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INDUSTRY FORUM



AUSTRALIAN STANDARD

AS/ACIF S009:2006

Installation requirements for customer cabling
(Wiring rules)

**Adopted for
regulatory purposes**



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

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FOREWORD

General

This Standard was prepared by the ACIF Working Committee CECRP/WC18 Cabling Standards. 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 ACMA.

This Standard is a revision of AS/ACIF S009:2001 *Installation requirements for customer cabling (Wiring Rules)*.

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

Standards revision

Australian Standards developed by the Australian Communications Industry Forum (AS/ACIF Standards) are updated, according to the needs of the industry, by amendments or revision. Users of AS/ACIF Standards should make sure that they possess the latest amendments or editions. Representations concerning the need for a change to this AS/ACIF Standard should be addressed to:

The Project Manager
Customer Equipment and Cable Reference Panel
The Australian Communications Industry Forum
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 2006. Until that date AS/ACIF S009:2001 remains in force.

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 ACMA at:

Australian Communications and Media Authority
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Law Courts PO
Melbourne VIC 8010
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Introduction

This introduction for the AS/ACIF S009:2006 **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 principle 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 principle differences between this edition of AS/ACIF S009 and the previous edition are:

- (i) content restructured with extensive use of headings
- (ii) increased informative content
- (iii) voltage classifications redefined
- (iv) service classifications added
- (v) general principles and objectives added
- (vi) fire detection and fire alarm system cabling variations accommodated
- (vii) building control system cabling variations accommodated
- (viii) EPR and LFI requirements amended and informative content added
- (ix) damp area restricted zone requirements amended
- (x) cable support requirements amended
- (xi) conduit requirements amended
- (xii) service separation requirements amended
- (xiii) 'network boundary distributor' term removed and 'MDF' reinstated
- (xiv) NTDE concept abandoned and requirements deleted (NTD remains)
- (xv) telecommunications outlet information expanded
- (xvi) aerial cabling requirements amended
- (xvii) functional earthing requirements amended

- (xviii) protective earthing information amended
- (xix) TFE requirements added instead of cross-reference to AS/NZS 3000
- (xx) two new earthing diagrams added (Figure 5 and Figure 6)
- (xxi) Appendix D (formerly Appendix A) amended
- (xxii) Appendix F (formerly Appendix C) amended
- (xxiii) appendices renumbered and the following new appendices added:
 - A Restricted zones in damp locations (normative)
 - B Cable colour codes (informative)
 - C Telecommunications outlets (informative)
 - G LV telecommunications circuits (informative)
 - H Interference from HV power systems (informative)
 - I The IP Code (informative)
 - J The network boundary (informative)
 - K Cabling Provider Rules (informative)

Appendix A forms an integral part of this Standard. Appendices B to K are for information only.

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 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.

This edition of the Standard deals with cabling work that was previously exempt from ACMA technical regulation or that was not specifically addressed by previous editions. Refer to Appendix G for a description of the changes made to accommodate such cabling and an explanation of how such cabling is captured by the telecommunications legislation.

1.2 Date of effect

This Standard comes into force as at 1 July 2006. Until that date AS/ACIF S009:2001 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/ACIF 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(Int):2003	Lightning protection
AS/NZS 2053.1:2001	Conduits and fittings for electrical installations - General requirements
AS/NZS 2211.1:2004	Safety of laser products - Equipment classification, requirements and user's guide (IEC 60825-1:2001, MOD)
AS/NZS 2211.2:1997	Laser safety – Safety of optical fibre communication systems
AS/NZS 2381.1:2005	Electrical equipment for explosive gas atmospheres - Selection, installation and maintenance - General requirements
AS/NZS 2648.1:1995	Underground marking tape - Non-detectable tape
AS/NZS 3000:2000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
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 60950.1:2003	Information technology equipment - Safety - General requirements
AS/NZS 61241.14:2005	Electrical apparatus for use in the presence of combustible dust - Selection and installation (IEC 61241-14, Ed.1.0(2004) MOD)
AS/ACIF Standards	
AS/ACIF S006:2001	Requirements for Customer Equipment, operating in the voiceband, for connection to the non-switched Telecommunications Network

Publication	Title
AS/ACIF S008:2006	Requirements for customer cabling products
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 S043.2:2005	Part 2: Broadband
AS/ACIF S043.3:2001	Part 3: DC, low frequency AC and voiceband
Other references	
ESAA/Telecom Code of Practice Issue 1 Jan. 1984	Joint Electricity Supply Code of Practice Association of Australia and Telecom Code of Practice (Protection of Personnel and Equipment against Earth Potential Rises caused by High Voltage Power Systems Faults)
SAA 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
SAA 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 1367:2000	Coaxial cable systems for the distribution of analogue television and sound signals in single and multiple unit installations
AS/NZS 2430.3	Classification of hazardous areas - Examples of area classification
AS/NZS 2430.3.1:2004	Part 3.1: General
AS/NZS 2430.3.2:2004	Part 3.2: Vehicle workshops, vehicle parking, fuel dispensing stations and aircraft hangars
AS/NZS 2430.3.3:2004	Part 3.3: Flammable liquids
AS/NZS 2430.3.4:2004	Part 3.4: Flammable gases

Publication	Title
AS/NZS 2430.3.5:2004	Part 3.5: Refineries and major processing plants
AS/NZS 2430.3.6:2004	Part 3.6: Laboratories, including fume cupboards and flammable medical agents
AS/NZS 2430.3.7:2004	Part 3.7: Landfill gas, sewage treatment and sewage pumping plants
AS/NZS 2430.3.8:2004	Part 3.8: Surface coatings and adhesives
AS/NZS 2430.3.9:2004	Part 3.9: Miscellaneous
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 3080:2003	Telecommunications installations – Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
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 3815–1998	A guide to coaxial cabling in single and multiple premises
AS/NZS ISO/IEC 15018:2005	Information technology — Generic cabling for homes
AS/NZS 60079.10:2004	Electrical apparatus for explosive gas atmospheres - Classification of hazardous areas (IEC 60079.10:2002 MOD)
AS/NZS 61241.10:2005	Electrical apparatus for use in the presence of combustible dust - Classification of areas where combustible dusts are or may be present
AS/ACIF Standards	
AS/ACIF S003:2005	Customer Access Equipment for connection to a Telecommunications Network
AS/ACIF Industry Codes	
ACIF C524:2004	External Telecommunication Cable Networks
ACIF C559:2005 Part 1	Unconditioned Local Loop Service (ULLS) Network Deployment Rules - Performance Requirements

Publication	Title
Other references	
SAA HB 13-2000	Electrical equipment for hazardous areas
SAA 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 60950.1:2003.

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 building

a substantial structure with a roof and walls, and includes, but is not limited to, a high-rise building, block of flats/apartments, factory, house, shed, caravan and mobile home.

3.1.4 Building Code

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

3.1.5 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*]

3.1.6 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 wire.

- 3.1.7 cabling
cable or cables and any associated works or parts such as trenching, pits, poles, conduits, trays, connecting devices, jumpers, etc.
- 3.1.8 cabling product
a passive device (including any cable, connecting hardware or surge suppression device) that is intended for use on the customer side of the network boundary.
- 3.1.9 cabling provider
a person who performs or supervises cabling work.
- 3.1.10 Cabling Provider Rules
the Telecommunications *Cabling Provider Rules 2000*, as amended from time to time.
- 3.1.11 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.
- 3.1.12 carriage service
a service for carrying communications by means of guided and/or unguided electromagnetic energy. [*Telecommunications Act 1997*]
- 3.1.13 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*]
- 3.1.14 carrier
the holder of a carrier licence. [*Telecommunications Act 1997*]

- 3.1.15 catenary support system
a suspension system, typically a wire rope, between two points to provide support for cables.
- 3.1.16 Certified Components List (CCL)
a list that was established by AUSTEL and that is published by 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)*.
- 3.1.17 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.
- 3.1.18 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'.
- 3.1.19 compliant
labelled in accordance with the *Telecommunications Labelling Notice*.
- 3.1.20 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.
- 3.1.21 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').

3.1.22 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*]

3.1.23 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.

3.1.24 cordage

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

3.1.25 cross-connection

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

3.1.26 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/ACIF S003:2005]

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).

3.1.27 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*]

3.1.28 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'.

3.1.29 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 roof or underfloor space) or floor duct.

3.1.30 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'.

3.1.31 differential earth clamp

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

3.1.32 distributor

a collection of components used to terminate cables and which provides for cross-connection of lines.

Note 1: An example of a distributor is a jumperable distribution frame or a patch panel.

Note 2: Where cable termination equipment is used to interconnect two or more cables without cross-connection, for the purposes of this Standard it is not regarded as a distributor.

- 3.1.33 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'.
- 3.1.34 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.
- 3.1.35 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.
- 3.1.36 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.
- 3.1.37 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.
- 3.1.38 equipotential bonding
special 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 3000:2000]

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'.
- 3.1.39 Extra-Low Voltage (ELV)
refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (3.1.79)

- 3.1.40 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]
- 3.1.41 first socket
- a telecommunications outlet within a customer's building which terminates a carrier's lead-in cabling, i.e. there is no intermediate 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.
- 3.1.42 functional earth
- the earthing of a point in equipment or in a system which is necessary for a purpose other than safety. [AS/NZS 60950.1:2003]
- 3.1.43 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 quantities such as to require special precautions for the construction, installation and use of apparatus.
- Note 1: Hazardous areas are classified in accordance with AS/NZS 60079.10, AS/NZS 61241.10 and AS/NZS 2430.3, 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.
- 3.1.44 hazardous service
- refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).
- 3.1.45 hazardous voltage
- refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).
- 3.1.46 High Voltage (HV)
- refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).

- 3.1.47 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.
- 3.1.48 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.
- 3.1.49 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.
- 3.1.50 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.
- 3.1.51 lead-in cabling
a carrier's telecommunications network cabling from the carrier's distribution point to the network boundary.
- 3.1.52 limited current circuit
refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).
- 3.1.53 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*]
- 3.1.54 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.
- 3.1.55 Low Voltage (LV)
refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).

3.1.56 Main Distribution Frame (MDF)

a distributor that provides, or is intended to provide, an electrical termination point for a carrier's 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.

3.1.57 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 must comply with the *Telecommunications Labelling Notice* and cabling work must be performed by a cabling provider.

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

3.1.58 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.

3.1.59 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.

3.1.60 patch cord

a flexible cable unit or cable element with connector(s), used to make a cross-connection within a distributor without the use of a tool.

3.1.61 power feeding

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

- 3.1.62 premises
any land together with its building(s) used as a place of business or residence.
- 3.1.63 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.
- 3.1.64 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 3000:2000]

Note: A protective earthing conductor is part of the electrical installation and usually needs to be installed by a licensed electrical worker.
- 3.1.65 readily accessible
capable of being reached quickly 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 3000:2000]
- 3.1.66 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.
- 3.1.67 Safety Extra-Low Voltage (SELV) circuit
refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).
- 3.1.68 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.
- 3.1.69 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.

- 3.1.70 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.
- 3.1.71 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*]
- 3.1.72 Telecommunications Network Voltage (TNV) circuit
refer to 'voltage classifications' (Clause 3.1.78) and 'service classifications' (Clause 3.1.79).
- 3.1.73 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.
- 3.1.74 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.
- 3.1.75 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.
- 3.1.76 trunking
a tray or trough system with removable cover(s) along its length for housing and protecting cables.

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

- 3.1.77 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.
- 3.1.78 voltage classifications
- 3.1.78.1 Extra-Low Voltage (ELV)
a voltage not exceeding 42.4 V peak or 60 V d.c.
[AS/NZS 60950.1:2003]
Note: This definition differs from the ELV definition contained in AS/NZS 3000:2000, which is more closely aligned to the TNV limits described below, i.e. 120 V d.c. or 70.7 V a.c. peak (50 V a.c. r.m.s.).
- 3.1.78.2 Telecommunications Network Voltage (TNV)
a voltage not exceeding—
(a) when telephone ringing signals are not present—
(i) 71 V peak or 120 V d.c.; or
(ii) if a combination of AC voltage and DC voltage is present, the sum of the AC peak voltage divided by 71 and the DC voltage divided by 120 must 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.
- 3.1.78.3 Low Voltage (LV)
a voltage exceeding ELV limits but not exceeding 1000 V a.c. or 1500 V d.c. [AS/NZS 60950.1:2003]
- 3.1.78.4 High Voltage (HV)
a voltage exceeding LV limits. [AS/NZS 60950.1:2003]
- 3.1.78.5 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 60950.1:2003]

3.1.79 service classifications

3.1.79.1 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 60950.1:2003]

3.1.79.2 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 60950.1:2003]

3.1.79.3 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 60950.1:2003.

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.

3.1.79.4 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 60950.1:2003]

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

3.1.79.5 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. However, for the purposes of this Standard these sub-classifications are not relevant.

3.1.79.6 limited current circuit

a secondary 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 60950.1:2003]

Note 1: For frequencies not exceeding 1 kHz, the steady-state current drawn through a non-inductive resistor of $2000\Omega \pm 10\%$ 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.

3.1.79.7 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.

3.1.79.8 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 240 V a.c. mains power cable within a building.

3.1.79.9 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.

3.1.79.10 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.

3.1.79.11 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).

3.2 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
C	Celsius
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
h	hour(s)
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
kg	kilogram(s)
km	kilometre(s)
kV	kilovolt(s)
LFI	Low Frequency Induction
LV	Low Voltage
m	metre(s)
mA	milliampere(s)
max.	maximum
MDF	Main Distribution Frame
min.	minimum
mm	millimetre(s)
mm ²	square millimetre(s)
NTD	Network Termination Device
NZS	New Zealand Standard
OH&S	Occupational Health and Safety
PABX	Private Automatic Branch eXchange
PVC	PolyVinyl Chloride
s	second(s)
SAA	Standards Association of Australia
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
µA	microampere(s)
ULLS	Unconditioned Local Loop Service
UV	UltraViolet (radiation/light), e.g. direct sunlight
V	Volt(s)

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 Health and safety

4.4.1 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 (see Note 1);
- (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.

4.4.2 Occupational Health and Safety (OH&S) requirements

Cabling providers should comply with relevant Commonwealth, State and Territory OH&S requirements including, but not limited to, Building Code requirements.

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 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 2211.1, AS/NZS 2211.2 and AS/NZS 3080.
- (e) Coaxial cabling — AS/NZS 1367.

Note: 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 subscription TV ('pay TV') or broadband data services; or
- (c) for fibre-to-the-premises (FTTP) cabling.

4.6 Cabling provider competency standards

To ensure that the safety and network integrity of the installation is maintained, in addition to the mandatory cabling provider registration requirements, it is recommended that the cabling provider meet appropriate competency standards for installation and repair work in each of the following categories, where relevant to the work being done:

- (a) Structured, balanced (twisted pair) cabling.
- (b) Optical fibre cabling.
- (c) Coaxial cabling.
- (d) Underground cabling.
- (e) Aerial cabling.
- (f) Fire detection and alarm systems.
- (g) Lifts, escalators and moving walks.
- (h) Intruder alarm systems.
- (i) Building control and automation systems.

5 GENERAL REQUIREMENTS

5.1 Safe and sound practice

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

Note 1: An example of practices that are not considered to be safe 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; or
- (b) physical protrusions in trafficable areas that a person may bump into or trip over (e.g. due to their location or low visibility).

Note 2: An example of practices that are not considered to be sound are those that may breach another industry Standard or Code.

5.2 Manufacturer's instructions

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

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

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

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 twisting and soldering of conductors.
- (c) For optical fibre cable, by fusion splicing.

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

5.8.2 Physical protection of the joint

The cable joint **shall** be suitably constructed, enclosed, positioned, and supported to prevent 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.

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 240 V a.c. single phase power or 415 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 the jointly agreed ESAA and Telecom Australia (Telstra) *Code of Practice for the Protection of Personnel and Equipment against Earth Potential Rises caused by High Voltage Power Systems Faults*.

Note 1: At the time of publication, Standards Australia was finalising for publication 'Earth potential rise (EPR) – Coordination of power and telecommunications systems' (to be AS/NZS 3835).

Note 2: A useful reference is SAA 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 SAA HB 101 (CJC 5) and SAA HB 102 (CJC 6).

Note: Another useful reference is SAA 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)

Equipment, including cabling and connecting hardware, for use in a hazardous area **shall** be selected and installed in accordance with—

- (a) AS/NZS 2381.1 for an explosive gas atmosphere; or
- (b) AS/NZS 61241.14 for an area where combustible dust may be present.

Note 1: The owner or occupant of the premises should be consulted regarding hazardous area classification before work is commenced.

Note 2: Refer to SAA HB 13 for basic guidance on the safe use of electrical equipment in a hazardous area.

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 A.1 to A.4.
- (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 A.5.
- (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 A.6.

- (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 subducted in a continuous run of insulating conduit complying with AS/ACIF 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 (Refer to Note 5).

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 other services so as not to impede access to, or repair of, the other service.

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

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 by a minimum distance of 100 mm.

Note: 'Hazardous service' is defined in section 3 and includes a gas pipe, oil pipe, steam pipe, hot water pipe exceeding 60° C and a pipe containing compressed air.

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 G.1 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 4262.1-1995, 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 Clause 3.1.75.

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.

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 4262.1-1995, 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 4262.1-1995.

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 4262.1-1995 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—

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

(2) 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 (1) 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/ACIF S008, AS/NZS 2211.1 and AS/NZS 2211.2.

11.1.3 Safety of the installation

Optical fibre systems should be installed and maintained in accordance with AS/NZS 2211.2. 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;
- (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; and
- (e) 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.

11.2 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 and AS 3815.

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 subscription TV ('pay TV') or 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 Cabling outside the boundaries of the premises

The records **shall** include details of any customer cabling connected to the distributor that runs outside the boundaries of the premises.

12.3.3 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/ACIF 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 60950.1:2003.
- (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 near the electrical switchboard to enable earthing/bonding of surge suppression devices within the conductor length limits described in Note 3 to Clause 20.20.1; and
- (b) 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
- (c) **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 doesn't.

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 Appendix J, Figure J.15 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 Appendix J, Figure J.15 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 Appendix J, Figure J.15 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 Appendix J, Figure J.15 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 Appendix J, Figure J.15 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 Appendix J, Figure J.16 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 Appendix J, Figure J.16 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 Outlet types

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

Note: In general, telecommunications outlets with 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: 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).

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 telecommunications outlet ('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 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 telecommunications outlet 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 telecommunications outlet.

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 a telecommunications outlet in the building (i.e. there is no intermediate MDF or NTD), a cabling provider may connect customer cabling—

(a) to the terminal strip of the carrier's telecommunications outlet; or

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

Note: Where insulation displacement connectors are used at the first TO, 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 a telecommunications outlet in the building (i.e. there is no intermediate NTD), a cabling provider **shall not** connect customer cabling to any point other than the front of the outlet 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 telecommunications outlet (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/ACIF 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).

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) A barrier of durable insulating material or metal.
- (c) A timber or metal stud, nogging, joist 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 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 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—

- (a) **shall** comply with the requirements of AS 1735.2 and AS/ACIF S008; and
- (b) **shall** 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/ACIF 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.

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 cabling between 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 www.dialbeforeyoudig.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 in accordance with Clause 12.3.2.

17.3 Cabling in 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 17.4 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 **shall—**

- (a) be separated from LV power cables and HV circuits in accordance with Clauses 16.3 and 16.4; and
- (b) comply with the relevant requirements of Section 8.

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/ACIF S008, whereas access holes are usually fabricated on site and are only subject to this Standard (AS/ACIF S009). It is a requirement of AS/ACIF 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.

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 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 or gas into the building.

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/ACIF S008 unless—

- (a) the conduit is to be installed as sub-ducting in a larger conduit that complies with AS/ACIF S008; or
- (b) otherwise allowed in this Standard.

Note 1: AS/ACIF 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/ACIF 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/ACIF 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.

18.4 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/ACIF 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') and/or grease or gel within the core ('filled' or 'flooded' cable) provides even higher protection against moisture entry.

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/ACIF S008.

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 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, unless the soil conditions preclude a trench 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 3.11.3.3 of AS/NZS 3000:2000 **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 2.

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 2.

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 2.

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 2

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 3.11.3.3 of AS/NZS 3000:2000 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 3.11.3.3 of AS/NZS 3000:2000 (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 3.11.3.3 of AS/NZS 3000:2000 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 3000:2000 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 3.11.3.3 of AS/NZS 3000:2000.

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/ACIF 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/ACIF 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/ACIF 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 3.

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 3.

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/ACIF 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 3

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 3, 4 and 5).
- (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 (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 30Ω (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 10Ω 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 5 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 mm² in cross-sectional area or cable lugs designed to terminate 6 mm² 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.

- (f) Spade terminals **shall not** be used for connection of earthing or bonding conductors.

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 1 to 4.

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 mm²; 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 4.

Table 4
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 mm² 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 1 to 4.

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 1 and 2). 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 5.

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 1 and 2.

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 4 may be used as a guide

Note 3: Some installations may require a conductor larger than the minimum sizes specified in Table 5 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 3, 4 or 5 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 5.
- (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 any 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 mm² with no part less than 3 mm thick.
- (b) 35 mm² 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 mm²; 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 5.

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 3, 4 and 5.

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 4 or 5, in which case—

- (a) a TFE **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 from 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 5Ω measured between the TRC link bar at the designated distributor and the TRC link bar at any other distributor or CAE.

Note 1: Table 4 may be used as a guide.

Note 2: Some installations may require a conductor larger than the minimum size specified in Table 5 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 4, 5 or 6. 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 4 and 5 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 mm²;
- (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 mm²; 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 6.
- (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 mm²; 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 mm².

Note 1: The connection may be made to a termination module backmount that is connected to protective earth via a minimum 6 mm² 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 mm².

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 5
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 1 or 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

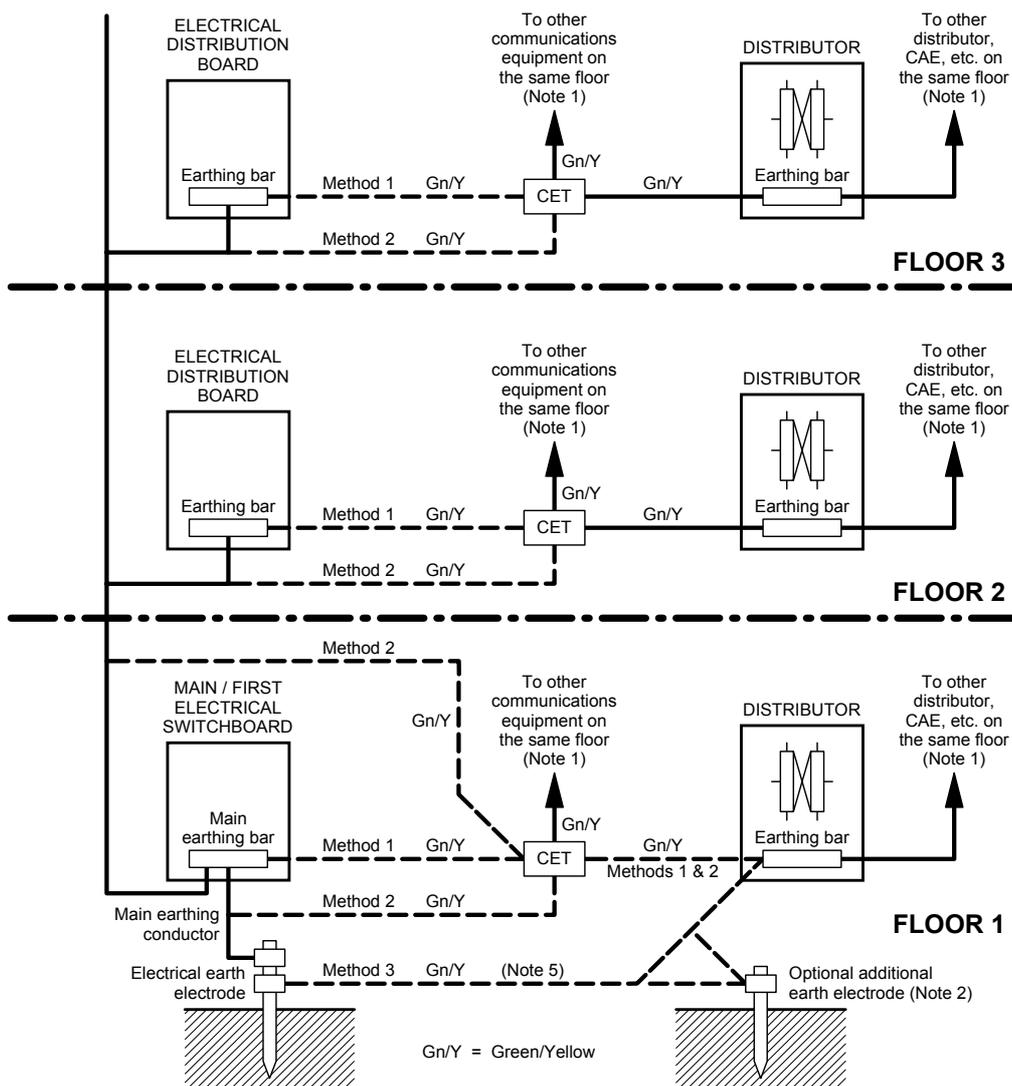
TRC

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.

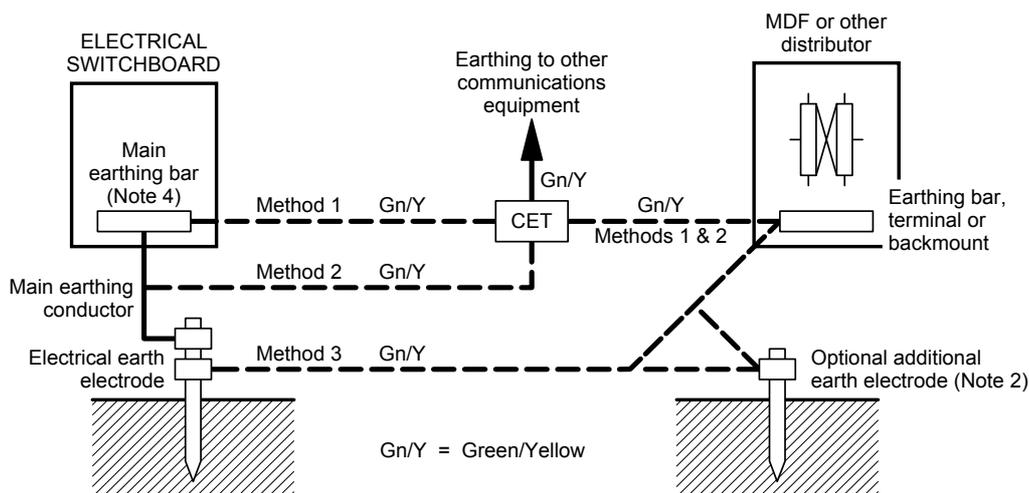
Note 4: The earthing conductor to any distributor may be cabled from either the CET or another distributor, as long as the resistance limit of Clause 20.12.4 is not exceeded.

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 1

Typical CES for commercial premises with distributed cabling



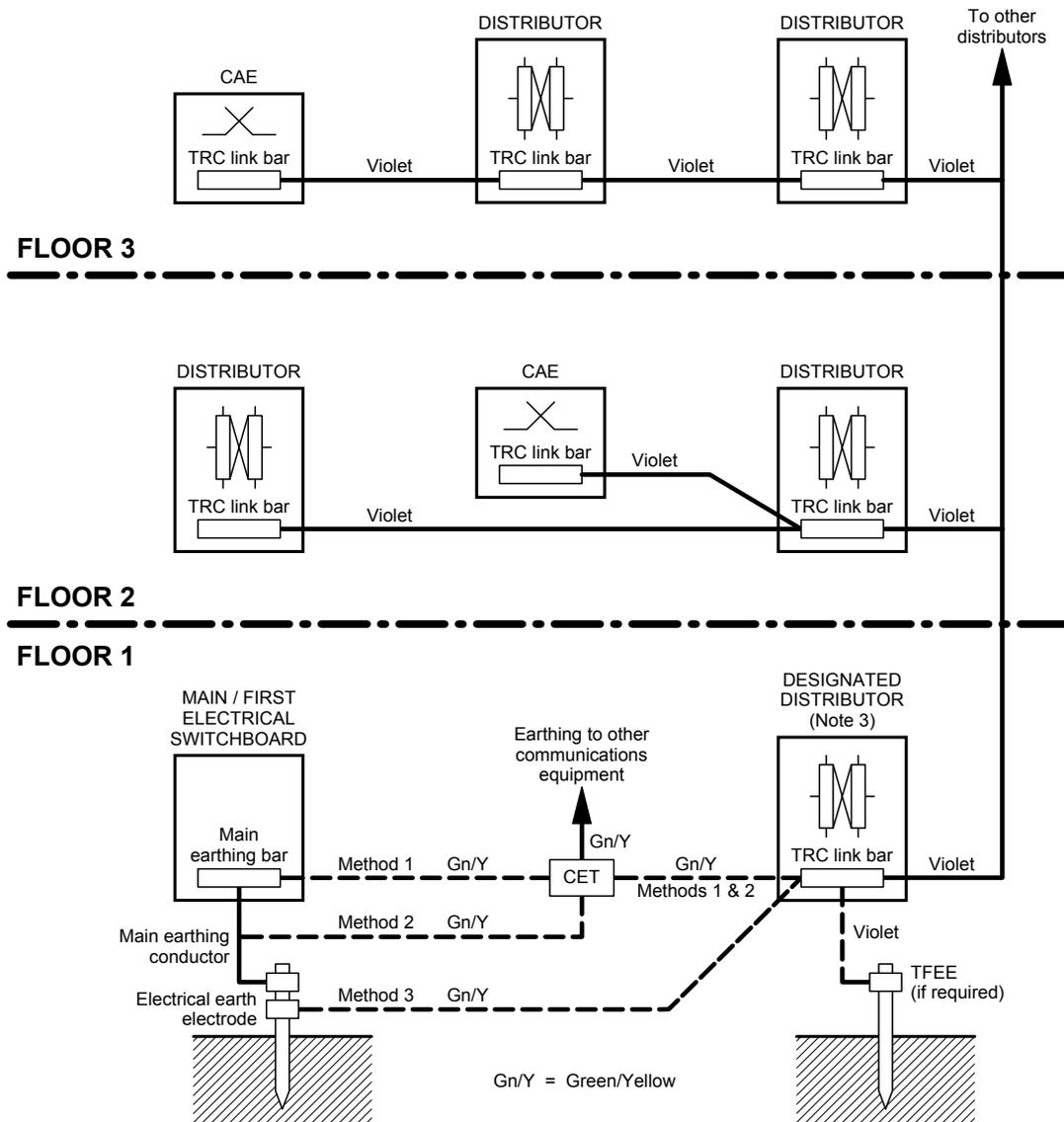
Note 1: In this configuration, the CET was formerly known as a 'bonding terminal'.

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.

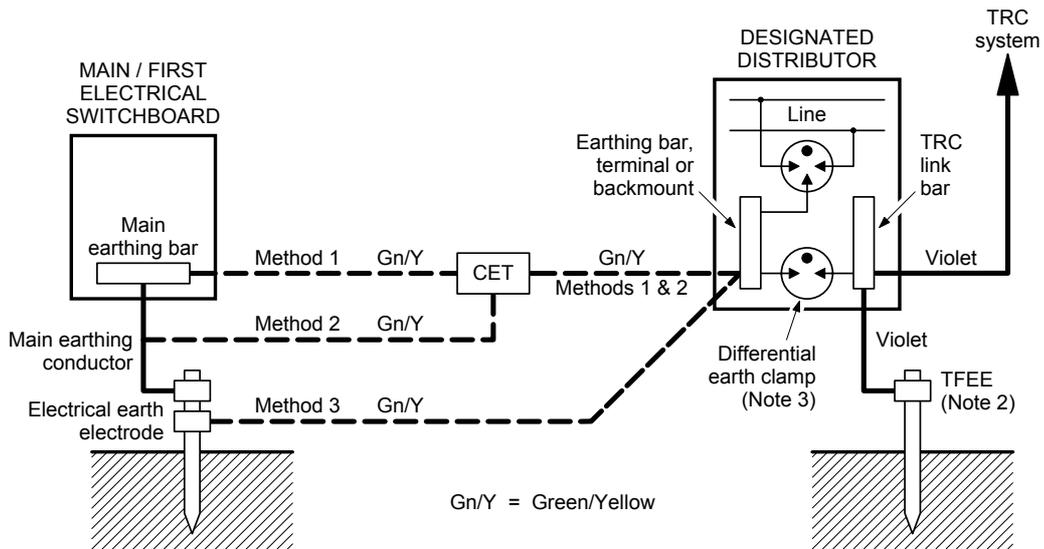
Figure 2
Earthing options for a small distributor installation
(e.g. domestic or small business premises)



- 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 4.
- 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 TFE (where required) is to be connected in accordance with Figure 5.

Figure 3

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 TFEF 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:

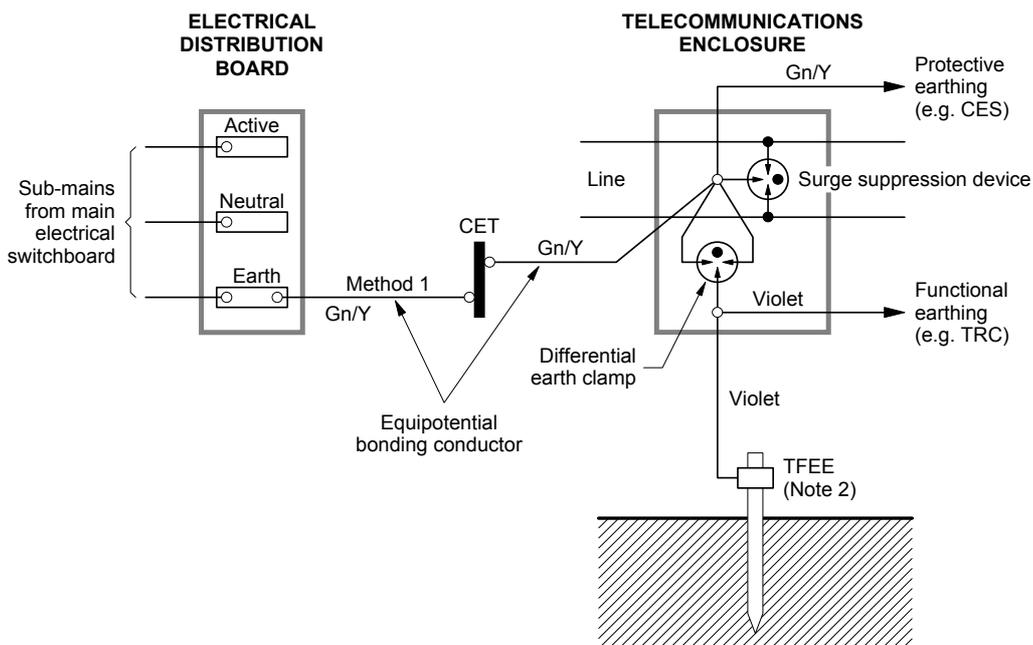
- (a) The differential earth clamp is to be connected in a way that it is not required to conduct surge current to the electrical earthing system from any surge suppression device connected to a telecommunications line.
- (b) All TRC link bars and terminations are to be enclosed or located to prevent 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 4

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 TFE to the general mass of earth should not exceed 30 Ω. The operational requirements of the customer equipment may require a lower resistance.

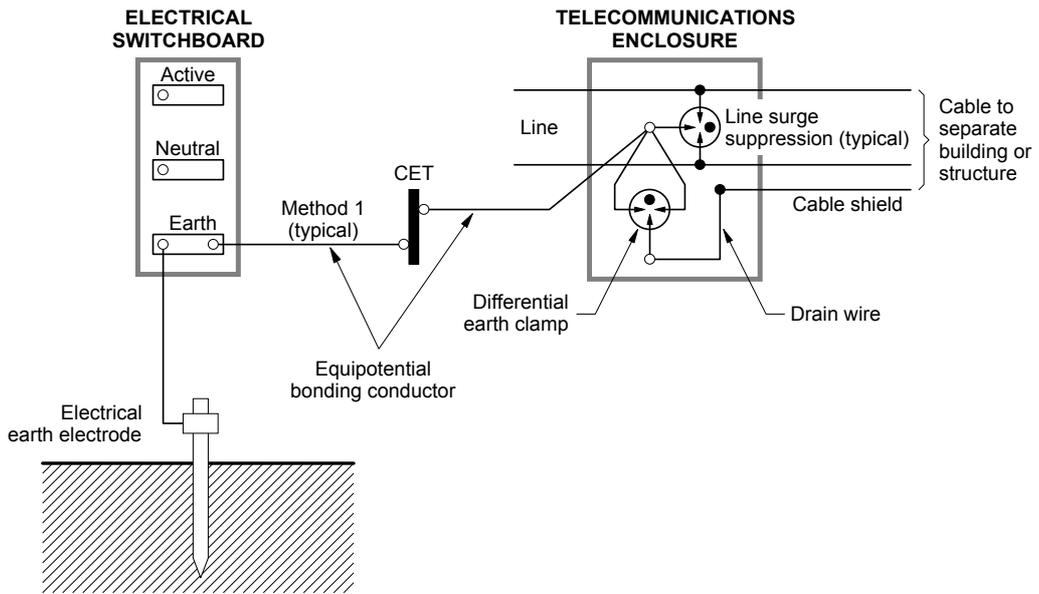
Note 3: Where the maximum limiting voltage of the differential earth clamp exceeds ELV limits, all functional earthing bars and terminals are to be suitably labelled to warn workers of possible voltage differences between the functional earth and other earths, e.g. 'WARNING! This earth is not directly 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 5

Installation of a TFE where the electrical earth electrode is located at another building or structure



Note: Refer to Clause 20.18.4.

Figure 6

Connection of a metallic cable shield (or moisture barrier) of an underground or aerial customer cable at a building or structure

APPENDIX A (NORMATIVE)

Restricted zones in damp locations

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 A.1 to A.4.

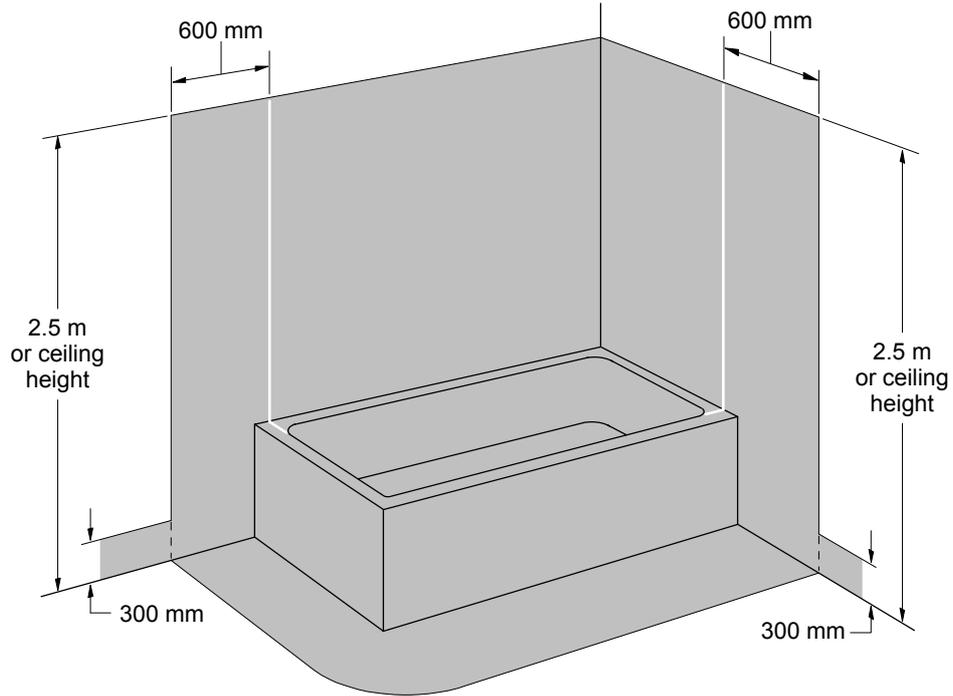


Figure A.1
Bath without a shower

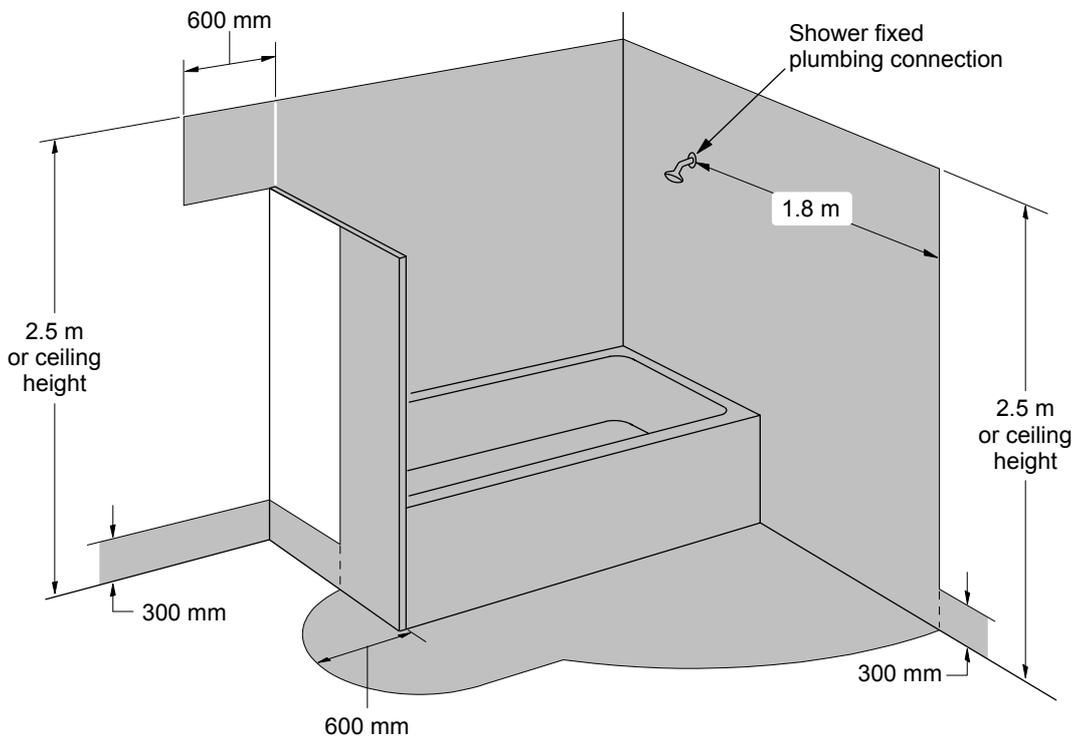


Figure A.2
Bath with a shower and fixed partition

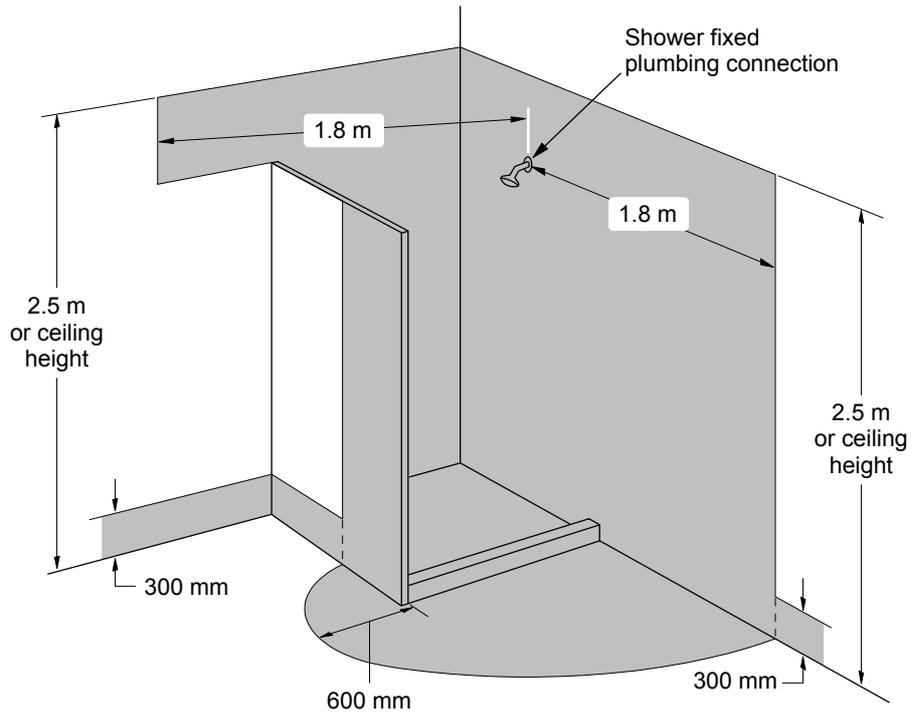


Figure A.3
Shower with a fixed partition

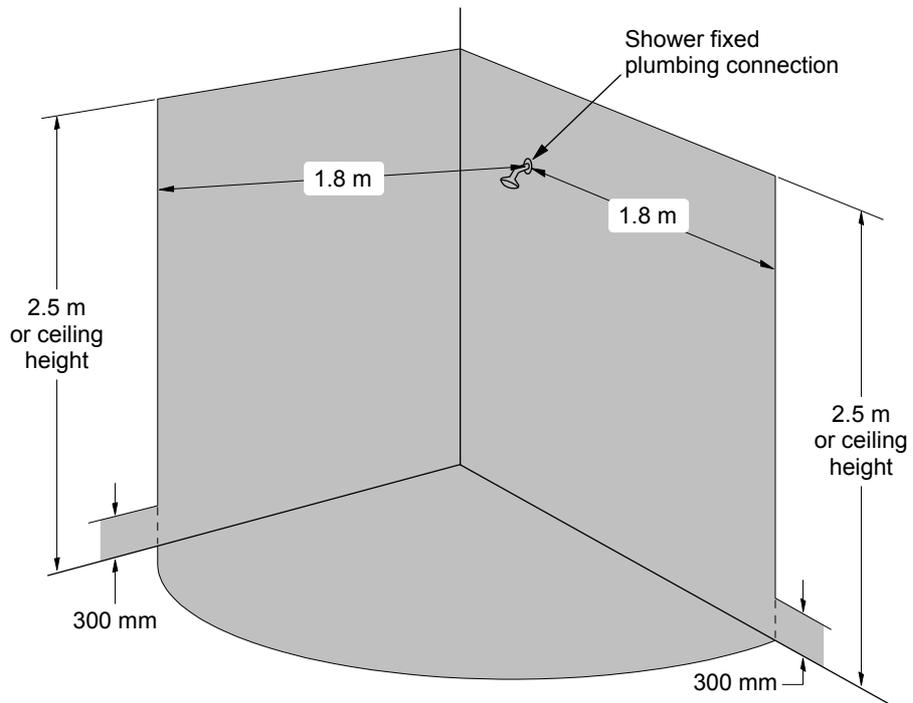


Figure A.4
Shower without a fixed partition

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 A.5.

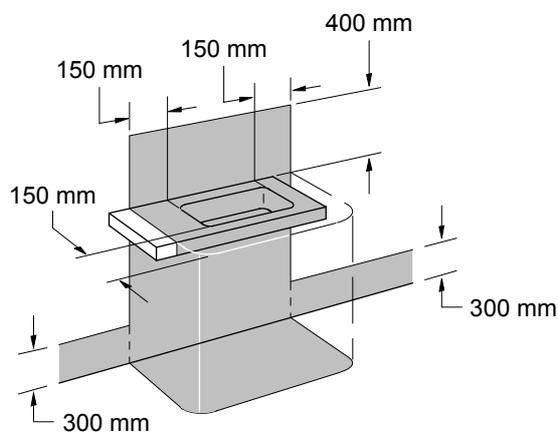


Figure A.5

**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 A.6.

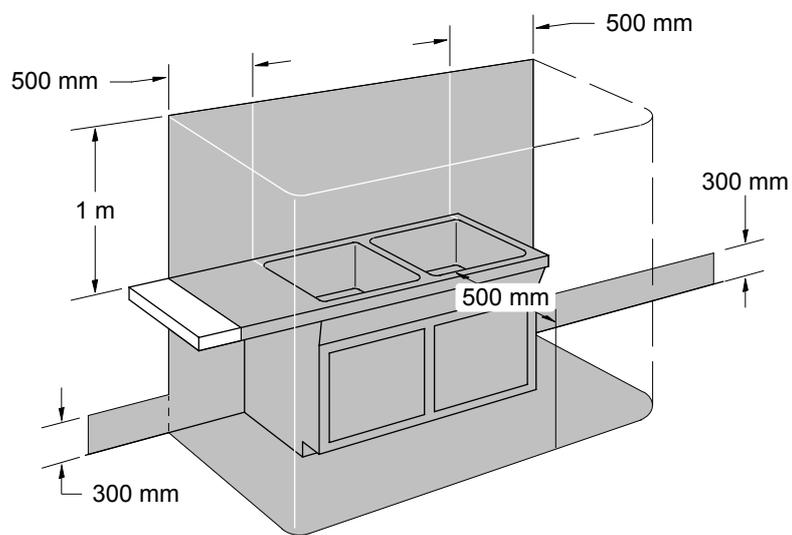


Figure A.6

Laundry tub or fixed water container exceeding 45 litres capacity

APPENDIX B (INFORMATIVE) Common cable colour codes

Cables are required by AS/ACIF 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 B.1 to B.7. 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 B.1

2-pair (quad) and 3-pair telephone cable colour code

Pair number	Colours
1	White Blue
2	Red Black
3	Orange Green

Table B.2

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 B.3

Colour code for 5-pair to 100-pair cables (20-pair units)

Pair number	A Leg (L+)	B Leg (L-)	Pair range	Mate colour
1	White	Blue	1-20	White
2	White	Orange		
3	White	Green		
4	White	Brown		
5	White	Grey	21-40	Yellow
6	White	Blue-White		
7	White	Blue-Orange		
8	White	Blue-Green		
9	White	Blue-Brown	41-60	Black
10	White	Blue-Grey		
11	White	Orange-White		
12	White	Orange-Green		
13	White	Orange-Brown	61-80	Violet
14	White	Orange-Grey		
15	White	Green-White		
16	White	Green-Brown		
17	White	Green-Grey	81-100	Red
18	White	Brown-White		
19	White	Brown-Grey		
20	White	Grey-White		

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 B.4
Colour code for 25-pair to 100-pair cables (25-pair units)

Pair number	Mate	Colour	Pair range	Whipping colour
1	White	Blue	1-25	Blue
2	White	Orange		
3	White	Green		
4	White	Brown		
5	White	Grey		
6	Red	Blue	26-50	Orange
7	Red	Orange		
8	Red	Green		
9	Red	Brown		
10	Red	Grey		
11	Black	Blue	51-75	Green
12	Black	Orange		
13	Black	Green		
14	Black	Brown		
15	Black	Grey		
16	Yellow	Blue	76-100	Brown
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		

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 B.5

Colour code for 5-pair to 100-pair cables (10-pair units)

Pair number	A Leg (L+)	B Leg (L-)	Pair range	Whipping colour
1	White	Blue	1-10	Blue
2	White	Orange	11-20	Orange
3	White	Green	21-30	Green
4	White	Brown	31-40	Brown
5	White	Grey	41-50	Grey
6	Red	Blue	51-60	Blue-White
7	Red	Orange	61-70	Orange-White
8	Red	Green	71-80	Green-White
9	Red	Brown	81-90	Brown-White
10	Red	Grey	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 B.6

Colour code for 5-pair to 200-pair cables (10-pair units)

Pair number	A Leg (L+)	B Leg (L-)	Pair range	Whipping colour
1	White	Blue	1-10	Blue-White
2	White	Orange	11-20	Orange-White
3	White	Green	21-30	Green-White
4	White	Brown	31-40	Brown-White
5	White	Grey	41-50	Grey-White
6	Red	Blue	51-60	Blue-Blue
7	Red	Orange	61-70	Orange-Orange
8	Red	Green	71-80	Green-Green
9	Red	Brown	81-90	Brown-Brown
10	Red	Grey	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 B.7
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 (INFORMATIVE)

Telecommunications outlets

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.

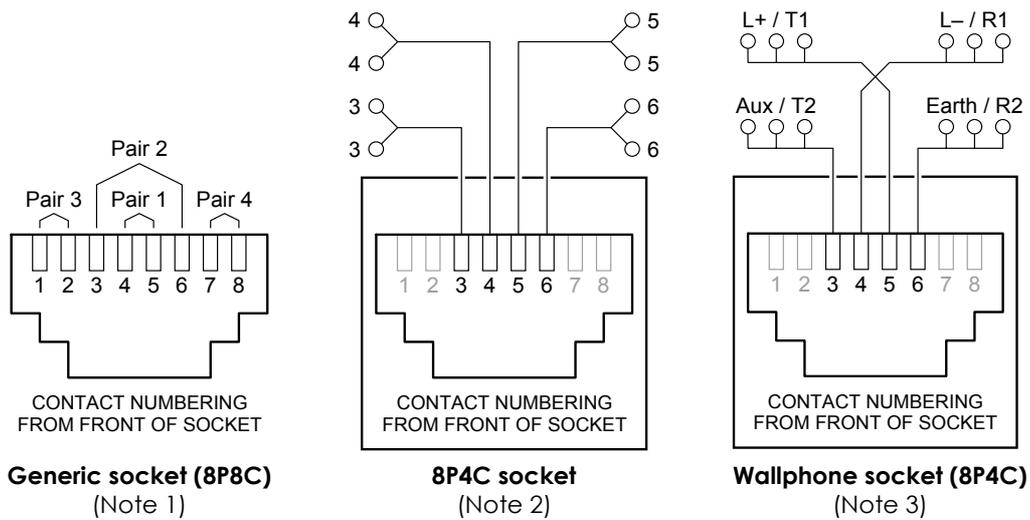
C.2 Socket types

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 C.1 to C.3 and Tables C.1 to C.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.

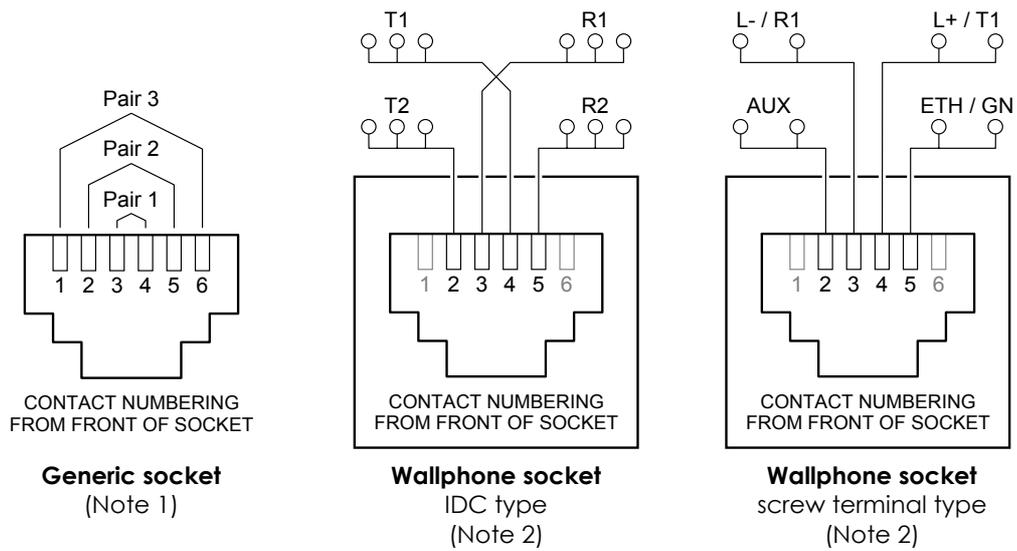
Figure C.1
8P modular socket contact numbering

Table C.1
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+	T1	5	1	White	White-Blue	White-Blue*	White	White
L-	R1	4		Blue	Blue	Blue-White*	Blue	Blue
Aux	T2	3	2	White	White-Orange	White-Orange*	Red	Red
Earth	R2	6		Orange	Orange	Orange-White*	Black	Black
-	-	1	3	White	White-Green	White-Green*	Orange	-
-	-	2		Green	Green	Green-White*	Green	-
-	-	7	4	White	White-Brown	White-Brown*	-	-
-	-	8		Brown	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.



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.

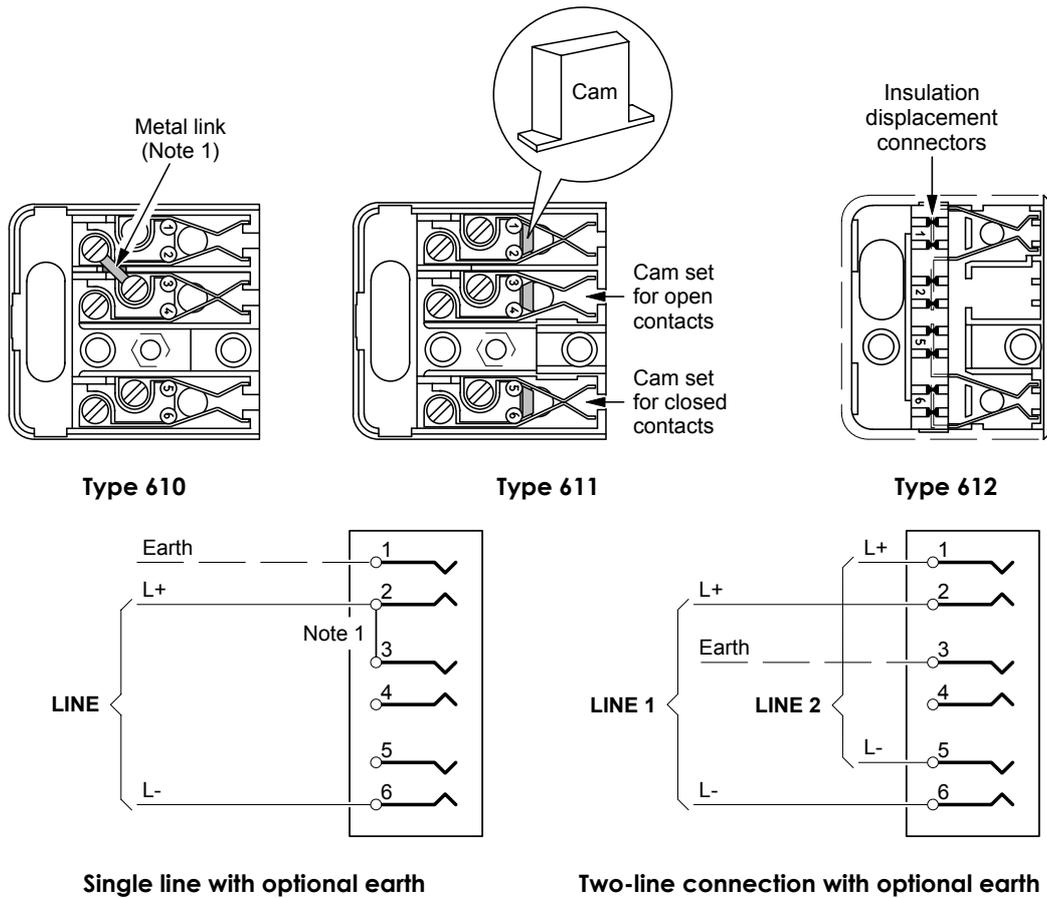
Figure C.2
6P modular socket contact numbering

Table C.2
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	T1	4	1	White	White-Blue	White-Blue*	White	White
R1	R1	3		Blue	Blue	Blue-White*		
R2	ETH	5	2	White	White-Orange	White-Orange*	Red	Red
T2	AUX	2		Orange	Orange	Orange-White*		
-	-	6	3	White	White-Green	White-Green*	Orange	-
-	-	1		Green	Green	Green-White*		
-	-	-	4	White	White-Brown	White-Brown*	-	-
-	-	-		Brown	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 C.3
600 series socket connections

Table C.3
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	2	2	1	White Blue	White-Blue Blue	White-Blue* Blue-White*	White Blue	White Blue
6	6	6		1	White Orange	White-Orange Orange	White-Orange* Orange-White*	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).

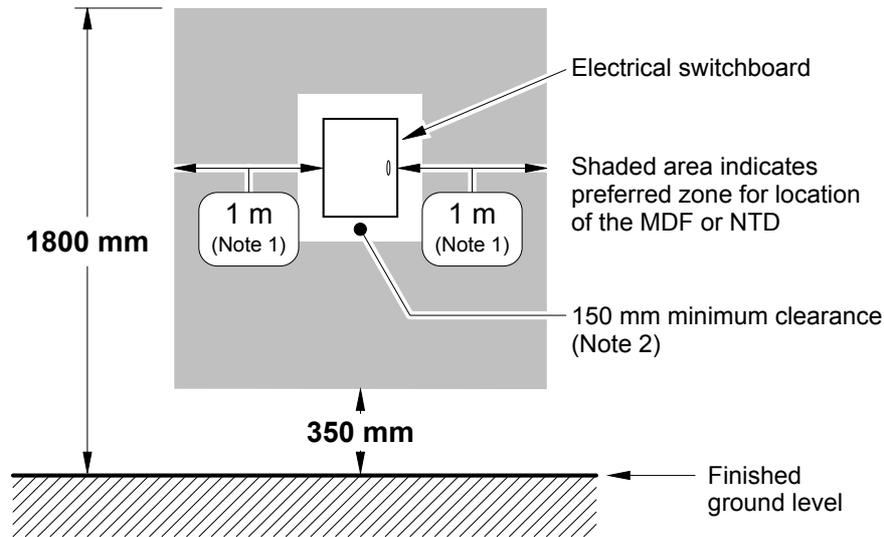
APPENDIX D (INFORMATIVE)

Recommended access clearances for MDFs and NTDs

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 D.1 to D.3 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.

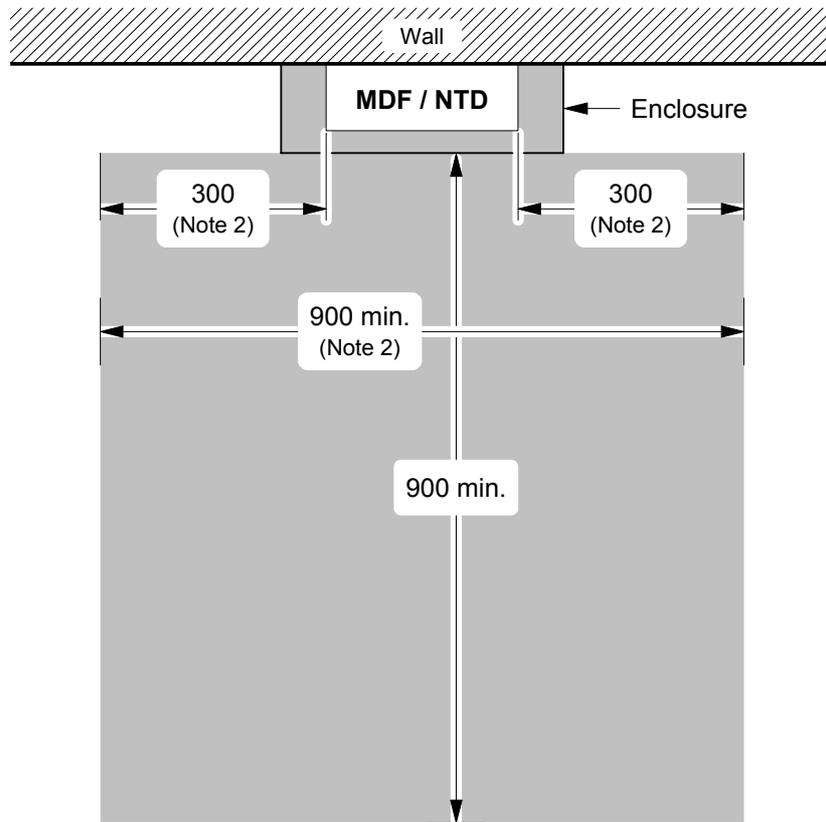
Note: An NTD is normally installed by the carrier but the cabling provider should maintain suitable NTD access clearances when installing customer cabling or customer equipment.



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 D.1
Installation zone for a wall mounted MDF or NTD
on the external wall of a dwelling



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 D.3

Access clearances for a wall mounted MDF or NTD

APPENDIX E (INFORMATIVE)

Direct current in the communications bonding conductor

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 $\mu\text{A}\cdot\text{h}$ per day.
- (b) 100 mA maximum (either polarity) for any period not exceeding 30 s.

The system designer should consider these values.

APPENDIX F (INFORMATIVE)

Current-limited power feeding in telecommunications networks

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 ACIF C559:2005 Part 1 *ULLS Performance Requirements*. 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 ACIF C559:2005 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 ACIF C559:2005 Part 1 is that any remote power feeding voltage must 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.

ACIF C559:2005 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 ACIF C559:2005 Part 1 (available on the ACIF web site at www.acif.org.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 (INFORMATIVE) LV telecommunications circuits

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 ACMA) technical regulation.

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/ACIF 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/ACIF 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/ACIF 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 G.1 was compiled to enable ready comparison of separation requirements between different telecommunications and power services for indoor cabling.

Table G.1 is provided for information only. For actual separation requirements, refer to the body of this Standard.

Table G.1
Minimum separation distances required between different types of telecommunications and power services for safety (indoor cabling)

Type of service		Dimensions in mm															
		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 (INFORMATIVE)

Interference from HV power systems

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.

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 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 to telecommunications cables by HV power systems 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 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 H.1, 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.

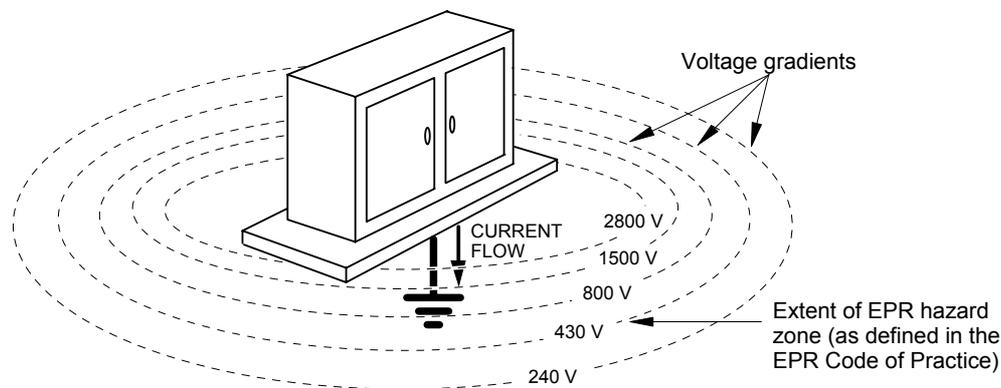


Figure H.1
EPR caused by fault current at an HV transformer

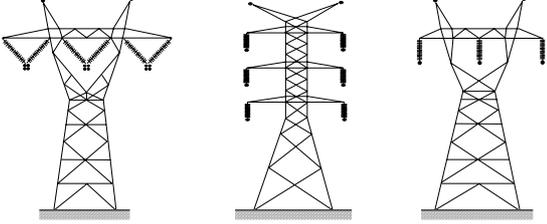
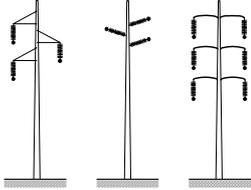
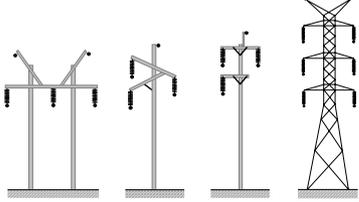
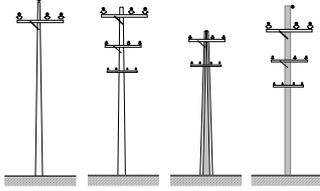
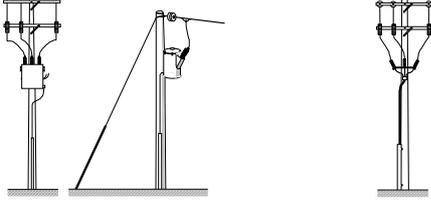
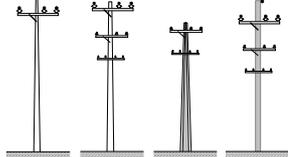
H.2.2 Identifying situations of possible EPR hazard

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 H.1 and H.2, 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).

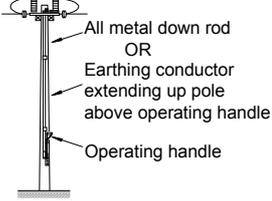
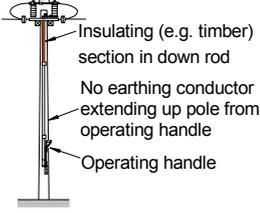
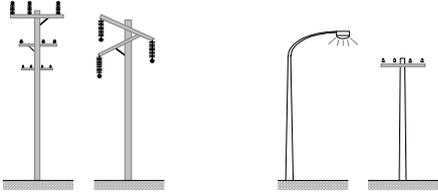
Table H.1

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)
<ul style="list-style-type: none"> • Steel lattice tower; or • wooden pole with down conductor to earth electrode (66 kV and 132 kV)		16 m (Note 1)
<ul style="list-style-type: none"> • 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)
<ul style="list-style-type: none"> • Metal or concrete pole; or • wooden pole with down conductor to earth electrode (lower than 66 kV)		15 m (Note 1)

cont:

**Table H.1
(continued)**

Type of HV pole or tower	Typically looks like this	Hazard zone
Wooden pole with pole-top switch and one of the following: <ul style="list-style-type: none"> • an all-metal down rod; or • an earthing conductor extending up the pole above the handle 	 <p style="font-size: small;">All metal down rod OR Earthing conductor extending up pole above operating handle Operating handle</p>	15 m (Note 1)
Wooden pole with pole-top switch and both of the following: <ul style="list-style-type: none"> • an insulating (e.g. timber) section in the down rod; and • no earthing conductor extending up the pole above the handle 	 <p style="font-size: small;">Insulating (e.g. timber) section in down rod No earthing conductor extending up pole from operating handle Operating handle</p>	2 m (Note 1)
<ul style="list-style-type: none"> • HV wooden pole without down conductor to earth electrode; or • any pole that only supports LV power lines 		1 m (Note 2)

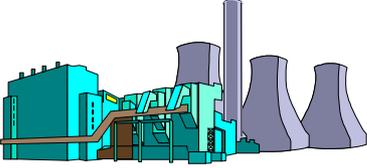
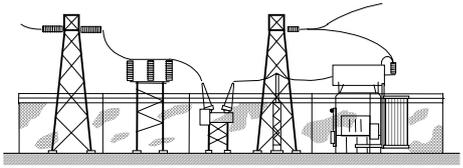
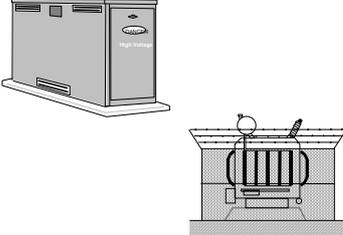
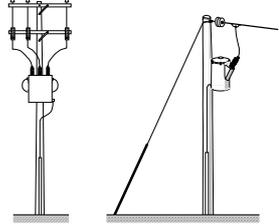
Note 1: This distance may be reduced if:

- (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 H.2

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.2.3 EPR hazard assessment

The level of the EPR at an HV site and the extent of the associated hazard zone are best determined by either 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 H.1 and H.2 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.

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 H.1 and H.2, 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

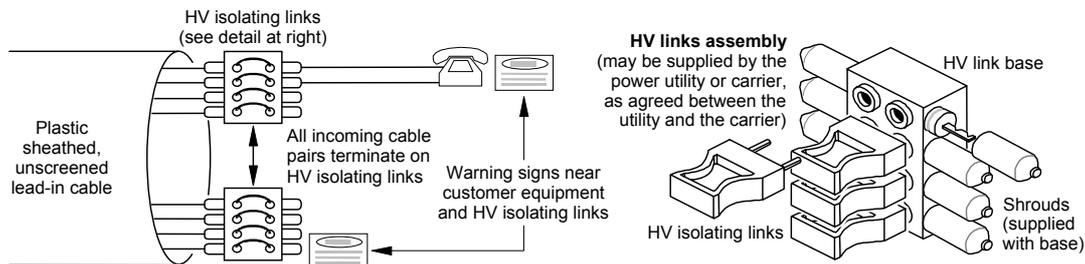
Only plastic-sheathed cables, preferably accommodated in rigid plastic conduit, may pass through an EPR hazard zone. The installation of pits, access holes and draw boxes for drawing in (not jointing) cables is also permitted in an EPR hazard zone. These should be labelled with

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 H.2. 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 H.2

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.

H3.2.2 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 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 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 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 must 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:

- (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 or 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 H.3.
- (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 H.3

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 H.3 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:

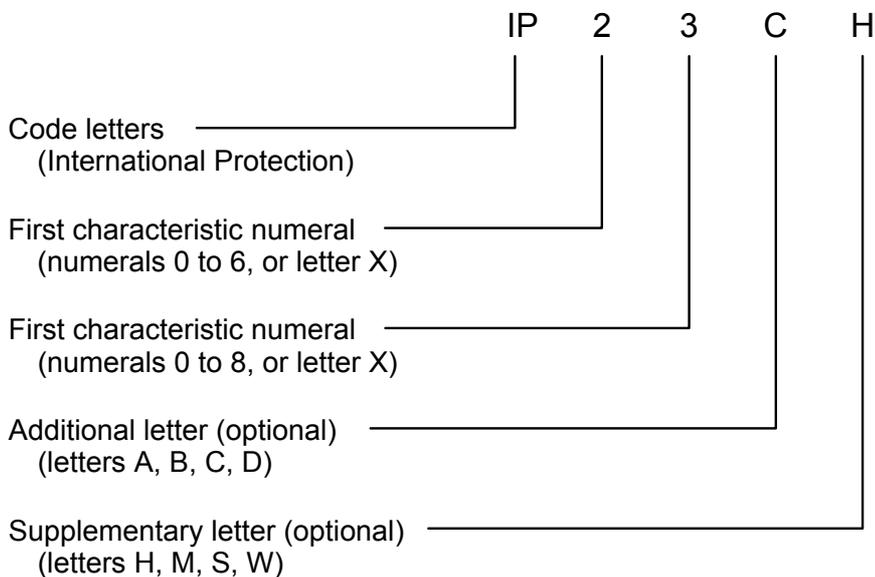
- (a) Telecommunications cabling is located within, or it is suspected that cabling is located within, an EPR hazard zone.
- (b) It is suspected that telecommunications cabling may be exposed to LFI of any magnitude.
- (c) It is suspected that aerial telecommunications cabling may be exposed to the effects of electrostatic coupling.

APPENDIX I (INFORMATIVE)

The IP Code

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 I.1 and Table I.1.



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 I.1 for the meaning of each numeral or letter.

Figure I.1
Arrangement of the IP Code

Table I.1
Summary of the IP Code

	IP	Meaning for the protection of EQUIPMENT	Meaning for the protection of PERSONS
First numeral		<i>Against ingress of solid foreign objects:</i>	<i>Against access to hazardous parts with:</i>
	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		<i>Against ingress of water with harmful effects:</i>	
	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)			<i>Against access to hazardous parts with:</i>
	A		Back of hand
	B		Finger
	C		Tool
	D		Wire
Supplementary letter (optional)		<i>Supplementary information specific to:</i>	
	H	High voltage apparatus	
	M	Motion during water test	
	S	Stationary during water test	
	W	Weather conditions	
<p>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.</p> <p>Note 2: Table I.1 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.</p>			

APPENDIX J (INFORMATIVE)

The network boundary

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 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 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.'

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 J.1. 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, such an agreement must 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.

J.6 Practical examples

Figures J.2 to J.14 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 J.15 to J.17 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'.

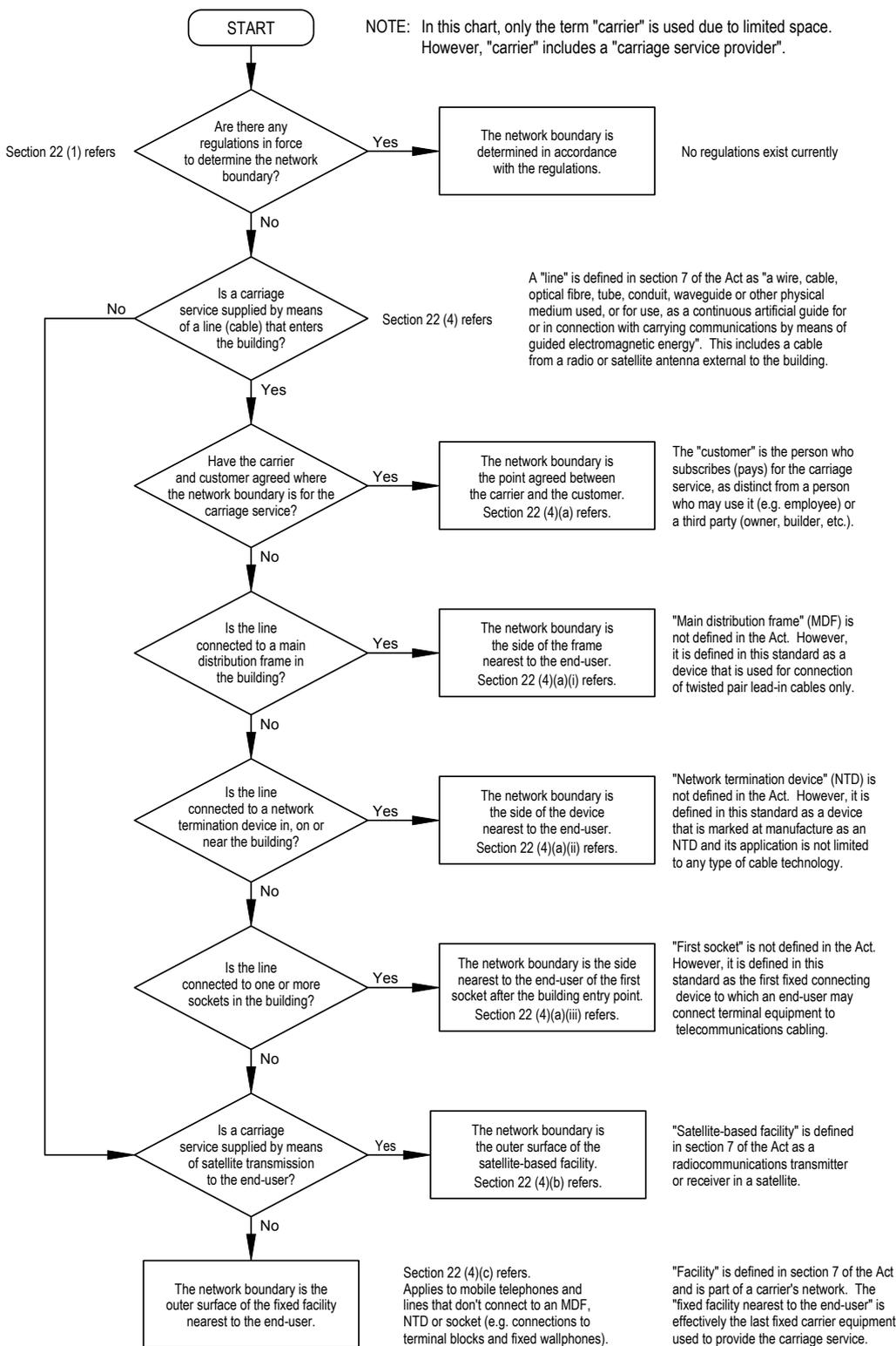
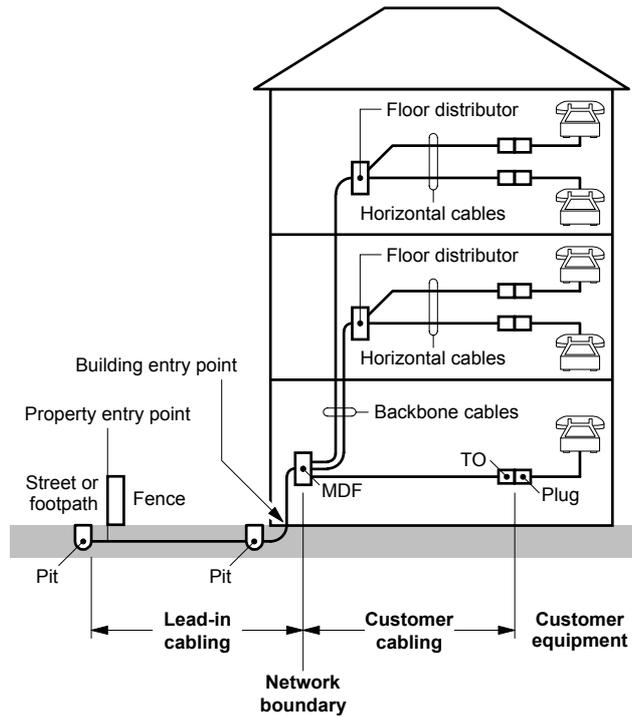
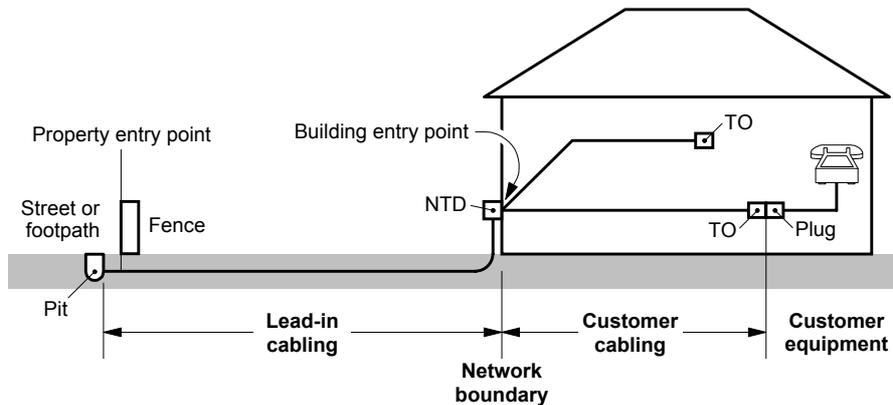


Figure J.1
Analysis of section 22 of the Telecommunications Act 1997



Note: In the above case, the installation satisfies section 22 (4)(a)(i) of the Act (refer to Figure J.1). The MDF is the network boundary for all lines that are connected to that MDF.

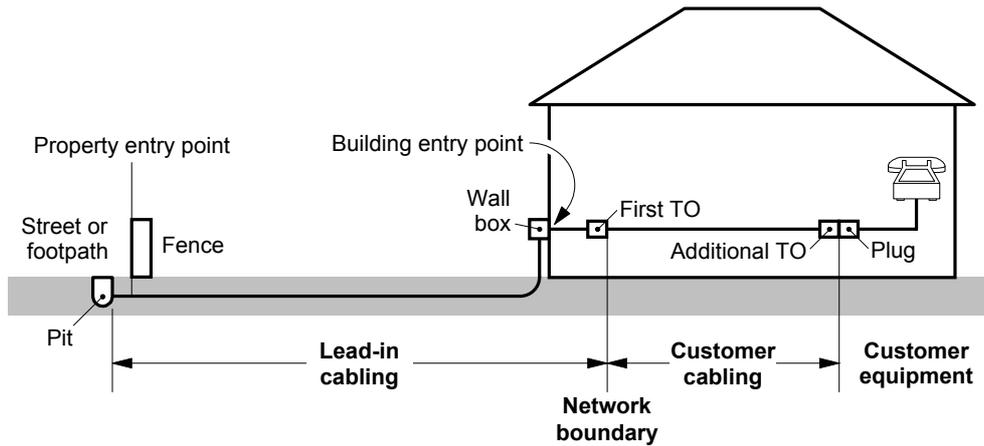
Figure J.2
Network boundary where a line connects to an MDF



Note 1: 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 J.1). Therefore, the NTD is the network boundary for all lines that are connected to that NTD.

Note 2: 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.

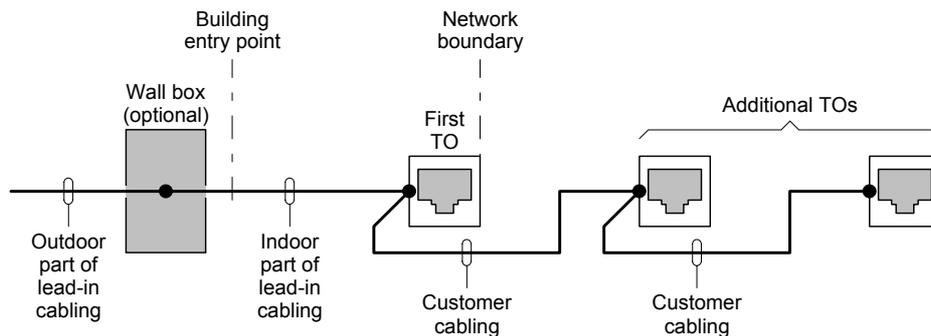
Figure J.3
Network boundary where a line connects to a network termination device (NTD)



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 J.1). Therefore, the first TO is the network boundary for all lines that are connected to that TO.

Note 2: The wall box is not an NTD unless it is marked as such at manufacture.

Figure J.4
Network boundary where a line connects to the first TO

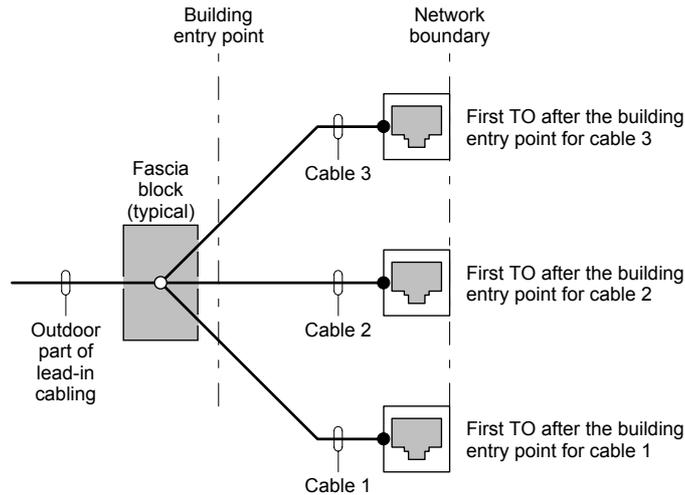


Note 1: In the above case, the installation does not satisfy section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the Act but satisfies section 22 (4)(a)(iii) (refer to Figure J.1). Therefore, the first TO connected to a cable or pair is the network boundary for that cable/pair.

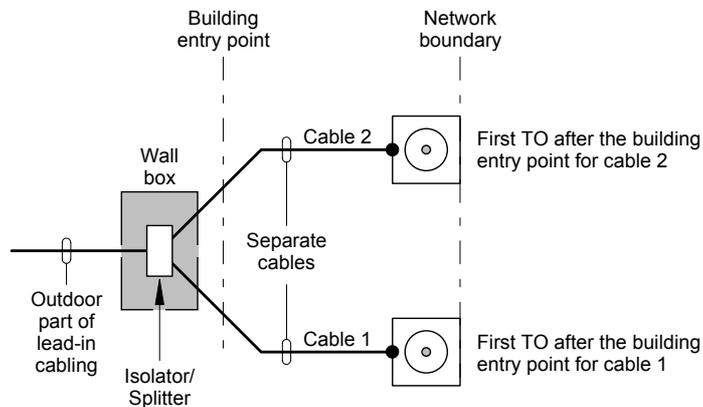
Note 2: Any socket or plug/socket connector inside the wall box is not the network boundary for two reasons:

- (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/connector in the wall box is not 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 J.5
Network boundary where the line connects to two or more TOs in a 'bus' configuration



(a) Legacy star-wired telephone installation (pre-1989)



(b) Standard cable TV or 'cable' internet installation

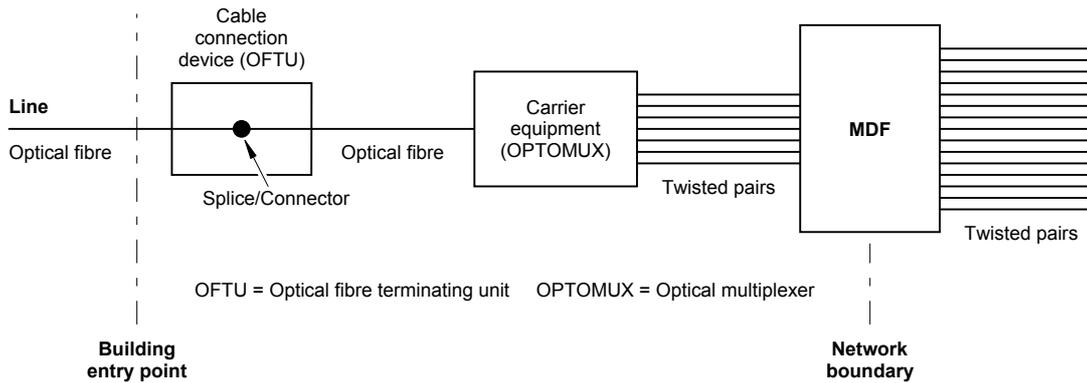
Note 1: In each of the above cases, the installation does not satisfy section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the Act but satisfies section 22 (4)(a)(iii) (refer to Figure J.1). Each TO is the first TO for the cable connected to that TO and is the network boundary for that cable.

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/connector in the wall box is not 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 J.6

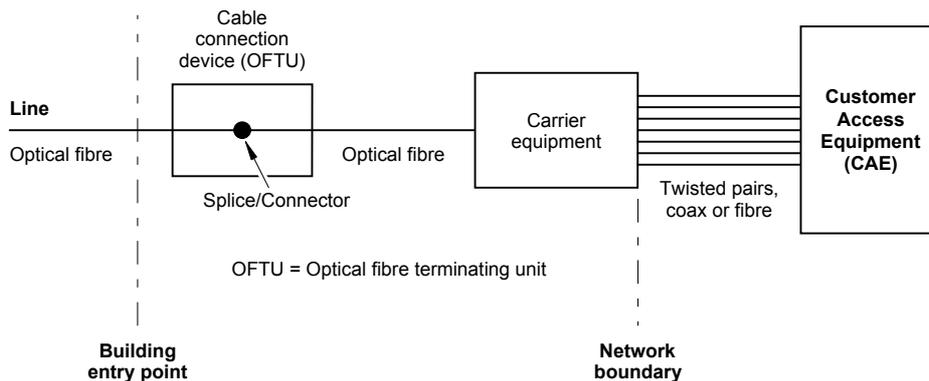
Network boundary where the line connects to two or more TOs in a 'star' configuration



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 J.7

Network boundary for optical fibre telecommunications network connecting to an MDF

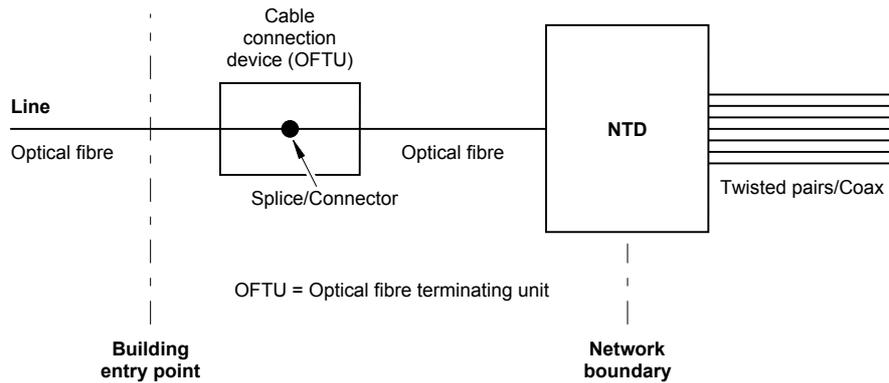


Note 1: In the above case, the installation does not satisfy section 22 (4)(a) or section 22 (4)(b) of the Act, so section 22 (4)(c) applies (refer to Figure J.1). The network boundary is the outer surface of the fixed facility nearest to the end-user. In practical terms, this will be the terminal blocks or connectors on the 'customer side' of the carrier equipment.

Note 2: 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 J.8

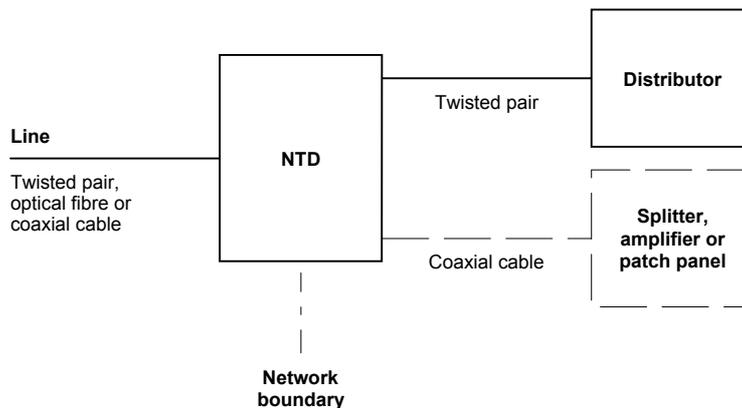
Network boundary for optical fibre telecommunications network connecting directly to CAE



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 J.9

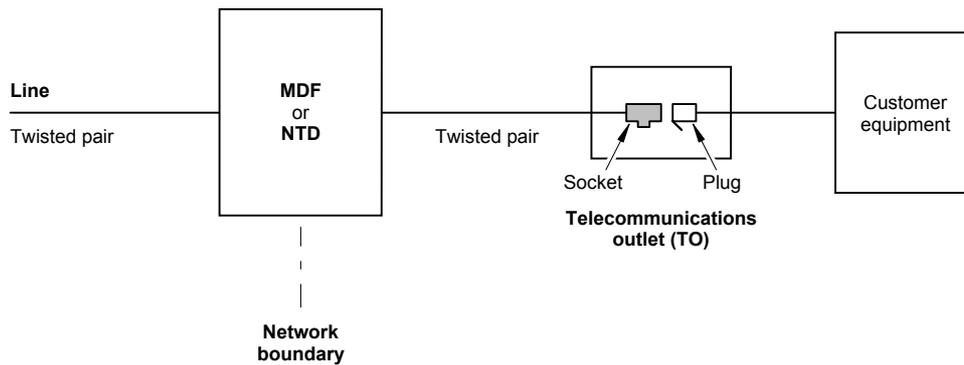
Network boundary for optical fibre telecommunication networks connecting to a NTD



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 J.1).

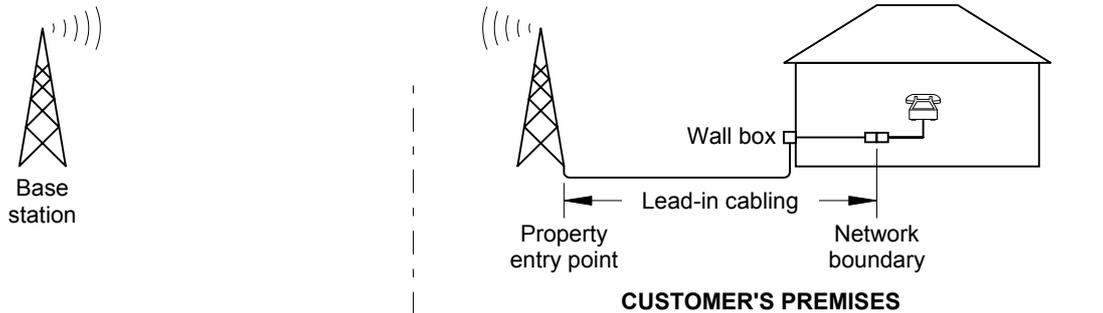
Figure J.10

Network boundary where a NTD precedes a distributor (e.g. home networking)



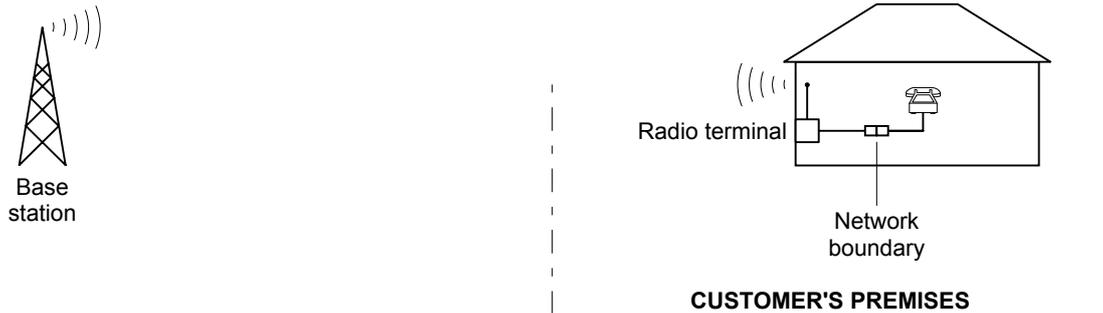
Note: In the above case, the installation satisfies section 22 (4)(a)(i) or section 22 (4)(a)(ii) of the Act, as applicable, so section 22 (4)(a)(iii) of the Act does not apply (refer to Figure J.1). The network boundary is at the MDF or NTD, as applicable.

Figure J.11
Network boundary where a MDF or NTD precedes a TO



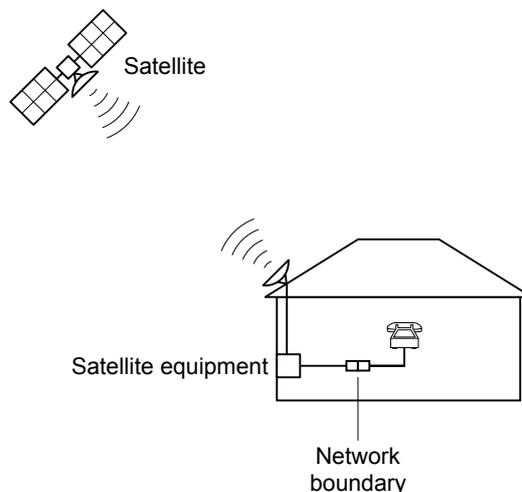
Note: In the above case, while radio is used to supply the service to the customer's premises, the final method of supply is by means of a line (cable) that enters the building. Therefore, section 22 (4)(a) of the Act applies and the network boundary will be at the MDF, NTD or first TO, as applicable (refer to Figure J.1).

Figure J.12
Network boundary for service supplied to premises by terrestrial radio (e.g. rural/remote premises)



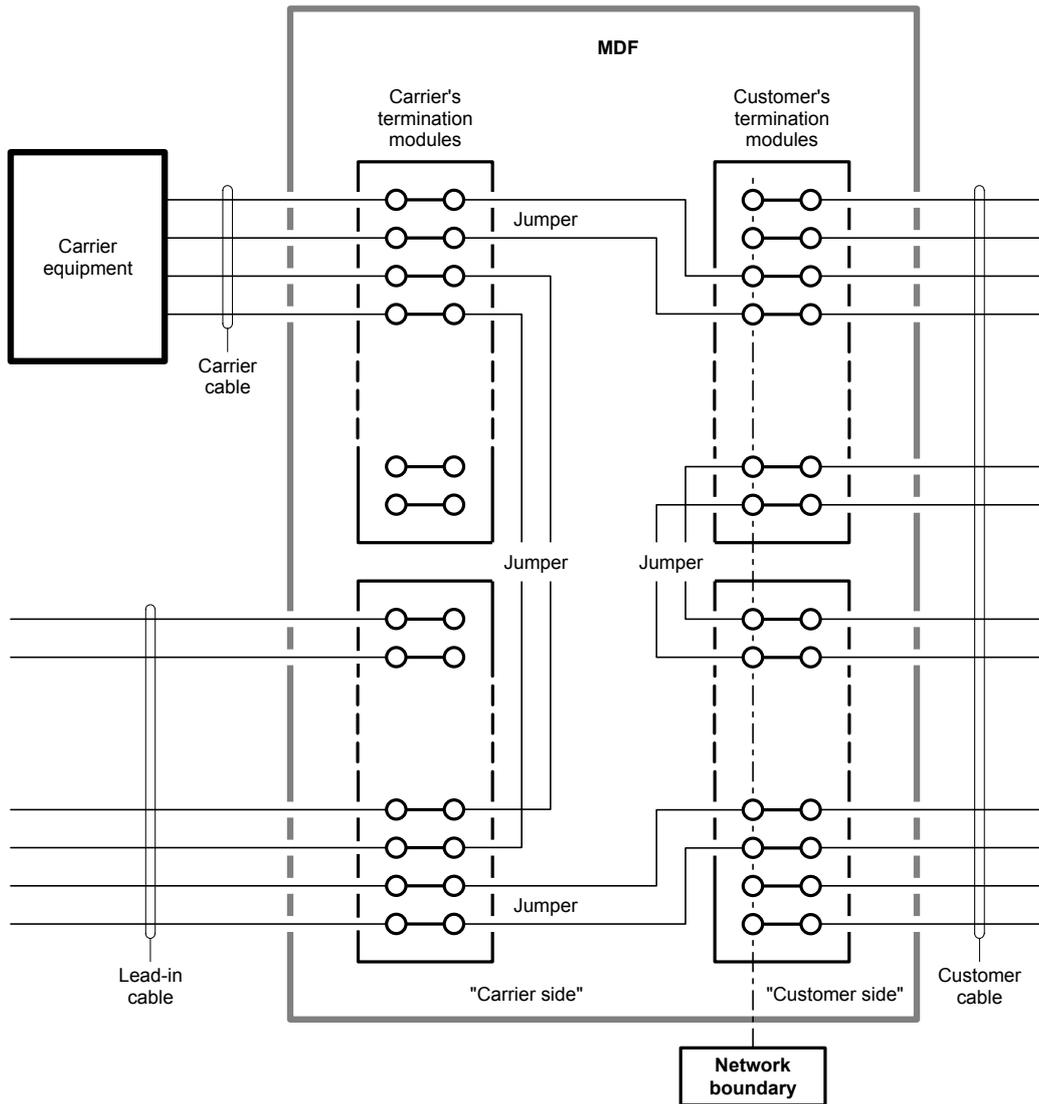
Note: In the above case, radio is used to supply the service directly to a radio terminal inside the building. In this scenario, section 22 (4)(c) of the Act applies and the network boundary is the outer surface of the fixed facility nearest to the end-user (refer to Figure J.1). If the radio terminal in the building is fixed (e.g. to a wall), the network boundary is at the first TO provided by the carrier (this being the nearest 'fixed facility'). If the radio terminal is not fixed (e.g. a hand-held mobile telephone), the network boundary is at the nearest base station.

Figure J.13
Network boundary for service supplied directly to building by terrestrial radio (e.g. wireless local loop)



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 usually be at the MDF, NTD or first TO, as applicable. 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 J.1.

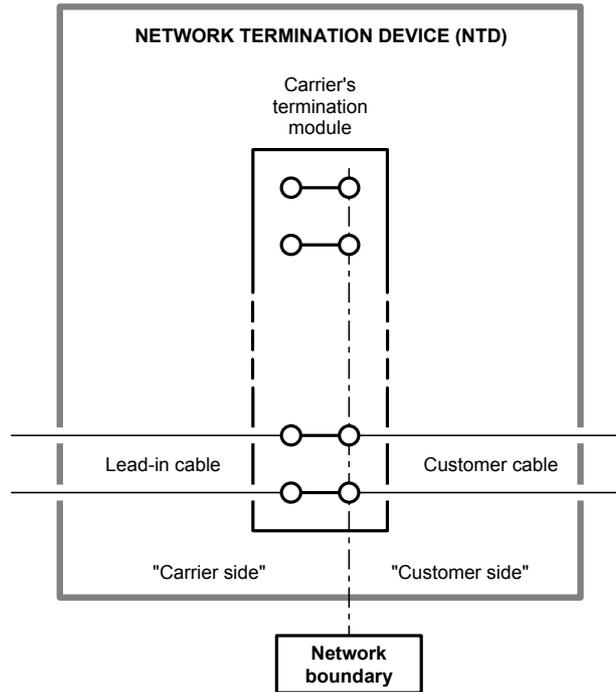
Figure J.14
Network boundary for service supplied to premises by satellite



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).

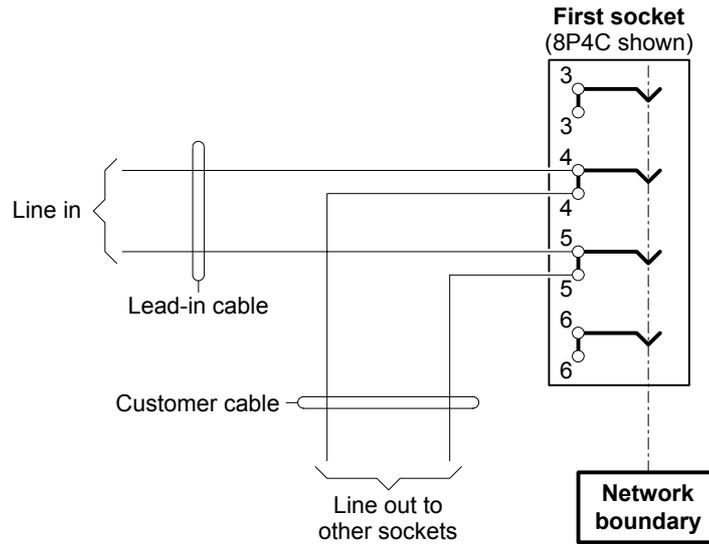
Figure J.15
Precise location of the network boundary at an MDF



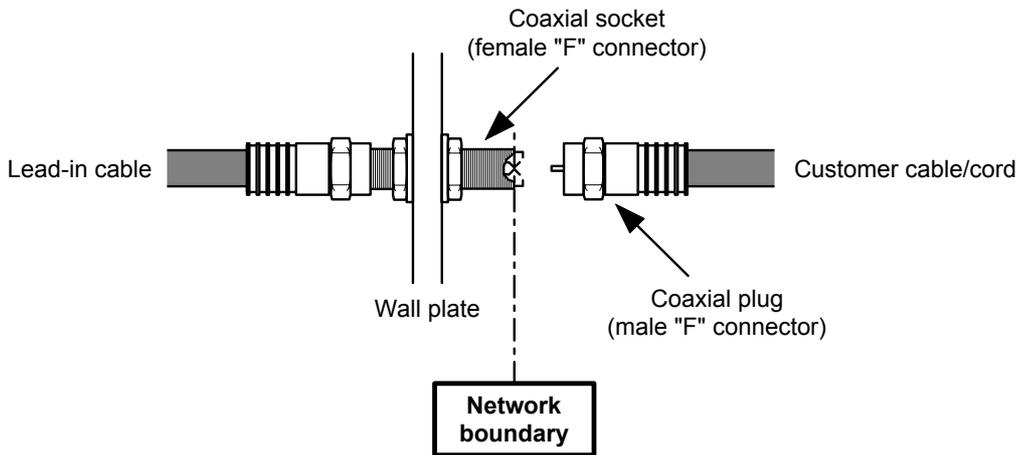
Note 1: The above drawing shows a typical NTD for twisted pair cables. The 'side of the device nearest to the end-user' means the terminals provided for the connection of cables on the 'customer side' of the NTD.

Note 2: Allowable connection points for customer cables will usually be indicated on a label inside the NTD.

Figure J.16
Precise location of the network boundary at a network termination device



(a) Twisted pair cable



(b) Coaxial cable (e.g. cable TV or 'cable' internet)

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. 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.

Figure J.17

Precise location of the network boundary at the first telecommunications outlet

APPENDIX K (INFORMATIVE)

Cabling Provider Rules

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 must 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 must—

- (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 must 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) must—
 - (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) 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 must 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 ACMA on 1300 850 115.

PARTICIPANTS

The ACIF Working Committee that developed this Standard consisted of the following organisations and their representatives:

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ADC KRONE	Voting	Peter Meijer
AEEMA (Prysmian Telecom Cables)	Voting	Andrew Kaczmarek
ASIAL (Chubb Electronic Security)	Voting	Clifford Vituli
Australian Communications and Media Authority	Non-voting	Rob Pruysers
Belden Australia	Voting	George Karanikolaou
Belden Australia	Non-voting	Jim Boukouvalas
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This Working Committee was chaired by Murray Teale. Terry Phillips provided editorial support. James Duck and Mike Johns of ACIF provided project management support.

NOTES

The policy objective of the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry is central to the regulatory scheme of the Telecommunications Act 1997.

ACIF was established to implement the policy of industry self-regulation. It is a company limited by guarantee and is a not-for-profit membership-based organisation. Its membership comprises carriers/carriage service providers, business and residential consumer groups, industry associations and individual companies.

ACIF's mission is to develop collaborative industry outcomes that foster the effective and safe operation of competitive networks, the provision of innovative services and the protection of consumer interests. In the development of Industry Codes and Technical Standards as part of its mission, ACIF's processes are based upon its principles of openness, transparency, consensus, representation and consultation. Procedures have been designed to ensure that all sectors of Australian society are reasonably able to influence the development of Standards and Codes. Representative participation in the work of developing a Code or Standard is encouraged from relevant and interested parties. All draft Codes and Standards are also released for public comment prior to publication to ensure outputs reflect the needs and concerns of all stakeholders.



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