the 50 Hz induced voltages under a phase-to-earth fault condition on the power line may exceed 430 V a.c. in the customer cabling, except as part of an engineered solution in accordance with Clause 6.2.2.

Note: More information about LFI is provided in Appendix H.

6.2.2 Engineered installation

Where the level of induction may exceed the limit specified in Clause 6.2.1, the installation **shall not** proceed unless on the basis of a design certified by a qualified electrical engineer as complying with the principles of HB 101 (CJC 5) and HB 102 (CJC 6).

Note: Another useful reference is HB 100 (CJC 4).

6.2.3 Carrier notification

The relevant carrier **shall** be notified in writing of an installation proposed under the conditions of Clause 6.2.2 before the installation proceeds.

7 HAZARDOUS AREAS AND DAMP LOCATIONS

7.1 Hazardous areas (explosive atmosphere)

7.1.1 Description

Many liquids, gases, vapours, dusts, flyings and fibres that are generated, processed, handled or stored are combustible. When ignited they may burn rapidly and with considerable explosive force if mixed with air in the appropriate proportions. Areas where they may occur in dangerous quantities are classified as hazardous areas.

Locations that may contain hazardous areas include, but are not limited to the following:

(a) Vehicle workshops, vehicle parking areas and residential garages.

(b) Fuel dispensing stations.

(c) Aircraft hangars.

(d) Flammable liquid, gas production, processing, handling and storage areas.

(e) Refineries and major processing plants.

(f) Laboratories, fume cupboards and storage areas for flammable medical agents.

(g) Landfill gas, sewage treatment and sewage pumping plants.

(h) Paint/adhesive manufacturing and storage areas.

(i) Paint spraying, drying and finishing areas.

(j) Fruit ripening rooms.

(k) Dry-cleaning, chemical/plastic/solvent recycling and distillation plants.

(l) Grain handling, storage and milling areas.

(m) Any location where combustible powder-based material is produced, prepared, processed, handled, stored or otherwise exists in significant quantities, such as food, organic compounds and timber products, coal, metallic powders and many other powders such as some types of ink powders and plastic dust.

7.1.2 Classification of hazardous areas

7.1.2.1 General

A hazardous area is an area in which an explosive gas atmosphere or dust/air mixture is present, or may be expected to be present, in

dangerous quantities so as to require special precautions for the selection, installation and use of cabling and equipment. Explosive gas atmospheres include flammable vapours (from liquids).

Note: A hazardous area may exist inside or outside a building.

Hazardous areas are classified as described in Clause 7.1.2.2 and Clause 7.1.2.3.

7.1.2.2 Business premises

7.1.2.2.1 Responsibility for classification

For business (commercial/industrial) premises, hazardous areas are classified in accordance with Australian Standards or, in certain cases such as mines or premises where explosives are processed or manufactured, industry-specific standards or codes.

The responsibility for classification of hazardous areas rests with the owner, occupier or person in control of the site who should provide the cabling provider with a plan of the premises identifying the hazardous areas with designated zones.

Note: 'NH' indicated on any documentation means 'non-hazardous'.

7.1.2.2.2 Flammable gas or vapour

An explosive atmosphere may consist of a mixture with air of flammable substances in the form of gas or vapour. In such cases, hazardous areas are classified in accordance with AS/NZS 60079.10.1 and are typically divided into the following zones based upon the frequency and duration of the occurrence of an explosive atmosphere:

(a) Zone 0 — The flammable gas or vapour is present continuously or for long periods or frequently.

(b) Zone 1 — The flammable gas or vapour is likely to occur in normal operation occasionally.

(c) Zone 2 — The flammable gas or vapour is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Note: All of the above zones are hazardous areas. This information is provided for information only to assist cabling providers in reading plans of hazardous areas.

7.1.2.2.3 Combustible dust

An explosive atmosphere may consist of a mixture with air of combustible dusts, fibres or flyings in cloud form. In such cases, hazardous areas are classified in accordance with AS/NZS 60079.10.2 and are typically divided into the following zones based upon the frequency and duration of the occurrence of an explosive atmosphere:

(a) Zone 20 — Combustible dust is present, as a cloud, continuously or frequently, during normal operation, in sufficient quantity to be capable of producing an explosive concentration of combustible dust mixed with air, and/or where layers of dust of uncontrollable and excessive thickness can be formed.

(b) Zone 21 — Combustible dust is likely to occur, as a cloud, during normal operation, in sufficient quantities to be capable of producing an explosive concentration of combustible dust mixed with air.

(c) Zone 22 — Combustible dust may occur as a cloud infrequently and persist for only a short period, or in which accumulations or layers of combustible dust may be present under abnormal conditions and give rise to combustible mixtures of dust in air.

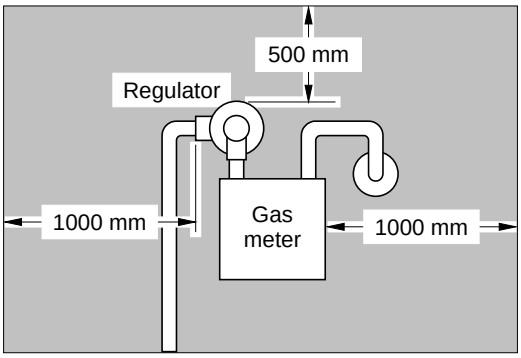
Note: All of the above zones are hazardous areas. This information is provided for information only to assist cabling providers in reading plans of hazardous areas.

7.1.2.3 Domestic premises

There are no specific Australian Standards for classification of hazardous areas in domestic premises. For domestic premises, hazardous areas are defined in this Standard for flammable gas installations only, as follows:

(a) Reticulated natural gas meters and regulators, as set out in Figure 1.

(b) Heavier-than-air bottled gas, e.g. Liquid Petroleum Gas (LPG), stored in exchange cylinders or in-situ fill cylinders, having an aggregate gas capacity exceeding 30 m^3 (approximately 56 kg of LPG) - as set out in Figure 2.



Note 1: The distances are measured from the surface of the gas meter, gas regulator or any gas fitting, whichever is outermost.

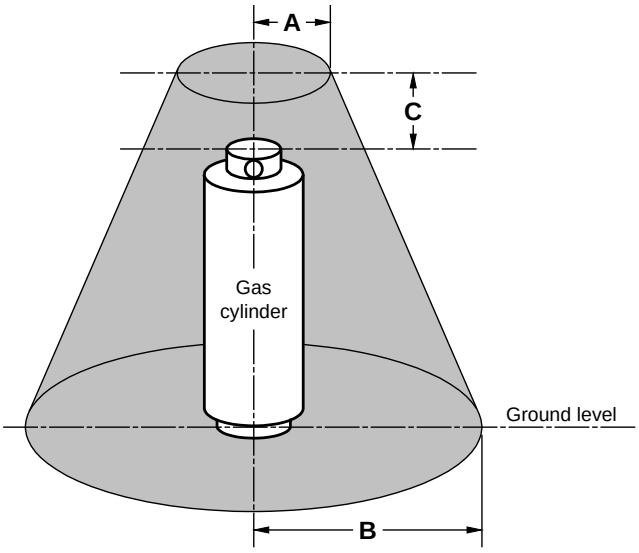
Note 2: The hazardous area does not extend outside—

(a) an approved gas enclosure; or

(b) the gas compartment of a combined gas and telecommunications enclosure approved by the relevant gas utility.

Figure 1

Hazardous area for reticulated gas supply meters and regulators (domestic premises)



Dimension	Exchange cylinder	In-situ fill cylinder
A	500 mm	1500 mm
B	1500 mm	3500 mm
C	500 mm	500 mm

Note 1: The horizontal distances are measured from the centre line of the gas cylinder.

Note 2: The vertical distance is measured from the top of any cylinder valve.

Figure 2

Hazardous area for heavier-than-air bottled gas (domestic premises)

7.1.2.4 Risk factors for cabling

Any conduit, cable or equipment installed, or being installed, within a hazardous area may create an explosion hazard due to—

(a) piping or leakage of flammable gas or liquid via conduits, cable sheaths or holes through walls to points outside the hazardous area where the explosion risk is not controlled;

(b) propagation of an explosion; or

(c) ignition of a flammable mixture by electric arcing or sparking caused by such things as—

(i) the use of electric tools and equipment during installation or repair;

(ii) jointing, connecting or jumpering of metallic conductors;

(iii) fusion splicing of optical fibre;

(iv) cable damage (e.g. impact, corrosion);

(v) overvoltages (e.g. due to lightning activity); or

(vi) static electricity.

7.1.3 Installation of customer cabling and equipment in hazardous areas

7.1.3.1 Identification of hazardous areas

7.1.3.1.1 Business premises

In business (commercial/industrial) premises, the classification of hazardous areas is the responsibility of the owner, occupier or person in control of the site. Before commencing work, the cabling provider **shall** obtain details of the hazardous areas determined in accordance with the relevant Standards or Codes (refer to Clause 7.1.2.2).

7.1.3.1.2 Domestic premises

In domestic premises, before commencing work the cabling provider **shall** identify any hazardous areas in accordance with Clause 7.1.2.3.

7.1.3.2 General requirements

Equipment, including cabling and connecting hardware, for use in a hazardous area **shall** be selected and installed in accordance with Clauses 7.1.3.3 to 7.1.3.8 of this Standard and the relevant requirements of AS/NZS 60079.14.

Where there is any conflict between this Standard and AS/NZS 60079.14, AS/NZS 60079.14 **shall** take precedence.

Note 1: Equipment should, as far as is reasonably practical, be installed outside the hazardous area.

Note 2: The requirements for installations in hazardous areas can be complex and installers should seek expert advice if necessary.

7.1.3.3 Conduits

Where a customer cabling conduit is installed in a hazardous area—

(a) any conduit that terminates in a hazardous area, including within any pit, draw box, enclosure or other cable access point, **shall** be sealed against the transmission of any gas or liquid from the hazardous area to any non-hazardous area; and

(b) any conduit located within a hazardous area **shall not** contain any discontinuity, union, coupling or other fitting between the boundaries of the hazardous area or between a sealed point described in Item (a) and any non-hazardous area.

7.1.3.4 Trunking

Trunking **shall not** be installed in a hazardous area.

7.1.3.5 Metallic conduits, trunking and enclosures

7.1.3.5.1 Metallic conduits and enclosures

Metallic conduits or enclosures constructed from aluminium or light alloys should not be installed within or above a hazardous area.

Note: Such materials have the propensity to give rise to sparking that may be incendiary under conditions of frictional contact and that may fall into the hazardous area if they are installed outside, but above, the hazardous area.

7.1.3.5.2 Metallic trunking

Metallic trunking constructed from aluminium or light alloys should not be installed above a hazardous area.

Note: The installation of trunking within a hazardous area is prohibited by Clause 7.1.3.4, regardless of the composition of the trunking.

7.1.3.5.3 Equipotential bonding

Where any metallic conduits, trunking or enclosures are located within or above a hazardous area, they should be equipotentially bonded to the protective earthing system to minimise the risk of static discharges and of voltage differences that may result in arcing or sparking if metallic services or parts are accidentally bridged.

7.1.3.6 Cables

Where any customer cable is located within a hazardous area:

(a) The cable **shall not** contain any discontinuity between the boundaries of the hazardous area or between a termination

point that complies with Clause 7.1.3.7 and any non-hazardous area.

(b) Any cable that contains electrically conductive elements passing through or above a hazardous area should be protected against mechanical damage (e.g. impact) or environmental damage (e.g. heat, UV) that may result in arcing or sparking.

Note 1: Cable damage has the propensity to give rise to sparking that may be incendiary and that may fall into the hazardous area if the cable is installed outside, but above, the hazardous area.

Note 2: Mechanical protection may be in the form of a robust building protrusion or recess, or may be provided by installing the cable in suitable conduit.

(c) Where any cable that contains electrically conductive elements passes through or above a hazardous area, lightning surge suppression should be installed in the cable outside the hazardous area to reduce any overvoltages to a level that would significantly reduce the risk of arcing or sparking within or above the hazardous area.

Note 1: Overvoltages have the propensity to give rise to sparking that may be incendiary and that may fall into the hazardous area if the cable is installed outside, but above, the hazardous area.

Note 2: Refer to AS/NZS 1768 for guidance about installing lightning surge suppression.

7.1.3.7 Cable terminations, joints, splices and telecommunications outlets

Equipment that may be a source of ignition, such as cable terminations, joints/splices and telecommunications outlets, **shall not** be located in a hazardous area described in Clause 7.1.2 unless they are selected and installed in accordance with AS/NZS 60079.14.

7.1.3.8 Safe working practices

The cabling provider **shall not** take electric tools and equipment into a hazardous area unless—

(a) they are approved for use in a hazardous area; or

(b) the area has been verified as safe (i.e. free from any flammable gas or combustible dust and applying suitable conditions of control to avoid such hazards during the works).

Note 1: Examples of electrical equipment include battery-operated tools and equipment, and personal items that are battery-operated (e.g. hearing aids, portable audio/video equipment, key-ring torches, calculators, watches, pagers, mobile phones, and remote-control car keys).

Note 2: Guidance on conditions of control for safe work may be found in AS/NZS 60079.14, Annex D. For major industries, works in a hazardous area may also be subject to a hot work permit issued by the site owner.

Note 3: Other practices that may create sparks or heat such as striking metal on metal or concrete and use of flames, should also be avoided in hazardous areas, e.g. driving a nail with a hammer could be replaced by use of screw fastenings using hand tools.

Note 4: Static electricity is a common cause of ignition in hazardous areas and conditions that may generate static electricity should be avoided, e.g. rubbing of plastic surfaces and wearing of synthetic clothing. Synthetic clothing with wool is particularly hazardous. Footwear should have antistatic soles.

Note 5: Full cover (ankle to neck to wrist) cotton clothing is recommended for working in hazardous areas to reduce static electricity on the body and provide protection in case of flash fires.

7.2 Damp locations

7.2.1 General

Telecommunications cabling in a damp location **shall** be of such a type or installed in such a manner to prevent the ingress of moisture.

7.2.2 Restricted zones

7.2.2.1 Application

The particular requirements of this Clause apply to zones in certain damp locations where—

(a) the risk of electric shock is increased by a reduction in body resistance and contact of the body with earth potential; and

(b) the presence of moisture and condensation, and consequential risk of corrosion due to electrolysis, is high.

Note: The installation of MDFs and TOs in restricted zones is prohibited by Clauses 13.4 and 15.3.1. Clause 7.2.3 applies to any other equipment installed in a restricted zone.

7.2.2.2 Restricted zone boundaries

The boundaries of the restricted zones are as follows:

(a) For a location containing a bath or shower — within the zones described in Appendix A, Clause A.1 and Figures A1 to A4.

(b) For a location containing a basin or fixed water container not exceeding 45 litres per container — within the zone described in Appendix A, Clause A.2 and Figure A5.

(c) For a location containing a tub or fixed water container exceeding 45 litres — within the zone described in Appendix A, Clause A.3 and Figure A6.

(d) For a location containing a spa pool, spa tub or swimming pool not exceeding a capacity of 5000 litres — within a horizontal distance of 1 m and a vertical distance of 2.5 m of the water container of the spa pool, spa tub or swimming pool.

(e) For a location containing a swimming pool exceeding a capacity of 5000 litres — within a horizontal distance of 2 m and a vertical distance of 2.5 m of the water container of the swimming pool.

(f) For a location containing a fountain or water feature — within a horizontal distance of 2 m and a vertical distance of 2.5 m of the water container of the fountain or water feature.

(g) Within a room or enclosure containing a sauna heater.

(h) Within a refrigeration room.

(i) Within the hosing down area of any location where general hosing down operations are carried out.

7.2.3 Equipment installed in a restricted zone

Any equipment installed in a restricted zone (other than an MDF or a telecommunications outlet, for which installation in a restricted zone is prohibited) **shall**—

(a) be of a type designed and constructed for the location and conditions of use; and

(b) have a minimum degree of protection against the entry of water, in accordance with AS 60529, for the following locations:

(i) IPX7 for a bathroom.

(ii) IPX6 for a shower room.

(iii) An appropriate degree of protection in other cases.

Note 1: The installation of an MDF or a telecommunications outlet in a restricted zone is prohibited by Clauses 13.4 and 15.3.1.

Note 2: The installation of customer equipment in any restricted zone, particularly in a bathroom or shower area, is not recommended.

Note 3: See Clause 17.1 for telecommunications outlets or other equipment exposed to the weather.

8 CABLE SUPPORTS AND ENCLOSURES

8.1 General

Customer cable **shall** be supported or secured at suitable intervals to—

(a) ensure the safe passage of persons where persons may reasonably be expected to pass;

(b) maintain separation from hazardous services; and

(c) comply with the cable manufacturer's instructions in accordance with Clause 5.2.

8.2 Improper support of cabling

8.2.1 Attachment to other services

Customer cabling **shall not** be secured to a cable, conduit or pipe of another service (e.g. a power cable/conduit or water/waste pipe).

Note: LV power and telecommunications conduits may share the same catenary support as long as they are independently secured to the catenary support and separated in accordance with Clause 8.5.

8.2.2 Suspended ceilings

Customer cabling installed in a suspended ('false') ceiling **shall not** be—

(a) laid on the ceiling tiles or their supports; or

(b) tied to the ceiling hanger rods.

Note: Cables should be secured to independent supports such as a tray, trough, hook or catenary support system within the ceiling space or should be secured directly to the underside of the floor above.

8.3 Conduit

8.3.1 Prohibited conduit colours

Customer cable, whether indoor or outdoor, **shall not** be enclosed in conduit of a colour specified in Table 1, except in the following three cases:

(a) Such parts of the conduit that are fully encased in concrete or inaccessible under structural concrete, in which case the ends of the conduit **shall** be made white in a durable manner and the conduit used exclusively for telecommunications cabling.

(b) Conduit that does not contain an HV circuit and which is sub-ducted in a continuous run of insulating conduit complying with AS/CA S008 and IPX8 of AS 60529 in which the customer cable **shall** be enclosed.

(c) A customer cable that does not contain electrically conductive elements which may be directly installed, or sub-ducted in insulating conduit that is not a prohibited colour, in an existing conduit containing a service listed in Table 1 in which case the cable **shall** be labelled at all access points with a suitable warning that it may contain a hazardous light source.

Note 1: The exception of Item (a) is based upon the rationale that subsequent access to the conduit between the existing ends of the conduit would be inhibited by the physical difficulty in doing so, and that the misleading colour of the conduit would therefore be unlikely to represent a safety hazard to cabling providers wanting to access a cable in the conduit.

Note 2: The exception of Items (b) and (c) are subject to the requirements of the relevant utility for any other service contained in the conduit and are based on the rationale that the enveloping conduit identifies the other enclosed service, not the telecommunications service that also happens to be enclosed or sub-ducted in the enveloping conduit.

Note 3: To avoid doubt, Item (b) precludes any customer cable containing electrically conductive elements from being installed or sub-ducted with HV circuits under any circumstances. Item (b) also applies even if the conduit is empty. In such cases, this provides some protection if a hazardous service is subsequently installed in the conduit, plus effectively incurs a cost penalty for not installing the correct colour of conduit for telecommunications cabling in the first place. However, it also allows the installation of a large enveloper conduit of a colour identified in Table 1 for sub-ducting of several services between draw points. (Clause 18.3.4 applies if the enveloper conduit is underground and is not a prohibited colour).

Note 4: See also Clause 18.3 for use of conduit for underground customer cabling.

Note 5: Access points described in Item (c) that are damp and contain electrical cables (e.g. underground electrical pits or access holes) may be hazardous to cabling providers, due to electrical leakage from power cables or joints, and should only be accessed by suitably qualified persons.

Table 1

Prohibited conduit colours for customer cabling

Colour	Service normally associated with the colour
Orange	AC mains power
Yellow or yellow-ochre	Fuel, process, toxic or medical gases
Silver-grey	Steam
Brown	Flammable and combustible liquids
Violet	Acids and alkalis
Light blue	Compressed air

8.3.2 Access to conduit of a prohibited colour

Where a customer cable is enclosed, in accordance with Clause 8.3.1, in conduit of a colour specified in Table 1, a cabling provider **shall not** access that conduit at any point along its length between existing access points (such as existing pits, access holes or junction boxes) unless the cabling provider is also licensed by the appropriate authority, or supervised by an appropriately licensed person, to work on the service normally identified by the colour of the conduit.

Note: An example is if the conduit is orange, the cabling provider should be a licensed electrical worker or be supervised by a licensed electrical worker.

8.3.3 Sharing of conduit with a hazardous service

8.3.3.1 Sub-ducting of customer cabling in conduit of another service

A customer cable that contains electrically conductive elements **shall not** be accommodated in the same conduit as a cable carrying a hazardous service irrespective of the colour of that conduit unless—

(a) the customer cable is sub-ducted in the conduit by the method described in Item 8.3.1(b); and

(b) the hazardous service is not an HV circuit.

8.3.3.2 Sub-ducting of LV telecommunications circuits with other customer cables

A cable carrying an LV telecommunications circuit **shall not** be installed in the same conduit as a cable carrying an ELV, SELV, TNV or limited current circuit unless all of the following are met:

(a) The cable carrying the LV telecommunications circuit is sub-ducted in a continuous run of insulating conduit that is not a prohibited colour (see Table 1) and that complies with IPX8 of AS 60529.

(b) The continuity of the sub-ducting is maintained through any common (shared) access points such as draw boxes, pits or access holes.

(c) The sub-ducting is clearly identified as carrying an LV telecommunications circuit at each access point.

(d) For underground cabling and any situations where moisture is present, any joint or termination of the LV telecommunications circuit is contained in a separate pit, access hole or enclosure to any pit, access hole or enclosure containing a cable carrying an ELV, SELV, TNV or limited current circuit.

(e) The owner or manager of the conduit containing the cables carrying an ELV, SELV, TNV or limited current circuit consents to the installation of the cable carrying the LV telecommunications circuit in the conduit.

Note: It is recommended that LV telecommunications circuits be installed in separate conduits, draw boxes, pits, access holes and enclosures to ELV, SELV, TNV and limited current circuits.

8.4 Earthing of cable support systems and cable enclosures

An electrically conductive support system may be connected to protective earth in accordance with Clause 20.19.

8.5 Separation from other services

Customer cable installed in or on a cable support system **shall** be separated from other services in accordance with the requirements of Section 16 if the support system—

(a) is in or on any building or other contiguous, permanent structure;

(b) is within an underground structure such as a service tunnel or mine;

(c) comprises an outdoor tray, trough or trunking system installed above the surface of the ground; or

(d) comprises an indoor or outdoor catenary support that does not support an HV circuit.

Note: In other cases, customer cable is to be separated from other services in accordance with Section 18 or 19, as applicable.

8.6 Removal of sharp edges

Conduits, trays and trunking **shall** have all sharp edges removed from their cable bearing surfaces.

8.7 Fire detection and fire alarm system cables

Cables and cable support systems should not be installed above fire detection and fire alarm system cables.

Note 1: Where fire detection and fire alarm system cables are required to comply with the degrees of protection specified in AS/NZS 3013, the cables should be installed in a manner such that the collapse of other cabling systems (e.g. due to heat or fire) will not compromise the fire detection and fire alarm system cabling.

Note 2: Cables associated with a fire detection and fire alarm system normally have a red sheath or permanent red markers on the sheath at regular intervals.

9 SEPARATION OF SERVICES – GENERAL

9.1 Separation from LV power or HV circuits

9.1.1 Separation from LV or HV cables

The requirements for separation of customer cables from LV power cables and HV circuits vary depending on their location, i.e. whether the cables are located in or on a building, underground or aerial. Refer to Sections 16, 17, 18 and 19.

9.1.2 Separation from LV power terminations

9.1.2.1 Shared enclosure

The conductors and terminations of a customer cable may be located within the same enclosure as the conductors and terminations of an LV power cable subject to the requirements of Clauses 9.1.2.2 and 9.1.2.3.

9.1.2.2 Prevention from accidental personal contact with LV power terminations

The conductors and terminations of a customer cable **shall not** be located within the same enclosure, building cavity or room as the uninsulated and single-insulated conductors and terminations of an LV power cable unless—

(a) accidental access to the LV power conductors and terminations by persons working on the customer cable conductors and terminations is prevented by means of a physical barrier or obstruction that prevents contact with the LV power conductors or terminations by any part of the body or by any tool being used by the cabling provider; or

(b) the customer cable and the LV power cable are terminated on building control or monitoring equipment that is installed in a restricted access location where only persons who are qualified and authorised to install or maintain both LV power installations and customer cabling can gain access.

Note: 'Restricted access location' is defined in Section 3.

9.1.2.3 Prevention from accidental electrical contact between customer cable terminations and LV power terminations

The conductors and terminations of a customer cable **shall** be separated from the uninsulated and single-insulated conductors and terminations of an LV power cable by either a minimum distance of 150 mm or by means of a permanent, rigidly-fixed barrier of durable insulating material or metal earthed in accordance with Clause 20.17 unless all of the following are met:

(a) The customer cable and the LV power cable are terminated on building control or monitoring equipment that is installed in a restricted access location where only persons who are

qualified and authorised to install or maintain both LV power installations and customer cabling can gain access.

(b) Separate cables are used for LV power and telecommunications.

(c) Any telecommunications circuit that is terminated on the building control or monitoring equipment—

(i) does not share the same cable sheath as any other telecommunications service; and

(ii) only connects to a telecommunications network via a compliant isolating interface.

Note 1: 'Restricted access location' is defined in Section 3.

Note 2: 'Compliant isolating interface' means carrier equipment or customer equipment that meets the requirements of AS/NZS 60950.1 for a TNV-1, TNV-2 or TNV-3 interface, as applicable to the circumstances. Examples are a modem or a Line Isolation Unit (LIU).

9.1.3 Separation from HV circuit terminations

9.1.3.1 Shared enclosure

The conductors and terminations of a customer cable **shall not** be located within the same enclosure or building cavity as the conductors and terminations of an HV circuit.

Note 1: Customer cable conductors and terminations and HV conductors and terminations may be contained in the same room, subject to the requirements of Clause 9.1.3.2, as long as the HV conductors and terminations are separately enclosed within the room.

Note 2: Installation of a distributor in the same room as any HV equipment is not recommended.

9.1.3.2 Separation of enclosures

The enclosed conductors and terminations of a customer cable **shall** be separated from the conductors and terminations of a separately enclosed HV circuit by a minimum distance of 450 mm, whether or not there is an interposing barrier.

Note: The 450 mm distance is measured between the actual conductors and terminations within their respective enclosures, not between the enclosures. However, allowance should be made for any future equipment expansion within each enclosure.

9.2 Separation from services other than LV power or HV circuits

9.2.1 General

The cables, conductors and terminations of customer cabling **shall** be separated from non-telecommunications services such as

plumbing and ELV power cables so as not to impede access to, or repair of, the other service.

Note 1: A minimum clearance of 50 mm is recommended where customer cabling runs alongside other service cables, conduits or pipes.

Note 2: The attachment of customer cabling to any non-telecommunications service is prohibited by Clause 8.2.1.

9.2.2 Separation from non-electrical hazardous services

The cables, conductors and terminations of customer cabling **shall** be separated from non-electrical hazardous services as follows:

(a) Any pipe containing flammable or corrosive liquid or gas, steam, hot water exceeding a temperature of 60° C, compressed air or any other liquid or gas under high pressure—

(i) for cable, conduit or trunking, a minimum distance of 150 mm except at crossings, within wall cavities or shared trunking, where separation by a suitable barrier or heat insulation, as appropriate, is acceptable; and

(ii) for cable terminations, a minimum distance of 150 mm.

(b) Any meter, container, cylinder, tap, vent, hose, regulator or associated fitting for oxygen or flammable gas—

(i) for cable, conduit or trunking, a minimum distance of 150 mm and in accordance with the relevant requirements of Clauses 7.1.3.3 to 7.1.3.6; and

(ii) for cable terminations, in accordance with Clause 7.1.3.7.

(c) Any meter, container, tap, vent, hose, regulator or associated fitting for flammable liquid, steam, hot water exceeding a temperature of 60° C, compressed air or any other liquid or non-flammable gas under high pressure—

(i) for cable or conduit, a minimum distance of 150 mm; and

(ii) for cable terminations, a minimum distance of 150 mm.

Note: Refer to Table 2 for a summary of minimum separation requirements.

Table 2

Telecommunications cabling — minimum separation requirements from other services in or on a building (informative)

Telecommunications		Electricity								Oxygen or flammable gas				Water or waste [9]				Heating oil, steam or compressed air		
		ELV		LV		HV														
		Cable	Connection	Cable	Connection	Cable		Connection[4]		Pipe	Connection	Meter	Cylinder	Pipe	Connection	Meter	Pump/ Cistern	Pipe	Connection	Pump/ Tank
						MC [5]	SC [5]	MC [5]	SC [5]											
Metallic cable	Unenclosed	0		50 [2]	150 [3]	300 [6]	450			150 [7]	150			50		150		150 [7]	150	
	In conduit	0		0	150 [3]	150	450			150 [7]	150			0		150		150 [7]	150	
	Connection, TO or joint	0	150 [3]	50 [2]	150 [3]	450				150	Outside hazardous area [8]			150				150		
Optical fibre cable [1]	Unenclosed	0		0	150 [3]	0	450			150 [7]	150			50		150		150 [7]	150	
	In conduit	0		0	150 [3]	0	450			150 [7]	150			0		150		150 [7]	150	
	Connection or splice	0	150 [3]	0	150 [3]	0	450			150	Outside hazardous area [8]			150				150		

Note 1: If the optical fibre cable contains any electrically conductive elements (e.g. a metallic strengthener or tracer), it is to be treated as a metallic cable (i.e. a cable with electrically conductive elements).

Note 2: If the cables are separated by a barrier of durable insulating material or metal (including enclosure in conduit), no further separation is required unless the cables are within 50 mm of any securing face of building framework.

Note 3: Accidental contact with ELV or LV connections by a telecommunications worker is to be prevented by effective means (e.g. a shield, shroud or suitable distance). In addition, the telecommunications and ELV/LV connections are to be separated by at least 150 mm unless they are separated by a permanent, rigidly fixed barrier of durable insulating material or earthed metal, in which case no further separation is required.

Note 4: The installation of conductors or terminations in the same enclosure as any HV conductor or terminations is not permitted.

Note 5: MC = Multi-Core SC = Single Core

Note 6: Only 150 mm is required if the cables are separated by a permanent, rigidly fixed barrier of durable insulating material or earthed metal as long as at least 175 mm is maintained between the cables around the barrier.

Note 7: Separation by a suitable barrier or heat insulation, as appropriate, is acceptable at crossings, within wall cavities or within shared trunking

Note 8: Connection devices, telecommunications outlets, joints or splices are not to be installed within a hazardous area unless they are selected and installed in accordance with Clause 7.1.3.7.

Note 9: These are the recommended minimum separation distances to ensure compliance with Clause 9.2.1 and to provide adequate clearance to install or access the telecommunications cabling.

Note 10: All dimensions given are in millimeters (mm).

9.3 Separation of ELV, SELV, TNV, limited current and LV telecommunications circuits

Note: For a summary of separation requirements for indoor cabling, refer to Table G1 in Appendix G.

9.3.1 Sharing of cable

An LV telecommunications circuit **shall not** be carried in the same cable (i.e. share the same cable sheath) as any ELV, SELV, TNV or limited current circuit.

Note: ELV, SELV, TNV and limited current circuits may be carried in the same cable (i.e. share the same cable sheath).

9.3.2 ELV circuit terminations

Any ELV circuit termination **shall** be separated from the terminations of an SELV, a TNV or a limited current circuit by either a minimum distance of 150 mm or by means of a permanent, rigidly fixed barrier of durable insulating material or metal earthed in accordance with Clause 20.17.

Note 1: A hazardous voltage could exist in an ELV circuit under single fault conditions.

Note 2: No separation is required between the terminations of SELV, TNV and limited current circuits.

9.3.3 LV telecommunications circuits

A cable carrying an LV telecommunications circuit and its terminations **shall** be separated from any cable carrying an ELV, SELV, TNV or limited current circuit and its terminations in the same way as for an LV power cable except for sub-ducting of cables carrying LV telecommunications circuits in accordance with Clause 8.3.3.2.

Note: A cable carrying an LV telecommunications circuit is customer cabling and, accordingly, is also required to be separated from LV power cables and HV circuits and terminations in accordance with this Standard.

9.4 Separation from lightning down-conductors

Customer equipment, customer cable that contains electrically conductive elements, and telecommunications earthing and power distribution conductors **shall** be separated from any lightning down-conductor from an air termination in accordance with the requirements of AS/NZS 1768.

Note: If a separation of more than 9 m cannot be achieved, the required minimum separation should be determined from AS/NZS 1768.

9.5 Steel wire armoured (SWA) cables

A customer cable that has steel wire armouring that is connected to protective earth in accordance with Clause 20.19 is exempt from

the LV power cable and HV circuit separation requirements in this Standard, as long as—

(a) the LV or HV cable also has an earthed SWA; and

(b) the LV or HV cable is fitted with an earth leakage circuit breaker that is appropriate to the site requirements.

10 SURGE SUPPRESSION

10.1 Assessment of the need for surge suppression

The cabling provider **shall** assess the need for surge suppression for the protection of the end-user of a telecommunications service, in accordance with AS 4262.1, where—

(a) twisted pair customer cabling is provided to a building or structure;

(b) the network boundary is not located in or on that building or structure; and

(c) the cabling will be used to connect terminal equipment in or on that building or structure.

Note 1: 'Terminal equipment' is defined in Section 3.

Note 2: The carrier usually assesses the need for surge suppression for the protection of the end-user at the building or structure containing the network boundary, and installs it at or before the network boundary if required.

Note 3: This requirement applies even if a telecommunications network service is supplied to the premises via an optical fibre, wireless, satellite or any other non-electrically conductive medium.

10.2 Installation of surge suppression where required

The cabling provider **shall** install surge suppression at a building or structure where terminal equipment will be connected, in accordance with Sections 4 and 5 of AS 4262.1, if—

(a) Clause 10.1 applies; and

(b) the risk of injury is assessed as high based on the criteria of Section 3 of AS 4262.1.

Note 1: For surge suppression to be effective, it needs to be installed at the building or structure where the terminal equipment is used. Refer to AS 4262.1 for details.

Note 2: Where a cable is provided between two buildings, the surge suppression should be installed at the point where the cable enters each building, i.e. at both ends of the cable between the buildings.

10.3 Surge suppression device

Where surge suppression is installed on twisted pair cable for any reason and—

(a) is connected between telecommunications line conductors and earth; and

(b) is installed in the customer cabling (e.g. at a distributor, terminal block or joint);

the device **shall** meet the requirements of AS/NZS 4117 for—

(i) either a Class 1 or a Class 3 device where installed within an MDF; or

(ii) a Class 1 device for any other location.

Note 1: Class 1 devices to AS/NZS 4117 should have a specified minimum DC firing voltage of 400 V to the common (earth) terminal. A device with a nominal firing voltage of between 500 V and 600 V will normally be required to allow for manufacturing tolerances.

Note 2: Class 3 devices to AS/NZS 4117 should have a specified minimum DC firing voltage of 190 V to the common (earth) terminal. A device with a nominal firing voltage of 230 V will normally be required to allow for manufacturing tolerances.

Note 3: Both Class 1 and Class 3 devices should have a maximum limiting voltage of 1200 V d.c. and a holdover test voltage of at least 52 V d.c.

Note 4: The reason a Class 3 device is allowable in Item (i) is in recognition of the higher integrity of a hard-wired earth at an MDF.

Note 5: Surge suppression devices installed on any lines carrying voltages exceeding 50 V d.c. (e.g. for remote power feeding) should have a specified minimum DC firing voltage and holdover voltage exceeding the normal DC line voltage.

10.4 Earthing of the surge suppression device

Any surge suppression device installed for any reason in twisted pair customer cabling (e.g. at a distributor, terminal block or joint) and connected between telecommunications line conductors and earth, **shall** be earthed in accordance with Clause 20.20.

11 OPTICAL FIBRE AND COAXIAL CABLE SYSTEMS

11.1 Optical fibre systems

11.1.1 General exemption from separation requirements

While customer cabling that does not contain electrically conductive elements is exempt from certain separation requirements in this Standard, it should be installed in such a way so as to ensure a cabling provider is not exposed to electrical hazards while testing or connecting the customer cabling.

Note: In some circumstances the installer of the cabling may need to be appropriately licensed. For example, the installer may be required to be a licensed electrical worker to draw the cabling through electrical conduits.

11.1.2 System compliance

Optical fibre systems **shall** comply with the applicable requirements of AS/CA S008, AS/NZS IEC 60825.1 and AS/NZS IEC 60825.2.

11.1.3 Inspection and cleaning

An optical fibre interface should be inspected using an instrument designed for the purpose.

If necessary the interface should be cleaned using equipment designed for the purpose and reinspected to ensure that it is clean before making the connection.

Note: Safe inspection and cleaning if required of optical fibre interfaces is recommended as contaminants will affect performance of the connection. Suitable inspection equipment should be used.

11.1.4 Inspecting apparatus

Visual inspecting apparatus **shall** be suitably safe to the eye.

Note: It is recommended that an indirect viewing devices be used in the inspection of connector end-faces, e.g. a video-scope or video probe.

11.1.5 Safety of the installation

Optical fibre systems should be installed and maintained in accordance with AS/NZS IEC 60825.2. In particular, the cabling provider **shall** ensure—

(a) optical fibre cables carry appropriate markings to distinguish them from metallic cables and cables containing other services (e.g. AC mains power);

(b) all access points (e.g. splice enclosures, connectors) where disconnected fibres may be able to emit laser radiation exceeding the accessible emission limit (AEL) for Class 1 are appropriately located, labelled and secured (refer to Cl. 11.1.6.8 for multiple connectors, outlets and access points);

(c) any manufacturer warning or instruction label in relation to the laser product is not damaged or obscured during installation;

(d) suitable mechanical protective eyewear and clothing is worn when preparing, cutting or splicing optical fibres;

(e) that suitable measures are taken to avoid exposure to hazardous light levels; and

(f) no fibre particles, hazardous solvents or chemicals are left on site at the completion of the work and are disposed of in a suitable hazardous material or 'sharps' container, as applicable.

11.1.6 Labelling of fibre optic panels and enclosures

11.1.6.1 Warning of potential hazardous laser levels

All optical fibre panels and enclosures **shall** be labelled to warn of the potential that hazardous laser levels may be present.

11.1.6.2 Access to emitted radiation

Each optical connector, splice box or other part emitting radiation when opened **shall** be marked, e.g. with a label, sleeve, tag or tape.

Note: The labelling for connectors may be located in close proximity where mounting the label on the connector itself is not practical.

11.1.6.3 Types of warning markings

The warning marking **shall** consist of—

(a) a Warning Label meeting the requirements of Figure 1 of AS/NZS IEC 60825.1; and

(b) an Explanatory Label meeting the requirements Figure 2 of AS/NZS IEC 60825.1.

11.1.6.4 Marking style

Markings **shall** be coloured black on a yellow background. It is acceptable to reduce the marking in size, providing that the result is legible.

11.1.6.5 Explanatory label wording

The text for the Explanatory Label should be as follows:

CAUTION - HAZARD
POTENTIAL VISIBLE AND INVISIBLE LASER RADIATION
DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY
WITH NON-ATTENUATING OPTICAL INSTRUMENT

The above wording for the Explanation Label is not mandatory and other words that contain the same meaning may be used.

11.1.6.6 Marking durability

The durability of the marking **shall** meet Clause 5.3.3.2 of AS/CA S008.

11.1.6.7 Fibre outlets in work areas

Fibre outlets in work areas in unrestricted and restricted locations do not require Explanatory Label markings unless the application is likely to exceed Class 1M.

11.1.6.8 Marking of groups of connectors, outlets and access points

Groups of connectors, outlets or access points such as patch panels may be marked as a group. A single clearly visible triangular Warning Label marking may be used rather than having one Warning Label for each connector/outlet. A minimum of one Explanatory Label **shall** be installed on the rack or frame for each location.

11.1.6.9 Multiple markings

Where a group of connectors/outlets are enclosed within a housing and it is a foreseeable event that exposure to optical radiation could result from accessing the connectors/outlets in that housing, then an Explanatory Label **shall** be clearly visible both before and after the housing is opened. This may require the use of more than one marking, such as one on the outside of a cabinet door and one inside on the rack/frame.

11.1.6.10 Hazard levels above 2M

Any optical fibre panel or enclosure supporting a hazard level above 2M **shall** be labelled in accordance with AS/NZS IEC 60825.1.

Note 1: Additional labelling may be provided to indicate the hazard level of services running over the installed cabling.

Note 2: The non-use of hazard levels within the Explanatory Label is a result of the cabler not being able to determine what services are likely to run over the fibre cabling during the life of the installation. For example, some test equipment output exceeds hazard level 1M.

11.1.7 Unused optical fibre ports or cords

11.1.7.1 Unused ports

Unused ports in optical fibre patch panels and in optical fibre TOs **shall** be covered by suitable plugs or protective covers.

11.1.7.2 Unconnected cords

Optical fibre cord, cable and pigtail connector ferrules **shall** be protected by suitable protective caps when not connected to a port, adaptor or TO.

Note 1: Protective covers and caps should provide suitable optical attenuation to reduce the laser hazard. They also provide physical

protection for the optical fibre interface and help minimise contamination of the interface.

Note 2: Laser classes above Class 1 are possible over the life of the installation.

11.2 Coaxial cable systems

A telecommunications circuit **shall not** be connected to the outer conductor of a coaxial cable that may be touched by an end-user, e.g. at a coaxial connector, unless—

(a) the circuit meets the requirements of an SELV circuit; or

(b) the outer conductor is permanently connected to protective earth in accordance with Clause 20.18.

Note 1: For guidance in the design, installation and repair of coaxial cable systems, refer to AS/NZS 1367.

Note 2: A carrier's specific requirements may need to be taken into account for the design, installation or repair of any coaxial cabling system used to supply broadband data services (e.g. 'cable' internet).

12 DISTRIBUTORS

12.1 General

This section applies to all distributors. Section 13 specifies additional requirements for a distributor that terminates a carrier's twisted pair lead-in cabling (i.e. an MDF).

12.2 Cross-connections

Cross-connections (e.g. jumpers or patch cords) should match or exceed the class of the installed cabling system.

Note: For example, a Class D cabling system (using Category 5 components) should use Category 5 or Category 6 jumpers or patch cords.

12.3 Records

12.3.1 General

Where cross-connections are made by means of jumpers—

(a) the cabling provider **shall** supply sufficient information (records) relating to the cabling work performed to enable cables and cross-connections to be correctly identified and connected; and

(b) the records **shall** be legible and updateable.

Note: AS/NZS 3085.1 provides guidelines for the recording of installation details, including distributor records.

12.3.2 Identification of power feeding circuits

Terminations and cross-connections used for any line providing power feeding exceeding 60 V d.c. or 42.4 V a.c. peak (30 V a.c. r.m.s.), but excluding a line that occasionally carries interrupted ring voltage (e.g. a standard telephone line), **shall** be clearly identified in the records and by appropriate labelling or marking of the distributor connection modules.

Note: Under normal operating conditions, power feed voltage in customer cabling should not exceed TNV limits, i.e. 120 V ripple-free d.c. or 71 V a.c. peak (50 V a.c. r.m.s.). Any power feeding circuit that exceeds these limits is an LV telecommunications circuit and is to be treated accordingly.

12.4 Outdoor installation

A distributor installed in a position exposed to the weather **shall**—

(a) have a minimum degree of protection against the entry of water of IPX3 of AS 60529 or be enclosed in an enclosure assessed against the relevant Clauses of AS/CA S008 and providing a minimum degree of protection of IPX3; and

(b) be installed in such a way that a minimum degree of protection of IPX3 of AS 60529 is maintained.

Note: Where the location is known to be subject to extreme environmental conditions, consideration should be given to the use of an enclosure with a superior degree of protection. In this respect, environmental features such as high temperature, snow, ice, driving rain, severe dust conditions, salt-laden or corrosive atmosphere, the presence of flora or fauna, and areas subject to unusual mechanical stresses, may influence the degree of protection required for the enclosure.

12.5 Enclosure construction

Where a distributor is constructed on site, it **shall** comply with the following:

(a) Cable entry holes **shall**—

(i) be free of sharp edges or burrs; or

(ii) have a grommet of insulating material fitted.

(b) Provision **shall** be made to enable electrically conductive enclosures, frames and backmounts to be connected to protective earth in accordance with Clause 20.19.

(c) Any openings in enclosures, other than cable entries, **shall** comply with the physical requirements for electrical enclosures given in Clause 4.6.1 of AS/NZS 60950.1.

(d) The enclosure **shall** be free of exposed sharp edges.

13 MAIN DISTRIBUTION FRAME (MDF)

13.1 Application

An MDF may be used to connect a carrier's twisted pair lead-in cabling at any type of premises. MDFs are not defined for connection of a carrier's coaxial or optical fibre cabling — but an MDF may include such connections on the customer side of the MDF (i.e. for connection of customer cabling to other customer cabling).

The MDF is generally the network boundary for lines connected to it. It is normally installed by the customer's cabling provider, but the lead-in connection modules form part of the telecommunications network and are usually supplied, installed and maintained by the carrier or carriage service provider.

Note: Refer to Appendix J for more information about the network boundary and the MDF.

13.2 General

An MDF **shall**—

(a) comply with the applicable requirements of Section 12 in addition to this section; and

(b) be structurally robust.

13.3 Location

The MDF—

(a) should be located at the same building as the end-user;

(b) should be located near the main or first electrical switchboard at the building to enable earthing/bonding of surge suppression devices within the conductor length limits described in Note 3 to Clause 20.20.1;

(c) where located inside the building, **shall** be installed in a position free from the ingress of dust and moisture and not subject to damp and/or humid conditions; and

(d) **shall** be securely attached to a permanent building element such as a wall, floor or column.

Note: The proposed location of the MDF should be discussed with the carrier prior to installation.

13.4 Prohibited locations

The MDF **shall not** be installed in any of the following locations:

(a) Any room containing washing, bathing, shower or toilet amenities.

(b) A boiler, plant or machine room.

(c) Any area subject to corrosive fumes or fluids.

(d) A fire escape stairway.

(e) Near an automatic sprinkler, unless—

(i) the MDF is provided with a shield to prevent water falling on it;

(ii) all sprinkler heads which could project water on to the MDF are provided with suitable deflectors; or

(iii) the sprinkler heads are of the dry type.

(f) Within any restricted zone described in Clause 7.2.2.

(g) Within a cupboard containing a fire hose reel.

13.5 Security

The MDF, or enclosure in which it is located, **shall** have provision for securing with a key, lock or tool.

Note 1: For the purpose of this Clause, an 'enclosure' includes a closet or room provided for the express purpose of housing the MDF, in which case the closet/room door is to have provision for securing with a key, lock or tool if the MDF does not.

Note 2: The building owner, manager or occupant is responsible for the security of the MDF. The MDF should be adequately secured against vandalism and access by children or unauthorised persons but reasonable access should be given to carriers, carriage service providers and cabling providers, as required.

13.6 Access clearances

Adequate space **shall** be provided around the MDF where persons are to pass to enable safe and convenient access to the MDF and ready escape from the vicinity under emergency conditions.

Note: Appendix D describes recommended access clearances that are deemed to be 'adequate space' for the purpose of this Clause to avoid a dispute with a carrier or carriage service provider.

13.7 Height

13.7.1 Highest terminal or socket

The highest terminal or socket of a wall-mounted MDF **shall not** be greater than 1800 mm above finished ground or floor level.

Note: This is to avoid the need for ladder access under variable ground conditions (outdoor MDF) or under variable room conditions (indoor MDF). A freestanding (floor-mounted) MDF would normally be located in a dedicated MDF room or equipment room with permanent access arrangements (e.g. a ladder) and no height restrictions need apply in such cases.

13.7.2 Lowest terminal or socket

13.7.2.1 Outdoor MDF

The lowest terminal or socket of an outdoor MDF **shall not** be less than 350 mm above finished ground or floor level.

Note: This is to allow for variable ground conditions in outdoor situations and also clearance for splashing water (rain or hosing of paths, gardens or lawns).

13.7.2.2 Indoor MDF

The lowest terminal or socket of an indoor MDF should not be less than 350 mm above finished ground or floor level.

Note: This minimum height is recommended to provide clearance for floor cleaning implements and easy access to the terminals or sockets by any person required to work on the MDF.

13.8 Exit from the MDF room

The cabling provider **shall not** install the MDF within any room that requires the use of a tool, key, card, number pad or the like to exit the room.

Note 1: For personal safety reasons, a cabling provider should not perform cabling work in such a room.

Note 2: Where an existing MDF is located in such a room, the cabling provider should report the condition to the building owner or manager for rectification.

13.9 Illumination

The MDF **shall** be provided with adequate lighting.

Note: A light intensity of 500 lux at a height of 1 m above ground or floor level is considered to be adequate lighting.

13.10 Inbuilt MDF compartment

Where the MDF enclosure forms an integral part of the building construction, a minimum clearance of 30 mm **shall** be provided between the carrier side termination modules and the inside face of the front cover or door of the enclosure in the fully closed position.

Note 1: This is to provide space for fitting of surge suppression on the carrier's modules.

Note 2: Refer to Figure J18 of Appendix J for an explanation of the expression 'carrier side'.

13.11 Carriers' terminations

The frame of the MDF **shall** be capable of mounting the carrier's standard termination modules on the carrier side.

Note 1: The termination modules on the carrier side are normally supplied and installed by the carrier.

Note 2: Refer to Figure J18 of Appendix J for an explanation of the expression 'carrier side'.

13.12 Marking

The MDF **shall** be clearly marked as follows:

(a) The vertical columns of jumperable terminations ('verticals') **shall** be alphabetically indicated, from left to right, omitting the letters 'I' and 'O'.

(b) The range of jumperable terminations within each vertical **shall** be indicated numerically in ascending order from the lowest module position unless clearly labelled otherwise, starting from numeral '1'.

Note: A partially equipped MDF should be marked so as to allow expansion without the need to redesignate verticals or renumber existing terminations.

13.13 Cross-connections

13.13.1 Connection on the carrier side of the MDF

A cabling provider is deemed to be authorised by a carrier to make a connection on the carrier side of the MDF if, and only if, a pair on the carrier side has been tagged, labelled, recorded or otherwise specified by the carrier for the customer service that is to be connected.

Note 1: For safety, security and privacy reasons, the use of patch cords in MDFs is not generally supported by carriers.

Note 2: Refer to Figure J18 of Appendix J for an explanation of the expression 'carrier side'.

13.13.2 Connection on the customer side of the MDF

A cabling provider may make or alter any connection on the customer side of the MDF.

Note: Refer to Figure J18 of Appendix J for an explanation of the expression 'customer side'.

13.13.3 Removal of 'dead' jumpers

A cabling provider is deemed to be authorised by a carrier to remove a redundant cross-connection from the carrier side of the MDF if all reasonable steps have been taken to ensure a working service is not inadvertently disconnected.

Note: Refer to Figure J18 of Appendix J for an explanation of the expression 'carrier side'.

13.13.4 Miscellaneous

The cabling provider **shall**—

(a) use the correct terminating tool;

(b) enter or adjust the service details in the MDF records or provide the relevant details to the building owner/manager where a secure cable distribution record system is maintained; and

(c) reinstate any cabling components removed if accessing the carrier side of the MDF, including any surge suppressors or covers.

14 NETWORK TERMINATION DEVICE (NTD)

14.1 Application

An NTD may be used by a carrier to connect twisted pair, coaxial or optical fibre lead-in cabling at any type of premises.

Note: The NTD is normally installed by the carrier as part of the carrier's network and is outside the scope of this Standard except for connection of customer cabling to the NTD. A carrier may or may not use an NTD or may only use an NTD in certain circumstances. Contact the relevant carrier for more information.

14.2 Connection on the customer side of the NTD

In customer premises where a carrier's lead-in cabling terminates on an NTD, a cabling provider is authorised by the carrier to connect customer cabling to the connectors on the customer side of the NTD whether or not a line has been tagged, labelled, recorded or otherwise specified by the carrier for that customer service.

Note: Refer to Figure J19 of Appendix J for an explanation of the expression 'customer side'.

14.3 Connection on the carrier side of the NTD

Apart from activities described in Clause 14.4, a cabling provider **shall not** make or alter any connection on the carrier side of the NTD unless the cabling provider has been authorised in writing by the carrier to do so.

Note: Refer to Figure J19 of Appendix J for an explanation of the expression 'carrier side'.

14.4 Testing

Where the NTD incorporates a socket, disconnect contact or removable link to enable isolation or testing of the line by a cabling provider:

(a) The cabling provider is authorised by the carrier to use the socket, disconnect contact or removable link for isolation or testing purposes, in accordance with the NTD instructions.

(b) Where isolation or testing necessitates removal of a component (e.g. a link, plug or surge suppressor), the cabling provider **shall** reinstate the component at the completion of testing unless it is faulty and its reinstatement would prevent the safe or proper functioning of a carriage service.

(c) Where the cabling provider is prevented from reinstating a component in accordance with Item (b), the cabling provider **shall** inform the carrier of the fault.

Note: Some NTD designs may support testing of the line by the customer (e.g. using a standard telephone), in which case the NTD will be appropriately labelled.

15 TELECOMMUNICATIONS OUTLETS

15.1 Socket types

The telecommunications sockets in common use in Australia for connection of customer equipment to twisted pair cables are described in Appendix C.

Note: In general 8-position modular sockets are recommended for new cabling work.

15.2 Protection against contact with live parts of sockets

Any 8-position modular socket, or any other type of socket with contacts that may be touched by a finger, which is located in any premises frequented by small children (e.g. a kindergarten or child care centre) should be—

(a) provided with mechanical protection that prevents finger access to live parts; or

(b) installed out of reach.

Note: Cords connected to a telecommunications outlet but not connected to customer equipment also represent a hazard to small children who may put the plug in their mouth and suffer an electric shock, particularly in earthed situations (e.g. while also in contact with an earthed object such as sitting on a concrete floor).

15.3 Damp locations

15.3.1 Restricted zones

A telecommunications outlet **shall not** be installed in any restricted zone described in Clause 7.2.2.

Note 1: Where it is necessary to install customer equipment within a restricted zone, the customer equipment should be a type that is not connected via a telecommunications outlet or the outlet should be located outside the restricted zone. The customer equipment should be designed and constructed for the location and conditions of use (refer to Clause 7.2.3).

Note 2: Any socket that is an integral part of customer equipment does not constitute part of a telecommunications outlet.

15.3.2 Outside restricted zones

A telecommunications outlet installed in a damp location, but outside a restricted zone, **shall** be installed in such a way as to minimise the ingress of moisture.

15.4 First socket

15.4.1 Application

Where a carriage service is supplied to an end-user in a building by means of a line (cable) that enters the building and the line does

not connect to an MDF or an NTD, the socket of the first telecommunications outlet connected to the line, after the building entry point (i.e. inside the building), is generally the network boundary for that line.

Note 1: The first socket is part of the telecommunications network and is usually supplied, installed and maintained by the carrier or carriage service provider.

Note 2: Refer to Appendix J for more information about the network boundary and the first socket.

15.4.2 Connection of customer cabling

15.4.2.1 Twisted pair cabling

In customer premises where a carrier's twisted pair lead-in cabling terminates on the first socket in the building (i.e. there is no MDF or NTD), a cabling provider may connect customer cabling—

(a) to the terminal strip of the first socket; or

(b) at any point on the customer side of the terminal strip described in Item (a), e.g. at any subsequent socket.

Note: Where insulation displacement connectors are used at the first socket, the customer cable conductors should be connected on separate tines (slots) to those used to connect the lead-in cable conductors.

15.4.2.2 Coaxial or optical fibre cabling

In customer premises where a carrier's coaxial or optical fibre lead-in cabling terminates on the first socket in the building (i.e. there is no NTD), a cabling provider **shall not** connect customer cabling to any point other than the first socket via a mating plug.

15.4.2.3 Obsolete hard-wired telephone

In customer premises where a carrier's twisted pair lead-in cabling terminates on a telephone without a socket (e.g. an obsolete fixed wall phone), a cabling provider may connect customer cabling to the terminals of the telephone connection strip or block.

15.4.2.4 Intermediate devices

The cabling provider **shall not** connect cabling to any lead-in cable connection device or equipment other than those described in Clauses 15.4.2.1, 15.4.2.2 and 15.4.2.3 unless the cabling provider has been authorised in writing by the carrier to do so.

16 INDOOR CABLING

16.1 Cable flammability

Customer cable installed inside a building **shall**—

(a) comply with the flammability requirements of AS/CA S008; or

(b) be installed such that the installation complies with the Building Code.

Note 1: This requirement relates mainly to cable installed wholly within a building and, in particular, cable that is run between FRL (fire resistance level) rated compartments within larger buildings or between adjoining living units.

Note 2: There is no requirement to change the cable type where an underground or aerial cable enters a building. However, any cable used within the building past the first cable connection point (e.g. distributor) should comply with Item (a) unless that cable will exit the building (e.g. run underground or aerial to another building) or the use of underground type cable is required by Clause 16.8.

16.2 Fire stopping

Any opening where customer cabling runs in or through a fire isolating wall, floor or riser shaft, **shall**—

(a) be suitably fire stopped; and

(b) comply with the Building Code.

16.3 Separation from LV power cables

16.3.1 General

A customer cable that contains electrically conductive elements, other than an undercarpet cable, **shall** be permanently separated from any LV power cable by one of the following methods:

(a) A minimum distance of 50 mm.

(b) Subject to the requirements of Clause 16.3.2, a barrier of durable insulating material or metal.

(c) A timber or metal stud, nogging, joist, bearer or rafter of any thickness.

Note 1: Compliance with Item (b) may be achieved by the enclosure of either the customer cable or the LV cable in conduit. Neither the metallic shield of a shielded cable nor the sheath of a double-insulated cable qualifies as a barrier for the purpose of Item (b).

Note 2: It is not a requirement of this Standard for a metallic barrier to be earthed in this case unless it is also used to separate customer cable terminations and LV power terminations (refer to Clause 9.1.2.3). However, in certain circumstances the barrier may be required to be earthed by the installer of the LV power cable as a requirement of AS/NZS 3000.

Note 3: A flexible customer equipment cord is not required to be separated from an electrical appliance cord or fixed LV power cable unless the customer equipment cord is installed as fixed or concealed cabling.

Note 4: Spatial or mechanical separation is necessary for safety purposes to minimise the risk of coincident insulation damage to both the customer cable and the LV power cable caused by excessive heat, abrasion, rodents or penetration by nails or screws.

16.3.2 Cabling in building framework

A customer cable that contains electrically conductive elements and an LV power cable **shall not** pass through the same hole that is within 50 mm of any securing face of building framework (e.g. a stud, nogging, joist, rafter, bearer, plate, or batten) whether or not there is a barrier provided between the cables.

16.3.3 Cables in common trunking or a common duct or enclosure

Customer cable that contains electrically conductive elements and which shares trunking, a duct or an enclosure with an LV power cable **shall** be installed in a separate channel or compartment of the common trunking, duct or enclosure such that the channel or compartment is separated by a fixed and continuous barrier complying with Item 16.3.1 (b), unless in the case of an enclosure containing cable terminations, the installation complies with the three conditions listed in Items 9.1.2.3 (a) to (c).

Note 1: Common trunking or a common duct may include a skirting duct, floor duct or service column.

Note 2: Breaks are permissible in the barrier at intersections of modular office furniture including abutments to service columns (due to assembly processes) where these can be opened for inspection, as long as cables do not cross into other channels and have fixings fitted where required to maintain separation at changes in direction of any cabling in the trunking, duct or enclosure.

16.3.4 Undercarpet cabling

Any undercarpet customer cable that contains electrically conductive elements—

(a) **shall** be separated for its entire length from any LV power cable by a minimum distance of 50 mm; or

(b) where the customer cable crosses an undercarpet power cable and a separation distance of 50 mm cannot be maintained, the customer cable—

(i) **shall** cross above the undercarpet power cable at right angles; and

(ii) **shall** be separated from the power cable by a rigid metallic barrier that is earthed in accordance with Clause 20.17 and which extends at least 25 mm beyond

the cable sheaths of both the customer cable and the power cable.

16.4 Separation from HV circuits

16.4.1 Single-core cables

A customer cable that contains electrically conductive elements and which runs alongside or crosses a single-core cable carrying an HV circuit **shall** be separated for its entire length from the single-core cable by a distance of at least 450 mm whether or not there is an interposing barrier.

16.4.2 Multi-core cables

A customer cable that contains electrically conductive elements and which runs alongside or crosses a multi-core cable carrying an HV circuit **shall** be separated for its entire length from the multi-core cable by—

(a) a distance of not less than 300 mm; or

(b) a distance of not less than 150 mm where there is an interposing barrier that—

(i) is of such dimensions that at every point the shortest path between the customer cable and the multi-core HV cable around the barrier is at least 175 mm measured from the outside of the cable sheaths; and

(ii) is made of either durable insulating material or metal earthed in accordance with Clause 20.17.

Note: Compliance with Item (b) may be achieved by the enclosure of either the customer cable or the HV cable in conduit.

16.5 Prohibited use of flame-propagating conduit

Conduit and fittings that are not classified as non-flame propagating, in accordance with AS/NZS 2053.1, **shall not** be used in any of the following locations:

(a) A lift or hoist shaft.

(b) A lift motor room.

(c) A fire-isolated exit (e.g. fire escape stairway).

(d) A location where the ambient temperature is in excess of 60° C.

Note: Clause 8.3 also applies to any conduit used for the customer cabling.

16.6 Cabling in lift and hoist shafts

16.6.1 Permanently fixed cables

A permanently fixed customer cable that is installed in a lift or hoist shaft **shall** —

(a) comply with the requirements of AS 1735.2 and AS/CA S008; and

(b) be separated from other services in accordance with Clauses 16.3 and 16.4 unless a compliant line isolation device is fitted to each end of the telecommunications circuit.

16.6.2 Travelling cables

A telecommunications circuit **shall not** be connected to a travelling cable associated with a lift cabin, hoist basket or travelling crane unless one of the following conditions are met:

(a) The cable meets the applicable requirements of AS/CA S008.

(b) A compliant line isolation device is fitted to each end of the telecommunications circuit.

(c) A compliant line isolation device is fitted at one end, and a compliant lift telephone is fitted at the other end, of the telecommunications circuit.

16.7 Cabling over or under floor covering

16.7.1 Physical protection

Where cabling other than a flexible equipment connecting cord is run on the surface of carpet or other floor material, it **shall** be protected by a suitable covering strip or by enclosure in conduit or trunking.

16.7.2 Separation from power cabling

An undercarpet cable **shall** be separated from any LV power cable in accordance with Clause 16.3.4.

16.8 Cables in floor conduit or duct

A cable that is installed in floor conduit or duct where part or all of the cable is immersed or is likely to be immersed in water within the conduit or duct (e.g. as a result of condensation, seepage through cracks/joints, rain ingress or the operational use of water in the vicinity), **shall** comply with the water penetration requirements of AS/CA S008 for underground cable as described in Clause 18.4.

17 OUTDOOR CABLING – GENERAL

17.1 Protection rating

A telecommunications outlet or any other customer equipment installed in a location exposed to the weather or to damp conditions **shall**—

(a) have a minimum degree of protection against the entry of water of IPX3 of AS 60529 or be enclosed in an enclosure that has a minimum degree of protection of IPX3; and

(b) be installed in such a way that a minimum degree of protection of IPX3 is maintained at all times.

17.2 Cabling between premises

A cabling provider **shall** install any cabling between separate premises in accordance with the relevant requirements of this Standard.

Note 1: The permission of the relevant local authority, or the owner of any third party property traversed by the cabling, is required.

Note 2: The cabling provider is not entitled to use a carrier's or other person's conduits, pits or manholes without their express permission.

Note 3: The Dial Before You Dig (DBYD) 'free call service' (telephone 1100 or visit the DBYD website at 1100.com.au) should be contacted for information about any underground services that may be in the vicinity if any earth breaking activity is contemplated.

Note 4: Details of such cabling should be recorded on suitable cabling plans and in relevant cable distribution records.

17.3 Cabling between buildings

17.3.1 General

Where any equipment is to be interconnected between separate buildings, the connection is to be made by one of the following methods:

(a) Cabling that does not contain any electrically conductive elements (e.g. optical fibre cable with non-metallic strengtheners) **shall** be used.

Note: The outdoor cabling may be connected via suitable 'media converters' to indoor cabling that contains electrically conductive elements.

(b) The equipment in each building **shall** be interconnected by means of wireless technology.

(c) Where coaxial cabling is used, the coaxial cable should be connected to the indoor cabling via an isolator that provides a minimum isolation of 3 kV r.m.s. and 7 kV impulse, and the outer conductor of the coaxial cable should be earthed on

the outdoor cabling side of the isolator in accordance with Clause 20.18.4.

(d) Where twisted pair cabling is used, the cabling provider **shall** assess the need for surge suppression and install surge suppression where required in accordance with Section 10; and—

(i) the cabling should only be connected to equipment or an equipment port that is classified as 'external' (i.e. complies with the TNV-1 or TNV-3 requirements of Clause 6 of AS/NZS 60950.1 for connection to a telecommunications network) and that also complies with the 'enhanced' requirements of Table 2 of ITU-T Recommendation K.21; or

(ii) the cabling should only be connected via a suitable Line Isolation Unit (LIU) to equipment or an equipment port that is classified as 'internal' (i.e. classified as SELV or TNV-2 in accordance with AS/NZS 60950.1).

Note 1: Equipment or an equipment port designed to be connected to a standard telephone line (such as a telephone handset or the line port of a modem or PABX) will usually be rated as 'external'. Ethernet equipment, Ethernet ports or IP-based (e.g. VOIP) service ports, will usually be classified as 'internal'.

Note 2: Where the manufacturer or supplier of the equipment indicates that only 'internal' (indoor) cabling is to be connected to the equipment or an equipment port, or that 'external' (outdoor) cabling is not to be connected to the equipment or an equipment port, connection of outdoor cabling to that equipment or port may be considered to be non-compliant with Clause 5.2 of this Standard.

17.3.2 Inter-building cabling within a sheltered structure

Cabling which is installed in a service tunnel, covered walkway, aboveground trunking system or other sheltered structure between buildings may be treated as indoor cabling as long as the requirements of Clauses 17.3.1, 17.4 and 17.5 are met.

17.4 Exposure to UV radiation (sunlight)

Where any outdoor cable or equipment is installed in a location exposed to direct sunlight—

(a) the exposed parts of the cable or equipment **shall** be manufactured of UV resistant material; or

(b) the cable or equipment **shall** be mechanically protected from exposure to UV radiation by suitable means.

Note 1: It may be necessary to confirm the UV resistant properties of a product with the supplier or manufacturer of the product.

Note 2: In some cases, two or more coats of exterior grade paint may provide suitable mechanical protection from UV radiation.

17.5 Outdoor surface cabling

Outdoor surface cabling, including cabling installed in trunking, troughs or trays at or above ground level—

(a) **shall** be separated from LV power cables and HV circuits in accordance with Clauses 16.3 and 16.4;

(b) **shall** comply with the relevant requirements of Section 8; and

(c) if part or all of a cable is immersed or is likely to be immersed in water within surface conduit, duct, trunking, trough or tray that is not adequately drained, the cable **shall** comply with the water penetration requirements of AS/CA S008 for underground cable as described in Clause 18.4.

17.6 Outdoor antennas

Where an outdoor radio, wireless ('Wi-Fi') or satellite antenna (including any active/powered antenna referred to as an 'Outdoor Unit' or 'ODU') is connected to customer cabling, the following should be met:

(a) To minimise static electricity charge and for lightning protection purposes, the antenna metal support, mast and boom (as applicable) should be earthed in accordance with Clause 20.19.

Note: The lightning protection is limited to shunting induced current from a nearby lightning discharge to earth and will not provide effective protection against a direct lightning strike.

(b) In areas of high lightning activity, if the highest extremity of any part of the antenna, including the cabling connected to it, is less than 2 m below the apex of the roof or more than 1.5 m from the building, the following should be met:

(i) An earthing conductor installed in accordance with Item (a) should have a cross-sectional area of at least 6 mm² and should be run by the most direct route to a suitable equipotential bonding point in accordance with AS/NZS 1768.

(ii) If the cable feed from the antenna is coaxial cable, the coaxial cable should be connected to the indoor equipment via an isolator that provides a minimum isolation of 3 kV r.m.s. and 7 kV impulse, and the outer conductor of the coaxial cable should be earthed on the antenna side of the isolator to the same equipotential bonding point described in Item (b)(i) via an earthing conductor with a cross-sectional area of at least 2.5 mm².

(iii) If the cable feed from the antenna is twisted pair cable, the cable should be shielded and the shield should be earthed to the same equipotential bonding point

described in Item (b)(i) via an earthing conductor with a cross-sectional area of at least 2.5 mm².

(c) Any antenna mast having a free length exceeding 3 m, other than those of the self-supporting type, should be stabilised by the use of three or more stay wires or rods.

(d) To reduce the severity of any atmospheric (lightning) discharge coming down the cable feed from the antenna to the equipment, an inductive loop (typically 3 turns of cable approximately 200 mm in diameter) should be formed in the outdoor portion of the cable feed (e.g. near the antenna connection).

18 UNDERGROUND CABLING

18.1 Pits and access holes

18.1.1 Identification and marking

A pit or access hole **shall** be legibly and permanently labelled on the cover to distinguish it from a pit or access hole of another service, except in a case where the pit or access hole is provided for another service and is traversed by the customer cabling in accordance with Clause 18.1.5.

Note 1: Pits are factory-made and are therefore subject to the requirements of AS/CA S008, whereas access holes are usually fabricated on site and are only subject to AS/CA S009. It is a requirement of AS/CA S008 that pit covers be labelled 'Communications' or 'Comms'. However, some pits may be manufactured to a previous Standard (e.g. AUSTEL TS 008-1997 *Requirements for Authorised Cabling Products*) which didn't require specific markings.

Note 2: Before entering the pit or access hole, the cabling provider should check it for the presence of dangerous gases and reptiles, insects or objects (e.g. snakes, spiders, syringes).

18.1.2 Driveways

A pit or access hole **shall not** be placed in a driveway unless the pit or access hole is suitably strengthened or protected.

Note: The pit or access hole should be strengthened with sides, lid and surrounds for the rated vehicle load class in accordance with AS 3996, subject to a minimum of Class C.

18.1.3 Heavy loads

A pit or access hole installed in a location that may be subjected to heavy loads (e.g. traversed by heavy vehicles) **shall** be—

(a) protected by suitable guards or barriers that prevent entry of the load to the area containing the pit or access hole; or

(b) manufactured and installed in accordance with a design certified by a qualified mechanical engineer.

18.1.4 Conduit and cable entry to pits or access holes

18.1.4.1 General

Conduit or cable should only enter the ends (short sides) of any pit.

18.1.4.2 Conduits

Any hole in a pit or access hole provided for conduit entry should be—

(a) spaced at least 50 mm above the inside bottom surface of the pit to form a siltation trap to prevent silt entering the conduit

and to enable the pit or access hole to be cleared of silt when necessary;

(b) spaced at least 25 mm away from any other conduit entry hole;

(c) the correct size to ensure a firm conduit fit to minimise siltation of the pit;

(d) fitted with a suitable bush (flange) inserted from the inside of the pit except in—

(i) highly reactive soils where allowance should be made for longitudinal movement of the conduit by extending the conduit at least 50 mm, but no more than 100 mm, into the pit or access hole; or

(ii) areas where ants or termites are particularly aggressive, in which case any conduit that runs to a building should be extended at least 50 mm, but no more than 100 mm, into the pit or access hole to allow the application of a suitable ant-proof sock; and

(e) plugged or sealed by suitable means to prevent siltation of the pit if the hole is not used for conduit entry.

18.1.4.3 Cables

Where a cable is directly buried in the ground without conduit—

(a) the cable should be installed in conduit for at least 300 mm before the pit or access hole to protect the cable sheath where it enters the pit or access hole;

(b) the conduit described in Item (a) should be installed in accordance with Clause 18.1.4.2; and

(c) the non-pit end of the conduit should be plugged or sealed in the ground to prevent siltation of the pit via the conduit.

18.1.4.4 Building entry conduit

A conduit entering a building **shall** be appropriately installed or plugged within the pit or access hole to inhibit the entry of fluid, gas, insects or vermin into the building.

18.1.4.5 Drainage of pits and access holes

Where practicable, pits and access holes should be drained as follows:

(a) Conduits running between pits or access holes should not be plugged or sealed to allow natural drainage of water to the lowest pit or access hole.

Note: Any conduit running downhill to a pit located next to a building should be plugged or sealed to minimise the risk of flooding the building unless the pit next to the building is

suitably drained. Any conduit entering a building is required by Clause 18.1.4.4 to be plugged or sealed within the pit or access hole.

(b) Subject to the requirements of any environmental regulations, the lowest pit or access hole should be drained to a lower drainage point such as the back of a roadway kerb, a stormwater drain or a natural watercourse.

18.1.5 Sharing with LV or HV power

A customer cable or joint **shall not** be installed in the same pit or access hole as an LV or HV power cable or joint except for—

(a) traversing of the pit or access hole by either the power cable or the customer cable, which **shall** be—

(i) enclosed in a continuous run of sealed, insulating conduit that is suitably identified and that extends beyond the outer extremities of the pit or access hole; and

(ii) separated within the pit or access hole from the other service in accordance with Clause 16.3 or 16.4, as applicable; or

(b) traversing of an LV or an HV pit or access hole by a customer cable that does not contain electrically conductive elements and that is installed in a conduit with a power cable in accordance with Item 8.3.1(c).

Note 1: Customer cabling may share a pit or access hole with ELV power cable. However, it is recommended that the ELV cable or the pit or access hole be labelled or marked with the working voltage carried by the ELV cable.

Note 2: Refer to Clause 8.3.3.2 for sharing of pits and access holes with cables carrying LV telecommunications circuits.

18.1.6 HV sites

Any pit or access hole installed in or near an HV site **shall** comply with Clause 6.1.

18.2 Pillars and cabinets

18.2.1 Locking in public areas

A pillar or cabinet installed in a public place (e.g. footway, roadway, park) **shall** have a lock installed.

Note: The permission of the relevant local authority is required to install a pillar or a cabinet in a public place.

18.2.2 HV sites

Any pillar or cabinet installed in or near an HV site **shall** comply with Clause 6.1.

18.3 Conduit and marking tape

18.3.1 Public footways and roadways

Underground customer cable installed under a public footway or roadway **shall** be—

(a) enclosed in compliant conduit; or

(b) covered by a white marking tape which—

(i) complies with AS/NZS 2648.1;

(ii) includes lettering to identify the service; and

(iii) is installed a minimum of 100 mm above the cable.

18.3.2 Other locations

Where underground customer cable is installed in a location other than a public footway or roadway, it is recommended that it is installed in accordance with one of the following:

(a) The cable is enclosed in compliant conduit.

(b) The cable is covered by white marking tape in accordance with Item 18.3.1(b).

(c) The cable route is marked at regular intervals (e.g. using cable marker posts).

18.3.3 Conduit compliance

Any conduit used for underground customer cabling **shall** comply with AS/CA S008 unless—

(a) the conduit is to be installed as sub-ducting in a larger conduit that complies with AS/CA S008; or

(b) otherwise allowed in this Standard.

Note 1: AS/CA S008 requires conduit to be marked 'COMMUNICATIONS' and non-metallic conduit to be coloured white or contain a white stripe.

Note 2: Conduit installed as sub-ducting in a larger conduit that complies with AS/CA S008 in accordance with Item (a) need only comply with Clauses 5.1 and 8.3.1(i.e. it should not have misleading markings that may create a safety hazard or be of a prohibited colour).

Note 3: Rigid conduit should be used for the purpose of drawing in cables. Flexible or corrugated conduit is not recommended for this purpose.

18.3.4 Sub-ducting of customer cable in enveloper conduit or pipe

A customer cable that contains electrically conductive elements installed in an enveloper conduit or pipe that is not a prohibited colour, but which does not comply with AS/CA S008, **shall** be sub-

ducted in compliant conduit through the enveloper conduit or pipe and any associated pits or access holes.

Note: Enveloper conduits and pipes are typically used for service crossings under roadways or for common service distribution in some industrial premises. Refer to Clause 8.3.3 if the enveloper conduit or pipe is to be shared with a hazardous service.

18.3.5 Conduit integrity

18.3.5.1 General

Conduits installed underground should—

(a) be designed and installed such that cables may be drawn through them between access points safely and without damage to any conduit or any cable;

(b) use rigid (e.g. UPVC or polyethylene) conduit with an inside diameter no less than 23 mm but which is sized for the type and number of cables to be drawn in; and

(c) be provided with a suitable rope or cord for drawing in cables.

Note: AS/NZS 3084 provides guidance on dimensioning of underground conduits.

18.3.5.2 Bends

No more than three 90° conduit bends, or equivalent, should be installed between access points and should be sized in accordance with Table 3.

Note: Bends should be prefabricated and not formed in the conduit by the application of heat or a bending tool and should not consist of flexible/corrugated conduit. However, conduit may be curved in the ground to a curvature radius of no less than 130 times the nominal inside diameter of the conduit. Such curves do not count as bends in applying the three-bend limit.

18.3.5.3 Conduit access points

A conduit access point may be a pit, access hole or an aboveground conduit termination point at a building. The distance between access points should not exceed the relevant distance set out in Table 3.

18.3.5.4 Conduit and bend couplings

All conduit and bend couplings should be made—

(a) free of snag points by cutting the end of the conduit at a right angle to the axis of the conduit and removing all burrs and sharp edges using a file or scraper; and

(b) using a solvent adhesive, weld or fitting that is watertight and able to resist significant longitudinal tension or torsion in the conduit during and after installation.

Note 1: While it is virtually impossible to keep water out of underground conduit (due to condensation and seepage in pits), watertight joints are necessary to—

(a) prevent blockages due to the ingress of water-borne silts;

(b) prevent damage and blockages due to invasion from plant roots; and

(c) prevent the ingress of insects (especially ants and termites) that may damage the cable or use the conduit as an access corridor to a building.

Note 2: Tension and torsion may be exerted on conduit after installation due to soil movement, especially in highly reactive soils.

Table 3

Conduit curves, bends and distances between access points

Nominal inside diameter (ID) of conduit (mm)	Typical actual inside diameter (mm)	Minimum curvature radius (130 x ID) (mm)	Minimum bend radius mid-run (mm)	Minimum bend radius within 500 mm of an access point (mm)	Maximum distance between access points (m)
20	23	2600	300	100	50
50	53	6500	800	300	100
100	105	13000	5000	800	100

Note: The conduit sizes are rounded to the nearest integer and are based on the values listed in AS/NZS 1477 for PN 9 and PN 12 PVC pressure pipes, which are the values used by carriers for their conduit.

18.4 Cable compliance

A customer cable installed underground, whether or not installed in conduit, other than coaxial cable, a blown fibre tube system or a special application cable, **shall** meet the requirements of AS/CA S008 for—

(a) UV resistance; and

(b) water penetration.

Note 1: Underground cable may be exposed to UV radiation (sunlight) at points where it enters or exits the ground or if a pit or access hole cover is dislodged or damaged for an extended period.

Note 2: Water penetration refers to the effectiveness of a cable to restrict the longitudinal movement of water or moisture along the core. This requirement is primarily intended to localise any water penetration so as to minimise the adverse effect on cable performance and to prevent water or moisture leaking into joints and terminations that may cause corrosion problems.

Note 3: Additionally, cable installed underground should have a high-density compound sheath material (such as polyethylene) that provides an adequate barrier to moisture entry to the cable core. The addition of a lapped metal tape ('moisture barrier') provides higher protection against moisture permeating through the sheath. Grease, gel or alternatively dry-core technology applying super absorbent polymers (water swellable yarns and tapes) within the core blocks the water entry longitudinally along the cable.

Note 4: Cable susceptible to ant/termite attack or that is buried directly in the ground without conduit should be a type that provides additional mechanical protection against abrasion and insects such as a nylon jacket with an optional sacrificial jacket.

Note 5: Not all cables sold as 'outdoor' or 'indoor/outdoor' cables meet the water penetration requirements for underground use. Installers should verify with the cable manufacturer that such a cable meets the water penetration requirements of AS/CA S008.

Note 6: Optical Fibre special application cable not meeting the UV resistance and water penetration of AS/CA S008 is deemed to be conductive when determining separation from hazardous services.

18.5 Blown fibre tube systems

A blown-fibre tube system installed underground **shall**—

(a) be contiguous between access points;

(b) have access points appropriately located or sealed to prevent the ingress of moisture; and

(c) be appropriately installed or plugged when entering a building to prevent the passage of fluid or gas into the building from any pit or access hole.

18.6 Depth of cover

18.6.1 Public footways or roadways

Underground customer cabling located under a public footway or roadway **shall** be installed at a minimum depth of 450 mm, measured from the finished ground/pavement surface to the top of the cable or conduit, or as otherwise agreed with the relevant local authority.

Note: The permission of the relevant local authority is required to install customer cabling in a public footway or roadway.

18.6.2 Places other than public footways or roadways

Underground customer cabling in a location other than a public footway or roadway **shall** be installed to a minimum depth of 300 mm, measured from the finished ground/pavement surface to the top of the cable or conduit, unless the soil conditions preclude a depth of 300 mm, e.g. solid rock or shale, in which case the cabling may be installed in accordance with one of the following methods:

(a) Installation of the cable or conduit at any depth under a covering of at least 50 mm of fine aggregate concrete.

(b) Installation of the cable in compliant medium duty metallic conduit chased into, or secured to the surface of, the ground and installed in such a way so as not to be hazardous to pedestrians.

(c) Installation of the cable in compliant conduit installed above the surface of the ground and secured against a fixed vertical structure such as a retaining wall or fence.

(d) Use of steel wire armoured (SWA) cable, without enclosure in conduit, either—

(i) chased into, or secured to, the surface of the ground and installed in such a way so as not to be hazardous to pedestrians; or

(ii) installed above the surface of the ground and secured against a fixed vertical structure such as a retaining wall or fence.

Note: Installation of metallic conduit and/or steel wire armoured cables in an EPR hazard zone may extend the hazard zone. In such cases, the installation should only proceed on the basis of an engineered design prepared in compliance with the relevant code agreed between the carrier and the power utility. Refer to Clause 6.1.

18.7 Crossing another service

18.7.1 General

Where underground customer cabling crosses another service, the separation at the crossing **shall** be in accordance with the requirements of the other utility provided that, where the other service is LV or HV power, the separation is greater than or equal to the minimum separations specified in Clause 18.7.2.

18.7.2 Crossing with LV or HV power

Where customer cabling crosses LV or HV power cabling—

(a) it should cross above the power cabling;

(b) where it is necessary for power to be uppermost and it is not enclosed in heavy duty orange conduit, a concrete barrier to Clause 3.11.4.3 of AS/NZS 3000 **shall** be placed above the power cables for 600 mm either side of the crossing; and

(c) whether or not the customer cabling crosses above or below the power cabling, separation between the customer cabling and the power cabling at the crossing **shall** be in accordance with Table 4.

18.8 Separate trench ('exclusive trench')

18.8.1 General

Where underground customer cabling runs in a separate trench ('exclusive trench') alongside trenching for another service, the separation **shall** be in accordance with the requirements of the other utility provided that, where the other service is LV or HV power, the separation is greater than or equal to the minimum separations specified in Clause 18.8.2.

18.8.2 Parallel run with LV or HV power

For a parallel run with LV or HV power cabling in a separate trench, the minimum separation between the customer cabling and the power cabling **shall** be in accordance with Table 4.

Note: The separation distances may be measured vertically or diagonally, as long as the customer cabling is above the power cabling for the total length of the run.

18.9 Shared trench with another service

18.9.1 General

Where customer cabling is installed in a trench together with a conduit, pipe or cable of another service such as gas, water or LV or HV power, physical separation between the customer cabling and the other service **shall** be as required by the other utility provided that, where the other service is LV or HV power, the separation is greater than or equal to the minimum separations specified in Clause 18.9.2.

Note: The trench may be shared with more than one service as long as the required separation is maintained from each service.

18.9.2 Shared trench with LV or HV power

No separation is required between an insulating customer cable conduit and an insulating LV power conduit where the customer cable conduit is coloured white (or with a white stripe) and is marked 'COMMUNICATIONS' and the power conduit is coloured orange and is marked 'ELECTRICAL'. In other cases, separation of customer cabling and LV or HV power cabling **shall** be in accordance with Table 4.

Note: The separation distances may be measured vertically or diagonally, provided the customer cabling is above the power cabling for the total length of the run.

18.10 Low frequency induction (LFI)

It is necessary, in cases of parallel runs with underground or aerial HV power lines, to evaluate the level of low frequency induction. If the level of induction exceeds the permissible limit, the installation should only proceed on the basis of an engineered design prepared in compliance with the relevant codes. Refer to Clause 6.2.

18.11 Exclusion zones

When installing or repairing underground customer cabling, the cabling provider **shall** comply with the relevant State or Territory regulations for working near underground utility services such as HV power cables, gas pipelines, water mains or sanitation pipes.

Note: Specific approval or accreditation may be required to work within any exclusion zone defined by the relevant authority.

Table 4
Underground customer cabling separation from power cabling

	Telecommunications cabling situation	Power cable protection	Minimum separation distance
LV	Exclusive trench crossing above LV	In or under a covering to AS/NZS 3000 requirements (Note 1)	100 mm
	Exclusive trench crossing above LV	No covering (Note 2)	300 mm
	Exclusive trench crossing under LV	Heavy duty orange conduit or a concrete barrier to Clause 3.11.4.3 of AS/NZS 3000 above the LV for 600 mm either side of the crossing	100 mm
	Exclusive trench parallel run	In or under a covering to AS/NZS 3000 requirements (Note 1)	100 mm
	Exclusive trench parallel run	No covering (Note 2)	300 mm
	Shared trench in insulating conduit	In heavy duty orange conduit marked 'ELECTRICAL'	Nil (Note 3)
	Shared trench	Under a covering to Clause 3.11.4.3 of AS/NZS 3000 (Note 1)	100 mm
	Shared trench	No covering (Note 2)	300 mm
HV	Exclusive trench crossing above HV	In or under a covering to AS/NZS 3000 requirements (Note 1)	300 mm
	Exclusive trench crossing above HV	No covering (Note 2)	450 mm
	Exclusive trench crossing under HV	Heavy duty orange conduit or a concrete barrier to Clause 3.11.4.3 of AS/NZS 3000 above the HV for 600 mm either side of the crossing	300 mm
	Exclusive trench parallel run	In or under a covering to AS/NZS 3000 requirements (Note 1)	300 mm
	Exclusive trench parallel run	No covering (Note 2)	450 mm
	Shared trench	In or under a covering to AS/NZS 3000 requirements (Note 1)	300 mm
	Shared trench	No covering (Note 2)	450 mm

Note 1: Clause 3.11 of AS/NZS 3000 applies. This includes Category A systems where the power cable is enclosed in a heavy duty cabling enclosure without further protection, such as in orange (heavy duty) insulating conduit, and Category B systems where additional mechanical protection is provided above the power cable in accordance with the requirements of Clause 3.11.4.3 of AS/NZS 3000.

Note 2: Installation of underground power cable in customer premises without a protective covering is not allowable under AS/NZS 3000. However, there may be cases where AS/NZS 3000 does not apply or has not been followed, in which case unprotected underground power cable may be encountered. In such circumstances it is recommended to use the separation distances stated in ACIF C524 Industry Code.

Note 3: No separation is required if the customer cable is enclosed in insulating conduit, coloured white (or with a white stripe) and is marked 'COMMUNICATIONS'.

Note 4: For added cable protection, customer cabling may be enclosed in insulating conduit that complies with AS/CA S008 requirements, but this does not reduce the minimum separation distances required except for the case described in Note 3.

19 AERIAL CABLING

19.1 Poles and support structures

19.1.1 General

Any pole or structure supporting aerial customer cable—

(a) **shall** be fit for the purpose;

(b) **shall** be installed to a depth or otherwise anchored to adequately support itself and the maximum likely load; and

(c) should be regularly inspected by a qualified pole inspector to ensure its ongoing safety.

19.1.2 Separation of poles and structures from aerial power lines

19.1.2.1 Parallel pole routes

Poles or structures supporting aerial customer cable in a parallel route to an aerial power line supported on separate poles or structures **shall** be installed such that the aerial customer cable, poles, structures, supports and fittings are separated from the vertical projection below any aerial power line, pole, structure, support or fitting by a minimum distance of—

(a) 50 m for an aerial HV power line exceeding 330 kV;

(b) 10 m for an aerial HV power line not exceeding 330 kV;

(c) 10 m for an uninsulated aerial LV power line;

(d) 10 m for an insulated aerial LV power line owned or operated by a power utility unless otherwise agreed by the power utility; or

(e) 2.4 m in all other cases.

19.1.2.2 Crossings

A pole or structure supporting aerial customer cable at a crossing with an aerial power line **shall** be separated from the aerial power line in accordance with Item 19.5.7.1(d).

19.2 Ground clearance

The minimum clearance from ground in any direction of an aerial customer cable **shall** be as follows:

(a) Over any customer premises land not traversable by road vehicles — 2.7 m.

(b) Over any residential driveway — 3.5 m.

(c) Over any commercial/industrial driveway or private roadway — 4.9 m.

(d) Over any public roadway or footway — as required by the relevant authority but, in any case, no less than 4.9 m.

Note: The ACIF C524 Industry Code may be used as a guide for cabling in public property.

19.3 Cable compliance

19.3.1 UV resistance

Customer cable installed as aerial cabling **shall** meet the requirements of AS/CA S008 for UV resistance unless the entire length of the cable is protected against exposure to direct sunlight, e.g. totally enclosed in suitable conduit.

19.3.2 Integral bearer cable

Cable with an integral bearer **shall** meet the relevant requirements of AS/CA S008.

Note: Integral bearer cable is required for crossings and shared poles with aerial power lines (see Clause 19.5.8.1).

19.4 Fastening of catenary supports or bearers

Catenary support or bearer fastenings to poles, walls or other supporting structures—

(a) **shall** be capable of supporting the load of the cable under the installed conditions taking account of span length, wind speed, ambient temperature range, sag, tension and applicable safety factors;

(b) **shall** be terminated so as to support the installation under extreme weather conditions; and

(c) should be terminated with a termination that tightens on the fixing device as the strain increases.

19.5 Crossings and shared poles (joint use) with aerial power lines

19.5.1 General

Aerial customer cabling may cross aerial power lines or may be run on the same poles or structures as aerial power lines, subject to the requirements of Clauses 19.5.2 to 19.5.10.

Note: Long parallel runs of aerial HV power lines and customer cabling that contains electrically conductive elements should be avoided where possible. Refer to Clause 6.2 and Appendix H.

19.5.2 Permission of the owner of the poles

Aerial customer cabling **shall not** be attached to any pole or structure carrying an aerial power line unless the owner of the pole or structure has authorised the attachment.

Note: Before any cable is attached, the pole or structure may need to be assessed to ensure it is capable of supporting the additional dynamic load.

19.5.3 Attachment to poles or structures carrying HV power lines exceeding 66 kV

Aerial customer cabling **shall not** attach to a pole or structure carrying an aerial power line exceeding 66 kV.

19.5.4 Attachment to poles or structures carrying HV power lines not exceeding 66 kV

Aerial customer cabling that contains electrically conductive elements **shall not** attach to a pole or structure carrying an HV power line unless—

(a) there is an existing LV power line below the HV power line and the pole or structure is not conductive; or

(b) the attachment is for a crossing only and the pole or structure is not conductive.

Note: Whether or not the customer cabling contains electrically conductive elements, it is to be separated from power and other services in accordance with Clause 19.5.7.

19.5.5 Attachment to a pole or structure carrying an HV power transformer

Aerial customer cabling **shall not** attach to a pole or structure carrying an HV power transformer.

19.5.6 Crossing aerial HV power lines exceeding 330 kV

Aerial customer cabling **shall not** cross an aerial power line exceeding 330 kV.

Note: Where it is necessary for customer cabling to cross an aerial power line exceeding 330 kV, the customer cabling should be installed underground for at least 50 m each side of the power line at an angle as near as practicable to 90° to the power line route.

19.5.7 Relative position of aerial customer cabling and aerial power lines

19.5.7.1 Crossings

Aerial customer cabling may cross aerial power lines not exceeding 330 kV at poles/structures or in span under the following conditions:

(a) The aerial customer cabling **shall** cross below the aerial power line except in unusual circumstances, e.g. cabling between tall buildings, in which case aerial customer cabling may cross above the aerial power line as long as—

(i) the span of the customer cabling and its height above the aerial power line are such that, in the event of a

failure at either extremity of the span, the customer cabling will clear the power line by at least 5 m; and

(ii) the agreement of the utility or body that owns or operates the aerial power line is obtained.

(b) The aerial customer cabling **shall** be separated from the aerial power line in accordance with Clause 19.5.7.3 and any other aerial services in accordance with Clause 19.6.

(c) The point of crossing **shall** be as far as practicable from the middle of the aerial power line span as long as—

(i) the customer cable is not within 2.4 m of any pole or structure carrying an aerial LV power line or within 3.6 m of any pole or structure carrying an aerial HV power line; or

(ii) the customer cable is attached to the pole or structure carrying the aerial power line, subject to the requirements of this Standard.

(d) A pole or structure supporting aerial customer cable on either side of a crossing with an aerial power line **shall not** be installed within 2.4 m of the vertical projection below any aerial power line unless the radial distance from any part of the pole or structure to the aerial power line is at least the distance specified in Table 5.

19.5.7.2 Shared poles or structures ('joint use')

Aerial customer cabling, including any joint or termination enclosure, that is installed on the same poles or structures as an aerial power line, i.e. run in parallel with the power line, **shall not** be installed above the aerial power line.

Note: This does not apply to aerial customer cabling and aerial power lines that are suspended between two buildings—

(a) on separate bearers or catenary supports and separated in accordance with Clause 19.1.2.1; or

(b) secured to the same catenary support, subject to the requirements of Clause 8.2.1, and separated in accordance with Clause 8.5.

19.5.7.3 Separation from aerial power lines and fittings

Aerial customer cabling, including any joint or termination enclosure, that attaches to the same pole or structure as an aerial power line or that crosses an aerial power line in span **shall** be separated from the aerial LV and HV power lines and fittings in accordance with Table 5.

19.5.8 Cable

19.5.8.1 Cable type

An aerial customer cable that crosses an aerial power line or that is attached to any pole or structure carrying an aerial power line **shall**

incorporate an insulated, integral bearer.

19.5.8.2 Cable bearer

The bearer of the customer cable—

(a) **shall** be insulated from any conductive pole or structure carrying an aerial power line;

(b) **shall** be insulated or shrouded to prevent accidental personal contact with the bearer by an electrical worker accessing the power line; and

(c) **shall not** be earthed.

19.5.9 Joints or terminations

Any aerial customer cable joint or customer cable connections installed on a pole or structure carrying an aerial power line **shall** be contained within an enclosure that has double insulation between the internal conductors and the external surface of the enclosure, in accordance with the requirements of AS/CA S008.

19.5.10 Power earthing conductors

Any power earthing conductor installed on a pole or structure to which aerial customer cabling is attached **shall** be insulated between the ground and 600 mm above the uppermost customer cabling attachment or fitting.

19.6 Separation from other telecommunications cabling

Aerial customer cabling **shall** be separated from any other aerial telecommunications cabling in accordance with the requirements of the relevant carrier, service provider or utility.

19.7 Cabling across watercourses

Aerial customer cabling over navigable water **shall**—

(a) be installed in a way that will allow normal safe passage of vessels; and

(b) comply with the requirements of the relevant authorities.

19.8 Exclusion zones

When working on or near any pole or structure carrying an aerial power line, the cabling provider **shall** comply with the relevant State or Territory regulations for working near aerial power lines.

Note: Specific approval or accreditation may be required to work within any exclusion zone defined by the relevant authority.

Table 5

Minimum separation of aerial customer cabling, including joint or termination enclosures and telecommunications poles or structures, from aerial power lines and fittings

Type of power line, structure or fitting		At a shared/ common pole or structure (Note 8)	In span	Telecommunications pole or structure		
				Crossing (Note 5)		Separate parallel route
				Horiz.	Radial	
Light fitting, stay fitting or power conduit at a pole		50 mm	n/a	n/a		n/a
LV cable independently secured to the same catenary support as the customer cable (Note 1)		50 mm or insulating conduit	Insulating conduit	n/a		n/a
Independently supported, insulated LV (Notes 2 and 3)		0.6 m	0.6 m	2.4 m	2.4 m	2.4 m
Uninsulated LV		1.2 m	0.6 m	2.4 m	2.4 m	10 m
HV (Note 3)	≤ 11 kV	2.4 m (Note 4)	1.2 m	2.4 m	3.7 m	10 m
	> 11 kV ≤ 33 kV		2.1 m	2.4 m	4.0 m	10 m
	> 33 kV ≤ 66 kV	3.0 m (Note 4)	2.1 m	2.4 m	4.0 m	10 m
	> 66 kV ≤ 132 kV	Note 6	3.0 m	2.4 m	4.6 m	10 m
	> 132 kV ≤ 220 kV		3.7 m	2.4 m	6.0 m	10 m
	> 220 kV ≤ 330 kV		4.6 m	2.4 m	7.5 m	10 m
	> 330 kV		Note 7	Note 7		50 m

Note 1: Refer to Clause 8.2.1 and Item 8.5(d).

Note 2: 'Independently supported, insulated LV' means—

(a) aerial bundled cable (ABC);

(b) insulated cable on a separate catenary support;

(c) aerial insulated cable to a light fitting; or

(d) an insulated service lead or neutral-screened cable servicing a building.

Note 3: Earthed Metallic Screened HV ABC may be treated as 'Independently supported insulated LV'.

Note 4: HV separations at the pole apply where no aerial LV power line is installed below the HV (attachment to the pole in such cases is only permitted for crossings).

Note 5: Where the horizontal distance cannot be met, the radial distance applies. The horizontal distance is measured from the vertical projection below the aerial power line to any part of the telecommunications pole or structure. The radial distance is measured from the power line itself to the closest part of the telecommunications pole or structure. Refer to Item 19.5.7.1(d).

Note 6: Attachment of customer cabling to a pole or structure carrying power lines exceeding 66 kV is not permitted (see Clause 19.5.3).

Note 7: Aerial customer cabling crossings with aerial power lines exceeding 330 kV are not permitted (see Clause 19.5.6). Where it is necessary for customer cabling to cross power lines exceeding 330 kV, the customer cabling should be installed underground for at least 50 m each side of the power lines at an angle as close as practicable to 90° to the power line route.

Note 8: The customer cable bearer is to be insulated from any conductive pole or structure and insulated or shrouded to prevent accidental personal contact with the bearer by an electrical worker accessing the power line. Refer to Clause 19.5.8.2.

20 TELECOMMUNICATIONS EARTHING AND POWER DISTRIBUTION

20.1 Application

This section applies to customer cabling used for telecommunications earthing and telecommunications power distribution in customer premises.

Note: An ELV (DC or AC) power supply system may be subject to the requirements of AS/NZS 3000 and the relevant energy authority in addition to this Standard.

Several systems of earthing may be used for telecommunications purposes, as described in Clause 20.2.

20.2 Earthing systems, general description

20.2.1 Communications Earth System (CES)

The CES is a dual-purpose telecommunications earthing system used for both functional and protective purposes. Earthing conductors used for this system have green/yellow insulation.

20.2.2 Telecommunications Reference Conductor (TRC)

The TRC is a low noise telecommunications earthing system used specifically for signalling and other functional purposes, which may include equipment reliability. TRC status is indicated by the use of earthing conductors with violet insulation. For new installations, a TRC system would normally only be used where a CES is too noisy for the intended application.

20.2.3 ELV DC power supply system

Installations in restricted access locations operating an ELV DC power supply system may provide for DC/earth return paths in accordance with AS/NZS 3015. With this system, the earth may be distributed to equipment via the positive or negative conductor of the DC supply.

20.2.4 DC earth return circuit

A DC earth return circuit may be required where continuous DC current will be discharged to earth, e.g. for remote power feeding purposes. Such circuits require the installation of a dedicated earth electrode to prevent damage to the electrical earthing system. Earthing conductors used for this purpose have violet insulation and are labelled at each termination point.

20.3 Compliance labelling

Earthing and telecommunications power distribution components (e.g. earthing/power conductors, earthing bars, busbars, earthing/power terminals, line tap devices, earth electrodes and

associated fittings, batteries, fuses and circuit breakers) are not required to comply with the *Telecommunications Labelling Notice*.

20.4 Power distribution current limiting

Where customer cabling is used for power feeding other than power derived from a carriage service, the cabling **shall** be protected from excessive current flow that may cause damage or fire, by such means as fuses, circuit breakers or current limiting circuitry.

Note: This includes single core conductors or busbars used for an ELV (DC or AC) power supply system used to power telecommunications equipment.

20.5 EPR hazard zones

An earthing or bonding connection **shall not** be made to any equipment, cabling, earth electrode or any earthed object that is located within an EPR hazard zone.

Note: This is to prevent—

(a) the EPR hazard being extended outside the hazard zone; and

(b) a remote earth being extended inside the hazard zone.

20.6 Functional earth requirement

Where a connection to a functional earth is specified for customer equipment by the manufacturer or supplier of the equipment—

(a) if connection to a particular type of earthing system is not specified, the functional earth connection may be made to a CES, TRC, ELV DC power supply system or a DC earth return circuit, as appropriate to the circumstances;

(b) if the equipment was manufactured after 1997 and connection to a particular type of earthing system is specified (e.g. TRC), the equipment **shall** be connected to that type of earthing system; or

(c) if the equipment was manufactured before 1998 and connection to a TRC, Telecommunications Service Earth (TSE) or Telecommunications Earth (TE) is specified, the functional earth connection may be made to a CES, TRC, ELV DC power supply system or a DC earth return circuit, as appropriate to the circumstances.

Note: A CES may be too noisy for some equipment in some situations.

20.7 Protective earth requirement

Where a connection to protective earth is specified for customer cabling or customer equipment in this Standard or elsewhere, it **shall** be connected in accordance with one of the following:

(a) To a CES.

(b) Where a TRC system is installed—

(i) to the CET (where provided); or

(ii) to the bar, terminal or backmount at the designated distributor where the green/yellow equipotential bonding conductor is connected (see Figures 5, 6 and 7).

(c) In appropriate circumstances, via an equipotential bonding conductor directly to the electrical earth electrode by an independent connecting device, which **shall** be clearly identified.

(d) Directly to the electrical earthing system via a protective earthing conductor (see Note 1).

(e) If there is no electrical earthing system at the building, to an earth electrode which—

(i) **shall** comply with Clause 20.13.8.2;

(ii) should comply with Clause 20.13.8.3;

(iii) **shall** have a resistance to the mass of earth not exceeding 30 Ω (see Note 2); and

(iv) should also be connected by an independent connecting device to any metallic structural building elements or services (e.g. water pipe).

Note 1: A protective earthing conductor is part of the electrical installation and usually needs to be installed by a licensed electrical worker.

Note 2: A resistance to the mass of earth of 10 Ω or less is recommended.

20.8 Earthing and bonding conductors

20.8.1 Conductor type

Except in the case of an individual signalling lead or cable shield/drain wire connection in accordance with Clause 20.8.2, all earthing and bonding conductors **shall** be multi-stranded copper conductor, single core, PVC insulated, 0.6/1.0 kV rated voltage.

Note: In this Standard, reference is made to earthing conductor size based on the total cross-sectional area of the stranded conductor.

20.8.2 Multi-pair cable

Multi-pair cable **shall not** be used for earthing distribution except for individual connection of a functional earth to customer equipment in conjunction with a telecommunications line (e.g. at a telecommunications outlet).

Note: The cable shield or drain wire of a multi-pair cable may be earthed in accordance with Clause 20.18.

20.8.3 Conductor size

An earthing or bonding conductor **shall** be of the minimum size listed for the relevant application in Table 7 as long as the resistance limits specified in Clauses 20.11.2.4, 20.12.4 and 20.13.11 are not exceeded.

20.8.4 Connection or jointing/coupling of conductors

All earthing and bonding conductors **shall** be connected, joined or coupled in accordance with Clauses 20.9.2 or 20.10, as applicable.

20.9 Earthing or bonding bars and terminals

20.9.1 Capacity

An earthing/bonding bar or terminal used for connection of earthing or bonding conductors, other than a terminal used for connection of an individual signalling lead or cable shield/drain wire described in Clauses 20.8.1 and 20.8.2, **shall**—

(a) be capable of terminating conductors of at least 6 mm^2 in cross-sectional area or cable lugs designed to terminate 6 mm^2 conductors; and

(b) be sized to suit the installation.

20.9.2 Earthing or bonding conductor connection

The following requirements apply to the connection of an earthing or bonding conductor to an earthing/bonding bar or terminal, other than a terminal used for connection of an individual signalling lead or cable shield/drain wire described in Clauses 20.8.1 and 20.8.2:

(a) The conductor **shall** be secured by means of a screw, either directly or using a cable lug.

(b) Sufficient insulation **shall** be removed from the conductor to secure all conductor strands in the termination.

(c) The bare strands of the conductor **shall** be twisted or otherwise consolidated before fixing in the termination.

(d) Consolidation of bare strands before termination **shall not** be made by means of soldering.

(e) Where a cable lug is used to terminate the conductor, the conductor **shall** be secured to the cable lug within a suitable ferrule that is crimped or compressed using a tool designed for the purpose.

Note: If required, the termination within the ferrule of a cable lug may be filled with solder after crimping to exclude moisture.

20.9.3 Access to earthing/bonding bars or terminals

The earthing/bonding bar or terminal **shall** be enclosed or located to prevent unintentional contact by a person who is not doing cabling work.

20.10 Earthing and bonding conductor joints and couplings

20.10.1 Jointing/Coupling method

20.10.1.1 General

Any earthing or bonding conductor joint or coupling **shall** be mechanically and electrically sound to reliably maintain electrical continuity by one of the methods described in Clauses 20.10.1.2 to 20.10.1.5.

20.10.1.2 Soldered connections

Where a soldered connection is used, it **shall** be made such that the conductors are retained firmly in position independently of the solder, e.g. by crimping in a metal ferrule or, for conductors of not more than seven strands, twisted together.

20.10.1.3 Clamped connections

Any clamped connection **shall** be made so that the conductors are securely retained between metal surfaces that are shaped or arranged to prevent spreading of any conductor strands.

20.10.1.4 Tunnel type connections

Where a tunnel type connector is used—

(a) the connector used **shall** have at least two screws per termination tunnel; and

(b) all conductors **shall** be secured by at least two screws within the same tunnel.

20.10.1.5 Crimped connections

Any crimped connection **shall** be made such that the conductors being joined or coupled are securely retained within a suitable ferrule that is crimped using a tool designed for the purpose.

20.10.1.6 Insulation displacement connectors

An insulation displacement connector **shall not** be used for jointing or coupling of earthing or bonding conductors.

20.10.2 Insulation of the joint/coupling

All earthing or bonding conductor joints and couplings **shall** be insulated or housed in an insulated enclosure.

20.11 Equipotential bonding

20.11.1 General

The CES or TRC **shall** be equipotentially bonded to the earthing system of the electrical installation to minimise the potential difference (voltage) between the earthing systems.

Note 1: Additional requirements for the CES or TRC are set out in Clauses 20.12.3 and 20.13.9 respectively.

Note 2: Equipotential bonding methods are illustrated in Figures 3 to 6.

20.11.2 Communications bonding conductor

20.11.2.1 Colour and size

The earthing conductor used for equipotential bonding **shall** have—

(a) a minimum cross-sectional area of 6 mm^2; and

(b) green/yellow insulation.

20.11.2.2 Length

The bonding conductor **shall** be as short and as direct as practicable.

Note: Where a surge suppression device is installed, the total earthing conductor length between the surge suppression device and the main earthing bar, terminal or connection in the electrical switchboard should not exceed 10 m. A total earthing/bonding conductor length of 1.5 m or less is preferred for more effective end-user protection and for protection of any equipment connected to the telecommunications line.

20.11.2.3 Labelling

The bonding conductor **shall** be legibly and durably labelled 'Communications Bonding Conductor' or 'Telecommunications Bonding Conductor' at the electrical installation end and, where both ends of the bonding conductor are not readily identifiable, at the telecommunications earthing system end.

20.11.2.4 Resistance

The resistance of the communications bonding conductor **shall not** exceed 0.5 Ω.

Note 1: This resistance is measured between the point where the bonding conductor connects to the electrical earthing system and the CET (bonding method 1 or 2) or the bar, terminal or backmount in the telecommunications equipment (bonding method 3).

Note 2: The resistance may be measured using a suitable instrument or may be calculated according to the length and size of the bonding conductor using Table 6.

Table 6

Resistance vs. length for standard copper earthing conductors

Nominal area (mm^2)	Maximum diameter (mm)	Nominal resistance @20°C plain annealed copper (Ω /km)	Nominal conductor length for 1 Ω resistance (m)
2.5	2.1	7.41	135
4	2.6	4.61	217
6	3.2	3.08	324
16	5.2	1.15	869
35	7.8	0.524	1908

Note: To determine the maximum conductor length for a given resistance, multiply the length in the last column with the resistance value, e.g. length of 2.5 mm^2 conductor for a resistance of 5 Ω = 135 x 5 = 675 m.

20.11.3 Communications Earth Terminal (CET)

20.11.3.1 General

A CET **shall** comply with Clause 20.9.

20.11.3.2 Location

Where a CET is used, the CET—

(a) **shall** be installed in a convenient and readily accessible location; and

(b) **shall not** be installed on or within an electrical switchboard.

Note: It is recommended that the CET be installed adjacent to the switchboard to which it is connected.

20.11.3.3 Marking

The CET **shall** be marked 'Communications Earth Terminal'.

20.11.4 Connection to the electrical earthing system

For equipotential bonding of the CES or TRC, the following **shall** be met:

(a) The bonding conductor connection to the electrical earthing system **shall**—

(i) be made by means prescribed in AS/NZS 3000 (see Note 1); and

(ii) be suitably protected against corrosion.

(b) The cabling provider **shall not** do anything to degrade the integrity of the earthing system of the electrical installation.

Note 1: Approved connection methods are illustrated in Figures 3 to 6.

Note 2: The connection to the electrical earthing system may need to be made by a licensed electrical worker. In particular, only a licensed electrical worker may cut or rearrange the main or sub-main earthing conductor or make any connection in the electrical switchboard.

20.12 Communications Earth System (CES)

20.12.1 Description of the CES

The CES may be used for protective and functional earthing and emanates from the CET or, where equipotential bonding method 3 is used, from the earthing bar, terminal or backmount to which the communications bonding conductor is connected (see Figures 3 and 4). The CES has low susceptibility to voltage differences between the telecommunications and electrical earthing systems under surge conditions that may cause damage to customer equipment. However, the CES may be noisy and may not be suitable for functional earthing of some customer equipment.

Note: The CES is available for all communications earthing in the building whether or not the communications cabling is connected to a carrier's telecommunications network.

20.12.2 CES conductors

20.12.2.1 Colour

Except for an individual signalling lead or cable shield/drain wire connection as described in Clauses 20.8.1 and 20.8.2, all earthing conductors used for the CES **shall** have green/yellow insulation.

20.12.2.2 Size

CES conductors—

(a) **shall** be sized to meet the resistance limits of Clause 20.12.4; and

(b) **shall not** be less than the applicable minimum size listed in Table 7.

20.12.3 Equipotential bonding of the CES

The CES **shall** be—

(a) connected to the earthing system of the electrical installation in accordance with the general requirements of Clause 20.11; and

(b) equipotentially bonded to the earthing system of the electrical installation at the relevant floor or section of the building by one of the methods shown in Figures 3 and 4.

20.12.4 Resistance of the CES

The resistance of the earthing conductor between the point of connection to the earthing system of the electrical installation and

the earthing bar or terminal at any MDF, NTD, distributor or CAE **shall not** exceed 1 Ω.

Note 1: This resistance includes the bonding conductor resistance (see Clause 20.11.2.4) which, in most cases, should be negligible.

Note 2: Table 6 may be used as a guide.

Note 3: Some installations may require a conductor larger than the minimum sizes specified in Table 7 in order to achieve this resistance limit.

20.13 Telecommunications Reference Conductor (TRC)

20.13.1 Description of the TRC distribution system

The TRC is a functional earthing system that is connected to an earth reference at one point only in a building to minimise noise and emanates from a TRC link bar located at the nearest distributor to the main or first electrical switchboard in the building. With the TRC, it is important that connections to other earth references are avoided to maintain the integrity of the TRC system. For this reason, TRC conductors have violet insulation for easy identification.

Note 1: On TRC systems installed before October 1990, the TRC conductor was coloured red.

Note 2: The TRC is generally considered to be a live conductor, comparable to the neutral conductor of an AC mains supply system, i.e. earthed at the source only.

20.13.2 TRC system components

Typically, a TRC distribution system may consist of—

(a) a TFEE where required;

(b) where a TFEE is installed, an earthing conductor between the TFEE and a suitable earthing bar or terminal (TRC link bar) at the designated distributor;

(c) TRC conductor(s) from the TRC link bar at the designated distributor to a suitable earth bar or terminal (TRC link bar) at each subsequent distributor where the TRC is to be provided; and

(d) conductor(s) which extend(s) the TRC from the TRC link bar at one distributor to a suitable earthing bar or terminal (TRC link bar) at another distributor or CAE where the TRC is to be provided.

Note 1: The ‘designated distributor’ is a distributor, near the main or first electrical switchboard in the building, designated by the cabling provider as the most appropriate distributor for distribution of the TRC system. Such a distributor may or may not be an MDF.

Note 2: An earthing bar or terminal may only be used as a TRC link bar if it complies with Clause 20.13.7.

20.13.3 TRC to be exclusive to telecommunications services

Where provided, the TRC system **shall** be exclusive to telecommunications services, and separate and distinct from any other building earth system apart from a single equipotential bonding connection to the main earthing bar, main earthing conductor or earth electrode of the main or first electrical switchboard as described in Clause 20.13.9.

20.13.4 Connection to an earth reference

The TRC system **shall** be connected to an earth reference in accordance with methods of connection shown in Figure 5, 6 or 7 whether or not the TRC is initially connected to customer equipment.

20.13.5 TRC system conductors

20.13.5.1 Colour

Except for the communications bonding conductor (refer to Clause 20.11.2) or an individual signalling lead connection in accordance with Clause 20.8.2, all TRC system conductors **shall** have violet insulation.

20.13.5.2 Size

The following requirements apply to TRC system conductors:

(a) The conductor **shall** be sized to meet the resistance limits of Clause 20.13.11.

(b) The conductor **shall not** be less than the applicable minimum size listed in Table 7.

(c) A conductor feeding any other conductor **shall not** be a smaller size than the conductor it feeds.

20.13.6 Cabling method

The TRC system **shall**—

(a) be equipotentially bonded to the main earthing bar, main earthing conductor or earth electrode at the main or first electrical switchboard in accordance with Clause 20.13.9;

(b) emanate from the designated distributor; and

(c) be cabled in a tree or star topology.

Note: The TRC system may comprise a single conductor with taps feeding each distributor, or there may be two or more TRC system conductors feeding distributors in a star configuration.

20.13.7 TRC link bars

A TRC link bar **shall**—

(a) comply with Clause 20.9; and

(b) be insulated to a minimum of 1.5 kV a.c. (50 Hz) without breakdown for 60 s from the conductive material of the body of the enclosure, backmount or frame, and from any other earth reference, other than at the point at the designated distributor where the TRC is equipotentially bonded to the main earthing bar, main earthing conductor or earth electrode of the main or first electrical switchboard.

Note: This may be achieved by the use of insulated mounting blocks typically available for this purpose.

20.13.8 Telecommunications Functional Earth Electrode (TFEE)

20.13.8.1 Application

A TFEE may be provided for operational purposes or to limit the direct current flowing in the communications bonding conductor.

Note: Recommendations regarding limits for direct current flowing in the communications bonding conductor are given in Appendix E.

20.13.8.2 Type of electrode

Where a TFEE is provided, it **shall** be one of the following types:

(a) Any of the following rods driven to a vertical depth of not less than 1.2 m:

(i) 12 mm non-ferrous or non-ferrous coated rod.

(ii) 12 mm stainless steel rod or stainless steel coated rod.

(iii) 16 mm galvanized steel rod or equivalent steel section with a cross-sectional area of at least 200 mm^2 with no part less than 3 mm thick.

(b) 35 mm^2 bare copper conductor, or a 40 mm × 3 mm hot-dipped galvanised strip electrode not less than 3 m in length, buried in a horizontal trench to a depth of not less than 0.5 m.

(c) A galvanised star picket of minimum mass of 4.5 kg (e.g. a galvanised 'Y' section fence post) either—

(i) driven to a vertical depth of not less than 1.2 m; or

(ii) buried in a horizontal trench to a depth of not less than 0.5 m.

20.13.8.3 Location of electrode

Where a TFEE is provided, in general it should be located in a position that meets all of the following:

(a) It is exposed to the weather.

(b) It is outside the building.

(c) It is separated from metallic enclosures of other buried services.

Note: It is recommended that a separation of not less than 0.5 m be maintained between an earth electrode and buried metallic services such as water, gas, flammable liquid and the AC mains supply electrode, in order to reduce possible electrolytic action adversely affecting the electrode or service.

20.13.8.4 Labelling

The TFEE **shall** be permanently labelled 'Telecommunications Electrode'.

20.13.8.5 Conductor colour and size

The conductor connecting the TFEE to the TRC link bar at the designated distributor **shall** have—

(a) a minimum cross-sectional area of 4 mm^2; and

(b) violet insulation.

20.13.8.6 Electrodes in separate buildings

Where the electrical earth electrode is not located in the same building as the designated distributor (e.g. if the AC mains supply and earth are fed from another building), a TFEE **shall** be connected in accordance with Figure 7.

20.13.9 Equipotential bonding of the TRC system

20.13.9.1 General

The TRC system **shall**—

(a) be connected to the earthing system of the electrical installation in accordance with the general requirements of Clause 20.11; and

(b) be equipotentially bonded to the earthing system of the electrical installation at one point only within the building where it is installed, by one of the methods shown in Figures 5, 6 and 7.

20.13.9.2 TRC noise problems or excessive direct current

Where there is excessive noise on the electrical earthing system or excessive direct current in the communications bonding conductor (refer to Appendix E), the TRC system may be equipotentially bonded to the earthing system of the electrical installation via a differential earth clamp in accordance with Figure 6 or 7, in which case—

(a) a TFEE **shall** be provided;

(b) a differential earth clamp **shall not** be connected in a way that it is required to conduct surge current to the electrical

earthing system via any surge suppression device connected to a telecommunications line;

(c) all TRC link bars and terminations **shall** be enclosed or located so as to prevent end-user access; and

(d) where the maximum limiting voltage of the differential earth clamp exceeds ELV limits, all TRC link bars and terminations **shall** be suitably labelled to warn workers of possible voltage differences between the TRC and protective earth, for example:

> WARNING! This TRC is not directly bonded to the electrical earthing system. A hazardous voltage may exist between the TRC and other earthed objects.

20.13.10 TRC in a separate building

20.13.10.1 Where there is an electrical earthing system in the separate building

Where a separate building in customer premises is fed by an AC mains supply to an electrical switchboard in that separate building and a TRC is required at the separate building—

(a) a separate TRC system **shall** be provided at the separate building in accordance with Clauses 20.13.2 to 20.13.9; and

(b) the separate TRC system **shall not** be connected to the main building TRC system.

20.13.10.2 Where there is no electrical earthing system in the separate building

Where the separate building does not have an electrical switchboard and a TRC is required at the separate building—

(a) the TRC may be fed to the separate building via a violet TRC system conductor or a cable pair, as appropriate (see Clause 20.8.2); and

(b) end-user access to the TRC in the separate building **shall** be prevented by effective means.

20.13.11 Resistance of the TRC system

The resistance of the TRC **shall not** exceed 5 Ω measured between the TRC link bar at the designated distributor and the TRC link bar at any other distributor or CAE.

Note 1: Table 6 may be used as a guide.

Note 2: Some installations may require a conductor larger than the minimum size specified in Table 7 in order to achieve this resistance limit.

20.14 Interconnection of CES and TRC systems

Where both CES and TRC systems are used in the same building, they **shall** be kept separate and distinct except at the point where the TRC is equipotentially bonded to the main earthing bar, main earthing conductor or earth electrode of the electrical installation. However, the TRC may be indirectly connected to a protective earthing conductor or CES at additional points via a differential earth clamp, e.g. gas-filled surge suppression device, to minimise the voltage differences between the earthing systems during surge conditions.

Note: For an example of a differential earth clamp, refer to Figure 6, 7 or 8. For more information about differential earth clamps, refer to AS/NZS 1768.

20.15 ELV DC power supply system

An installation in a restricted access location operating an ELV DC power supply system that provides DC/earth return paths on the positive or negative conductor of the DC supply, should comply with AS/NZS 3015.

20.16 DC earth return circuit

20.16.1 Separation from other earthing systems

Where customer equipment requires a functional earth for DC earth return line current (e.g. double-current teleprinters, earth cailho signalling equipment or earth cailho power feeding)—

(a) the earth used—

(i) **shall** be totally separate from the earthing system of the electrical installation, CES and TRC system; and

(ii) **shall not** be directly connected to any other earthing system or any building metalwork; and

(b) a separate DC functional earth conductor **shall** be used to extend a dedicated DC functional earth electrode connection to the distributor or customer equipment.

Note: The DC functional earth may be indirectly connected to another earthing system or building metalwork via a differential earth clamp, e.g. gas-filled surge suppression device, to minimise the voltage differences between the systems during surge conditions. Figure 6 and 7 may be used as a guide and show how a functional earth may be indirectly connected to the earthing system of the electrical installation via a differential earth clamp.

20.16.2 Earth electrode

The dedicated DC functional earth electrode used for the DC earth return circuit—

(a) **shall** comply with Clause 20.13.8.2; and

(b) should comply with Clause 20.13.8.3.

20.16.3 Conductor colour, size and labelling

The earthing conductor used for extension of the dedicated DC functional earth electrode to the distributor or directly to the customer equipment **shall**—

(a) have a minimum cross-sectional area of 4 mm^2;

(b) have violet insulation; and

(c) be legibly identified 'DC Functional Earth' at each termination point of the conductor, including at the earth electrode termination.

Note: A cable pair may be used to extend the DC functional earth from a distributor to the customer equipment connection point.

20.17 Earthing of metallic barriers

20.17.1 Prohibition — connection to TRC

A metallic barrier **shall not** be connected to a TRC except at a point described in Item 20.7(b).

20.17.2 Earthing connection

Where a metallic barrier is required to be connected to an earth reference, this connection **shall** be made to protective earth in accordance with Clause 20.7.

20.17.3 Earthing conductor colour and size

The conductor used for earthing of a metallic barrier **shall** have—

(a) a minimum cross-sectional area of 2.5 mm^2; and

(b) green/yellow insulation.

20.18 Earthing of cable shields and drain wires

20.18.1 General

A metallic cable shield or drain wire may be earthed or unearthed, depending on operational requirements.

Note: If a cable shield is to be earthed, Clauses 20.18.2, 20.18.3 and 20.18.4 apply.

20.18.2 Prohibition — connection to TRC

A metallic cable shield or drain wire **shall not** be connected to the TRC except at a point described in Item 20.7(b).

20.18.3 Allowable earthing points

Where a metallic cable shield is required to be connected to an earth reference, this connection **shall** be made at—

(a) a point connected to protective earth in accordance with Clause 20.7; or

(b) any metallic part connected in accordance with AS/NZS 3000 to the earthing system of the electrical installation, including to a power socket-outlet via an equipment connection.

Note 1: Connection to the shield may be made via the drain wire (if provided), a suitable clamp in contact with the shield, or a fixed connector that is permanently connected to protective earth.

Note 2: As the shield (outer conductor) of coaxial cable provides a signal return path, it should be connected at both ends but may be earthed at one end or both ends subject to the requirements of Clause 20.18.4.

20.18.4 Cabling between separate buildings or structures

Where shielded cable is installed between separate buildings or structures the following is to be met:

(a) Where the shield is earthed, either intentionally or unintentionally, at the distant end or at an intermediate point (e.g. at a pole or within a pit) the shield—

(i) **shall** be insulated from any earth reference within the building or structure (see Note); or

(ii) **shall** only be connected to an earth reference via a differential earth clamp that has a minimum DC firing voltage of 400 V, in accordance with Figure 8.

(b) Where the shield is not earthed at an intermediate point (e.g. at a pole or within a pit)—

(i) one end of the shield may be connected directly to an earth reference at the building or structure; and

(ii) at least one end of the shield **shall** be treated in accordance with Item (a).

Note: In the case of coaxial cable, the insulation may be provided by a suitable coaxial isolator.

20.19 Earthing of metallic supports, enclosures, frames, backmounts and steel wire armouring

20.19.1 General

A metallic cable tray, conduit, trunking system, distribution frame, backmount, enclosure, catenary support or the steel wire armouring of an SWA cable, may be earthed or unearthed, depending on operational requirements.

Note: The steel wire armouring of an SWA cable may need to be earthed for the purposes of Clause 9.5.

20.19.2 Prohibition – connection to TRC

A metallic cable tray, conduit, trunking system, distribution frame, backmount, enclosure, catenary support or the steel wire armouring of an SWA cable **shall not** be connected to a TRC except at a point described in Item 20.7(b).

20.19.3 Earthing connection

Where a metallic cable tray, conduit, trunking system, distribution frame, backmount, enclosure, catenary support or the steel wire armouring of an SWA cable is required to be connected to an earth reference, this connection **shall** be made to protective earth in accordance with Clause 20.7.

20.19.4 Earthing conductor colour and size

The conductor used for earthing of a metallic cable tray, conduit, trunking system, distribution frame, backmount, enclosure, catenary support or the steel wire armouring of an SWA cable **shall** have—

(a) a minimum cross-sectional area of 2.5 mm^2; and

(b) green/yellow insulation.

20.20 Earthing of surge suppression devices

20.20.1 Surge suppression for the protection of end-users

Any surge suppression device provided for the protection of the end-user and connected between telecommunications line conductors and earth—

(a) **shall** be connected to protective earth in accordance with Clause 20.7 or to a suitable bonding point specified in AS 4262.1 or AS/NZS 1768 using an earthing/bonding conductor with green/yellow insulation; and

(b) the cross-sectional area of the earthing/bonding conductors between the surge suppression device and the main earthing bar, terminal or connection in the electrical switchboard, main earthing conductor or earth electrode, as applicable, or any other bonding point specified in AS 4262.1 or AS/NZS 1768 **shall not** be less than 6 mm^2.

Note 1: The connection may be made to a termination module backmount that is connected to protective earth via a minimum 6 mm^2 green/yellow conductor.

Note 2: This type of surge suppression is sometimes referred to as 'primary protection' and should be provided at the cabling point of entry into the building or at the first cable connection point within the building (e.g. at the MDF). Refer to AS 4262.1, AS 4262.2 and AS/NZS 1768 for more information.

Note 3: The total earthing/bonding conductor length between the surge suppression device and the earthing bar, terminal or connection in the electrical switchboard should not exceed 10 m. A total earthing

conductor length of 1.5 m or less is preferred for more effective end-user protection and for primary protection of any customer equipment connected to the telecommunications line.

Note 4: Additional requirements for surge suppression devices are given in Clause 10.3.

20.20.2 Surge suppression for the protection of customer equipment

Any surge suppression device provided for the protection of customer equipment and connected between telecommunications line conductors and earth—

(a) **shall** be connected to protective earth in accordance with Clause 20.7 or to a suitable bonding point specified in AS 4262.2 or AS/NZS 1768 using an earthing/bonding conductor with green/yellow insulation; and

(b) the cross-sectional area of any earthing/bonding conductors **shall not** be less than 2.5 mm^2.

Note 1: This type of surge suppression is sometimes referred to as 'secondary protection' and should be provided in addition to, and not as a substitute for, the surge suppression ('primary protection') described in Clause 20.20.1. Secondary protection is normally provided within, or as close as possible to, the equipment. Refer to AS 4262.1, AS 4262.2 and AS/NZS 1768 for more information.

Note 2: The earthing/bonding conductor should be as short as possible (preferably no longer than 1.5 m) for more effective equipment protection.

Note 3: Surge suppression devices may be connected to a TRC or other earth reference within customer equipment to minimise electric stress between conductive elements during voltage surge conditions. Such devices are intrinsic to the design of the customer equipment and require no specific action by the installer.

Table 7
Minimum conductor sizes for earthing or bonding

Metallic barriers/parts

Relevant Clause	Function	Colour	Minimum size (cross-sectional area)
20.17	Earthing of a metallic barrier to protective earth	Green/ Yellow	Minimum 2.5 mm^2
20.19	Connection of a metallic cable tray, conduit, trunking system, distribution frame, backmount, enclosure, catenary support or the steel wire armouring of an SWA cable to protective earth	Green/ Yellow	Minimum 2.5 mm^2 (except where used for connection of surge suppression for protection of end-users)

CES

20.11.2 20.12.4	Connection from the equipotential bonding point on the earthing system of the electrical installation to the CET (bonding method 1 or 2) or the bar, terminal or backmount of the distributor (bonding method 3)	Green/ Yellow	Size for allowable resistance Minimum 6 mm^2
20.12.2 20.12.4 20.20.1	Connection from the CET (bonding method 1or 2) or the bar, terminal or backmount in the distributor (bonding method 3) to any distributor or other connection device that contains surge suppression for the protection of end-users	Green/ Yellow	Size for allowable resistance Minimum 6 mm^2
20.12.2 20.12.4 20.20.2	Connection from the CET to any distributor or other connection device that does not contain surge suppression for protection of end-users	Green/ Yellow	Size for allowable resistance Minimum 2.5 mm^2
20.12.2 20.12.4	Connection from any distributor to any other distributor or CAE earthing bar or terminal	Green/ Yellow	Size for allowable resistance Minimum 2.5 mm^2

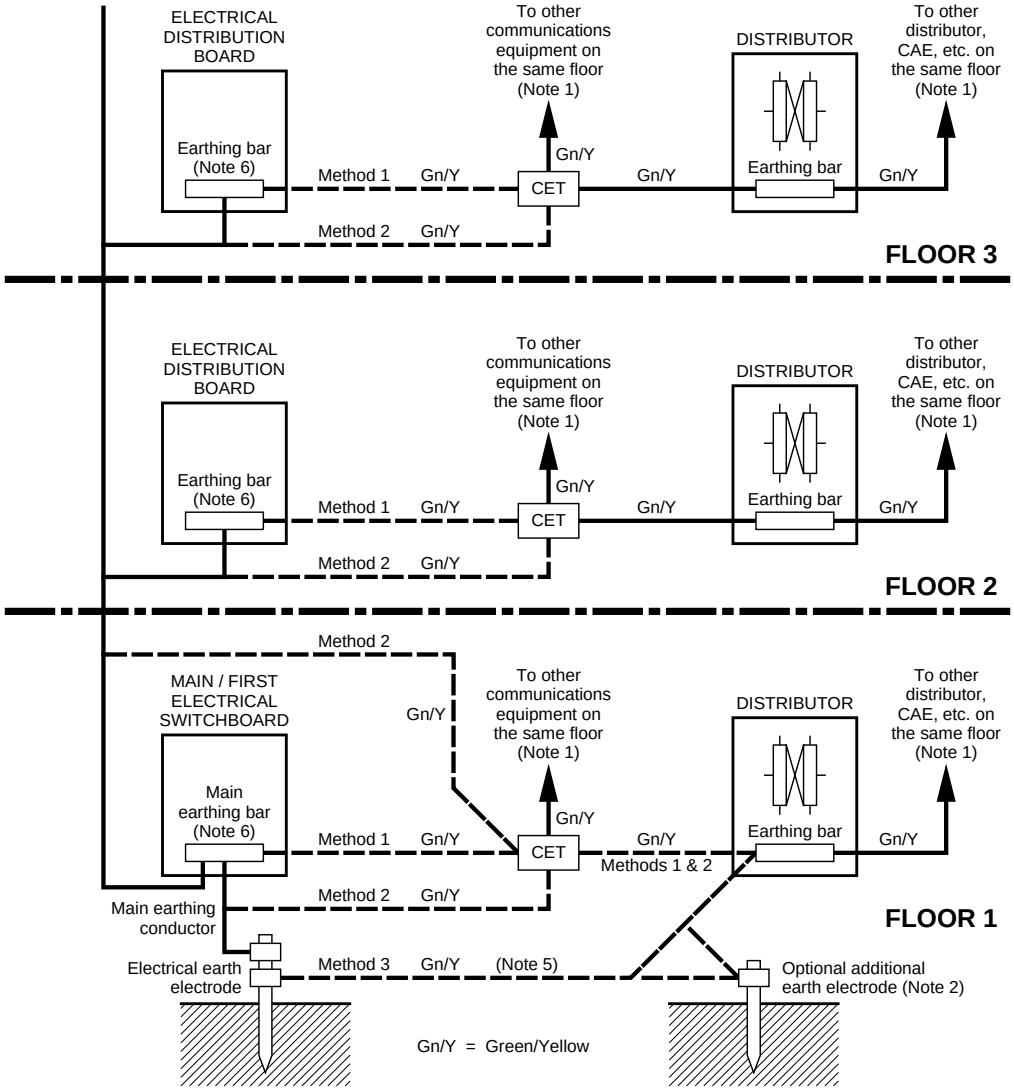
TRC

20.11.2 20.13.9	Connection from the equipotential bonding point on the earthing system of the electrical installation to the TRC link bar at the designated distributor	Green/ Yellow	Size for allowable resistance Minimum 6 mm^2
20.13.5 20.13.11	Connection from the TRC link bar of any distributor to the TRC link bar of any other distributor or CAE	Violet	Size for allowable resistance Minimum 2.5 mm^2
20.13.8.5	TRC connection from the designated distributor to a TFEE (where provided)	Violet	Minimum 4 mm^2

Surge suppression

20.11.2.1 20.11.2.4 20.20.1	Connection of a surge suppression device for the protection of end-users	Green/ Yellow	Size for allowable resistance Minimum 6 mm^2
20.20.2	Connection of a surge suppression device for the protection of customer equipment	Green/ Yellow	Minimum 2.5 mm^2

Note: Where customer equipment requiring connection to a TRC or CES is connected to roof antennae or similar exposed equipment, consideration should be given to the need to dimension the TRC or CES to carry lightning down current.



Note 1: CES conductors should only be used for earthing of equipment in the same floor or section of the building where the CES is equipotentially bonded to the electrical earthing system.

Note 2: There is no restriction on connecting an additional earth electrode to the communications bonding conductor as long as it is installed in accordance with the relevant requirements of AS/NZS 3000. However, AS/NZS 3000 does not support the installation of an earth electrode at a building that does not already have an earth electrode, e.g. where the main switchboard and electrical earth electrode are installed at a pole or another building.

Any additional earth electrode should be connected by means of a looped connection to a single earth clamp attached to the electrode and not by means of two earth clamps on the additional electrode.

Note 3: Where surge suppression devices are installed, the total earthing conductor length between the device and the earthing bar in the electrical switchboard should not exceed 10 m. A total earthing/bonding conductor length of 1.5 m or less is preferred for more effective end-user protection and for protection of customer equipment connected to the telecommunications line.

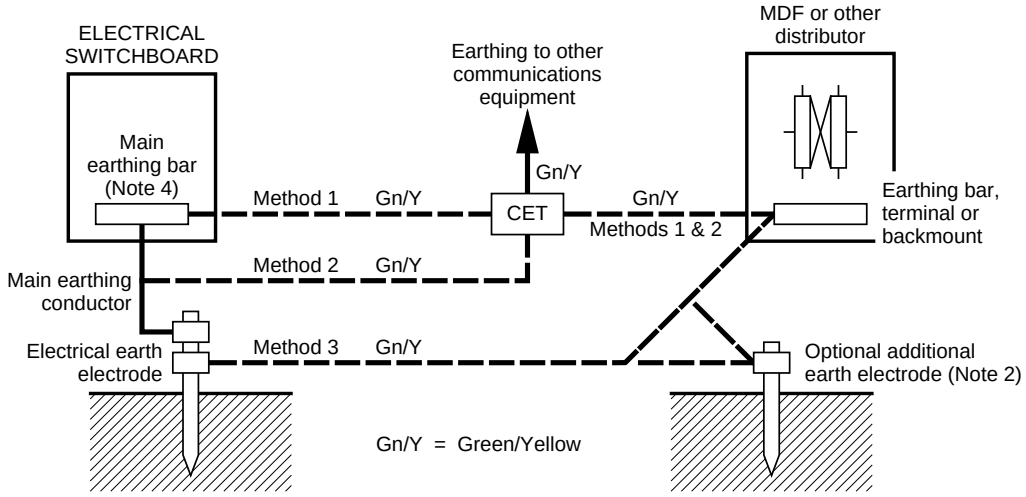
Note 4: The earthing conductor to any distributor may be cabled from either the CET or another distributor, as long as the resistance limit of Clause 20.12.4 is not exceeded.

Note 5: Bonding method 3 is only available at the switchboard at which the electrical earth electrode is installed.

Note 6: Only a licensed electrical worker may make any connection in the electrical switchboard.

Figure 3

Typical CES for commercial premises with distributed cabling



Note 1: In this configuration, the CET was formerly known as a 'bonding terminal'.

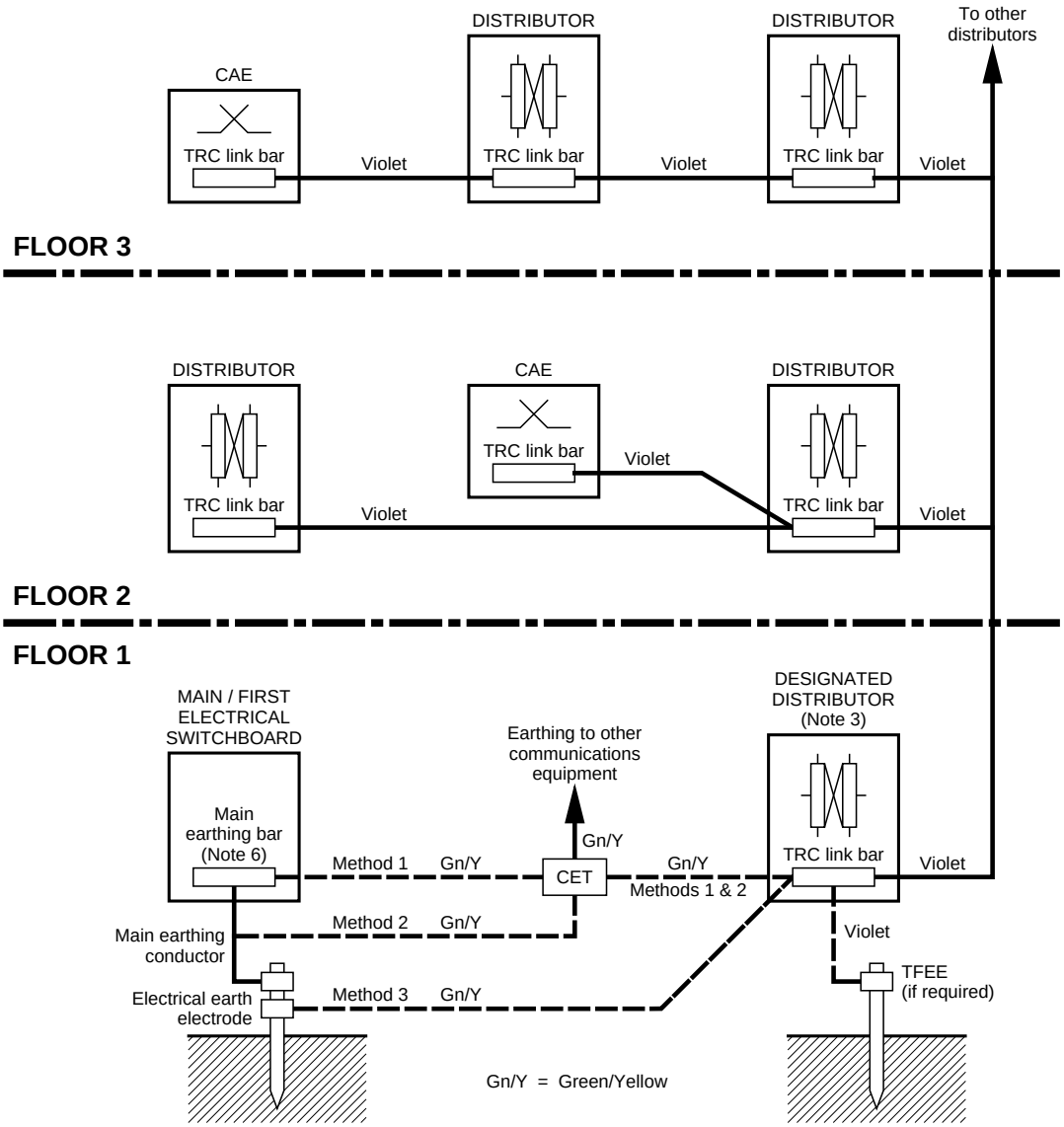
Note 2: There is no restriction on connecting an additional earth electrode to the communications bonding conductor as long as it is installed in accordance with the relevant requirements of AS/NZS 3000. However, AS/NZS 3000 does not support the installation of an earth electrode at a building that does not already have an earth electrode, e.g. where the main switchboard and electrical earth electrode are installed at a pole or another building. Any additional earth electrode should be connected by means of a looped connection to a single earth clamp attached to the electrode and not by means of two earth clamps on the additional electrode.

Note 3: Where surge suppression devices are installed, the total earthing conductor length between the device and the main earthing bar or connection in the electrical switchboard should not exceed 10 m. A total earthing/bonding conductor length of 1.5 m or less is preferred for more effective end-user protection and for protection of customer equipment connected to the telecommunications line.

Note 4: Domestic switchboards do not always contain a main earthing bar. In such cases, the equipotential bonding connection is made to the main earthing terminal or conductor within the switchboard and not to the neutral bar. Only a licensed electrical worker may make any connection in the electrical switchboard.

Figure 4

Earthing options for a small distributor installation (e.g. domestic or small business premises)



Note 1: On installations made prior to October 1990, the TRC is coloured red.

Note 2: In this configuration, the CET was formerly known as a 'bonding terminal'.

Note 3: The 'designated distributor' is a distributor, near the main or first electrical switchboard in the building, designated by the cabling provider as the most appropriate distributor for distribution of the TRC system. This distributor may or may not be an MDF.

Note 4: Where surge suppression devices are installed at the designated distributor, the total earthing conductor length between the device and the main earthing bar in the electrical switchboard should not exceed 10 m. A total earthing/bonding conductor length of 1.5 m or less is preferred for more effective end-user protection and for protection of customer equipment connected to the telecommunications line.

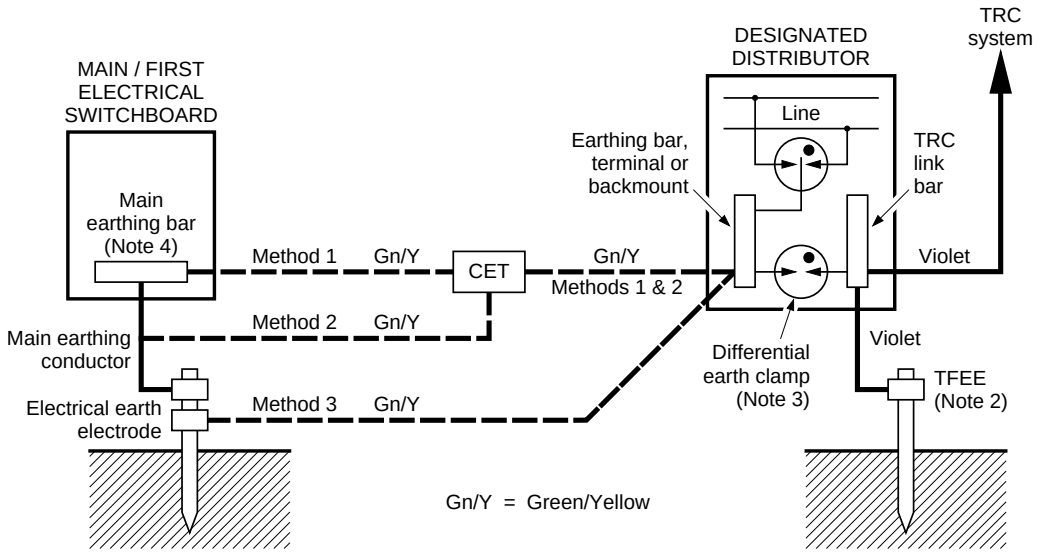
Note 5: In situations where there is excessive noise voltage on the earthing system of the electrical installation or excessive direct current in the communications bonding conductor (refer to Appendix E), it may be necessary to make the equipotential bonding via a differential earth clamp (e.g. gas filled surge suppression device) as shown in Figure 6.

Note 6: Only a licensed electrical worker may make any connection in the electrical switchboard.

Note 7: Where the electrical earth electrode is not located in the same building as the designated distributor (e.g. AC mains supply and earth fed from another building), the TFEE (where required) is to be connected in accordance with Figure 7.

Figure 5

Typical TRC system for commercial premises with distributed cabling



Note 1: Where surge suppression devices are installed at the designated distributor, the total earthing conductor length between the device and the main earthing bar in the electrical switchboard should not exceed 10 m. A total earthing/bonding conductor length of 1.5 m or less is preferred for more effective end-user protection and for protection of customer equipment connected to the telecommunications line.

Note 2: The resistance of the TFEE to the general mass of earth should not exceed 30 Ω. The operational requirements of the customer equipment may require a lower resistance.

Note 3: Where the TRC is equipotentially bonded to the earthing system of the electrical installation via a differential earth clamp:

(a) The differential earth clamp is to be connected in a way that it is not required to conduct surge current to the electrical earthing system from any surge suppression device connected to a telecommunications line.

(b) All TRC link bars and terminations are to be enclosed or located to prevent customer access.

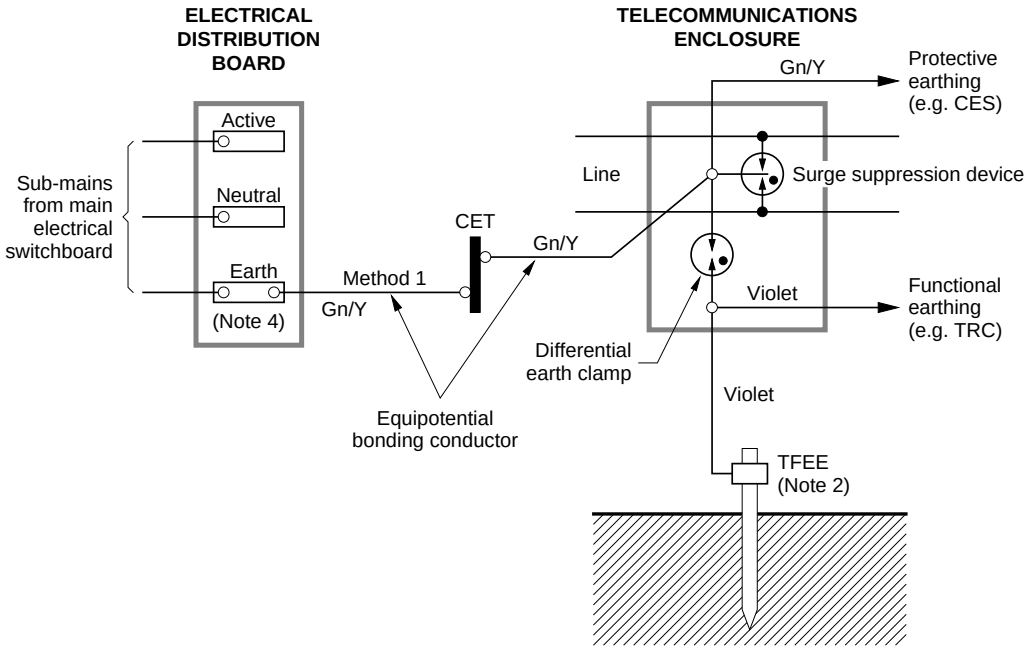
(c) Where the maximum limiting voltage of the differential earth clamp exceeds ELV limits, all TRC link bars and terminations are to be suitably labelled to warn workers of possible voltage differences between the TRC and other earths, e.g. 'WARNING! This TRC is not directly bonded to the electrical earthing system. A hazardous voltage may exist between the TRC and other earthed objects.'

Note 4: Only a licensed electrical worker may make any connection in the electrical switchboard.

Note 5: Refer to Clause 20.13.9.2.

Figure 6

Equipotential bonding of TRC to the electrical earthing system via a differential earth clamp (where excessive noise or direct current)



Note 1: Where surge suppression devices are installed, the total earthing conductor length between the device and the earthing bar in the electrical switchboard should not exceed 10 m. A total earthing/bonding conductor length of 1.5 m or less is preferred for more effective end-user protection and for protection of customer equipment connected to the telecommunications line.

Note 2: The resistance of the TFEE to the general mass of earth should not exceed 30 Ω. The operational requirements of the customer equipment may require a lower resistance.

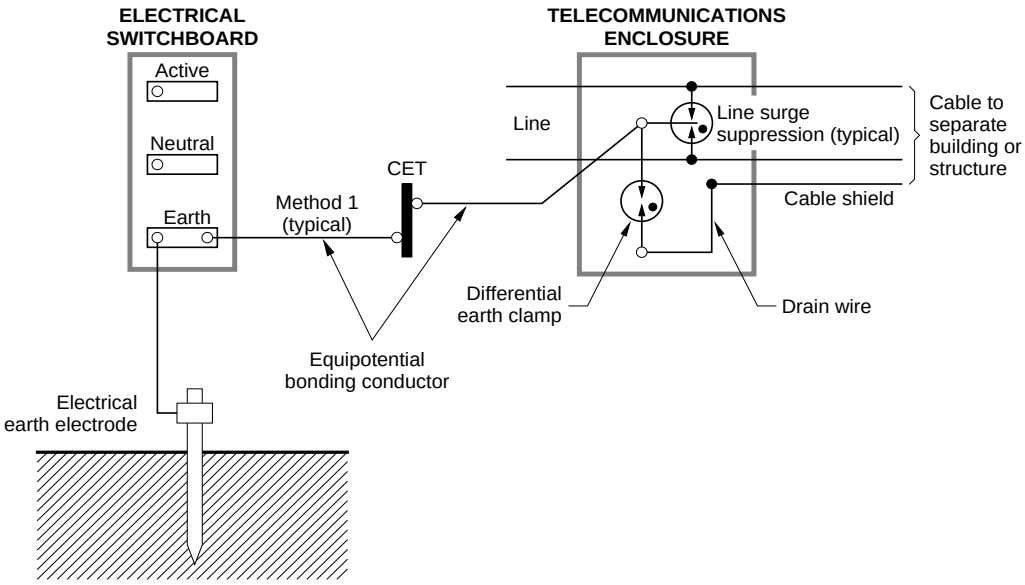
Note 3: Where the maximum limiting voltage of the differential earth clamp exceeds ELV limits, all functional earthing bars and terminals are to be suitably labelled to warn workers of possible voltage differences between the functional earth and other earths, e.g. 'WARNING! This earth is not directly bonded to the electrical earthing system. A hazardous voltage may exist between this earth and other earthed objects.'

Note 4: Only a licensed electrical worker may make any connection in the electrical switchboard.

Note 5: Refer to Clause 20.13.8.6.

Figure 7

Installation of a TFEE where the electrical earth electrode is located at another building or structure



Note: Refer to Clause 20.18.4.

Figure 8

Connection of a metallic cable shield (or moisture barrier) of an underground or aerial customer cable at a building or structure

APPENDIX

A Restricted zones in damp locations (NORMATIVE)

A.1 A location containing a bath or shower

The restricted zone for a location containing a bath or shower is comprised of the following areas:

(a) For a bath, within a vertical plane circumscribed by a horizontal distance of 600 mm from the internal rim of the bath and a vertical distance of 2.5 m from the floor or to the height of the ceiling, whichever is the lower.

(b) For a shower—

(i) within a vertical plane circumscribed by a horizontal distance of 1.8 m from the shower fixed plumbing connection and a vertical distance of 2.5 m from the floor or to the height of the ceiling, whichever is the lower; or

(ii) within a vertical plane circumscribed by a horizontal distance of 600 mm from the inside edge of a fixed partition with a height no less than 1.8 m from the floor or the height of the shower fixed plumbing connection, whichever is the greater, and a vertical distance of 2.5 m from the floor or to the height of the ceiling, whichever is the lower.

(c) Within 300 mm of the floor at any point in the room containing the bath or shower.

The restricted zone does not extend beyond the boundaries of the room containing the bath or shower.

The restricted zone is pictorially represented for typical situations in Figures A1 to A4.

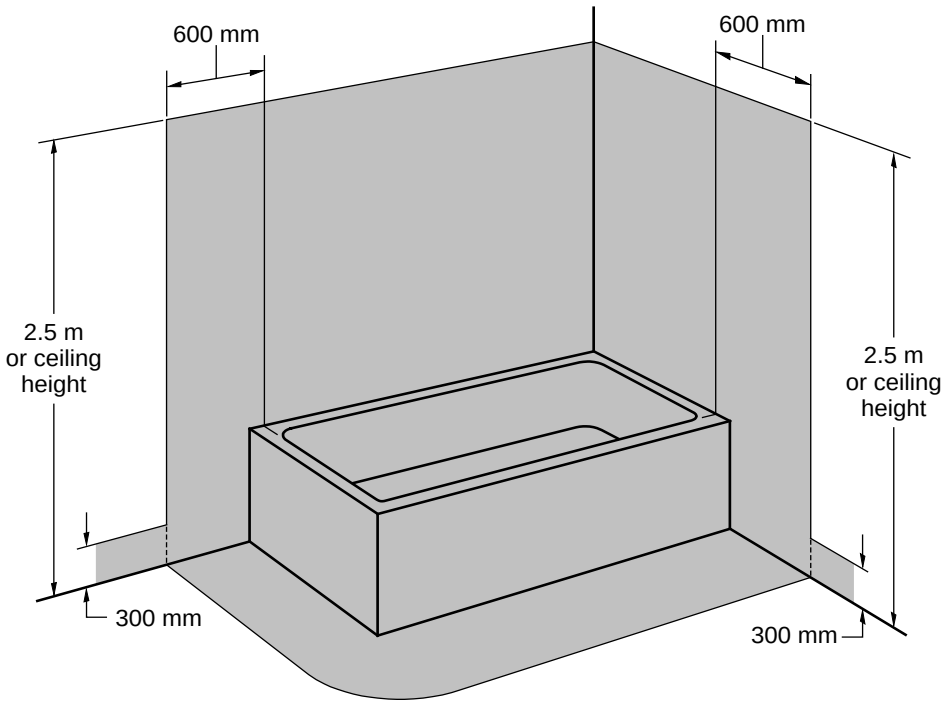


Figure A1
Bath without a shower

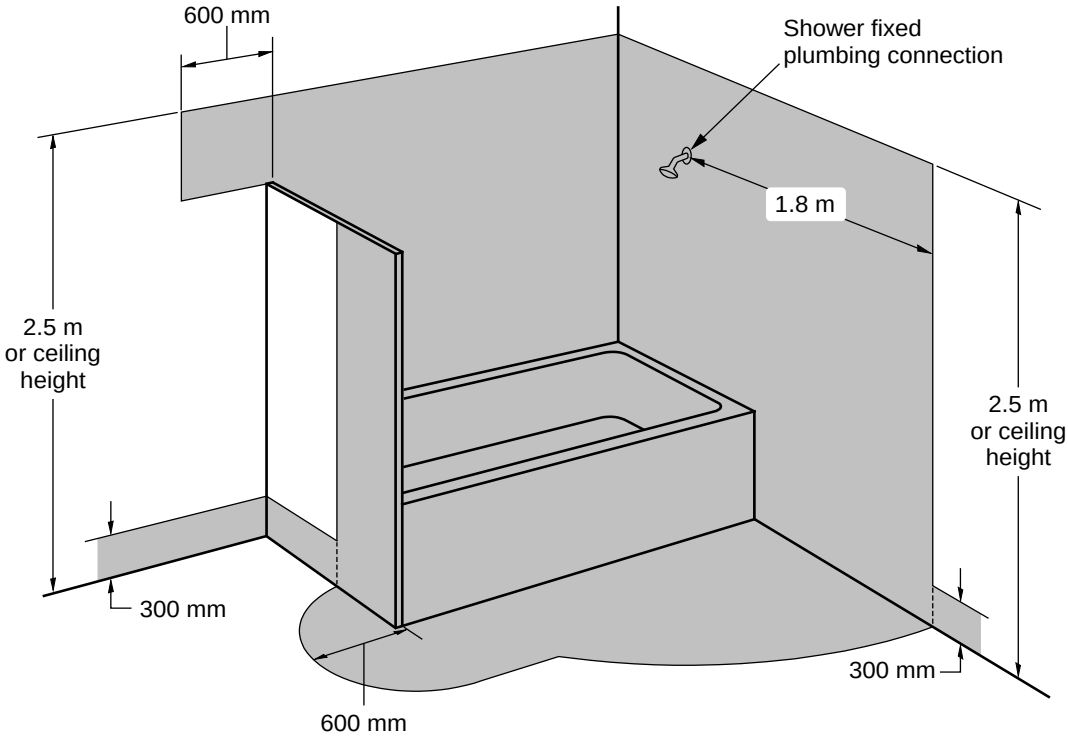


Figure A2
Bath with a shower and fixed partition

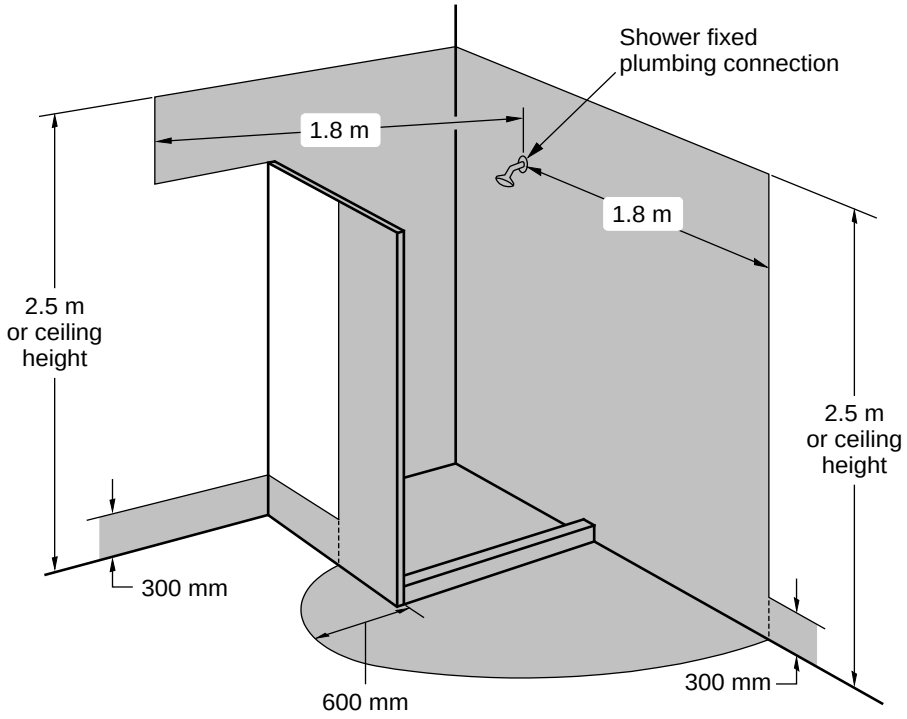


Figure A3
Shower with a fixed partition

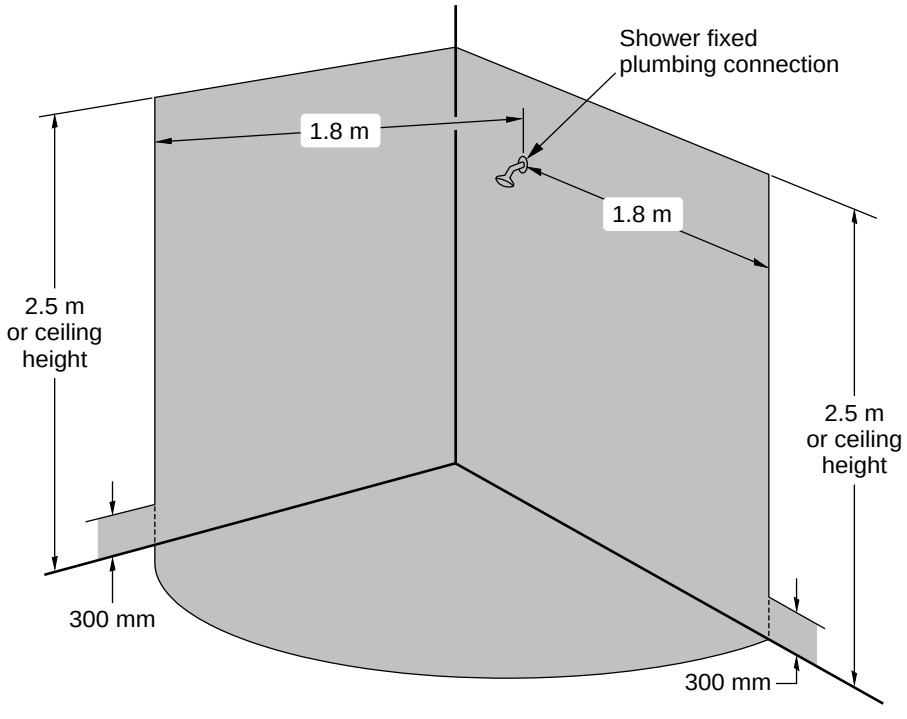


Figure A4
Shower without a fixed partition

A.2 A location containing a basin or fixed water container not exceeding 45 litres per container

The restricted zone for a location containing a basin or fixed water container not exceeding 45 litres per container is described as follows:

(a) Within a vertical plane circumscribed by a horizontal distance of 150 mm and a vertical distance of 400 mm from the internal rim of the water container.

(b) Within 300 mm of the floor at any point in the room containing the basin or fixed water container.

The restricted zone is pictorially represented in Figure A5.

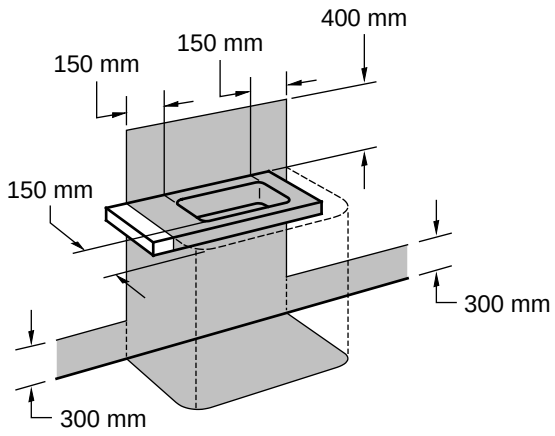


Figure A5
Hand basin or fixed water container not exceeding 45 litres capacity per container

A.3 A location containing a tub or fixed water container exceeding 45 litres

The restricted zone for a location containing a tub or fixed water container exceeding 45 litres is described as follows:

(a) Within a vertical plane circumscribed by a horizontal distance of 500 mm and a vertical distance of 1 m from internal rim of the water container.

(b) Within 300 mm of the floor at any point in the room containing the basin or fixed water container.

The restricted zone is pictorially represented in Figure A6.

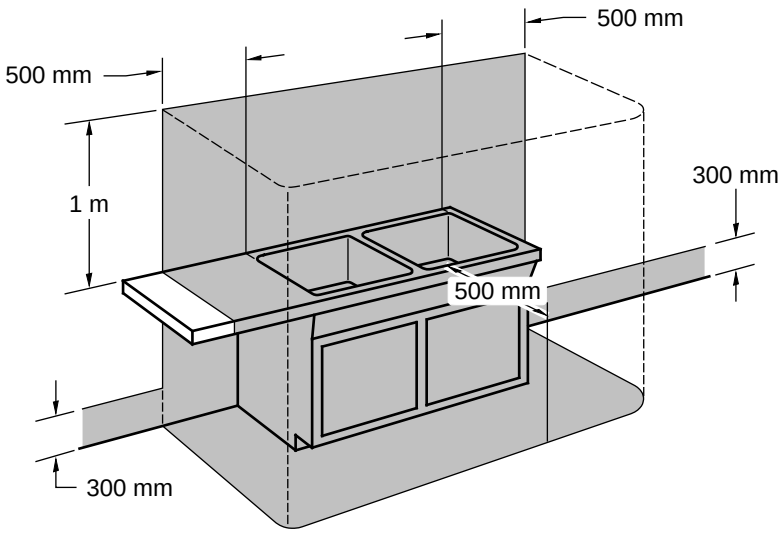


Figure A6

Laundry tub or fixed water container exceeding 45 litres capacity

APPENDIX

B Common cable colour codes (INFORMATIVE)

Cables are required by AS/CA S008 to have some method of coding that enables pairs, conductors and optical fibres to be visually distinguishable from one another.

Common colour codes for various types of cable are provided in Tables B1 to B7. While it is not mandatory for cable manufacturers to follow these colour codes, they usually do.

Where a cable colour code does not correspond to the colours in the tables in this Appendix, the colour code provided by the manufacturer of the cable should be followed as required by Clause 5.2 of this Standard.

Table B1

2-pair (quad) and 3-pair telephone cable colour code

Pair number	Colours
1	White Blue
2	Red Black
3	Orange Green

Table B2

1-pair to 5-pair cable colour code

Pair number	Colour code variations		
1	White Blue	White-Blue Blue	White-Blue * Blue-White *
2	White Orange	White-Orange Orange	White-Orange * Orange-White *
3	White Green	White-Green Green	White-Green * Green-White *
4	White Brown	White-Brown Brown	White-Brown * Brown-White *
5	White Grey	White-Grey Grey	White-Grey * Grey-White *

* The first-named colour is the predominant colour

Table B3

Colour code for up to 100-pair cables (20-pair units)

Pair number	A Leg (L+)	B Leg (L-)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	White	Blue-White
7	White	Blue-Orange
8	White	Blue-Green
9	White	Blue-Brown
10	White	Blue-Grey
11	White	Orange-White
12	White	Orange-Green
13	White	Orange-Brown
14	White	Orange-Grey
15	White	Green-White
16	White	Green-Brown
17	White	Green-Grey
18	White	Brown-White
19	White	Brown-Grey
20	White	Grey-White

Pair range	Mate colour
1-20	White
21-40	Yellow
41-60	Black
61-80	Violet
81-100	Red

Note: These cables are normally constructed using layer stranding, with the pair count sequence commencing from the centre and progressing through successive outer layers.

Table B4

Colour code for up to 100-pair cables (25-pair units)

Pair number	Mate	Colour
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey
11	Black	Blue
12	Black	Orange
13	Black	Green
14	Black	Brown
15	Black	Grey
16	Yellow	Blue
17	Yellow	Orange
18	Yellow	Green
19	Yellow	Brown
20	Yellow	Grey
21	Violet	Blue
22	Violet	Orange
23	Violet	Green
24	Violet	Brown
25	Violet	Grey

Pair range	Whipping colour
1-25	Blue
26-50	Orange
51-75	Green
76-100	Brown

Note 1: 50 to 100 pair cables are constructed with 25 pair sub-units and coloured whipping.

Note 2: The mate conductor may include a thin band of the corresponding colour, while the coloured conductor may have a thin band of the corresponding mate colour.

Note 3: At installation, each of the whippings should be tied around each bundle at the end of the cable sheath to maintain the bundle identification.

Table B5

Colour code for up to 100-pair cables (10-pair units)

Pair number	A Leg (L+)	B Leg (L-)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey

Pair range	Whipping colour
1-10	Blue
11-20	Orange
21-30	Green
31-40	Brown
41-50	Grey
51-60	Blue-White
61-70	Orange-White
71-80	Green-White
81-90	Brown-White
91-100	Grey-White

Note 1: The cable pairs may have a very light twist and care is required, when stripping the cable sheath and fanning out the pairs, that the mates do not separate from their primary colours and get mixed up.

Note 2: At installation, each of the whippings should be tied around each bundle at the end of the cable sheath to maintain the bundle identification.

Table B6

Colour code for up to 200-pair cables (10-pair units)

Pair number	A Leg (L+)	B Leg (L-)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Grey
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Grey

Pair range	Whipping colour
1-10	Blue-White
11-20	Orange-White
21-30	Green-White
31-40	Brown-White
41-50	Grey-White
51-60	Blue-Blue
61-70	Orange-Orange
71-80	Green-Green
81-90	Brown-Brown
91-100	Grey-Grey
101-110	White-White
111-120	Red-Red
121-130	Yellow-Yellow
131-140	Violet-Violet
141-150	Black-Black
151-160	Blue-Red
161-170	Orange-Red
171-180	Green-Red
181-190	Brown-Red
191-200	Grey-Red

Note 1: The cable pairs may have a very light twist and care is required, when stripping the cable sheath and fanning out the pairs, that the mates do not separate from their primary colours and get mixed up.

Note 2: At installation, each of the whippings should be tied around each bundle at the end of the cable sheath to maintain the bundle identification.

Table B7
Optical fibre colour code

Fibre number	Colour
1	Blue
2	Orange
3	Green
4	Brown
5	Grey
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink
12	Aqua

Note 1: This colour code applies to both loose tube and tight buffered fibre.

Note 2: For stranded (multiple) loose tube construction, the tube colour sequence is the same as the fibre colour sequence.

APPENDIX

C Telecommunications outlets (INFORMATIVE)

C.1 Introduction

A telecommunications outlet (TO) typically consists of a wall plate, housing or other mounting device containing a socket or sockets. In some cases, the socket is an integral part of the wall plate or housing.

This Appendix describes three distinct types of socket used in Australia for telecommunications outlets and some design variations within each type.

C.2 Socket types

The most common types of socket used for telecommunications outlets in Australia are the following:

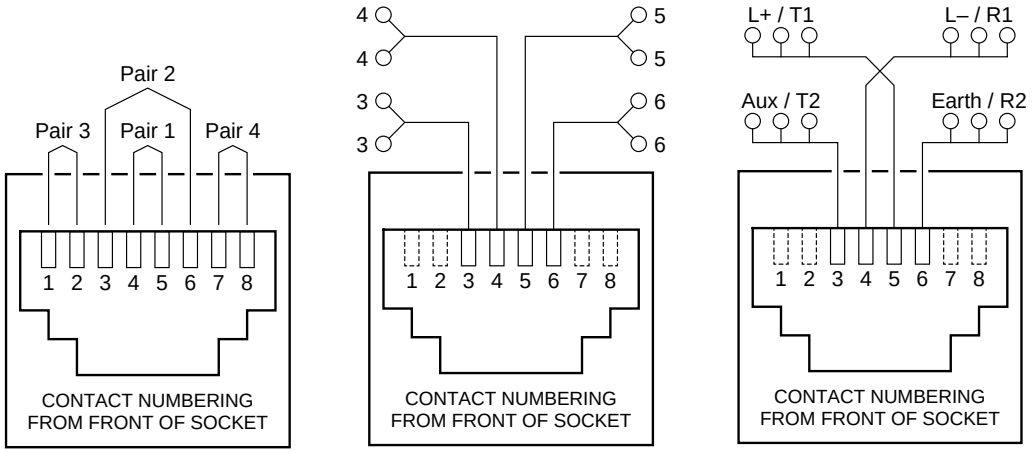
(a) 8 position (8P) modular.

(b) 6 position (6P) modular.

(c) 600 series.

8P sockets are recommended for new cabling work. 6P and 600 series sockets should only be used for additions or repairs to existing installations.

Contact numbering and standard connections for these socket types are described in Figures C1 to C3 and Tables C1 to C3.



Generic socket (8P8C) (Note 1)

8P4C socket (Note 2)

Wallphone socket (8P4C) (Note 3)

Note 1: Recommended 8P8C socket pair assignments (T568A) for generic cabling are shown.

Note 2: With 8P4C sockets, only the inner 4 contacts are fitted, which allows 2 conductor terminations to be provided per contact spring to support bus wiring of outlets.

Note 3: The terminals for wallphone-mounting outlets may be marked with line designations as shown, rather than with the socket contact numbers.

Figure C1

8P modular socket contact numbering

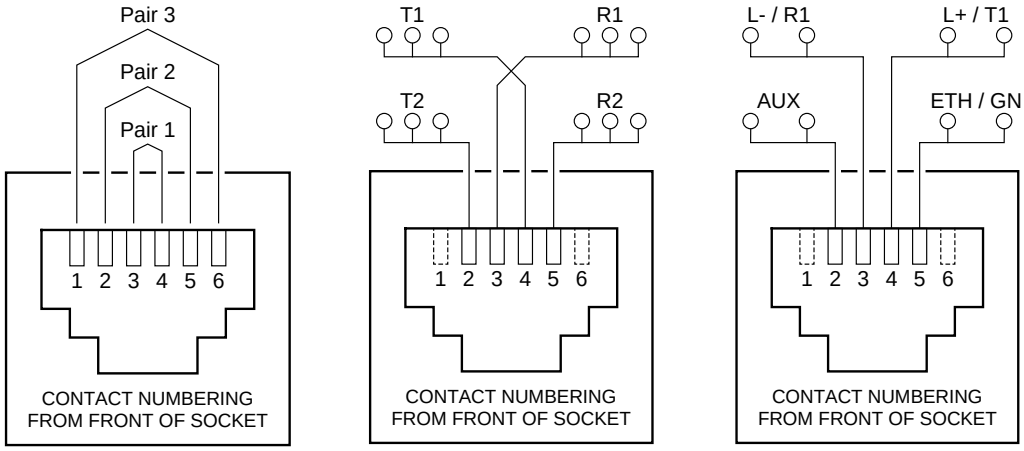
Table C1

8P socket contact/pair assignments and cable colour code

Contact designations			Pair No.	4-pair cable colour code variations			3-pair cable	2-pair cable
L+ L-	T1 R1	5 4	1	White Blue	White-Blue Blue	White-Blue* Blue-White*	White Blue	White Blue
Aux Earth	T2 R2	3 6	2	White Orange	White-Orange Orange	White-Orange* Orange-White*	Red Black	Red Black
-	-	1 2	3	White Green	White-Green Green	White-Green* Green-White*	Orange Green	-
-	-	7 8	4	White Brown	White-Brown Brown	White-Brown* Brown-White*	-	-

* The first-named colour is the predominant colour

Note: With bus-wired (e.g. telephone) outlets, only working pairs should be connected to the socket (e.g. pair 1 for one line). With generic cabling (i.e. cabling star wired from a distributor), all pairs should be terminated on the socket.



Generic socket
(Note 1)

Wallphone socket
IDC type
(Note 2)

Wallphone socket
screw terminal type
(Note 2)

Note 1: The outer contact springs (1 and 6) are not fitted on some 6P modular sockets.

Note 2: The terminals for wallphone-mounting outlets may be marked with line designations as shown, rather than with the socket contact numbers.

Figure C2

6P modular socket contact numbering

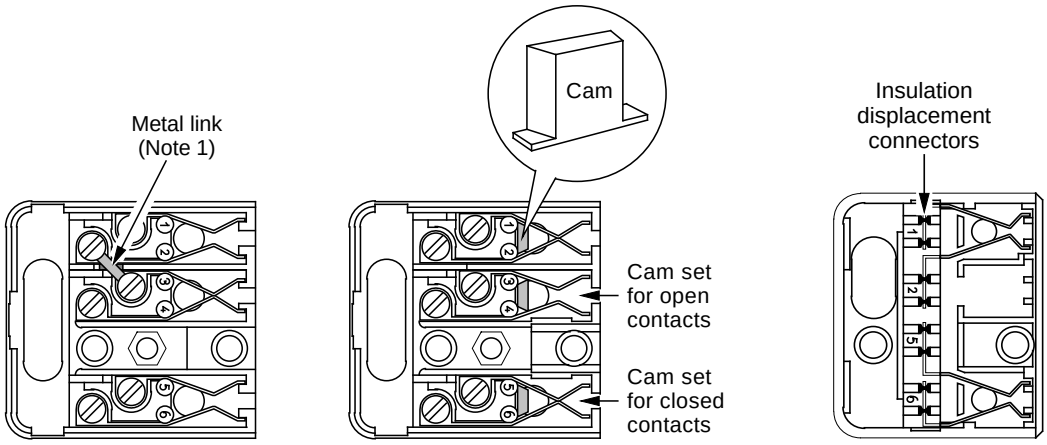
Table C2

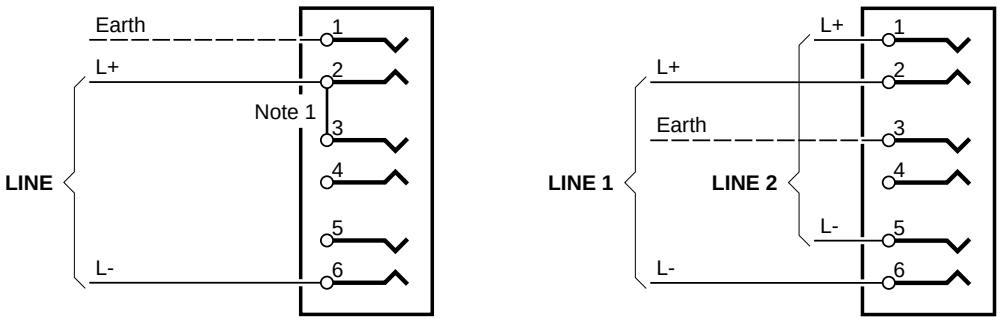
6P socket contact/pair assignments and cable colour code

Contact designations			Pair No.	4-pair cable colour code variations			3-pair cable	2-pair cable
T1 R1	T1 R1	4 3	1	White Blue	White-Blue Blue	White-Blue* Blue-White*	White Blue	White Blue
R2 T2	ETH AUX	5 2	2	White Orange	White-Orange Orange	White-Orange* Orange-White*	Red Black	Red Black
-	-	6 1	3	White Green	White-Green Green	White-Green* Green-White*	Orange Green	-
-	-	-	4	White Brown	White-Brown Brown	White-Brown* Brown-White*	-	-

* The first-named colour is the predominant colour

Note: Only working pairs should be connected to the socket (e.g. pair 1 for one line).





Note 1: A metal link or strap is required between terminals 2 and 3 with older customer equipment to provide a circuit for the ringer (bell).

Note 2: Contact springs 3 and 4 are not fitted with some sockets (e.g. type 612).

Figure C3

600 series socket connections

Table C3

600 series socket contact/pair assignments and cable colour code

Contact No.			Pair No.	4-pair cable colour code variations			3-pair cable	2-pair cable
612	611	610						
2 6	2 6	2 6	1	White Blue	White-Blue Blue	White-Blue* Blue-White*	White Blue	White Blue
1 5	1 5	1 5	2	White Orange	White-Orange Orange	White-Orange* Orange-White*	Red Black	Red Black
-	3 4	3 4	3	White Green	White-Green Green	White-Green* Green-White*	Orange Green	-
-	-	-	4	White Brown	White-Brown Brown	White-Brown* Brown-White*	-	-

* The first-named colour is the predominant colour

Note: Only working pairs should be connected to the socket (e.g. pair 1 for one line).

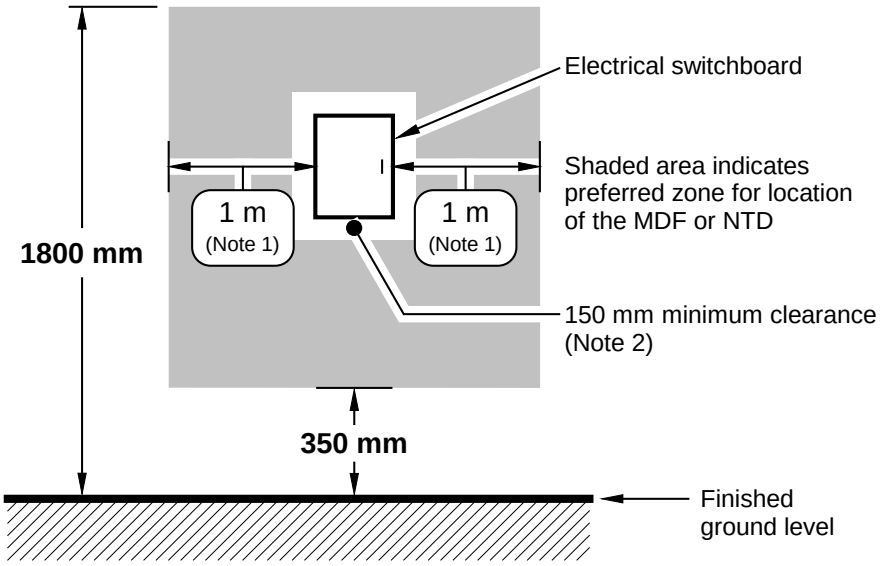
APPENDIX

D Recommended access clearances for MDFs and NTDs (INFORMATIVE)

Suitable access clearances are required around an MDF or NTD to provide safe and convenient access by carriers, carriage service providers, cabling providers and, in some cases, customers (e.g. where customer testing is supported by the MDF or NTD). The access space is necessary so a person has sufficient head and shoulder room to terminate cables and to connect or test telecommunications services. The area above, below and beside the MDF or NTD should not contain any protruding obstacles that may require any person to stoop or twist their body in order to gain access to cables or terminations within the MDF or NTD.

Figures D1 to D4 show the minimum and maximum height and clearances recommended to ensure that the installation complies with this Standard and to ensure safe and convenient access.

Note: An NTD is normally installed by the carrier but the cabling provider should maintain suitable NTD access clearances when installing customer cabling or customer equipment.

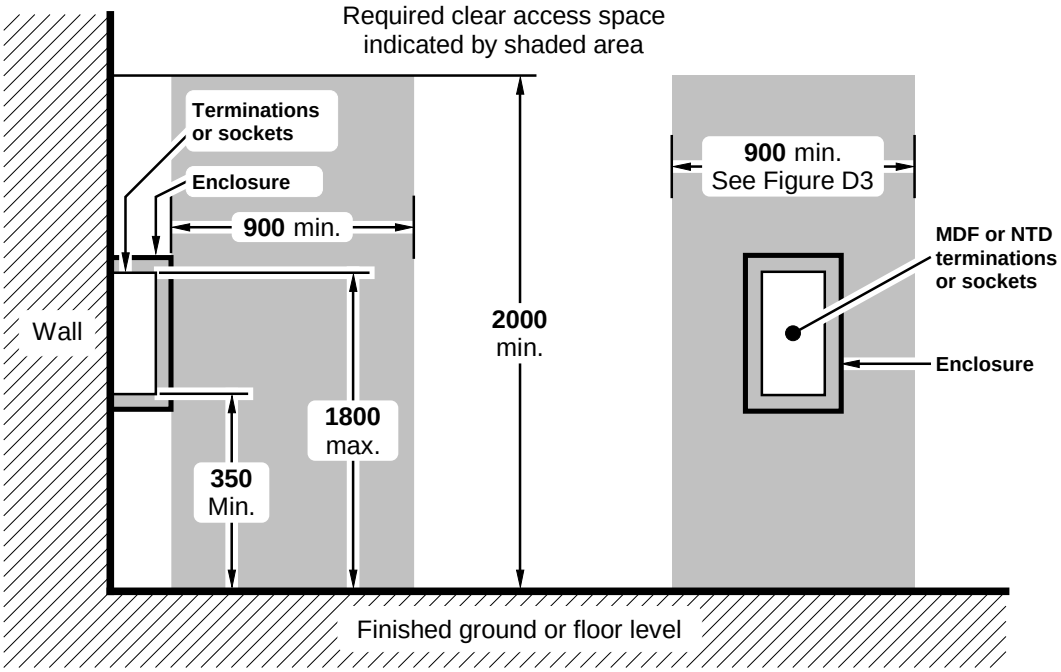


Note 1: An MDF is installed by the cabling provider. An NTD is normally installed by the carrier (however, the cabling provider still needs to know where the NTD will be located in order to provide the customer cabling that will be connected to it). It is recommended that an MDF or NTD be installed within 1 m of the electrical switchboard for ready location, access and to enable effective surge suppression to be provided. Care needs to be taken to avoid building fixtures such as downpipes, water pipes/taps, etc. and fences that adjoin the building.

Note 2: The 150 mm clearance is an operational clearance (e.g. to allow for opening of the door/cover of the MDF/NTD or future expansion), and is not a safety requirement.

Figure D1

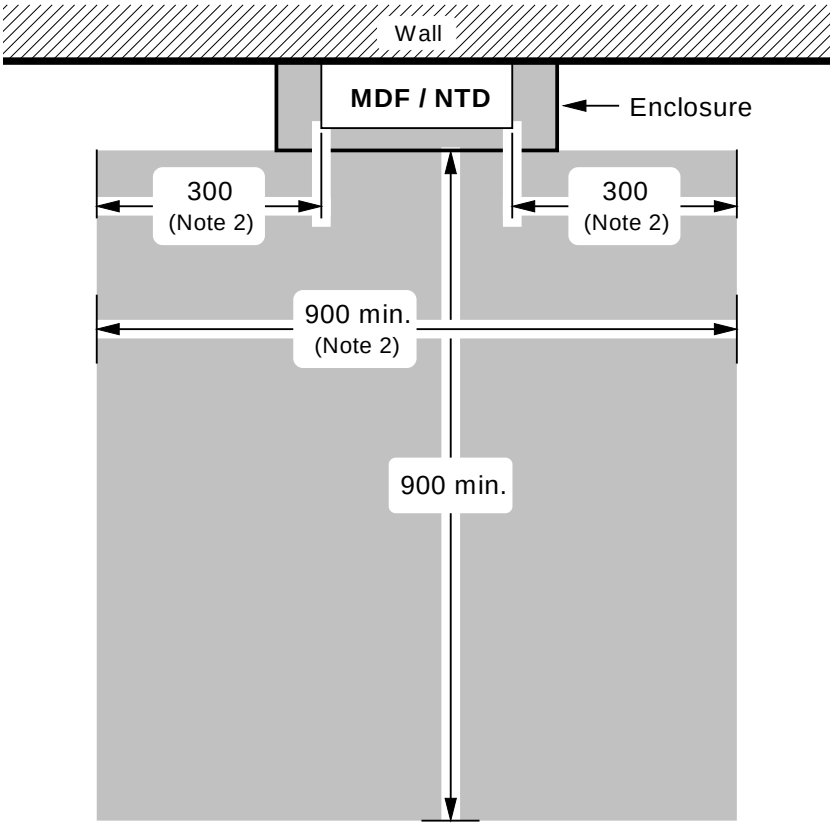
Installation zone for a wall mounted MDF or NTD on the external wall of a dwelling



All dimensions are in mm.

Figure D2

Access clearances for a wall mounted MDF or NTD



All dimensions are in mm.

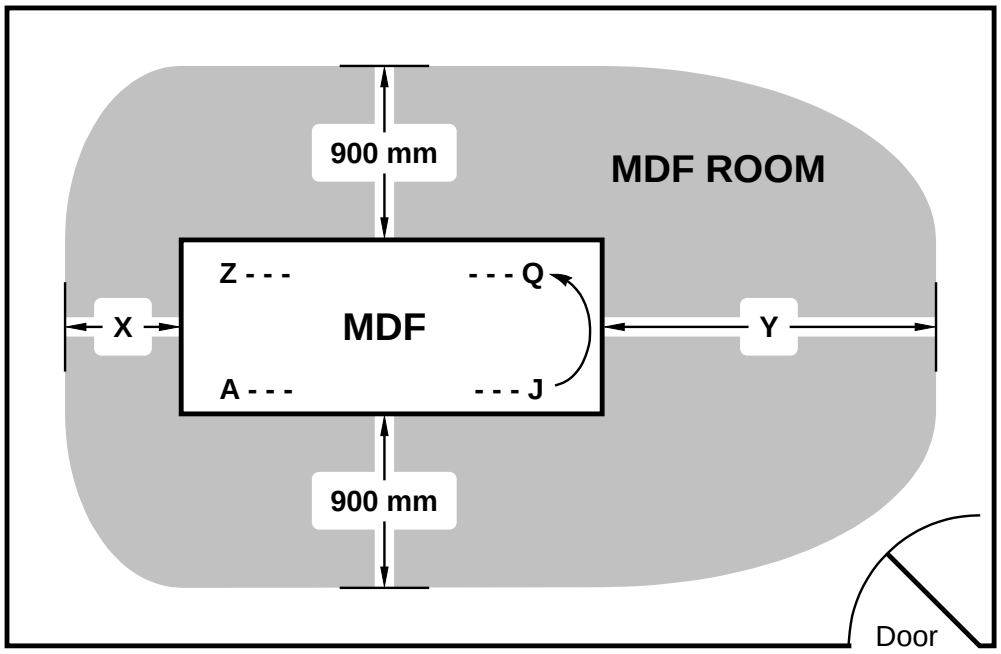
Plan view

Note 1: The shaded area indicates the space that should be kept clear of obstacles.

Note 2: The 300 mm side clearance provides 'shoulder room' for working on the MDF/NTD. The minimum required total clearance width in front of the device is 900 mm.

Figure D3

Access clearances for a wall mounted MDF or NTD



Note 1: Position the MDF within the room to obtain the required minimum clearances around it.

Note 2: The fixed end clearance, marked '**X**', should be sufficient to provide 'shoulder room' for working on the MDF, i.e. a minimum of **300 mm**. However, sufficient clearance should be provided to enable ready escape from the vicinity under emergency conditions — a minimum distance of **600 mm** is recommended for this purpose. If the MDF has cable terminations facing the end wall, a minimum distance of **900 mm** is required.

Note 3: The end clearance marked '**Y**' should be sufficient to provide for MDF expansion, access and ready escape from the vicinity under emergency conditions — a minimum distance of **1200 mm** is recommended.

Note 4: A minimum frontal clearance of **900 mm** working space from the vertical face of the termination side of the MDF and a minimum vertical clearance of **2 m** from the walked-on surface are required.

Note 5: The MDF verticals are required to be designated alphabetically from left to right (i.e. in an anti-clockwise direction) as shown. A gap should be provided in the vertical designations as indicated above (e.g. **K-P**) to allow for verticals to be added later without the need to redesignate the existing verticals.

Figure D4

Access clearances for a floor mounted or 'island' MDF

APPENDIX

E Direct current in the communications bonding conductor (INFORMATIVE)

E.1 Introduction

The installation and operation of customer access equipment (CAE) and other customer equipment may give rise to direct current being discharged to earth via the equipotential bond to the earthing system of the electrical installation. This is additional to any DC that may already exist in the earthing system.

E.2 Recommendation

To reduce the chance of additional electrolytic corrosion of the electrical earth electrode, the aggregate current flow through the electrode from all communications bonding conductors should be limited to the following:

(a) 25 µA continuous (either polarity), i.e. the average current measured over 24 h should not exceed 600 µA.h per day.

(b) 100 mA maximum (either polarity) for any period not exceeding 30 s.

The system designer should consider these values.

APPENDIX

F Current-limited power feeding in telecommunications networks (INFORMATIVE)

F.1 Introduction

With some carriage services, carriers and carriage service providers may install equipment in customer premises that is powered from the distant end via the telecommunications line. In some cases, the line voltage at the customer premises may exceed TNV limits. However, the power feeding circuit may be within the defined safety limits of a network Standard or Code.

One such code is Industry Code C559 Part 1. This Code sets out voltage and current limits and other safety requirements for remote power feeding into customer premises.

This Appendix is a summary of some of the requirements in C559 Part 1 as at the time of drafting this Standard. Reliance on this summary may not ensure compliance with the requirements of the Code and therefore carriers, carriage service providers and their representatives are advised to refer to the provisions of the Code.

F.2 Power feeding limits

An important requirement of C559 Part 1 is that any remote power feeding voltage is required to either—

(a) be within the TNV-3 limits of AS/NZS 60950.1; or

(b) if the TNV-3 limits are exceeded—

(i) only DC power feeding is to be used;

(ii) the power feed voltage is not to exceed 300 V d.c.; and

(iii) current limiting is to be used.

Remote power feeding circuits that meet the requirements of Item (b) above are referred to herein as 'Remote Feeding Telecommunications — Current-limited', or 'RFT-C', circuits.

F.3 Implications for cabling providers

Cabling providers need to be aware that RFT-C circuits may exist on telecommunications networks and may appear on some lines at an MDF, NTD or other cable termination device used to connect carrier or carriage service provider equipment at customer premises.

While RFT-C circuits are not considered to be dangerous, like normal ring voltage on standard telephone lines, they may deliver a nasty shock to cabling providers under certain conditions. Consequently, cabling providers should heed the general warning notice in the introductory part of this Standard and be particularly careful when working on ladders or in restricted spaces, as physical reaction to any electric shock may result in personal injury.

F.4 Power feeding in customer cabling

An RFT-C circuit is an LV telecommunications circuit, as defined in Section 3 of this Standard, and is precluded from sharing a customer cable with ELV, SELV and TNV circuits (see Clause 9.3.1). However, an RFT-C circuit may be installed in a separate customer cable which may share cabling pathways, spaces and distributors with customer cabling subject to the separation requirements of Clause 9.3.3.

C559 Part 1 sets down certain requirements for remote power feeding into customer premises, by carriers and carriage service providers, to minimise the likelihood of unintentional contact with RFT-C circuits by cabling providers and others. These requirements include the use of physical separation or insulating barriers, warning labels and appropriate entries in cable records at cable termination points. For more information, refer to Section 9 of C559 Part 1(available on the Communications Alliance web site at www.commsalliance.com.au).

Cabling providers should keep clear of any cables, terminations or circuits that are labelled as power feeding circuits by a carrier or carriage service provider. Where terminations so labelled have not been protected by a rigidly-fixed insulating barrier, the cabling provider should ensure that adequate spatial separation is maintained between the power feeding terminations and any customer cabling terminations as set out in Clause 9.3.3 of this Standard.

APPENDIX

G LV telecommunications circuits (INFORMATIVE)

G.1 Introduction

The commencement of the *Telecommunications Act 1997* (the *Act*) heralded many changes that included the introduction of *Cabling Provider Rules* that ultimately captured all forms of communications cabling, including security and fire alarm system cabling, that were previously exempt from AUSTEL/ACA (now the ACMA) technical regulation.

The ACMA has the power to regulate any communications cabling that connects to a carrier's telecommunications network — even if that connection appears to be far removed from the cabling in question.

Communications cabling that is connected to a carrier's telecommunications network is called *customer cabling* and the installation, connection or maintenance of such cabling is called *cabling work*.

Any person performing cabling work is called a *cabling provider* and is subject to the Cabling Provider Rules, which includes the requirement for the cabling provider to comply with the *Wiring Rules* (currently AS/CA S009 — this Standard).

The mechanism by which virtually all forms of communications cabling are captured by the *Act* and thus the Cabling Provider Rules and, through the Cabling Provider Rules, AS/CA S009, is explained in Clause G.2.

G.2 Relevant definitions

Connected, in relation to—

(a) a telecommunications network;

(b) a facility;

(c) **customer cabling**; or

(d) customer equipment;

includes connection otherwise than by means of physical contact, for example, a connection by means of radiocommunication.
[s7 of the *Telecommunications Act 1997*]

Customer cabling means a **line** that is used, installed ready for use or intended for use on the customer side of the boundary of a telecommunications network.
[s20 of the *Telecommunications Act 1997*]

Line means a wire, cable, optical fibre, tube, conduit, waveguide or other physical medium used, or for use, as a continuous artificial guide for or in connection with carrying **communications** by means of guided electromagnetic energy.
[s7 of the *Telecommunications Act 1997*]

Communications includes any communication—

(a) whether between persons and persons, things and things or persons and things; and

(b) whether in the form of speech, music or other sounds; and

(c) whether in the form of data; and

(d) whether in the form of text; and

(e) whether in the form of visual images (animated or otherwise); and

(f) whether in the form of signals; and

(g) whether in any other form; and

(h) whether in any combination of forms.

[s7 of the *Telecommunications Act 1997*]

G.3 Changes necessary to accommodate cabling that was previously exempt from this Standard

Some communications systems that were not previously subject to this Standard could not comply with it because the systems traditionally use voltages and currents for signalling and power feeding purposes that are defined as hazardous in the reference Standards. These reference Standards cannot be changed (or be deviated from) to redefine what is or is not hazardous because the nature of human physics cannot be changed. Therefore AS/CA S009 (this Standard) was changed to accommodate hazardous communications systems in a way that protects the safety of persons who are not required to work on these systems.

To accommodate the hazardous communications systems, it was necessary to define them in this Standard in a way that they can be differentiated from other hazardous and non-hazardous systems. The expression, *LV telecommunications circuit*, was introduced and other voltages/services were redefined and grouped together in section 3 to make the distinction between the various voltages/services clearer.

G.4 Comparison – separation of services to prevent transfer of hazardous voltages between systems

Table G1 was compiled to enable ready comparison of separation requirements between different telecommunications and power services for indoor cabling.

Table G1 is provided for information only. For actual separation requirements, refer to the body of this Standard.

Table G1

Minimum separation distances required between different types of telecommunications and power services for safety (indoor cabling)

Dimensions in mm

Type of service		Cables								Terminations							
		SELV	ELV	TNV	Limited current circuit	LV telecommunications	LV power	HV circuit multi-core	HV circuit single core	SELV	ELV	TNV	Limited current circuit	LV telecommunications	LV power	HV circuit multi-core	HV circuit single core
Non-hazardous	SELV	0	0	0	0	50 [a]	50 [a]	300 [c]	450	0	150 [b]	0	0	150 [b]	150 [b]	450 [d]	450 [d]
	ELV	0	0	0	0	50 [a]	50 [a]	300 [c]	450	150 [b]	150 [b]	150 [b]	150 [b]	150 [b]	150 [b]	450 [d]	450 [d]
	TNV	0	0	0	0	50 [a]	50 [a]	300 [c]	450	0	150 [b]	0	0	150 [b]	150 [b]	450 [d]	450 [d]
	Limited current circuit	0	0	0	0	50 [a]	50 [a]	300 [c]	450	0	150 [b]	0	0	150 [b]	150 [b]	450 [d]	450 [d]
Hazardous	LV telecommunications	50 [a]	50 [a]	50 [a]	50 [a]	0	50 [a]	300 [c]	450	150 [b]	150 [b]	150 [b]	150 [b]	0	150 [b]	450 [d]	450 [d]
	LV power	50 [a]	50 [a]	50 [a]	50 [a]	50 [a]	Per AS/NZS 3000			150 [b]	150 [b]	150 [b]	150 [b]	150 [b]	Per AS/NZS 3000		
	HV circuit multi-core	300 [c]	300 [c]	300 [c]	300 [c]	300 [c]				450 [d]	450 [d]	450 [d]	450 [d]	450 [d]			
	HV circuit single core	450	450	450	450	450				450 [d]	450 [d]	450 [d]	450 [d]	450 [d]			

a 50 mm or a durable barrier of insulating material or metal.

b 150 mm or a permanent, rigidly-fixed barrier of durable insulating material or earthed metal. In addition, accidental personal contact with the hazardous service is to be prevented by effective means

c The separation distance may be reduced to 150 mm if there is an interposing barrier of durable insulating material or earthed metal, which is of such dimensions that the shortest path around the barrier between the cables is at least 175 mm.

d A physical barrier is also required, e.g. separate enclosures.

APPENDIX

H Interference from HV power systems (INFORMATIVE)

H.1 Introduction

H.1.1 Types of HV interference

Interference from an HV power system may be hazardous or non-hazardous. Hazardous interference may cause injury to persons or damage to equipment. Non-hazardous interference may affect service reliability (network integrity) and quality (e.g. noise). It is therefore essential to ensure that any interference is avoided or reduced to an acceptable level.

Note: While an optical fibre cable that does not contain electrically conductive elements is immune from HV interference, earth potential rise (EPR) is still a potential threat to cabling providers.

H.1.2 Hazardous interference

The two main types of possible hazardous interference from HV power systems are earth potential rise (EPR) and low frequency induction (LFI). EPR and LFI do not usually occur during normal power system operation but, if they do, it is usually non-hazardous (but can cause noise). However, under a phase-to-earth fault condition on the HV power system, EPR and LFI can be hazardous (and for the remainder of this appendix, the terms EPR and LFI refer to the hazardous levels of these conditions).

In some rural situations, electrostatic coupling between an HV power line and telecommunications cables that contain electrically conductive elements may produce a hazard, the effect of which may be experienced during installation and repair activities. Unlike EPR and LFI, electrostatic coupling may exist under the normal operating conditions of the HV power system.

H.1.3 Non-hazardous interference

The main types of non-hazardous interference by HV power systems to telecommunications cables that contain electrically conductive elements are—

(a) low-level 50 Hz a.c. voltage;

(b) low-level higher frequency currents; and

(c) low-level electrostatic coupling, also known as capacitive coupling.

These three types of interference may be experienced under normal operating conditions of the HV system. Low level of 50 Hz a.c. voltage may cause service malfunction, while higher frequency currents and capacitive coupling may cause nuisance audible noise in a voice service and unwanted signal swamping noise in a data service.

Other sources of HV noise interference are AC traction lines (e.g. electric trains/trams) and electric fences.

The use of effective separation and/or continuous, earthed cable screening or shielding may reduce or totally eliminate the possibility of non-hazardous interference.

H.2 Earth potential rise (EPR)

H.2.1 What is EPR?

EPR is a condition caused by the flow of power system fault current to earth at an HV installation such as an electrical substation, HV transformer or, commonly, an HV pole with a conductive element to earth. The electrical potential of the ground near the installation rises due to the large amount of current flowing to earth through the impedance of the HV installation earthing system. This could create a hazard for a person in the EPR zone who may be bridging the voltage gradients within the EPR zone with their body, touching a nearby earthed object or touching a wire or termination connected to a distant earth, such as a telephone line that is earthed at the exchange.

The concept of EPR is demonstrated in Figure H1, which shows theoretical ground voltage gradients emanating from a pad-mounted HV transformer (as a typical example) under fault conditions. While the EPR condition may only last for a very short time (less than 2 s) until the HV power feed circuit breaker operates, the effects could be fatal and could also cause damage to telecommunications cabling and equipment installed within, or connected to cabling or equipment installed within, the EPR hazard zone.

An EPR hazard zone may exist within buildings, e.g. where the building is supplied with HV power, as well as on land surrounding external HV power plant such as a pole, tower or transformer.

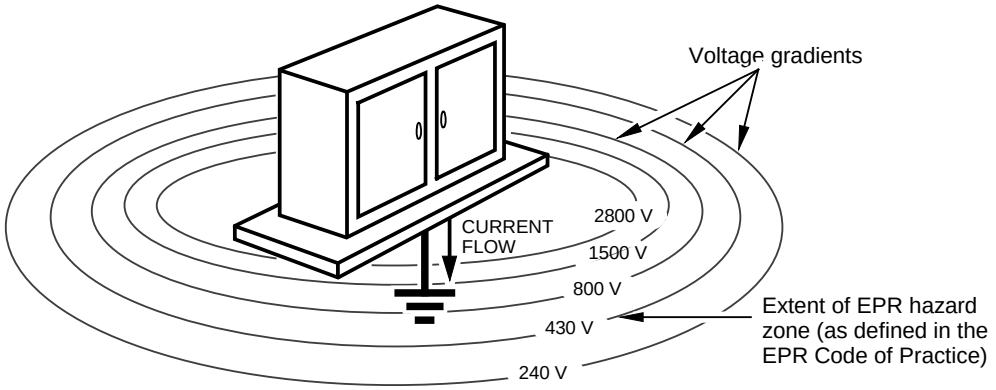


Figure H1

EPR caused by fault current at an HV transformer

H.2.2 Identifying situations of possible EPR hazard

A possible EPR problem may be identified by the presence of HV power poles, towers, transformers, etc. and, hence, the likely presence of HV earths that may carry fault current.

Possible EPR hazards are associated with the types of HV sites described in Tables H1 and H2, which indicate the possible extent of the EPR hazard zone around the HV site in typical soil conditions. The hazard zone may extend further in areas of high soil resistivity (e.g. rocky or dry, sandy terrain).

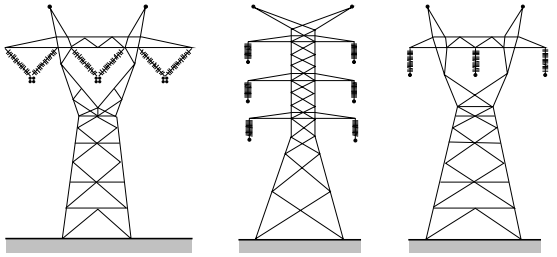
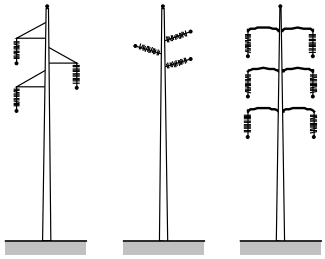
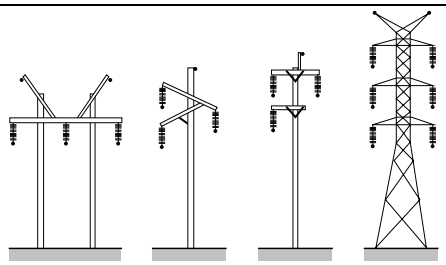
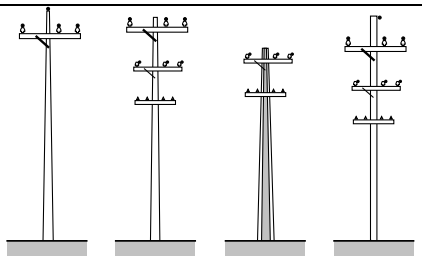
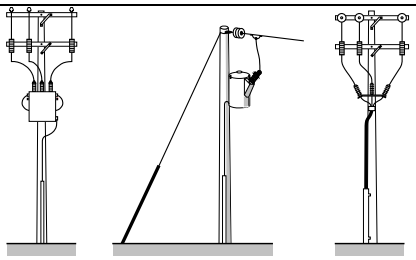
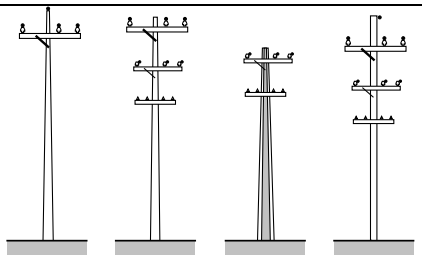
H.2.3 EPR hazard assessment

The level of the EPR at an HV site and the extent of the associated hazard zone are best determined by theoretical calculation and/or site tests. The methods of calculation and test, however, are outside the scope of this Appendix.

Nevertheless, in most cases such calculations and/or tests may not be required where the minimum distance specified in Tables H1 and H2 can be maintained between the HV site and the telecommunications cabling. Note however that power generating stations, large substations, SWER (single wire earth return) systems and HV sites in areas of high soil resistivity (e.g. rocky or dry, sandy terrain) require special consideration. In such cases, advice should be sought from the power utility in accordance with Clause 6.1.2.

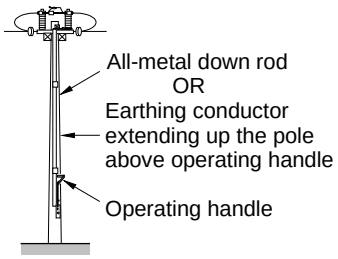
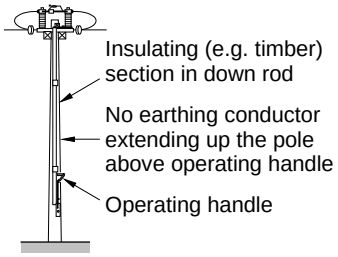
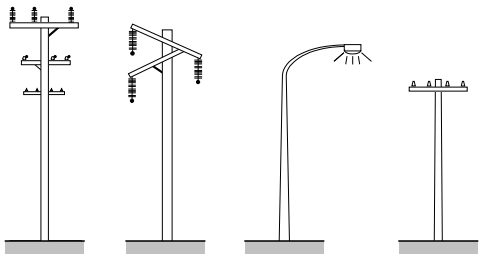
Table H1

Typical EPR hazard zones associated with HV power poles and towers

Type of HV pole or tower	Typically looks like this	Hazard zone
Steel lattice tower (220 kV and higher)		**40 m** (Note 1)
Metal or concrete pole (220 kV and higher)		**40 m** (Note 1)
• Steel lattice tower; or • wooden pole with down conductor to earth electrode (66 kV and 132 kV)		**16 m** (Note 1)
• Metal or concrete pole; or • wooden pole with down conductor to earth electrode (66 kV and 132 kV)		**16 m** (Note 1)
Pole with three-phase or SWER transformer, or with connections to underground power cable (lower than 66 kV)		**15 m** (Note 1)
• Metal or concrete pole; or • wooden pole with down conductor to earth electrode (lower than 66 kV)		**15 m** (Note 1)

cont:

Table H1
(continued)

Type of HV pole or tower	Typically looks like this	Hazard zone
Wooden pole with pole-top switch and one of the following: • an all-metal down rod; or • an earthing conductor extending up the pole above the handle		**15 m** (Note 1)
Wooden pole with pole-top switch and both of the following: • an insulating (e.g. timber) section in the down rod; and • no earthing conductor extending up the pole above the handle		**2 m** (Note 1)
• HV wooden pole without down conductor to earth electrode; or • any pole that only supports LV power lines		**1 m** (Note 2)

Note 1: This distance may be reduced if—

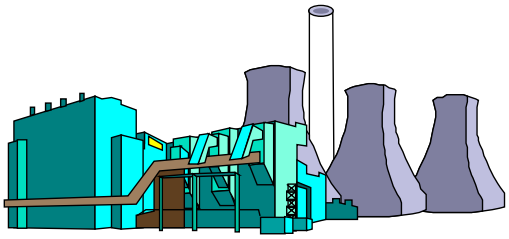
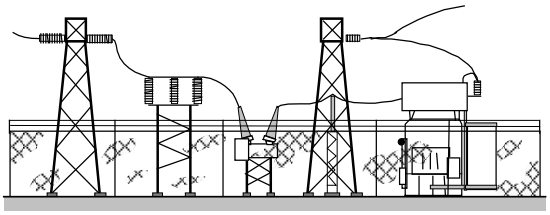
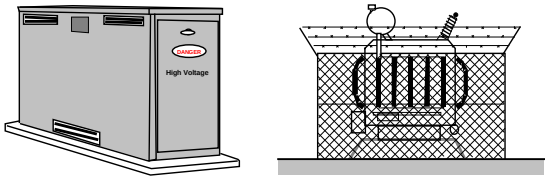
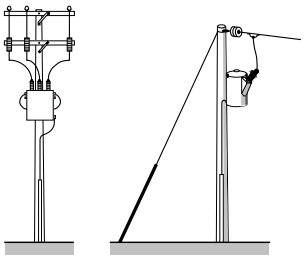
(a) the power utility has determined that the extent of the EPR hazard zone at a particular site is a lesser distance; or

(b) the installation is part of an engineered design in accordance with Clause 6.1.3.

Note 2: In this case, there is no HV earth and therefore no EPR hazard. However, 1 m is the recommended minimum operational clearance to enable pole replacement with minimal disturbance of the telecommunications cabling.

Table H2

Typical EPR hazard zones associated with power stations, substations and transformers

Type of HV plant	Typically looks like this	Hazard zone
Power generating station		**Indefinite** (Note 1)
Power substation		**Indefinite** (Note 1)
Pad-mount or ground transformer		**15 m** (Note 2)
Pole-mounted three-phase or SWER transformer (wooden, concrete or metal pole)		**15 m** (Note 2)

Note 1: The EPR hazard zone may extend for hundreds of metres in some cases. Therefore, the extent of the hazard at the particular site should be obtained from the power utility in accordance with Clause 6.1.2, and the installation may need to be designed by a certified electrical engineer in accordance with Clause 6.1.3. In such cases, the relevant carrier is to be notified of the proposed installation in accordance with Clause 6.1.4.

Note 2: This distance may be reduced if—

(a) the power utility has determined that the extent of the EPR hazard zone at a particular site is a lesser distance; or

(b) the installation is part of an engineered design in accordance with Clause 6.1.3.

H.2.4 EPR mitigation

H.2.4.1 General rules

Mitigation for EPR problems should be determined at the planning stage. Simple rules, such as installing cabling and equipment outside the minimum distance specified in Tables H1 and H2, are generally sufficient to overcome most EPR problems.

The following equipment should not be installed inside an EPR zone:

(a) Customer equipment.

(b) Surge suppression devices.

(c) Earth electrodes.

(d) Any earthing terminals, link bars or the like.

(e) Metallic conduits, trays, ducts, etc.

(f) Cabling provider or customer access points that will be used, now or in the future, to connect or house any cable that contains electrically conductive elements, for example—

(i) cable connection devices (distributors, terminal boxes, telecommunications outlets, joints, pillars, cabinets, etc.); or

(ii) pits or access holes.

Where installation of the above equipment in an EPR hazard zone is unavoidable, the installation may only proceed on the basis of an engineered design in accordance with Clause 6.1.3.

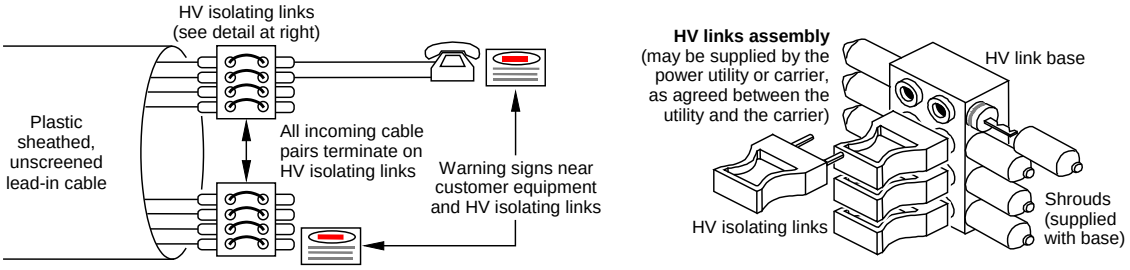
H.2.4.2 Cable passing through an EPR hazard zone

Only plastic-sheathed cables, preferably accommodated in rigid plastic conduit, may pass through an EPR hazard zone. The installation of pits, access holes and draw boxes for drawing in (not jointing) cables is also permitted in an EPR hazard zone. These should be labelled with a suitable EPR hazard warning. In such cases, cabling providers should insulate themselves from local earth in accordance with Clause H.5.

H.2.4.3 Special requirements for services within HV sites

Provision of telecommunication services within HV sites (e.g. inside power generating stations or HV substations) may require the installation of special isolating links, HV isolation units and the application of special installation practices.

Typical arrangements are illustrated in Figure H2. For more information, refer to the EPR code mentioned in Clause 6.1.3.



Note 1: The diagram above shows a simple installation without an MDF. Where an MDF is installed, the HV isolating links are installed between the building entry point and the MDF. The HV isolating links should be removed prior to performing any cabling work or customer equipment repairs.

Note 2: The carrier and power utility may agree to make the HV isolating links the network boundary or may agree about who supplies what within the HV site.

Figure H2

HV isolating links within a power generating station or HV substation

H.3 Low frequency induction (LFI)

H.3.1 What is LFI?

LFI may occur where any telecommunications cable with electrically conductive elements runs parallel with an HV power line for some distance.

If there is a phase-to-earth fault on the HV power line, the phase current in the faulted power line produces a magnetic field that causes a low frequency current to be induced into the telecommunications cable. Power line faults can result from insulation flashover, mechanical failure, storms, lightning and contact with other objects.

The fault condition only lasts for a short time (less than 2 s) but may be hazardous to telecommunications workers and customers and may also damage cabling and equipment. LFI voltages need to be kept within certain limits to minimise the risk of injury or damage. LFI is different from electrically induced noise in telecommunications cables, which is not hazardous but degrades system performance.

LFI does not occur under normal operating conditions because a balanced three-phase HV power line will not induce hazardous voltages into nearby telecommunications cables. The magnetic fields produced by balanced phase conductors tend to cancel each other out and the resultant LFI will be negligible.

H.3.2 LFI hazard assessment

H.3.2.1 General

LFI may occur whether the telecommunications cables or HV power lines are aerial or underground. Furthermore, the power line need not be within sight of the telecommunications cable to cause LFI. For

example, in a rural situation a telecommunications cable may run for several kilometres down a valley and still be affected by LFI from a power line running down an adjacent valley up to a kilometre away.

For customer cabling, LFI is normally only a concern—

(a) in urban areas where there are nearby overhead HV power distribution lines; and

(b) in outer urban or rural areas where long cable runs are likely.

Refer to Clause H.3.2.3 for more details.

H.3.2.2 Factors

Any telecommunications cable exposed to an HV power line with a phase-to-earth fault will be subjected to an LFI voltage. How much LFI voltage will be induced into the telecommunications cable depends upon—

(a) the phase-to-earth fault current on the power line — the higher the fault current, the higher the LFI;

(b) the length of the telecommunications cable exposed to the power line — the greater the length of exposure, the higher the LFI;

(c) the separation between the power line and the telecommunications cable — the closer the telecommunications cable is to the power line, the higher the LFI;

(d) earth resistivity under the power line — the higher the earth resistivity, the higher the LFI; and

(e) the presence or absence of shielding conductors or environmental shielding (such as metallic water pipes) near the power line or the telecommunications cable — the presence of shielding reduces the LFI.

LFI voltages accumulate over the total distance of a power line run. For example, if the power line and telecommunications cable diverge for some distance and then reconverge and run parallel again, the voltages induced in each parallel section will add together. Similarly, any LFI voltages induced into customer cabling will add to any LFI voltages induced into electrically conductive telecommunications cabling within the carrier's network.

H.3.2.3 When does LFI need to be considered?

Cables without electrically conductive elements (e.g. optical fibre cables without metallic or carbon fibre strengtheners or bearers) are immune from LFI.

A possible LFI problem may be identified by the presence of HV power lines installed on a route that essentially parallels electrically conductive telecommunications cables. A possible hazard generally exists when

the total exposure length (e.g. within the carrier's network **and** within the customer's premises) typically exceeds a few hundred metres.

While the carrier may have taken steps to keep the LFI within network cables to safe limits, improperly installed customer cabling will have an additive effect and may raise the LFI above safe limits.

In practical terms, for customer cabling it is not necessary to consider LFI under the following conditions:

(a) Where the total length of any electrically conductive customer cabling between the network boundary and the end of the cabling does not exceed 200 m.

(b) Where the separation distance between customer cables and any HV power line exceeds 1 km.

(c) Where the total length of exposure between electrically conductive telecommunications cables (network cabling + customer cabling) and any HV power line does not exceed 1 km.

H.3.3 LFI mitigation

Where the voltages induced into the telecommunications cable may exceed permissible limits, the following steps may be taken to reduce the LFI to a safe level:

(a) Cabling route — where possible, select a cabling route that will not be in parallel with the HV power line. Even running the cable obliquely (45 degrees or more) to the power line will reduce the LFI.

(b) Separation distance — maintain maximum possible separation between telecommunications cables and parallel HV power lines.

(c) Shielding or screening — maximum shielding against LFI will be provided by enclosing the telecommunications cables in steel or galvanised iron pipe. Other, less effective measures include—

(i) enclosing the cables in non-magnetic metallic conduits (e.g. aluminium or copper) earthed at regular intervals or buried in the ground;

(ii) the use of shielded (screened) cable or cable with a metallic moisture barrier (MB), ensuring that the cable screen or MB is electrically continuous for the full length of the cable run and connected to a low resistance earth at each end or at regular intervals; or

(iii) installation of a shielding conductor parallel to and in immediate proximity to the telecommunications cable — such installations require a high conductivity, bare copper conductor buried directly in the ground or insulated conductor connected to a low resistance earth at each end or at regular intervals.

(d) Gas-filled protectors — installation of earthed, three-electrode gas protectors on all cable pairs at selected locations along the cable route. This arrangement is required to be an engineered design to ensure the protectors are correctly located and that an EPR condition is not developed at the protector earthing points when the protector operates.

H.4 Electrostatic coupling

H.4.1 What is electrostatic coupling?

In some rural locations with long cable runs, electrostatic coupling may occur between aerial telecommunications cables and certain types of HV power lines under normal power line operating conditions.

Underground cables are generally immune to electrostatic coupling.

A hazard may be created by the build-up of electrostatic charges (voltages) on open-circuit bearers or (spare) pairs of a multi-pair telecommunications cable. The effect of these electrostatic charges may only be experienced during installation or repair activities, i.e. if the cabling provider comes into contact with an open-circuit pair.

The severity of the hazard varies depending on some factors, such as the following:

(a) The power line configuration — SWER (single wire earth return), single-phase and two-phase systems are the worst case. Balanced three-phase systems, on the other hand, normally have no electrostatic coupling effect of a hazardous nature.

(b) Separation — the closer the telecommunications cable and the longer the exposure length to the HV power line, the greater the hazard produced.

(c) Cable screening — a continuous cable screen on the aerial telecommunications cable, earthed at both ends, provides a discharge path to ground for the electrostatic charges and virtually eliminates the hazard.

H.4.2 Mitigation of electrostatic coupling

Electrostatic coupling may be avoided or reduced to a safe level by applying one of more of the following practices:

(a) Installing the customer cabling underground.

(b) For unscreened aerial cable or aerial cable where the cable screen is not earthed, maintaining the minimum separation distance set out in Table H3.

(c) Using aerial cable with a continuous screen earthed at both ends of the cable or at both sides of the section of cable exposed to the parallel HV power line.

Table H3

Minimum separation from parallel HV power line to avoid an electrostatic coupling hazard

Minimum separation from HV line	Length of parallel exposure
4 m	100 m
10 m	200 m
20 m	500 m
50 m	2 km

Note: Table H3 only applies to unscreened aerial cable or screened aerial cable where the screen is not continuous or is not earthed at both ends. Underground cable is generally immune to electrostatic coupling.

H.5 Safety practices

Before working on equipment, cable conductors or other metallic cable elements (such as cable screens or bearers), cabling providers should take steps to ensure they are insulated from the local earthed environment by using electrically insulated gloves, mats, tools and safety boots in any of the following situations:

(a) Telecommunications cabling is located within, or it is suspected that cabling is located within, an EPR hazard zone.

(b) It is suspected that telecommunications cabling may be exposed to LFI of any magnitude.

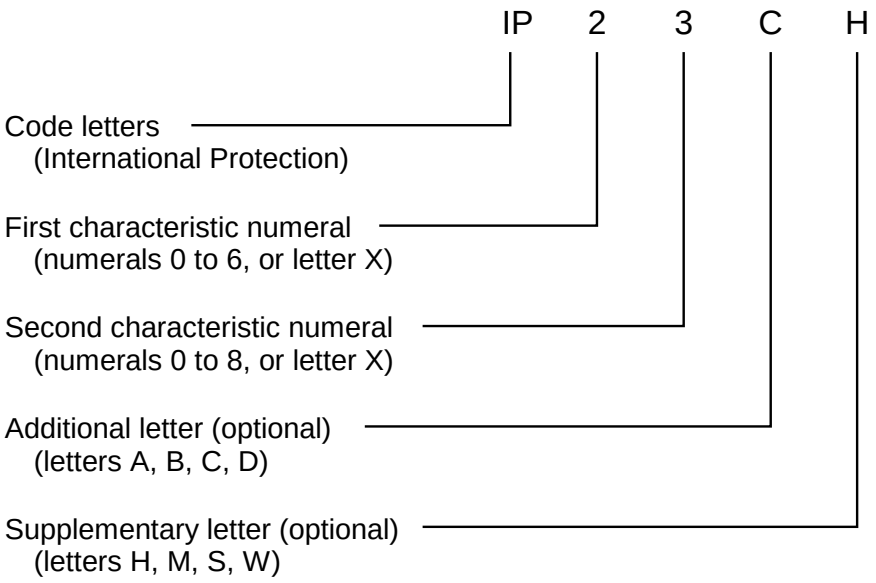
(c) It is suspected that aerial telecommunications cabling may be exposed to the effects of electrostatic coupling.

APPENDIX

I The IP Code (INFORMATIVE)

The IP Code is a system for classifying degrees of protection provided by enclosures of electrical equipment with regard to protection of persons against access to hazardous parts inside the enclosure and protection of equipment inside the enclosure against the ingress of solid foreign objects and harmful effects due to the ingress of water.

The degree of protection provided by an enclosure is expressed using an alphanumerical code consisting of four, five or six characters, as described in Figure I1 and Table I1.



Note 1: Where a characteristic numeral is not required to be specified, it is replaced by the letter 'X'.

Note 2: Additional letters and/or supplementary letters may be omitted without replacement.

Note 3: See Table I1 for the meaning of each numeral or letter.

Figure I1
Arrangement of the IP Code

Table I1
Summary of the IP Code

	IP	Meaning for the protection of EQUIPMENT	Meaning for the protection of PERSONS
First numeral		*Against ingress of solid foreign objects:*	*Against access to hazardous parts with:*
	X	Unimportant	Unimportant
	0	Non-protected	Non-protected
	1	≥ 50 mm diameter	Back of hand
	2	≥ 12.5 mm diameter	Finger
	3	≥ 2.5 mm diameter	Tool
	4	≥ 1.0 mm diameter	Wire
	5	Dust-protected	Wire
	6	Dust-tight	Wire
Second numeral		*Against ingress of water with harmful effects:*	
	X	Unimportant	
	0	Non-protected	
	1	Vertically dripping	
	2	Dripping (15° tilted)	
	3	Spraying	
	4	Splashing	
	5	Jetting	
	6	Powerful jetting	
	7	Temporary immersion	
	8	Continuous immersion	
Additional letter (optional)			*Against access to hazardous parts with:*
	A		Back of hand
	B		Finger
	C		Tool
	D		Wire
Supplementary letter (optional)		*Supplementary information specific to:*	
	H	High voltage apparatus	
	M	Motion during water test	
	S	Stationary during water test	
	W	Weather conditions	

Note 1: As an example, IP54 means protected against dust and splashing. In another example, IPXXB means protected against access to hazardous parts with a finger.

Note 2: Table I1 is derived from AS 60529 and is provided for basic guidance to interpret any given IP Code. Refer to AS 60529 for the full IP Code description.

APPENDIX

J The network boundary (INFORMATIVE)

J.1 Introduction

The network boundary is defined in the *Telecommunications Act 1997* ('the *Act'*). The network boundary—

(a) is a nominal demarcation point between carrier-owned and customer-owned cabling and equipment;

(b) determines whether cabling or equipment is subject to the ACMA technical regulation;

(c) is a physical boundary and not a service boundary; and

(d) is not a boundary of competition — in principle, there are no boundaries to competition under the *Act*.

Note: The network boundary is not a definitive boundary of cabling and equipment ownership (section 47 of Schedule 3 of the *Act* applies). Carriers may own cabling or equipment on the customer's side of the network boundary and non-carriers may own facilities on the carrier's side of the network boundary. However, facilities on the carrier's side of the network boundary are protected from unlawful tampering or interference under section 474.6 of the *Criminal Code 1995* ('Cwth').

J.2 Interpretation

As with all legislation, the *Act* is open to interpretation and there may be a number of 'valid interpretations'. This Appendix represents interpretation agreed by the ACMA and industry to provide industry certainty.

J.3 Legislation

The boundary of a telecommunications network (referred to in this Standard as the 'network boundary') is determined by section 22 of the *Act*. The relevant passages in the *Act* are as follows:

'(4) The boundary of a telecommunications network is:

(a) in a case where a telecommunications network is used to supply a carriage service to an end-user in a building by means of a line that enters the building — the point agreed between the customer and the carrier or carriage service provider who operates the telecommunications network, or, failing agreement:

(i) if there is a main distribution frame in the building and the line is connected to the frame – the side of the frame nearest to the end-user; or

(ii) if subparagraph (i) does not apply but the line is connected to a network termination device located in, on or within close proximity to, the building – the side of the device nearest to the end-user; or

(iii) if neither subparagraph (i) nor (ii) applies but the line is connected to one or more sockets in the building — the side nearest to the end-user of the first socket after the building entry point; or

(b) in a case where a telecommunications network is used to supply a carriage service to an end-user by means of a satellite-based facility that transmits to, or receives transmissions from, the point where the end-user is located — the outer surface of the satellite-based facility; or

(c) in a case where:

(i) a telecommunications network is used to supply a carriage service to an end-user; and

(ii) paragraphs (a) and (b) do not apply;

the outer surface of the fixed facility nearest to the end-user, where the facility is used, installed ready for use or intended for use to supply the carriage service.

(5) If, immediately before 1 July 1997, the boundary of a telecommunications network used to supply a standard telephone service to an end user in a building by means of a line that enters the building is the side of a main distribution frame, or a telephone socket, nearest to the end user, paragraph (4)(a) has effect, on and after 1 July 1997, as if the customer and the carrier or carriage service provider who operates the network had agreed to the boundary at that point.

(6) Subsection (5) does not prevent the customer and the carrier or carriage service provider agreeing to a boundary at a different point.'

Note 1: In accordance with section 7 of the *Act*, 'satellite-based facility' means a radiocommunications transmitter, or a radiocommunications receiver, in a satellite.

Note 2: The Explanatory Memorandum to *the Telecommunications Bill 1996* (the Bill presented to Parliament to make the *Act*) cited 'mobile telecommunications services' as an example where paragraph (c) applies.

Note 3: In this Standard, the requirements for a main distribution frame (MDF) apply to twisted pair cables only and do not embrace coaxial cables and optical fibre cables.

J.4 Analysis

The network boundary is determined by means of legal and technical analysis according to the hierarchy set by section 22 of the *Act*. This 'pecking order' effectively comprises a 'true' or 'false' breakdown that may be simply expressed by use of a flow chart such as Figure J1. However, interpretation of certain words and expressions affects interpretation of section 22 of the *Act*.

J.5 Agreements with customers about the network boundary

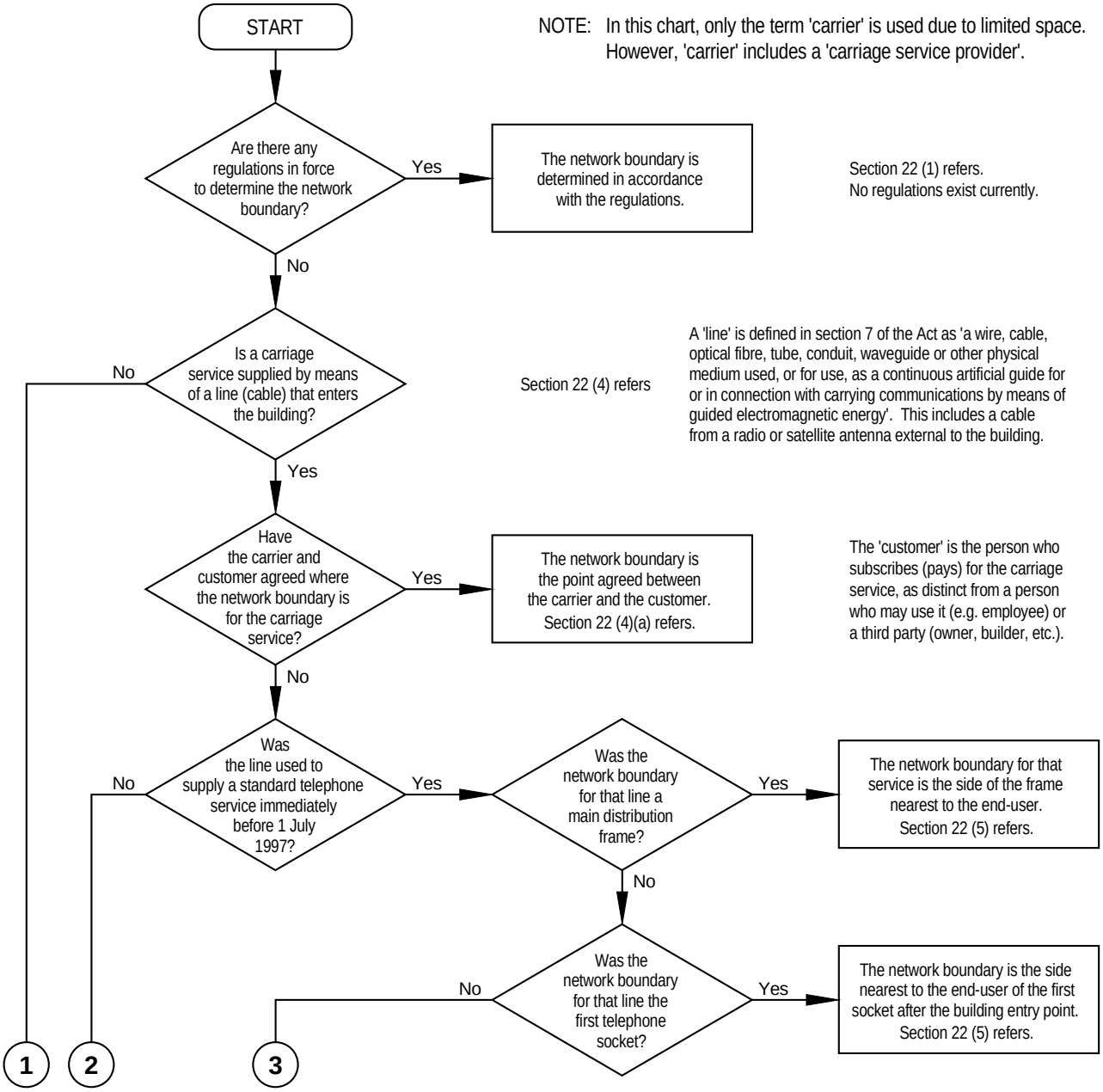
Where a carriage service is supplied to an end-user in a building by means of a line that enters the building, section 22 (4)(a) of the *Act* allows customers and carriers or carriage service providers to agree on a network boundary point. To be enforceable, it is necessary for such an agreement to be made with the customer of the service and not with a third party such as a body corporate, owner, builder or developer who is not actually the customer.

The problem with such agreements is that cabling providers and other carriers or carriage service providers may have no knowledge of them and may assume that the network boundary is at the 'default' point, as described in this Standard. Such agreements also lapse when the customer cancels the service, at which point the network boundary returns to the 'default' point.

J.6 Practical examples

Figures J2 to J17 provide practical examples in determining where the network boundary is, based on section 22 of the *Act* and the relevant definitions in this Standard.

Figures J18 to J20 provide practical determination of the expression, 'the side nearest to the end-user', used in section 22 of the *Act* in relation to a main distribution frame, a network termination device and the 'first socket'.



[Continued on the following page]

Figure J1

Analysis of section 22 of the *Telecommunications Act 1997*

[Continued from the previous page]

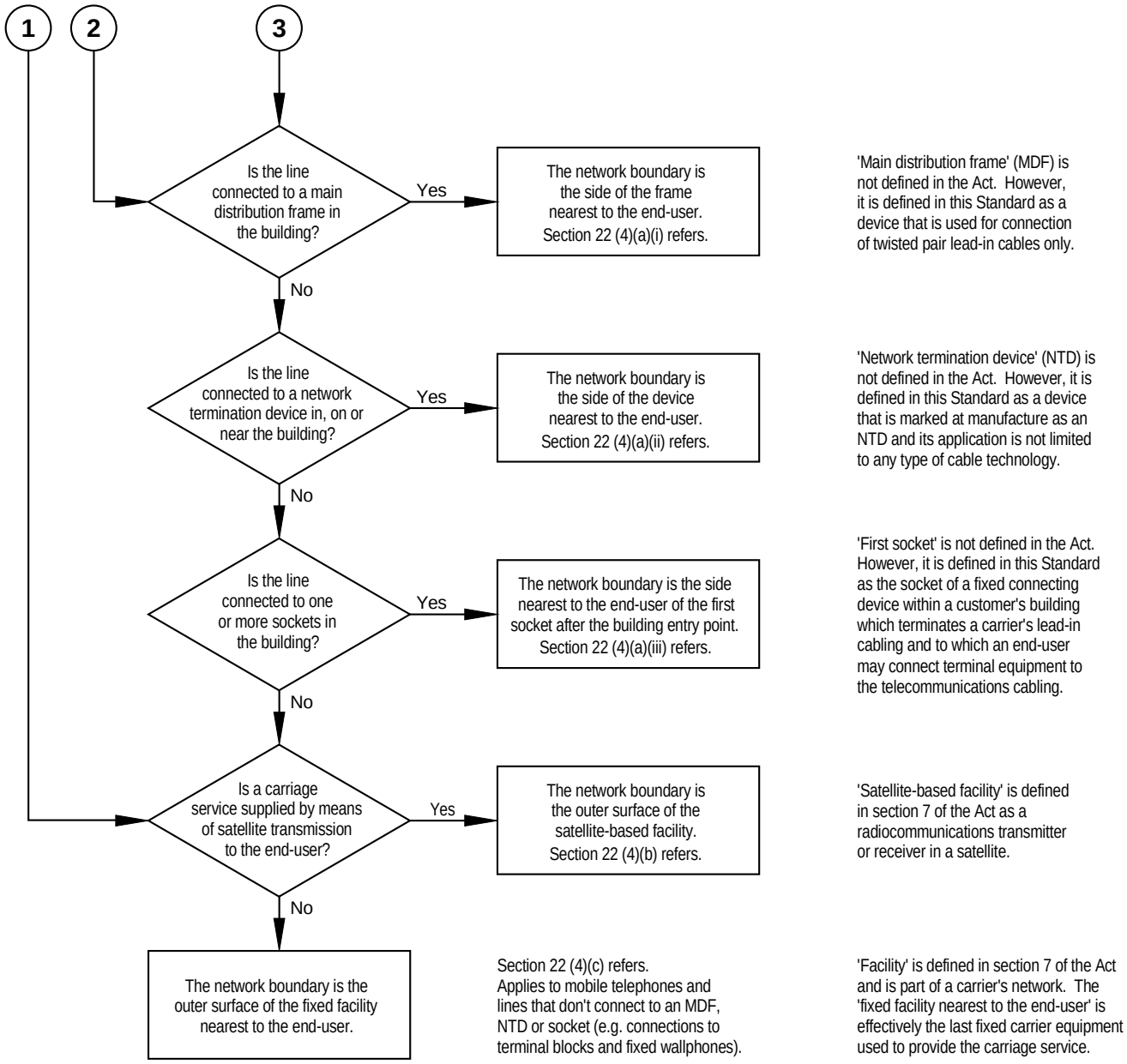
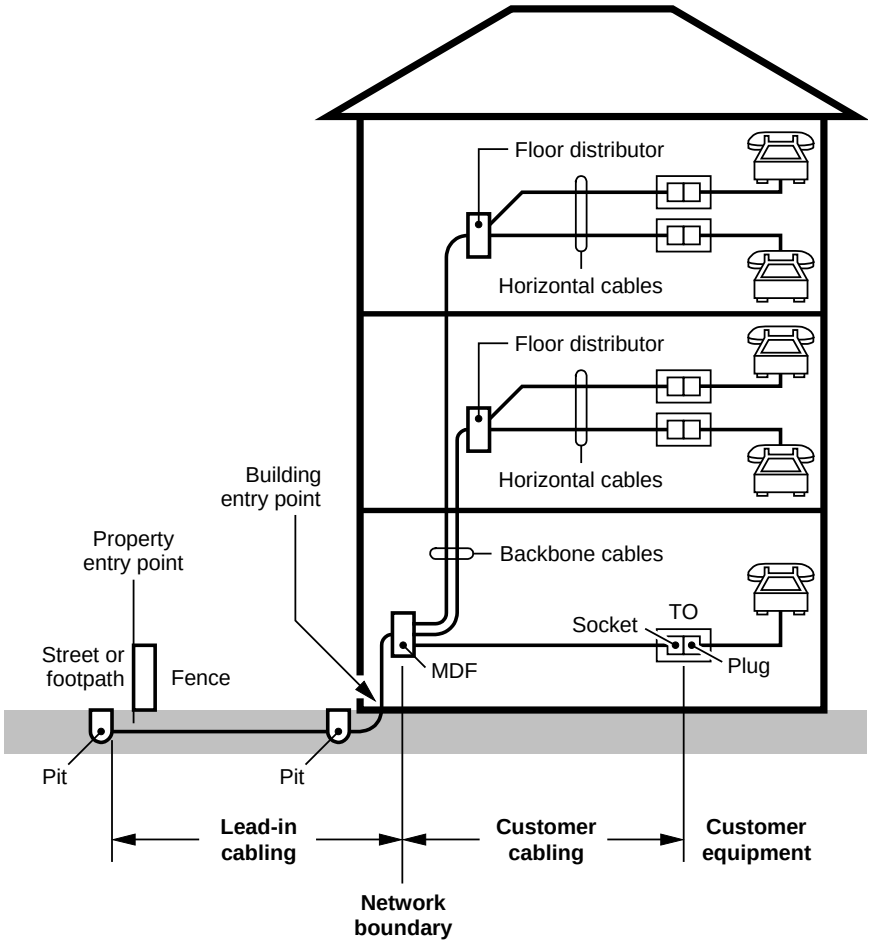


Figure J1

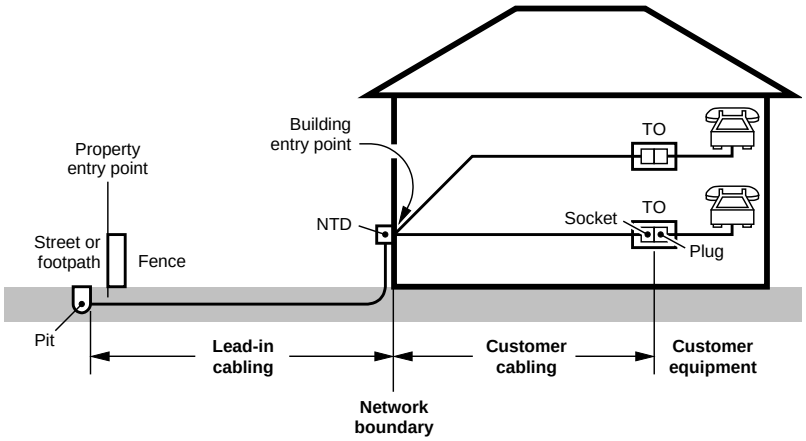
Analysis of section 22 of the *Telecommunications Act 1997* (continued)



Note: In the above case, the installation satisfies section 22 (4)(a)(i) of the *Act* (refer to Figure J1). The MDF is the network boundary for any line that is connected to that MDF and that is used to supply a carriage service to an end-user in that building.

Figure J2

Network boundary for copper twisted pair telecommunications networks where a line connects to an MDF in the end-user's building



Note 1: NTDs were introduced in the *Telecommunications Act 1997*. If, immediately before 1 July 1997, the network boundary for a line used to supply a standard telephone service to an end-user in a building was the MDF or the first socket, the network boundary for that service remains at that MDF or socket, as applicable, unless the customer agrees otherwise.

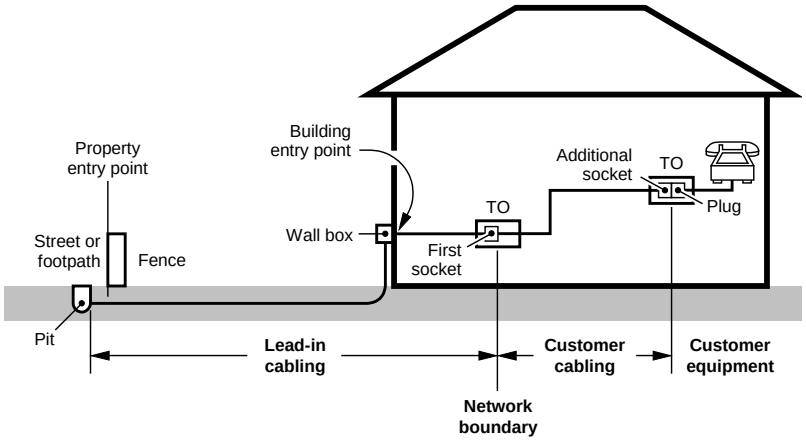
Note 2: In the above case, the installation does not satisfy section 22 (4)(a)(i) of the *Act* but satisfies section 22 (4)(a)(ii) (refer to Figure J1). Therefore, the NTD is the network boundary for any line that is connected to that NTD.

Note 3: An NTD is a device provided by the carrier that is marked at manufacture, 'Network Termination Device' or 'NTD'. A device that is not so marked is not an NTD.

Note 4: The NTD may be located in, on or within close proximity to, the end-user's building.

Figure J3

Network boundary where a line connects to a network termination device (NTD)

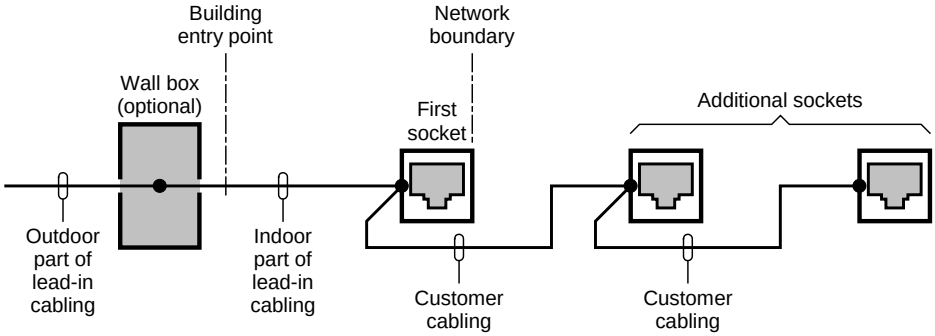


Note 1: In the above case, the installation does not satisfy section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the *Act* but satisfies section 22 (4)(a)(iii) (refer to Figure J1). Therefore, the first socket is the network boundary for any line that is connected to that socket.

Note 2: The wall box is not an NTD unless it is marked as such at manufacture.

Figure J4

Network boundary where a line connects to the first socket after the building entry point



Note 1: In the above case, the installation does not satisfy section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the *Act* but satisfies section 22 (4)(a)(iii) (refer to Figure J1). Therefore, the first socket connected to a cable or pair is the network boundary for that cable/pair.

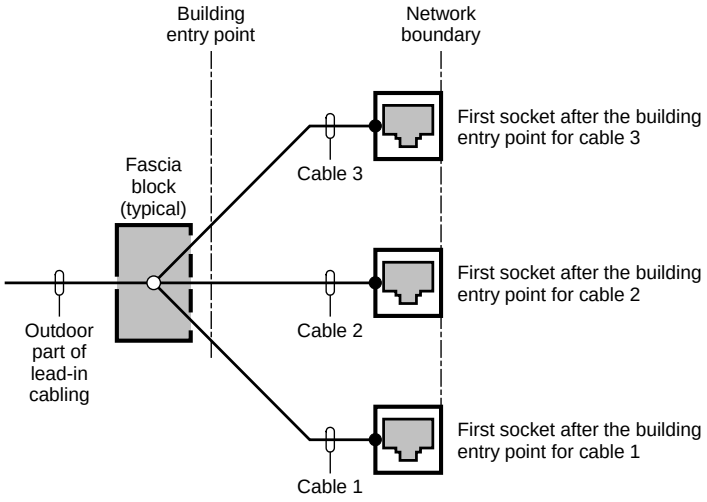
Note 2: Any socket or plug/socket connector inside the wall box is not the network boundary for two reasons:

(a) in principle, an external socket is not 'after the building entry point' as required by section 22 (4)(a)(iii) of the *Act*; and

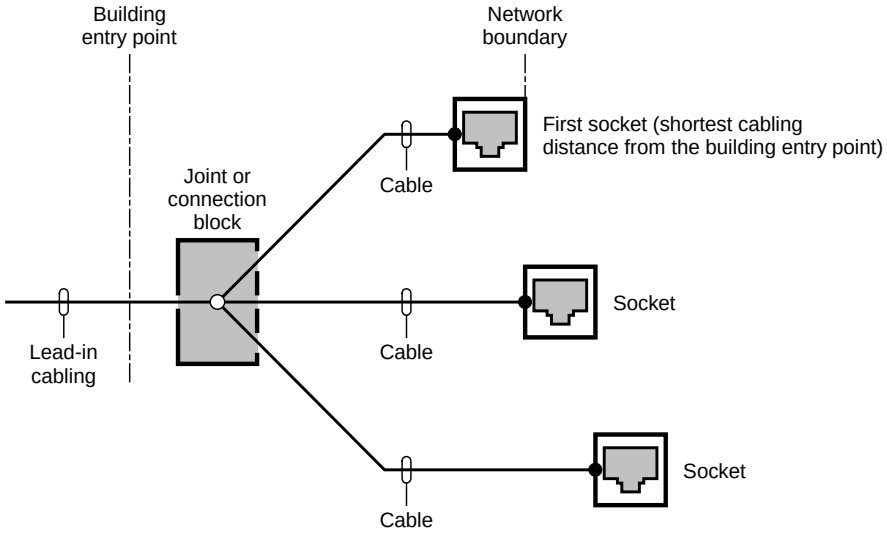
(b) in accordance with the 'first socket' definition in this Standard, the socket or connector in the wall box is not part of a telecommunications outlet (TO), and therefore is not the network boundary, unless it is provided for the express purpose of allowing an end-user to connect terminal equipment.

Figure J5

Network boundary where the line connects to two or more sockets in a 'bus' configuration



(a) Star-wired before the building entry point



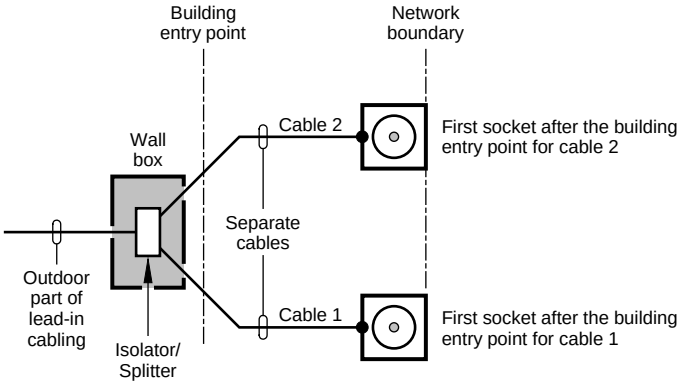
(b) Star-wired after the building entry point

Note 1: In case (a), the installation does not satisfy section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the *Act* but satisfies section 22 (4)(a)(iii) (refer to Figure J1). Each socket is the first socket for the cable connected to that socket and is the network boundary for that cable.

Note 2: In case (b), what socket is the 'first socket after the building entry point' is determined by cable length in accordance with the principle conveyed in Figure J5. In other words, the first socket is the socket that is the shortest cabling distance from the building entry point.

Figure J6

Network boundary for a legacy telephone installation (pre-1989) where the line connects to two or more sockets in a 'star' configuration



Note 1: The installation does not satisfy section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the *Act* but satisfies section 22 (4)(a)(iii) (refer to Figure J1). Each socket is the first socket for the cable connected to that socket and is the network boundary for that cable.

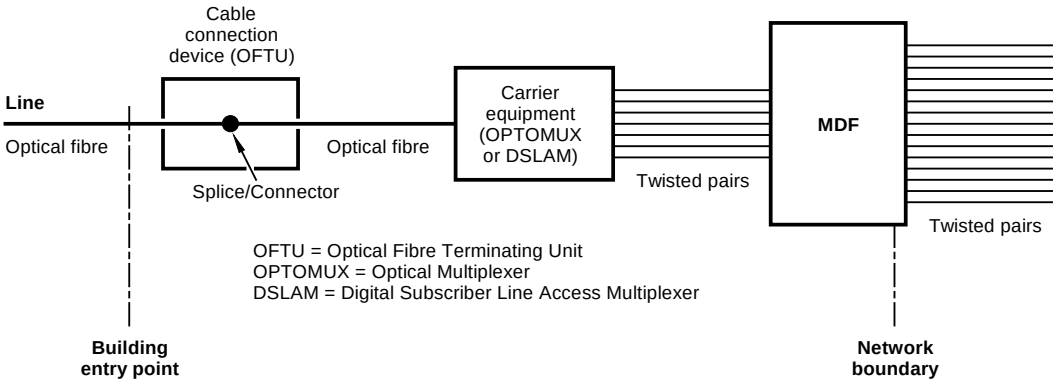
Note 2: Any socket or plug/socket connector inside the wall box is not the network boundary for two reasons:

(a) in principle, an external socket is not 'after the building entry point' as required by section 22 (4)(a)(iii) of the *Act*; and

(b) in accordance with the 'first socket' definition in this Standard, the socket or connector in the wall box is not part of a telecommunications outlet (TO), and therefore not the network boundary, unless it is provided for the express purpose of allowing an end-user to connect terminal equipment.

Figure J7

Network boundary for a standard coaxial cable broadband internet installation



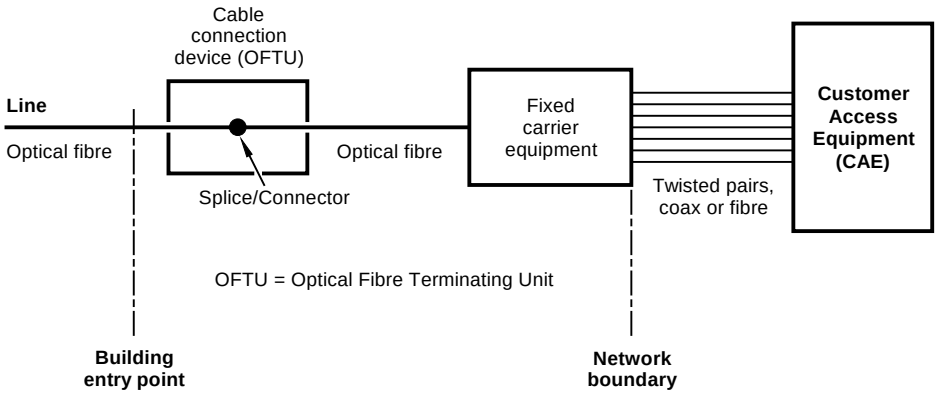
Note 1: There may be more than one optical fibre cable connection device within the premises.

Note 2: In the above case, the carrier equipment is usually rack-mounted and hard-wired, either directly or indirectly, to the MDF.

Note 3: An optical fibre connection device is not an MDF, even if it contains cross-connections, because an MDF only provides for electrical (as distinct from optical) termination of lead-in cabling.

Figure J8

Network boundary for optical fibre telecommunications network connecting to an MDF



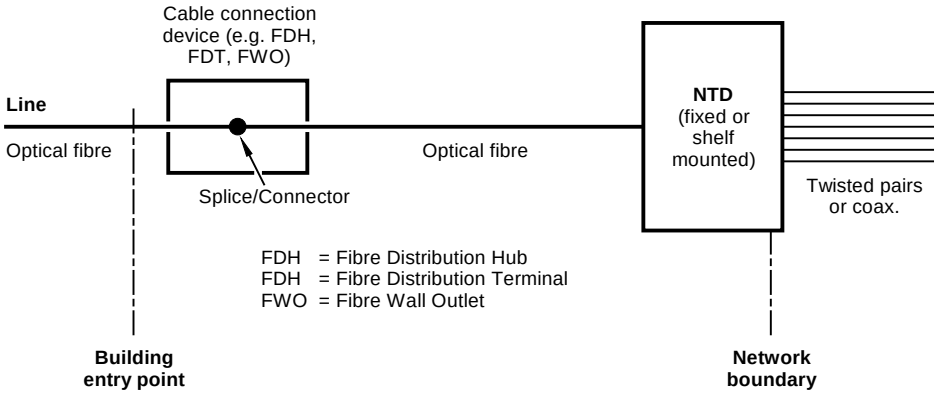
Note 1: There may be more than one optical fibre cable connection device within the premises.

Note 2: In the above case, the carrier equipment usually provides for direct connection of the CAE via plug/socket and the installation does not satisfy section 22 (4)(a) or section 22 (4)(b) of the *Act*, so section 22 (4)(c) applies (refer to Figure J1). The network boundary is the outer surface of the fixed facility nearest to the end-user. In practical terms, this will be the connectors on the 'customer side' of the carrier equipment.

Note 3: An optical fibre connection device is not an MDF, even if it contains cross-connections, because an MDF only provides for electrical (as distinct from optical) termination of lead-in cabling.

Figure J9

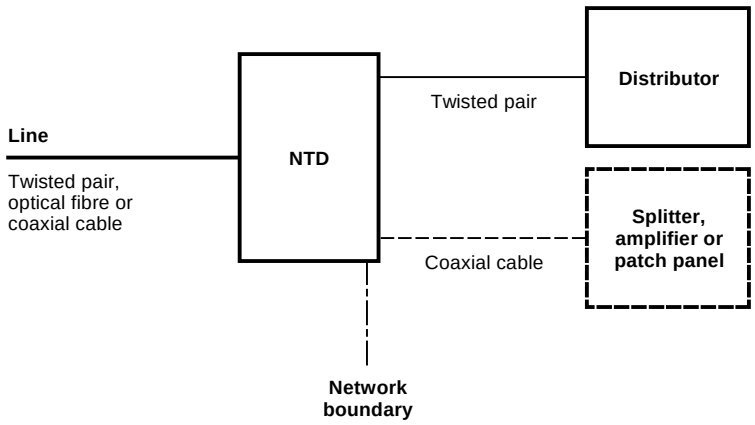
Network boundary for optical fibre telecommunications network connecting directly to CAE



Note: An optical fibre connection device is not an MDF, even if it contains cross-connections, because an MDF only provides for electrical (as distinct from optical) termination of lead-in cabling.

Figure J10

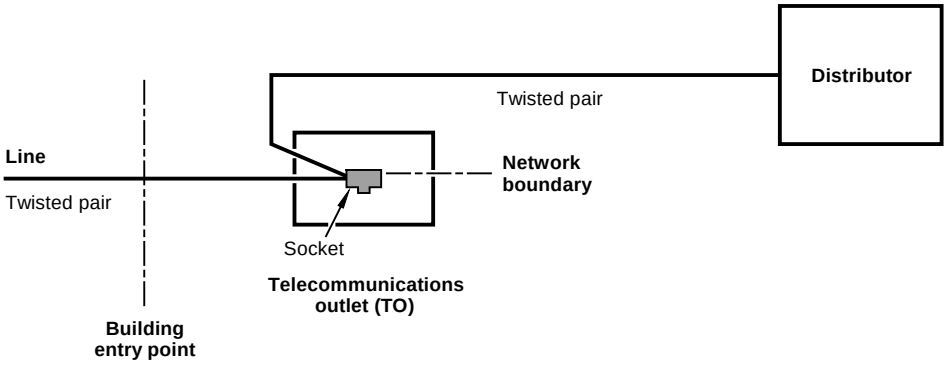
Network boundary for optical fibre telecommunications networks connecting to an NTD (FTTP model)



Note: In the above case, the location of the network boundary hinges on the definition of 'Main Distribution Frame (MDF)' in this Standard. In accordance with the MDF definition, the distributor is not an MDF because it does not terminate a carrier's lead-in cabling (the lead-in cabling is terminated on the NTD). Therefore, the installation does not satisfy section 22 (4)(a)(i) of the *Act* but satisfies section 22 (4)(a)(ii) and the network boundary is at the NTD (refer to Figure J1).

Figure J11

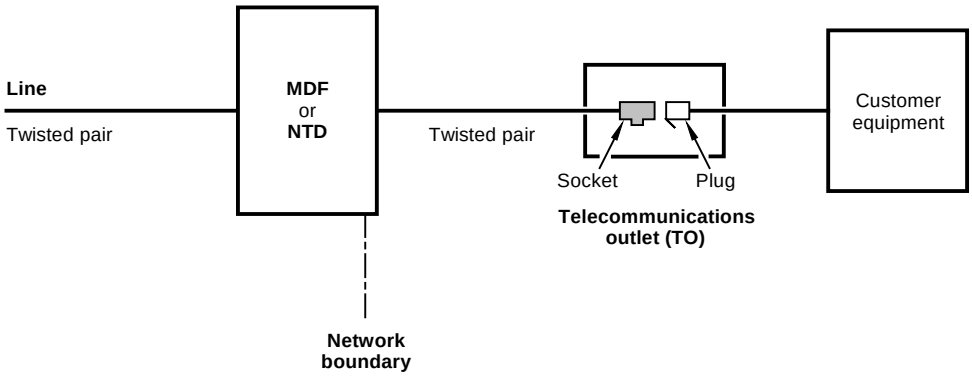
Network boundary where an NTD precedes a distributor (e.g. FTTP or home networking)



Note: In the above case, the location of the network boundary hinges on the definition of 'Main Distribution Frame (MDF)' in this Standard. In accordance with the MDF definition, the distributor is not an MDF because it does not terminate a carrier's lead-in cabling (the lead-in cabling is terminated on the TO). Therefore, the installation does not satisfy section 22 (4)(a)(i) of the *Act* but satisfies section 22 (4)(a)(iii) and the network boundary is at the first socket (refer to Figure J1).

Figure J12

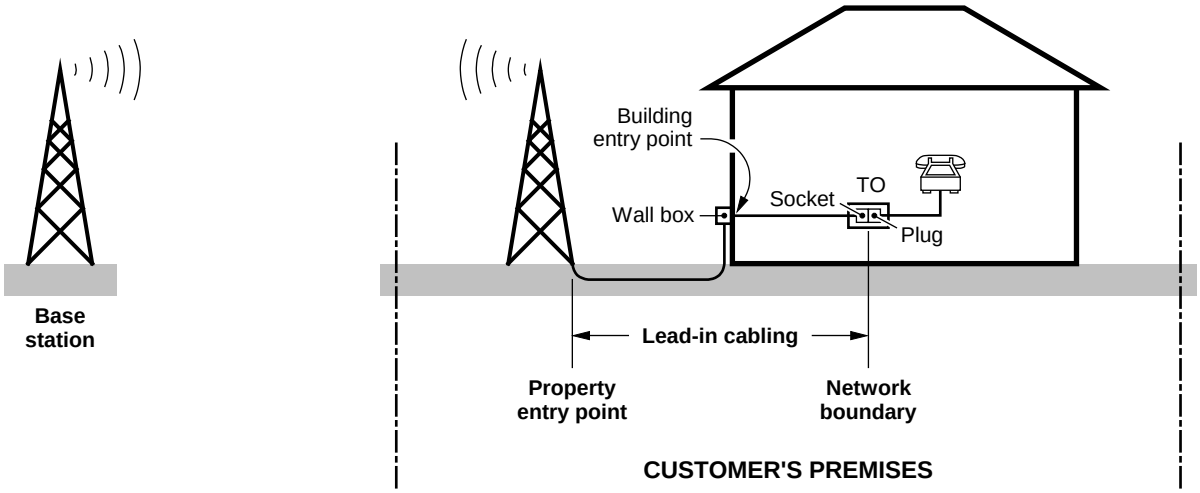
Network boundary where a TO precedes a distributor (e.g. home networking)



Note: In the above case, the installation satisfies section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the *Act*, as applicable, so section 22 (4)(a)(iii) of the *Act* does not apply (refer to Figure J1). The network boundary is at the MDF or NTD, as applicable.

Figure J13

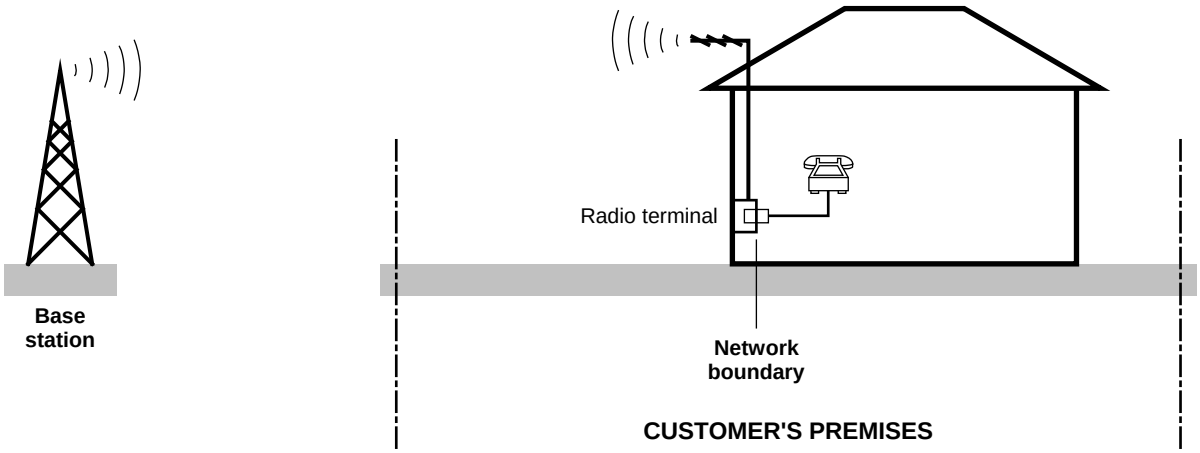
Network boundary where an MDF or NTD precedes a TO socket



Note: In the above case, while radio is used to supply the service to the customer's premises, the final method of supply is by means of a line (cable) that enters the building. Therefore, section 22 (4)(a) of the *Act* applies and the network boundary will be at the MDF, NTD or first socket, as applicable (refer to Figure J1).

Figure J14

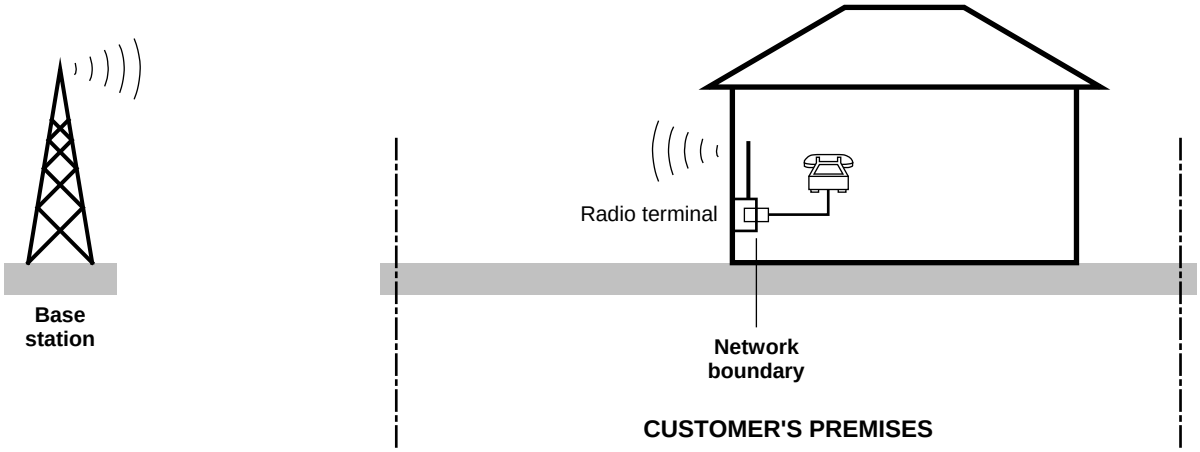
Network boundary for service supplied to premises by terrestrial radio (e.g. rural/remote premises)



Note: In the above case, while radiocommunication is used to supply the service to the customer's premises, the final method of delivery is by means of a line (antenna cable) that enters the building. Therefore, section 22 (4)(a) of the *Act* applies and the network boundary will be at the MDF, NTD or first socket, as applicable, or otherwise section 22 (4)(c) of the *Act* applies and the network boundary is the outer surface of the fixed facility nearest to the end-user ((i.e. the radio terminal). If the radio terminal is not marked as an NTD, it will usually incorporate a socket into which terminal equipment may be plugged. In practical terms, the network boundary is this socket on the radio terminal.

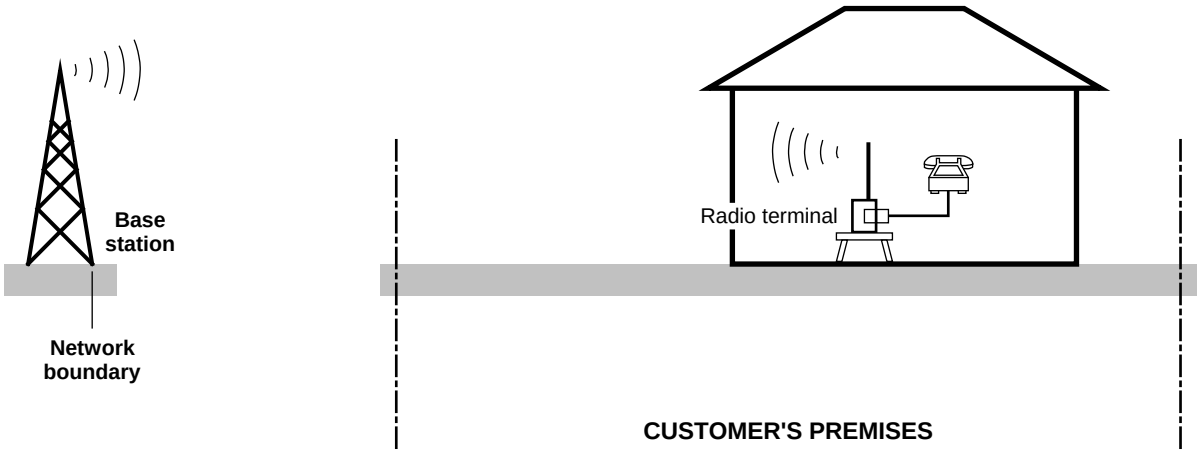
Figure J15

Network boundary for service supplied directly to an external antenna on a building by terrestrial radio



Note: In the above case, radiocommunication is used to supply the service directly to a radio terminal inside the building. In this scenario, section 22 (4)(c) of the *Act* applies and the network boundary is the outer surface of the fixed facility nearest to the end-user (refer to Figure J1). This means the network boundary is at the access port on the fixed radio terminal.

(a) Fixed radio terminal within the building

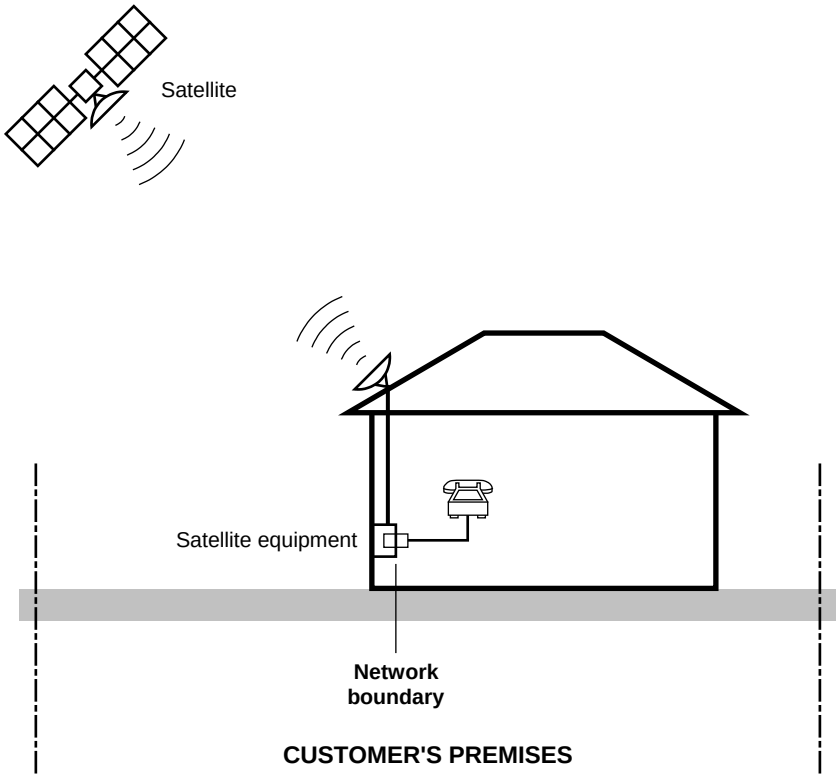


Note: In the above case, radiocommunication is used to supply the service directly to a radio terminal inside the building. In this scenario, section 22 (4)(c) of the *Act* applies and the network boundary is the outer surface of the fixed facility nearest to the end-user (refer to Figure J1). As the radio terminal in the customer's premises is not fixed, this means the network boundary is at the nearest radio base station (this being the nearest 'fixed facility' to the end-user).

(b) Portable radio terminal within the building

Figure J16

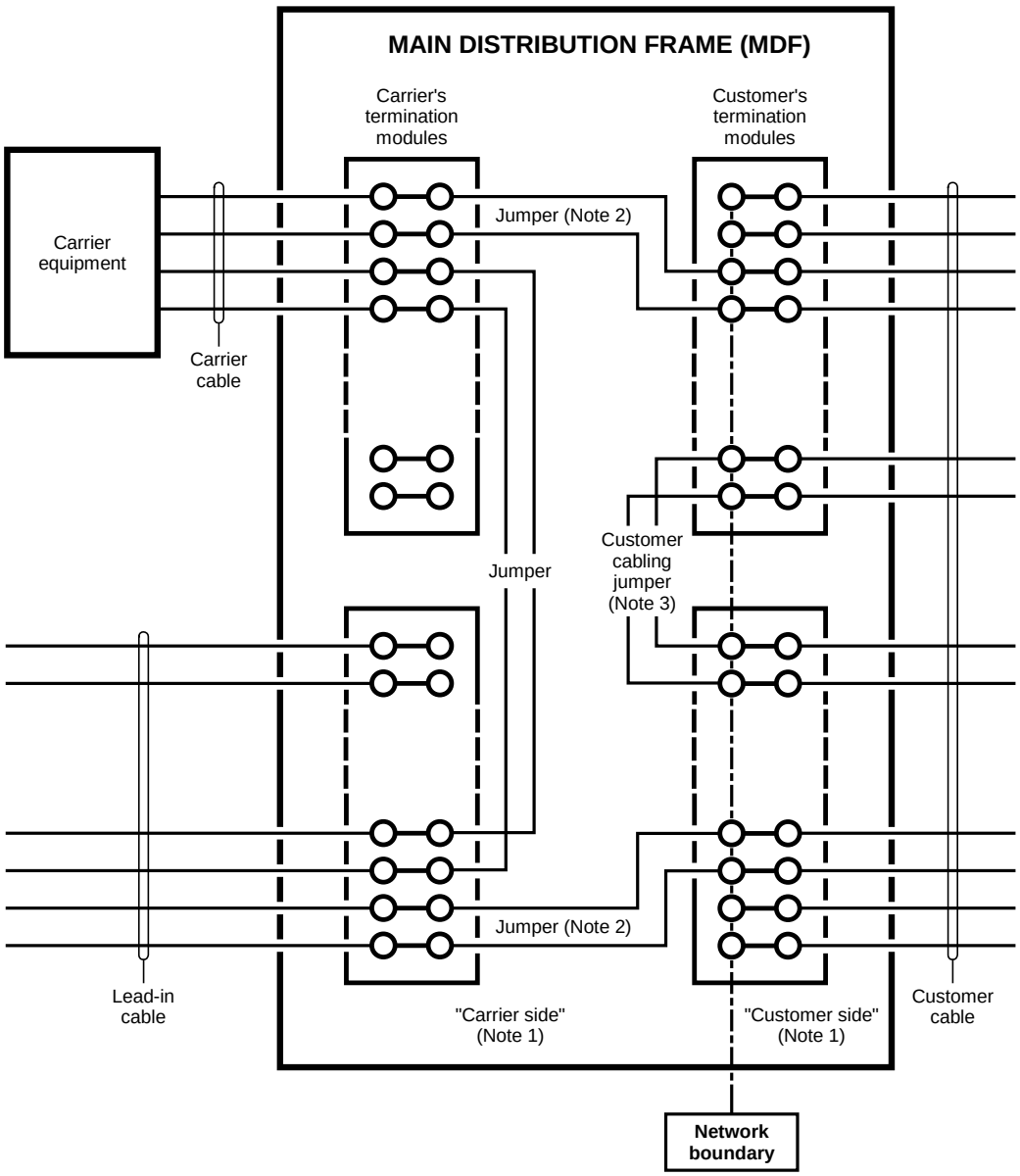
Network boundary for service supplied directly to a building by terrestrial radio



Note: In the above case, while the satellite is used to supply the service to the customer's premises, the final method of delivery is by means of a line (antenna cable) that enters the building. Therefore, section 22 (4)(a) of the *Act* applies and the network boundary will be at the MDF, NTD or first socket, as applicable, or otherwise section 22 (4)(c) of the *Act* applies and the network boundary is the outer surface of the fixed facility nearest to the end-user ((i.e. the satellite equipment). If the satellite equipment is not marked as an NTD, it will usually incorporate a socket into which terminal equipment may be plugged. In practical terms, the network boundary is this socket on the satellite equipment. However, if the satellite antenna is inside the building or built into the customer equipment (e.g. a portable sat-phone), section 22 (4)(b) of the *Act* applies and the network boundary is at the satellite. Refer to Figure J1.

Figure J17

Network boundary for service supplied to premises by satellite



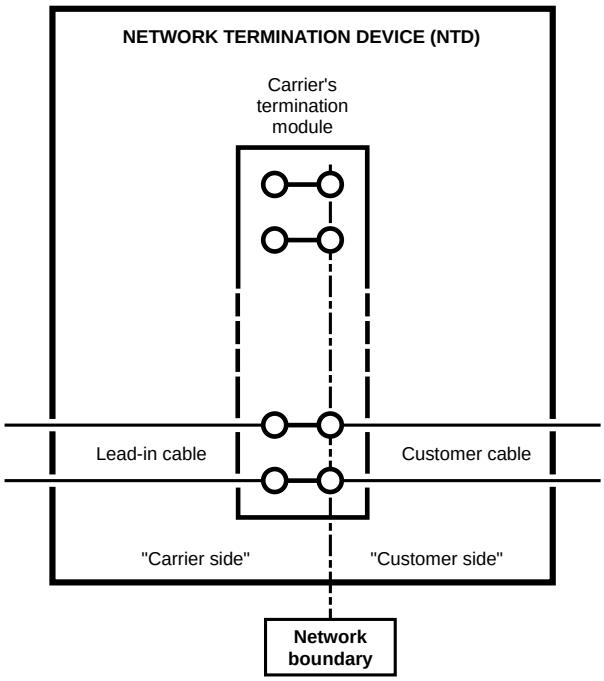
Note 1: The 'side of frame nearest to the end-user' is the 'customer side' of the MDF, i.e. the termination modules and other hardware provided by the customer's cabling provider. Lead-in termination modules and other hardware provided by the carrier are on the 'carrier side' of the MDF.

Note 2: A cabling provider is authorised by carriers to connect a jumper to the carrier's termination module under certain conditions (refer to Clause 13.13).

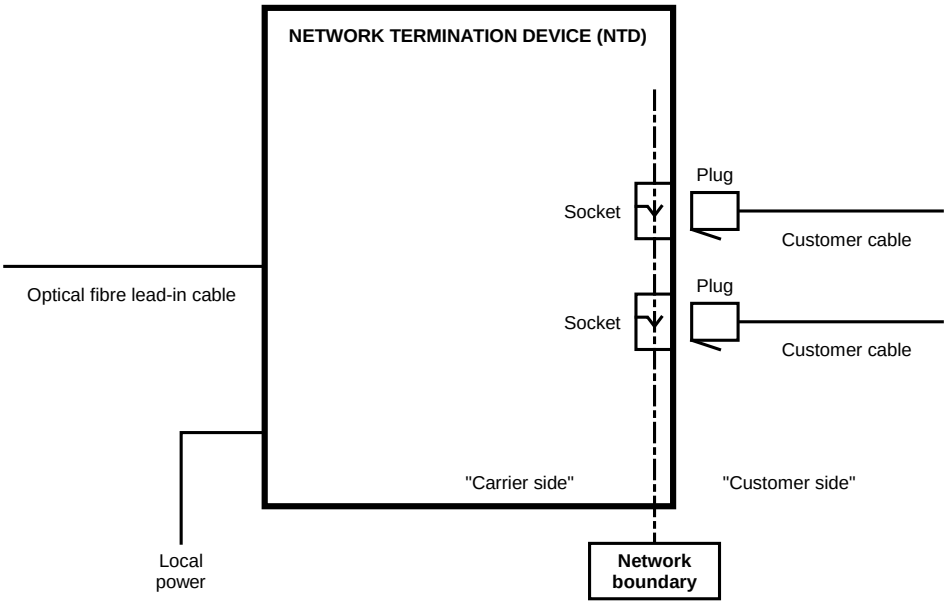
Note 3: A jumper that interconnects customer cables on the customer's termination modules is customer cabling.

Figure J18

Precise location of the network boundary at an MDF



(a) Twisted pair cables



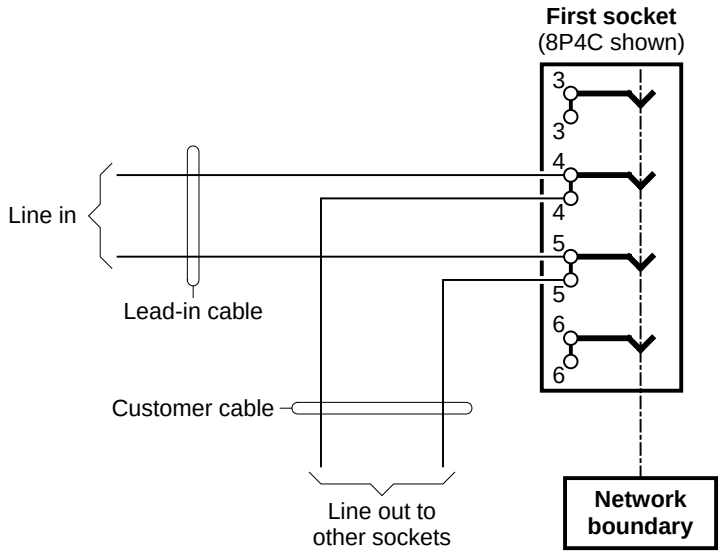
(b) Optical network terminal

Note 1: The above drawings show typical NTDs for twisted pair and optical fibre telecommunications network cables. The 'side of the device nearest to the end-user' means the terminals or sockets provided on the NTD for the connection of cable or equipment on the 'customer side' of the NTD.

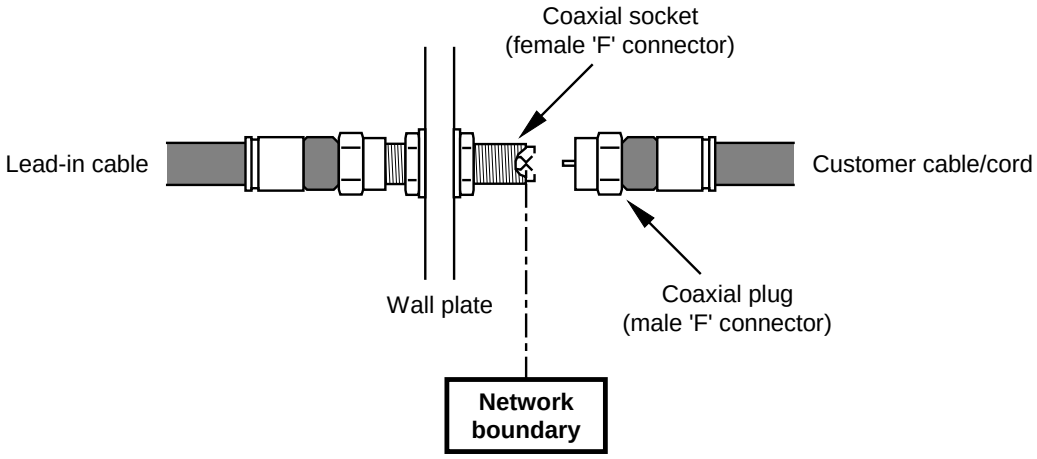
Note 2: Allowable connection points for customer cable or customer equipment will usually be indicated on the NTD label or user guide.

Figure J19

Precise location of the network boundary at a network termination device



(a) Twisted pair cable



(b) Coaxial cable (e.g. a broadband internet installation)

Note 1: The 'side nearest to the end-user' means the socket contacts to which connection may be made by a mating plug.

Note 2: For twisted-pair lead-in cable only, a cabling provider is authorised by carriers to connect customer cabling to the socket wiring terminals (refer to Clause 15.4.2.1). In other cases (e.g. coaxial lead-in cable), a cabling provider may only connect customer cabling to the front of the socket via a mating plug (refer to Clause 15.4.2.2).

Figure J20

Precise location of the network boundary at the first socket

APPENDIX

K Cabling Provider Rules (INFORMATIVE)

K.1 Introduction

The *Telecommunications Cabling Provider Rules 2000* place requirements on cabling providers performing customer cabling work and sets out arrangements for the operation of an industry-run system for the registration of cabling providers. Non-compliance with the *Cabling Provider Rules* is an offence under the *Telecommunications Act 1997 (the Act*).

Two key requirements under the Cabling Provider Rules relate to the supervision and certification of cabling work. For information, a summary of these requirements is set out in Clauses K.2 and K.3 below.

Reliance on this summary may not ensure compliance with the requirements of the Cabling Provider Rules and therefore the reader is advised to refer to the provisions of the Rules.

K.2 Supervision of unregistered cabling provider

If a registered cabling provider supervises an unregistered cabling provider, the registered cabling provider is required to ensure that—

(a) the unregistered cabling provider is supervised, at all times while performing cabling work, by a registered cabling provider;

(b) each registered cabling provider who supervises that cabling work accepts full responsibility for the standard of the work performed under the provider's supervision; and

(c) all work performed under supervision complies fully with—

(i) the competency requirements mentioned in paragraph 3.1 (2) (a) of the *Cabling Provider Rules*; and

(ii) the Wiring Rules (this Standard).

K.3 Certification of cabling work

(1) This section applies whenever a cabling provider finishes any cabling work (including a discrete part of a cabling project) other than—

(a) running jumpers on distribution frames;

(b) transposing jumpers on distribution frames;

(c) removing jumpers from distribution frames; or

(d) replacing a piece of minor cabling equipment (including a plug, socket, module or overvoltage unit).

(2) The cabling provider who performed the cabling work or supervised the performance of the cabling work is required to—

(a) prepare a statement that identifies the cabling work, and states that the cabling work—

(i) has been completed; and

(ii) complies fully with the Wiring Rules; and

(b) give the statement to—

(i) the cabling provider's employer;

(ii) if the cabling provider has been engaged to perform the cabling work through a person other than an employer — that person; or

(iii) in any other case — the customer who engaged the cabling provider to perform the cabling work.

(3) The statement may be prepared—

(a) in an approved form; or

(b) as an attachment to, or an entry on, an invoice or receipt that relates to the cabling work.

(4) The statement may show whether the cabling work was performed by the cabling provider—

(a) on the cabling provider's own behalf;

(b) as an employee; or

(c) on behalf of a person who is not the cabling provider's employer.

(5) If the cabling provider who performed the cabling work gives the statement to a person mentioned in subparagraph (2) (b) (i) or (ii), that person is required to give the statement to the customer who asked for the cabling work to be performed.

(6) A cabling provider who prepares a statement mentioned in subsection (2) is required to—

(a) keep a copy of the statement for at least one year after preparing it; and

(b) make the copy available, on reasonable request, to—

(i) the ACMA and its inspectors; or

(ii) an auditor authorised by the ACMA to inspect the copy for the purpose of monitoring compliance with the Rules.

K.4 Compliance with the Wiring Rules

Another important requirement under the *Cabling Provider Rules* is that all customer cabling work is required to comply with the Wiring Rules (this Standard).

K.5 Where to get a copy of the Cabling Provider Rules

A copy of the Cabling Provider Rules is available on the ACMA website www.acma.gov.au (search the site for '*Telecommunications Cabling Provider Rules*') or by contacting the ACMA on 1300 850 115.

APPENDIX

L Guidance for domestic installations (INFORMATIVE)

Customer cabling in domestic premises should be—

(a) a minimum of category 5 twisted pair cable;

(b) have a cable run not exceeding 90 m from the central point to each telecommunications outlet;

Note: Further length restrictions may apply as a result of heat and specific applications. Refer to AS/NZS 3080 or AS/NZS ISO/IEC 15018.

(c) point-to-point without taps or joints;

(d) installed in conformance with the cable manufacturer's installation instructions in regard to maximum hauling tension, minimum bending radii and ensuring no twisting or kinking of cables;

(e) terminated in matching 8P8C modular sockets (such as category 5 or higher) to the wiring plan T568A (refer to Figure C1 and Table C1); and

Note: Fixed cabling should be terminated onto the socket of an outlet and not directly to a modular plug.

(f) tested for data throughput of 1 Gbps Ethernet in both directions as a minimum.

APPENDIX

M Aerial cabling requirements (INFORMATIVE)

While care has been taken to correctly interpret this Standard in this Appendix, ultimately it is the responsibility of cabling providers to ensure that they comply with the requirements of the Standard. Note that the requirements of this Standard only apply to customer cabling and not to carrier cabling (e.g. lead-in cabling). Carrier cabling is installed to the relevant carrier's requirements and is not subject to the requirements of this Standard. Customer cabling may, however, be installed outside the boundaries of customer premises subject to the approval of the relevant government authority or the owner of any land traversed by the cabling, as applicable.

M.1 Introduction

Aerial cabling is potentially the unsafest form of cabling to use, especially when installed in the vicinity of aerial power lines. Aerial cabling is fully exposed to the elements (e.g. sun, wind, rain and snow) and to human encounter, so care needs to be taken to ensure that the cabling stays put in adverse weather and that its mere existence does not create a hazard for a passing person or vehicle.

The aerial cabling requirements set out in this Standard are relatively straightforward if the cabling is not to be installed in the vicinity of aerial power cabling. With aerial telecommunications cabling on its own, only the following factors need to be considered—

(a) cable compliance (especially UV resistance);

(b) the integrity of the poles or other supporting structures (a building can also be a suitable support structure);

(c) the integrity of the cable fastenings on the poles; and

(d) ground clearance (height of the cable from ground).

These aspects are discussed further in M.2 to M.5.

M.2 Cable compliance

Aerial cable should not be filled with grease or gel. Filled cable is only required for underground cabling, which is invariably immersed in water, and is unnecessary and undesirable with aerial cable (which is permanently 'hanging out to dry'), because—

(a) the grease/gel adds to the weight of the cable; and

(b) grease/gel can create a slipping hazard for a cabling provider if it is transferred from the cabling provider's hands or gloves to the rungs of the ladder.

For short distances, e.g. a single span of cable between two buildings, it is permissible to use indoor type cable (such as category 5 or category 6 unshielded twisted pair) installed in (UV stabilised) conduit to protect it from UV exposure and tied at regular intervals to a catenary wire suspended between the buildings.

Otherwise use aerial cable manufactured specifically for outdoor application using UV-resistant materials.

If a long aerial cabling installation is planned, first it needs to be determined how far the cable can be safely spanned between supports. To do this, assuming it is planned to use cable with an integral bearer, the aerial cable manufacturer's specifications need to be checked. The manufacturer's data sheets should indicate the weight of the cable for a given length, bearer tension limits and allowable sag at various temperatures. The data sheets may even recommend minimum and maximum span lengths (pole spacing). This data should be used in conjunction with the information described below to select the class, size and type of pole to support the aerial cable.

M.3 Pole integrity

The installed poles need to be of sufficient strength and durability to avoid falling over or breaking in normal service (including climbing by a cabling provider) or under adverse weather conditions, for the anticipated life of the cable installation. There are some standards available to provide guidance.

If wooden poles are used, they should comply with AS 3818.11 *Timber - Heavy structural products - Visually graded Part 11: Utility poles*. Steel poles should comply with AS/NZS 4677 *Steel utility services poles*, while concrete poles should comply with AS/NZS 4065 *Concrete utility services poles*. The poles should be selected and installed in accordance with AS/NZS 4676 *Structural design requirements for utility services poles*. Compliance with the relevant requirements of these standards should ensure that the requirements of this Standard are met.

Of course, no poles will last forever and they should be inspected regularly to check their ongoing integrity.

Note that a tree is not a 'pole' or a 'structure', so the use of trees to carry aerial cabling is not supported by this Standard. Trees are not 'fit for the purpose' and should not be used.

M.4 Aerial cable fastenings

The cable fastenings need to be capable of supporting the dead weight of the cable and any accumulated snow or ice with an added dynamic loading factor for strong winds. The manufacturer's data for the device to be used combined with the cable data described above should be consulted to ensure that the cable fastening will not fail in normal service or under adverse weather conditions.

M.5 Ground clearance

This Standard specifies minimum clearances for three different scenarios, described below and illustrated in Figure M1.

For non-trafficable areas, the lowest part of any aerial cable or attachment is required to be at least 2.7 m from the ground. This should put the cabling out of reach of the average person. For example, a person 1.8 m tall cannot generally reach higher than 2.4 m without standing on a chair or a ladder. 2.7 m normally provides a safety margin of 0.3 m in this respect.

Note: Earlier versions of this Standard allowed a minimum ground clearance of 2.4 m in non-trafficable areas, so some existing aerial cables (installed prior to 2002) may be

as low as 2.4 m above the ground. If such cables are altered or replaced, they should be installed to the current required minimum clearance of 2.7 m in accordance with Clause 5.12 of this Standard.

If the aerial cable traverses a residential driveway, a minimum ground clearance of 3.5 m is required to allow, for example, a removal van to pass underneath it. At least 4.9 m clearance is required above a commercial/industrial driveway or any roadway or public footway to allow for the passage of larger commercial vehicles. The relevant authority may require a higher clearance than 4.9 m over any public roadway or footway as a condition of any approval to cross that roadway or footway with a cable.

Note 1: Earlier versions of this Standard allowed a minimum ground clearance of 3.7 m for 'driveways not used by high vehicles', which may have included some commercial/ industrial driveways. Therefore, some existing aerial cables above commercial/ industrial driveways (installed prior to 2002) may be as low as 3.7 m above the ground. If such cables are altered or replaced, they should be installed to the current required minimum clearance of 4.9 m in accordance with Clause 5.12 of this Standard.

Note 2: In previous versions of this Standard, a minimum ground clearance of 3.7 m was required for areas where horse riding was likely and where the aerial cable was installed at a horizontal distance from any fence greater than 1 m. This requirement was removed in the 2001 edition of this Standard and no longer applies.

Remember that the cable will sag more in hot weather as the cable expands, so more height needs to be added if installing the cable in cooler weather so that the minimum ground clearance will be maintained at maximum summer temperatures. Using the manufacturer's tables of sags and tensions helps overcome this problem.

Cable height (and separation distances from any nearby power lines) should be measured using lengths of UPVC conduit, a telescopic height measuring rod, or an optical height finder. Measuring tapes or any conductive material should not be used for this purpose, particularly near power lines.

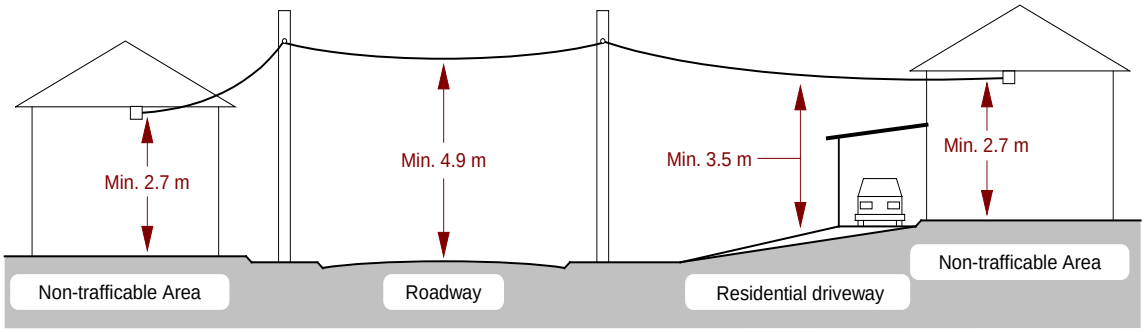


Figure M1

Minimum aerial customer cabling ground clearances required by this Standard

M.6 Aerial cabling installed near aerial power cabling

The requirements get complicated if aerial customer cabling is to be installed near aerial power lines or on shared poles with power. The complications are due to the variable nature and voltages of aerial power cabling and the different hazards that arise with each power cabling arrangement.

The simplest arrangement involves running a single span of aerial cable between two buildings where there is also an insulated, sheathed aerial power cable between the buildings. There are two options, either to—

(a) install the aerial cabling independently at a distance from the aerial power cabling of at least 2.4 m — or 10 m if the power cabling is owned or operated by a power utility or it carries High Voltage (HV); or

(b) install the aerial cabling on the same catenary support as the aerial power cabling as long as—

  (i) the aerial power cable is insulated Low Voltage (LV) cable that is not owned or operated by a power utility;

  (ii) either the power cable or the telecommunications cable is installed in insulating conduit; and

  (iii) the telecommunications cable/conduit is independently secured to the catenary support.

The more complicated arrangements are described below.

M.7 Telecommunications poles running parallel with power poles

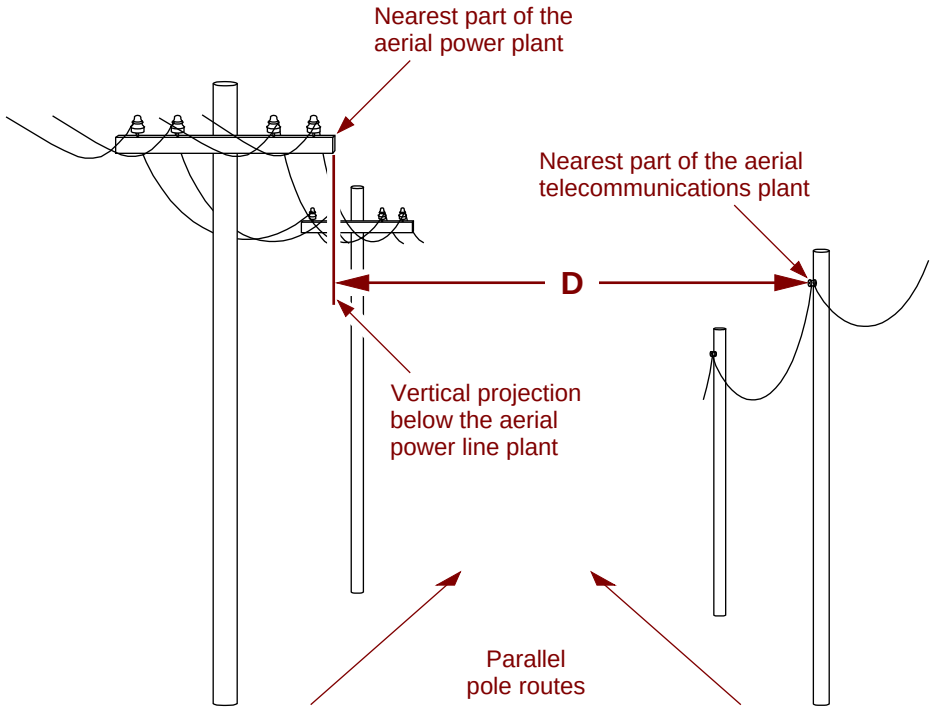
If the aerial telecommunications cabling runs on separate poles alongside or near aerial power lines, adequate separation needs to be provided between the services to allow each service to be safely accessed by the relevant utility without danger of touching or damaging the other service. This has nothing to do with Low Frequency Induction (LFI), which needs to be considered separately if—

(a) the power lines are HV;

(b) the telecommunications cable contains any electrically conductive elements; and

(c) the length of customer cabling exposure to the power lines exceeds 200 m (refer to Appendix H for details).

Figure M2 illustrates the requirements for separation of power and telecommunications aerial cabling plant (poles, cables, etc.). Essentially, where the power lines exceed 330 kV (usually supported by towers), sufficient space (namely 50 m) is required to accommodate the power utility's machinery to access the power line plant. For power lines not exceeding 330 kV, a lesser distance (10 m) is required to accommodate, for example, an elevated platform vehicle ('cherry picker'), to access either the power lines or the telecommunications cabling. For insulated LV power lines not owned or operated by a power utility, 2.4 m separation is required to ensure that a worker accessing either service (e.g. by ladder) will not accidentally come into contact with or damage the other service.



Note: Distance '**D**' is required to be at least—

(a) 50 m for HV power lines exceeding 330 kV (these are usually installed on towers);

(b) 10 m for other HV power lines;

(c) 10 m for uninsulated LV power lines and power utility owned/operated LV power lines; and

(d) 2.4 m for insulated LV power lines not owned/operated by a power utility.

Figure M2

Pictorial representation of the requirements of Clause 19.1.2.1 of this Standard

M.8 Crossing power lines and shared poles with power

There are some cases where aerial crossings or shared poles are prohibited for any type of customer cabling (i.e. whether optical fibre or metallic cables/bearers) and separate poles will need to be erected for the telecommunications cabling or the cabling will need to be installed underground.

Aerial crossings are prohibited for any aerial HV power lines exceeding 330 kV (the customer cabling needs to be installed underground for at least 50 m each side of the crossing in such cases). Why 50 m? Because it is not permissible to locate aerial telecommunications plant within 50 m of 330 kV power lines (refer to Figure M2).

Attachment of customer cabling to any pole or structure carrying aerial power is prohibited under any of the following circumstances:

(a) If the owner of the pole or structure does not authorise the customer cabling attachment.

(b) If the pole or structure supports HV power lines exceeding 66 kV (whether or not there are LV power lines installed below the HV lines).

(c) If the pole or structure carries an HV power transformer.

If none of conditions (a) to (c) applies and the customer cabling does not contain any electrically conductive elements (e.g. optical fibre with integral non-conductive bearer/strengthener), the cabling may attach to a pole or structure carrying aerial power lines subject to the separation requirements described in M.9 below.

If none of conditions (a) to (c) applies and the customer cabling does contain electrically conductive elements, the cabling may only attach to a pole or structure carrying HV power lines if—

(a) there is an existing LV power line below the HV power lines and the pole or structure is not conductive (e.g. not made of metal or concrete); or

(b) the attachment is for the purpose of crossing the power lines only and the pole or structure is not conductive.

State/Territory electrical codes may require that the installer of any telecommunications cabling that is to be installed within the vicinity of any power cabling be appropriately trained and accredited, e.g. by successfully completing a ‘power awareness’ course.

M.9 Separation from power for crossings and shared poles

The requirements for separation of aerial telecommunications cabling and aerial power lines are mainly intended to minimise hazards for telecommunications and power workers required to access the telecommunications and power plant.

Where aerial telecommunications cables cross aerial power lines or are installed on the same pole or structure as aerial power lines, with one notable exception illustrated in Figure M3, they are required to be installed below the power lines. This is to avoid the need to haul telecommunications cables over the power lines before stringing them up and so that a telecommunications worker doesn’t need to climb or reach over the power lines to access the telecommunications cabling — to do so may require the person to be an accredited electrical worker.

The separation requirements for in-span crossings are shown in Figure M4 while the requirements for crossings attached to power poles are illustrated in Figure M5.

Figure M6 and Figure M7 show the requirements for separation of telecommunications and power cables and fittings on shared poles.

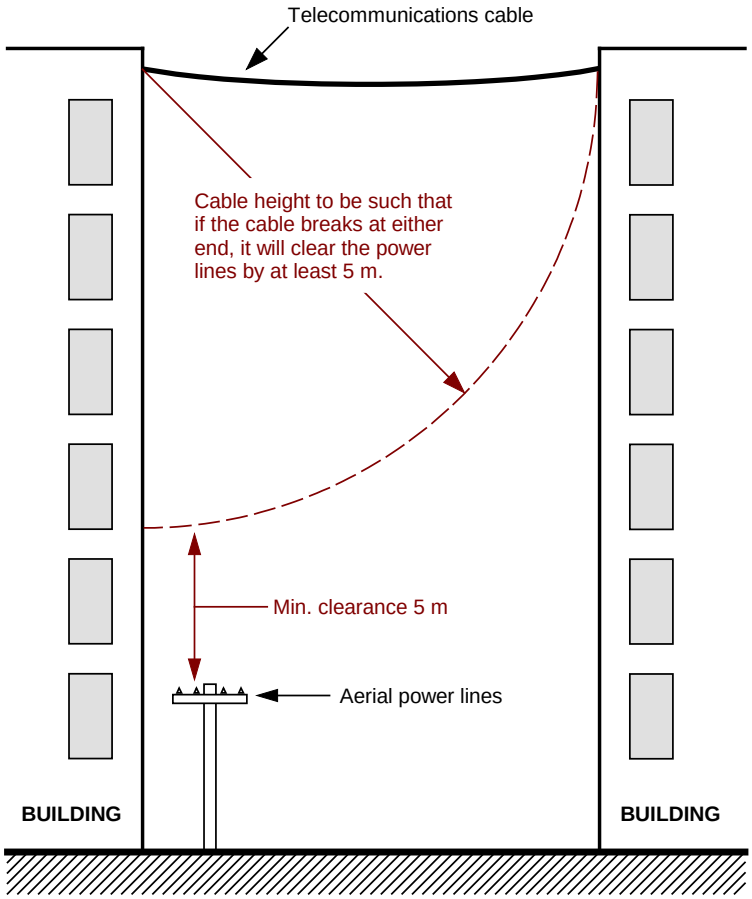
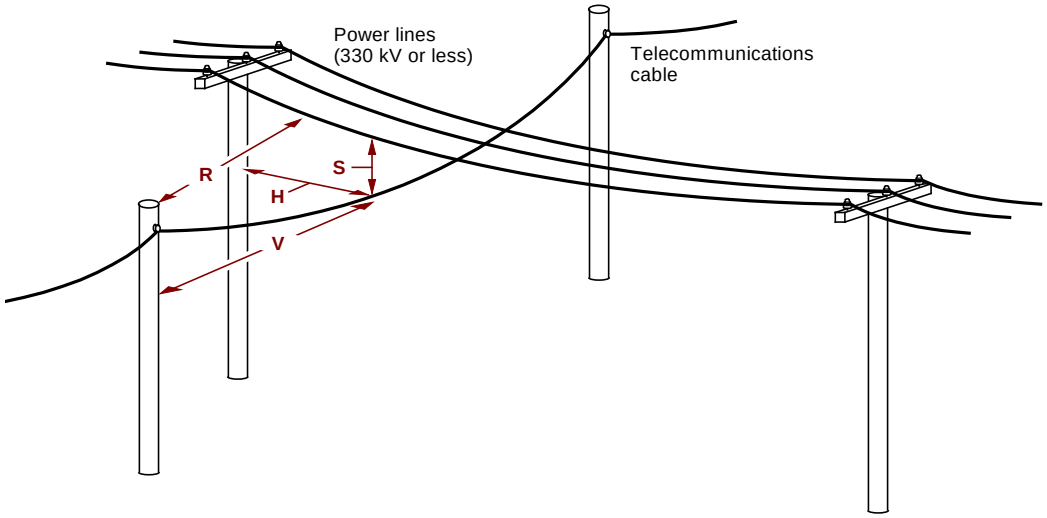


Figure M3

Crossing above aerial power lines (cable suspended between tall buildings)



Note 1: The in-span crossing is required to be as far as practicable from the middle of the aerial power line span as long as—

(a) If the pole carries only LV power lines, '**H'** is no less than 2.4 m

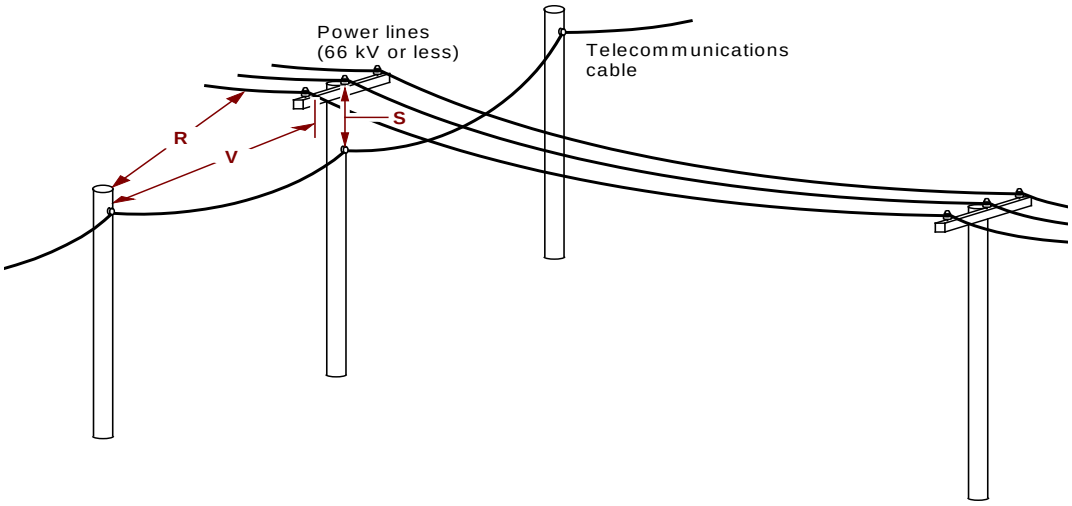
(b) If the pole carries HV power lines, '**H'** is no less than 3.6 m.

Note 2: '**S'** is required to be at least 0.6 m for LV power lines or from 1.2 m to 4.6 m for HV power lines depending on the voltage of the power lines (see Table 5 of this Standard).

Note 3: '**V**' is the distance between the telecommunications pole or structure and the vertical plane below the nearest power line, which is to be at least 2.4 m unless the radial distance '**R**' between any part of the telecommunications pole or structure and any point on the power line is at least the distance specified in Table 5 of this Standard (from 2.4 m to 7.5 m depending on the voltage of the power lines).

Figure M4

In-span crossing below aerial power lines

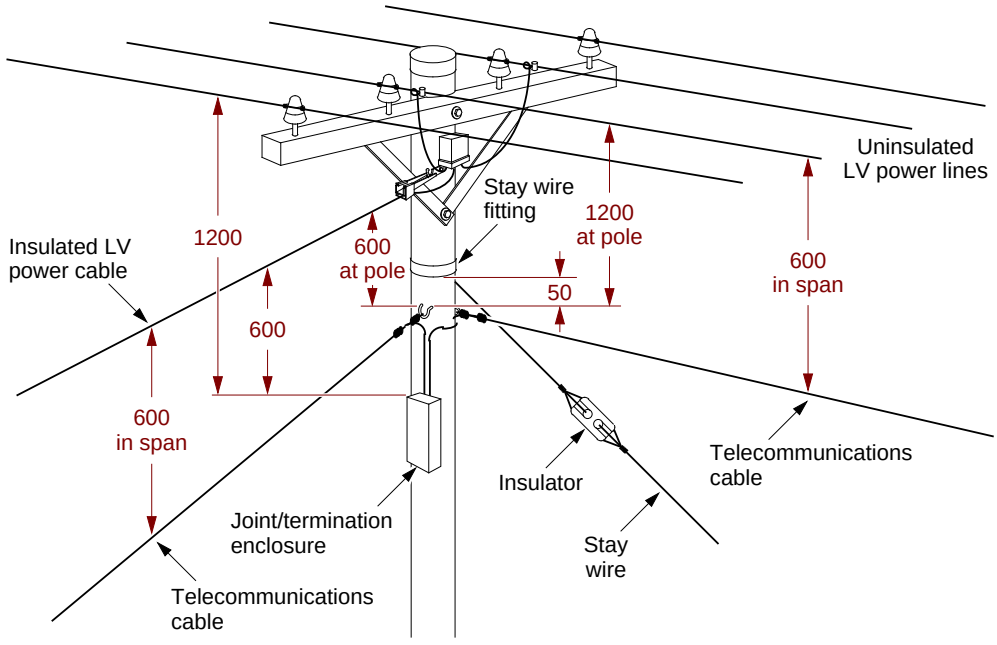


Note 1: '**S'** is required to be at least 0.6 m for insulated LV power lines or from 1.2 m to 3.0 m for uninsulated LV power lines or HV power lines depending on the voltage of the power lines (see Table 5 of this Standard).

Note 2: '**V**' is the distance between the vertical plane below the nearest power line and the telecommunications pole or structure, which is to be at least 2.4 m unless the radial distance '**R**' between any part of the telecommunications pole or structure and any point on the power line is at least the distance specified in Table 5 of this Standard (from 2.4 m to 4.0 m depending on the voltage of the power lines).

Figure M5

Attached crossing below aerial power lines



Note: Any joint or termination enclosure should be installed below the aerial telecommunications cable and is to be kept at least 50 mm away from any light fitting, stay fitting or power conduit.

Figure M6

Minimum clearances for shared poles

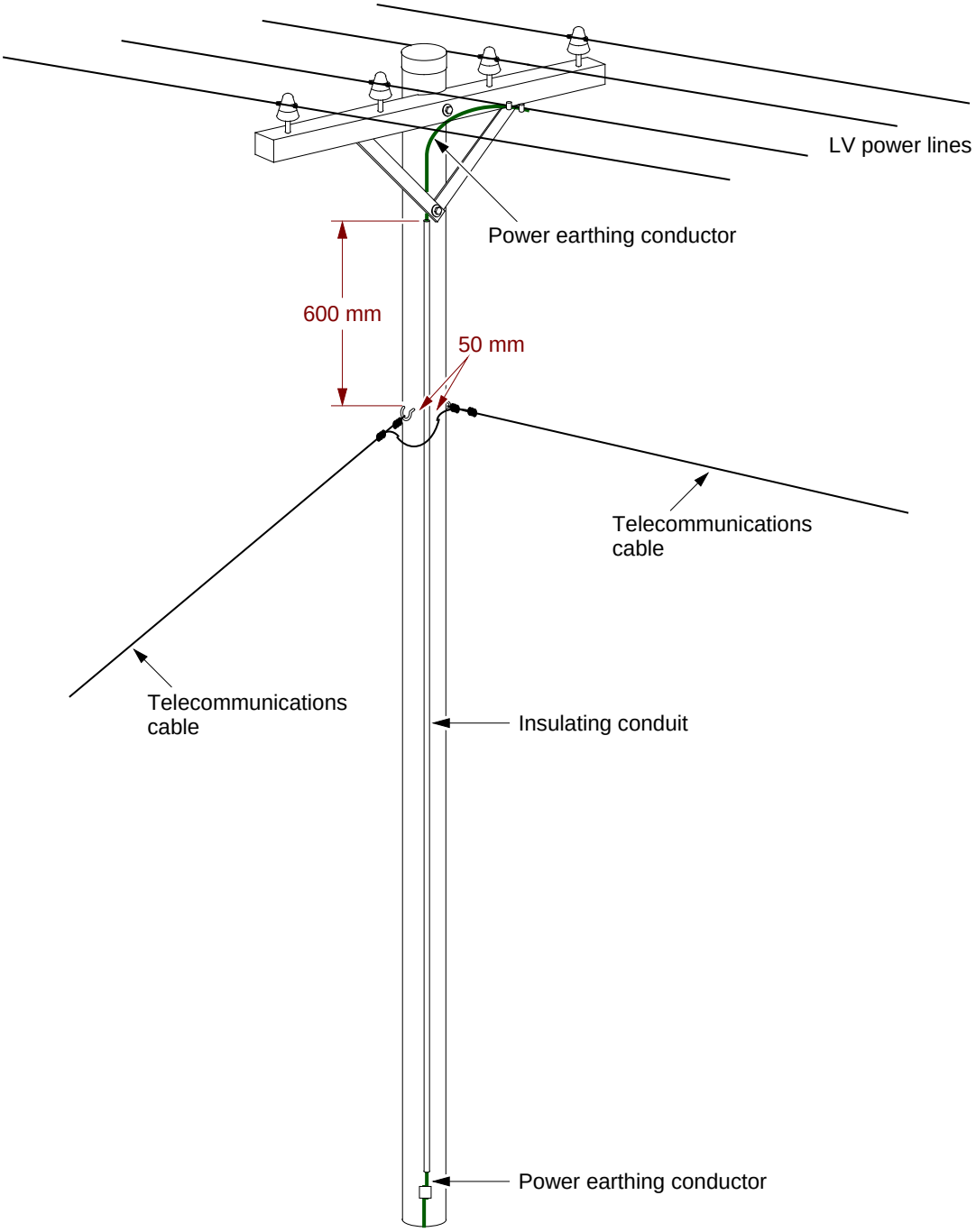


Figure M7

Insulation of, and clearance from, any power earthing conductor on a shared pole

M.10 Cable bearer insulation

Where a telecommunications cable is attached to a pole carrying power lines, it is required to have an integral insulated bearer that is to remain insulated at any fastening or fitting at the pole. For smaller cables, the insulated bearer should be tied off to an insulator ring as shown in Figure M8. With larger cables, the bearer should be tied off using a metallic pre-formed termination, in which case the termination needs to be wrapped with several layers of durable insulating tape or shrouded using durable insulating material.

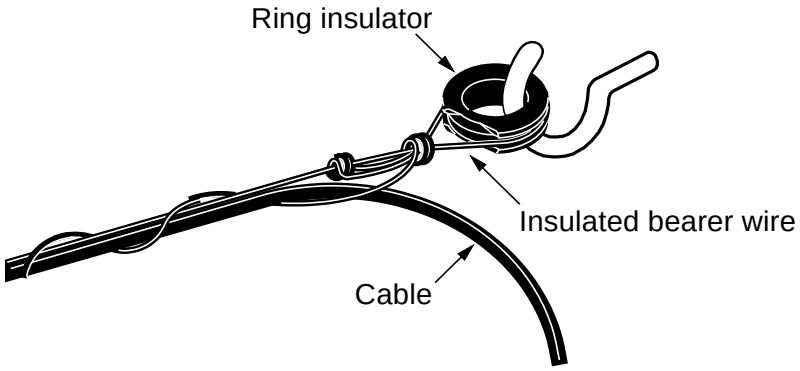


Figure M8

Termination of an insulated bearer (small cables) on a shared pole

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The Working Committee responsible for the revisions made to this Standard consisted of the following organisations:

Organisation	Membership	Name
3M Australia	Voting	Oivind Bakken
ACMA	Non-voting	Rob Pruysers
BICSI / BRCA	Voting	Paul Stathis
International Copper Association Australia	Voting	Ian Millner
NBN Co	Voting	Vaskos Tsiatis
NECA	Non-voting	Murray Teale
Optus	Voting	Andrew Robinson
Panduit	Voting	Ian Gale
Ramsden Telecommunications Training	Voting	Bevan Ramsden
TE Connectivity	Voting	Ashley Martin
Telstra	Voting	Terry Phillips
-	Non-voting	Frank Novacco

This Working Committee was chaired by Murray Teale. Ashley Martin provided editorial support. Mike Johns of Communications Alliance Ltd provided project management support.

Communications Alliance was formed in 2006 to provide a unified voice for the Australian communications industry and to lead it into the next generation of converging networks, technologies and services.

In pursuing its goals, Communications Alliance offers a forum for the industry to make coherent and constructive contributions to policy development and debate.

Communications Alliance seeks to facilitate open, effective and ethical competition between service providers while ensuring efficient, safe operation of networks, the provision of innovative services and the enhancement of consumer outcomes.

It is committed to the achievement of the policy objective of the *Telecommunications Act 1997* - the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry.

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