



Telecommunication cables—Insulation, sheath and jacket

Part 1: Materials



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- Australian Communications and Media Authority
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Australian Standard[®]

Telecommunication cables—Insulation, sheath and jacket

Part 1: Materials

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee CT-001, Communications Cabling, to supersede, AS 1049.1—2008, *Telecommunication cables—Insulation, sheath and jacket, Part 1: Materials*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

AS 1049.1 (this Standard) has been updated to incorporate a new grade of polyamide compound available to the market. AS 1049.2—2008, *Test methods* [including AS 1049.2—2008/Amdt 1(2010)] remains unchanged.

The objective of this Standard is to specify the material requirements of the finished products and some of the compounds used to manufacture telecommunication cables. Test methods to evaluate the properties are specified in Part 2. This Standard is intended for use by polymer manufacturers, communication cable manufacturers and end-users.

Statements expressed in mandatory terms in footnotes to tables are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the Appendix to which they apply. A ‘normative’ Appendix is an integral part of a Standard, whereas an ‘informative’ Appendix is only for information and guidance. Informative sections are included also in the main body of this Standard.

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STANDARDS AUSTRALIA

Australian Standard

Telecommunication cables—Insulation, sheath and jacket

Part 1: Materials

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies the material requirements of the finished products and some of the compounds used to manufacture telecommunication cables. AS 1049.2 provides test methods to evaluate the properties specified.

This Standard specifies the requirements for the composition of various materials for insulation, sheath and jacket.

Section 2 discusses the selection of materials. Sections 3 to 6 specify the requirements of the compounds and finished products for polyolefins, polyvinyl chloride (PVC), polyamides and others.

NOTE: Appendix A sets out a summary of the material test methods that are included in AS 1049.2, which provides a set of reference test methods for determination of compliance with the requirements of this Standard.

The scope of this Standard does not include the following:

- (a) Cables using materials that are semi-conductive.
- (b) Aspects of telecommunication cables such as spacers or cores in coaxial cables.
- (c) Dimensions or electrical requirements of completed cables.
- (d) Cables used to conduct electrical power.

1.2 APPLICATION

This Standard is intended for use by the following:

- (a) Polymer manufacturers, to form the basis of the raw material quality control procedures for the manufacture of PE and PA compounds.
- (b) Cable manufacturers, to form the basis of the cable material quality control procedures for the manufacture of a range of insulation, sheath and jackets of different materials.
- (c) Cable end users, to form the basis of the cable acceptance procedures for the completed cable.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1049	Telecommunication cables—Insulation, sheath and jacket
1049.2	Part 2: Test methods

AS	
1886	Glossary of terms relating to plastics
2700	Colour standards for general purposes
AS/NZS	
1660	Test methods for electric cables, cords and conductors
1660.2.4	Method 2.4: Insulation, extruded semi-conductive screens and non-metallic sheaths—Methods specific to polyethylene and polypropylene materials
1660.5.4	Method 5.4: Fire tests—Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity
3008	Electrical installations—Selection of cables
3008.1.1	Part 1.1: Cables for alternating voltages up to and including 0.6/1 kV—Typical Australian installation conditions
IEC	
60304	Standard colours for insulation for low-frequency cables and wires
60811	Common test methods for insulating and sheathing materials of electric cables and optical cables
60811-1-2	Part 1-2: Methods for general application—Thermal ageing methods
60811-4-2	Part 4-2: Methods specific to polyethylene and polypropylene compounds—Tensile strength and elongation at break after conditioning at elevated temperature—Wrapping test after conditioning at elevated temperature—Wrapping test after thermal ageing in air—Measurement of mass increase—Long-term stability test—Test method for copper-catalyzed oxidative degradation
ISO	
18553	Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds
ASTM	
D1248	Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
D1506	Standard Test Methods for Carbon Black—Ash Content
D1514	Standard Test Method for Carbon Black—Sieve Residue
D1618	Standard Test Method for Carbon Black Extractables—Transmittance of Toluene Extract
D3849-95a	Standard Test Method for Carbon Black—Primary Aggregate Dimensions from Electron Microscope Image Analysis
D4294	Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry
D4565	Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable
EIA	
359	Colors for Color Identification and Coding

ETSI

EN 50290 Communication cables

EN 50290-2-23 Part 2-23: Common design rules and construction—PE insulation

1.4 DEFINITIONS

For the purpose of this Standard, the definitions in AS 1886 and those below apply.

1.4.1 General

1.4.1.1 *May*

Indicates the existence of an option.

1.4.1.2 *Shall*

Indicates a statement is mandatory.

1.4.1.3 *Should*

Indicates a recommendation.

1.4.2 Cable constructions

1.4.2.1 *Air-core cable*

A cable construction where the interstices of the cable are not filled.

1.4.2.2 *Integrally bonded sheath and jacket*

A cable construction where the polyethylene sheath is integrally bonded to the PA jacket by chemical modification or by multiple processing techniques, or by both.

NOTE: One such method is to use a specifically formulated PE which meets the requirements of Clauses 3.5 and 5.4.

1.4.2.3 *Jelly-filled cable*

A cable construction that has a cable core that is filled with a jelly-like substance which prevents water from seeping or flowing along the length of the cable in the event of a rupture through the protective sheath layer.

1.4.2.4 *Moisture-barriered cable*

A cable construction that has a metallic tape which is bonded to the inner surface of the sheath to prevent moisture permeation into the cable core. The metallic tape may also serve as an electrical screen.

1.4.3 Layers of cables

NOTE: The definitions below are listed according to the position of layers in the cables (see Figure 1).

1.4.3.1 *Insulation*

A single or multiple layer of the same or different dielectric material(s) over the conductors. An example of multiple layer insulation is termed 'foam-skin', which comprises a cellular layer covered with a solid layer.

NOTE: The material(s) may be solid or cellular or a combination of these. Cellular insulation is manufactured by using a blowing agent compounded in the granules or by using air- or gas-blowing at the extrusion process.

1.4.3.2 *Core*

An assembly of insulated conductors, coaxial elements and optical fibre elements, or any combination of the three.

1.4.3.3 Sheath

A protective layer, for example, an inner sheath over the core of a cable or an outer sheath over the armouring.

1.4.3.4 Armouring

A layer over the sheath of a cable to protect the installed cable against, for example, rodents or mechanical equipment. The armouring may be bonded to the sheath and is typically manufactured from steel tape, wire or corrugated sheet. An example is rodent resistant armouring over a PE sheath with an outer sheath of PE and a PA jacket.

1.4.3.5 Jacket

The protective layer over the sheath of a cable. Examples are a PE jacket over a metallic sheath and a PA jacket over a PE sheath.

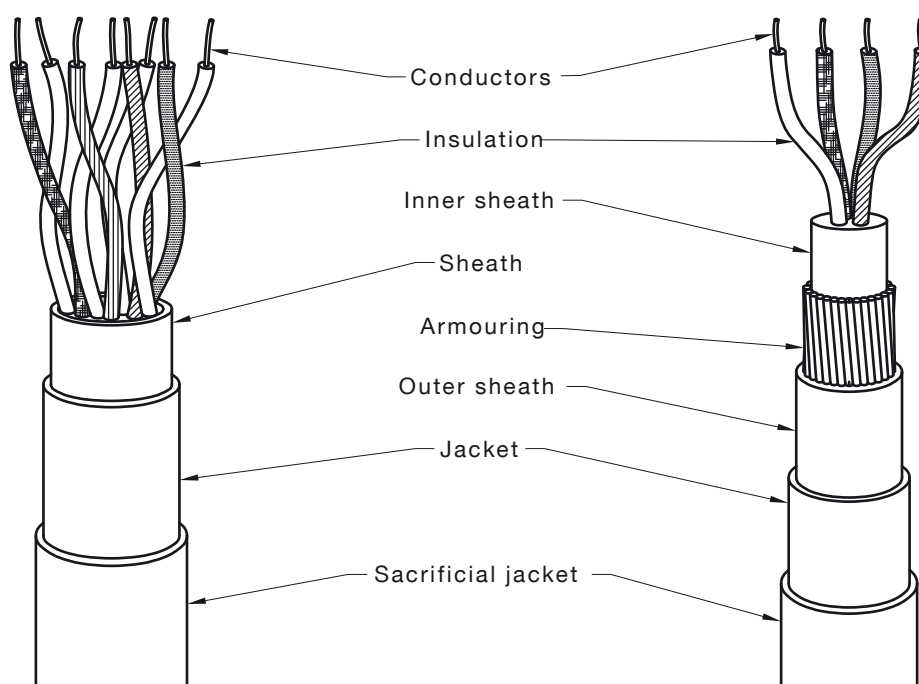


FIGURE 1 EXAMPLES OF CABLE CONSTRUCTION

1.4.3.6 Sacrificial jacket

An additional layer over an existing jacket that is designed to protect the cable, in particular the PA jacket, against mechanical damage during installation. An example is a sacrificial jacket over a PA jacket and a PE sheath.

1.4.3.7 Finished product

A general term used to describe insulation, sheath and jacket.

1.4.4 Materials and material properties of cables

1.4.4.1 *Colour bleeding*

The migration of a colorant from the plastic it is added to, into any material in contact with this plastic. Factors that affect colour bleeding are—

- (a) an increase in temperature, which usually accelerates colour bleeding;
- (b) compatibility with the plastic; and
- (c) compatibility with the contact material.

1.4.4.2 *Fire retardant*

A substance added or a treatment applied to a material in order to suppress, reduce or delay the combustion of the material.

1.4.4.3 *Flame retardant*

A substance added or a treatment applied to a material in order to suppress or delay the appearance of a flame, reduce its propagation rate, or both.

1.4.4.4 *Insect resistance*

The principal property of a PA 10.12, PA 11, or PA 12 jacket, providing resistance to insect attack, particularly from ants and termites.

1.4.4.5 *Non-halogenated*

A term used to describe a material that does not contain fluorine, chlorine, bromine or iodine and that is used in the form of an additive in a compound or in the main backbone of a polymer.

Halogens are used in various compounds to act as fire or flame retardants, or both. Non-halogenated materials are used where the halogenated material properties of evolution of corrosive and toxic gases in a fire are not desired.

1.4.4.6 *Polyethylene plastics*

Thermoplastic materials based on homopolymers or copolymers of ethylene and containing not less than 85% ethylene and not less than 95% olefins.

NOTE: This definition is based on AS 1886, but specific limits have been added. Within the limits of this definition, all possible structures and densities of polyethylene are included, for example, long-chain branched, short-chain branched, linear, alpha-olefin copolymers and melt homogenized blends of any of these.

1.4.4.7 Temperature rating

The maximum continuous service temperature of the cable.

75°C rated is a combination of materials, the base constituent of which is thermoplastic polyvinyl chloride, suitable for up to 75°C maximum continuous operating temperature.

90°C rated or 90°C HT rated are higher temperature versions of type V-75, suitable for up to 90°C maximum continuous operating temperature. 60°C rated PVC is a combination of materials, the base constituent of which is thermoplastic polyvinyl chloride, suitable for up to 60°C maximum continuous operating temperature.

75°C rated PVC is a higher temperature version of 60°C rated PVC, suitable for up to 75°C maximum continuous operating temperature.

NOTES:

- 1 PVC is subject to thermal deformation at temperatures of 90°C and above. The use of higher temperature rated insulation material does not necessarily permit a higher current rating. These higher temperature materials are for use as appropriate where cables are subject to elevated external temperatures. For further guidance, refer to AS/NZS 3008.1.1.
- 2 Where it is possible to guard against plastic flow and where reduced insulation resistance can be tolerated, 90°C HT rated cable can be operated at a temperature of 105°C for an average of 500 h per annum.
- 3 Compliance with AS 1049 does not imply that cables can be operated at the maximum continuous service temperature indefinitely; all plastics will eventually degrade. The rate of degradation will depend upon operating and environmental conditions.

1.5 ABBREVIATIONS

For the purpose of this Standard, the abbreviations below apply.

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BSI	British Standards Institution
CIE	International Committee on Illumination
ECTFE	Copolymer of ethylene and chlorotrifluoroethylene
EIA	Electronic Industries Association
ESCR	Environmental stress cracking resistance
ETFE	Copolymer of ethylene and tetrafluoroethylene
FEP	Copolymer of tetrafluoroethylene and hexafluoropropylene
HALS	Hindered amine light stabilizers
HDPE	High density polyethylene
HFFR	Halogen free flame retardant thermoplastic
ISO	International Organization for Standardization
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
MDPE	Medium density polyethylene
MFI	Melt flow index
NA	Not applicable
OIT	Oxidation induction time

PA	Polyamide
PE	Polyethylene
PFA	Poly(perfluoro alkoxy alkane)
PP	Polypropylene
PPO	Poly(phenylene oxide)
PTFE	Polytetrafluoroethylene
PVC	Poly(vinyl chloride)
PVDF	Poly(vinylidene fluoride)
RH	Relative humidity
UV	Ultraviolet
XLEVA	Cross linked poly(ethylene-vinyl acetate)
XLPE	Cross linked polyethylene
XLPO	Cross linked polyolefin
XL PVC	Cross-linked poly(vinyl chloride)

SECTION 2 MATERIAL SELECTION

2.1 GENERAL

This Standard covers the specification of materials for both indoor and outdoor applications. The materials themselves are not restricted to indoor or outdoor use; it is the combination of the materials, cable design and installation practices that determines the suitability of a material for its application, for example, if the cable is directly exposed to UV, if the insulation is jointed in an outdoor enclosure and therefore subject to high thermal loads or if the material is for telecommunication switch cable, restrictions apply. Choices within a materials type have therefore been added which are based on known application requirements. However, methods other than the choice of material may be used to overcome environmental restrictions, for example, if a cable is subject to UV exposure, a black PE sheath could be used or another material used if the cable is installed under eaves or within conduit.

Material choices are summarized in Table 2.1.

NOTE: Purchasing guidelines are given in Appendix B.

2.2 TEMPERATURE RATINGS

Some materials involve additional choice because of their temperature rating, an important parameter for use in service. For the purposes of this Standard, the temperature rating of a material is used when selecting the temperature for heat ageing prior to testing for some properties.

2.3 FIRE AND FLAME TESTS

Fire and flame tests have not been included in this material Standard because the end performance in a fire is influenced by material choice, cable design and installation practice.

2.4 MULTIPLE LAYER INSULATION

Where multiple layer insulation construction is used, the final properties of the composite insulation will be a combination of the properties of the individual layers and the test specification shall be as used between the supplier and purchaser.

TABLE 2.1
SUMMARY OF MATERIAL CHOICES WITHIN THIS STANDARD

Material	Choice 1	Choice 2	Choice 3	Choice 4
PE insulation	Cables jointed outdoors/less severe condition	Cables jointed outdoors/more severe condition	Other cables	—
PA 12 insulation	One choice only	—	—	—
PPO based insulation	One choice only	—	—	—
PVC insulation	Cables with a choice of temperature rating of 60, 75, 90 or 105°C ¹⁾	—	—	—
PP insulation	One choice only	—	—	—
PE sheath/jacket	Cable exposed to UV radiation/black	Cable exposed to UV radiation/coloured	Other cable/coloured	—
PA jacket	Black jacket	Coloured jacket	—	—
Integrally bonded PE sheath and PA jacket	Black PA jacketed composite	Coloured PA jacketed composite	—	—
PVC sheath/jacket	Cables with a choice of temperature rating of 60, 75, 90 or 105°C ¹⁾	—	—	—
HFFR sheath/jacket	Cable not exposed to UV radiation	—	—	—
Fluoropolymer insulation, sheath/jacket	Insulation: ECTFE, ETFE: 50°C rating FEP: 200°C rating PFA: 200°C rating PTFE: 250°C rating PVDF: 125°C and 150°C ratings	Sheath/jacket: ECTFE, ETFE: 150°C rating FEP: 200°C rating PFA: 200°C rating PTFE: 250°C rating PVDF: 125°C and 150°C ratings	—	—
XL insulation, sheath/jacket	Insulation: XLPE, XLPVC, XLEVA: 90°C rating XLPO: 105°C rating	Sheath/jacket: XLPE, XLPVC, XLEVA: 90°C rating XLPO: 105°C rating	—	—

¹⁾ Refer to Clause 1.4.3.7 regarding PVC operation at 105°C.

SECTION 3 POLYOLEFINS

3.1 GENERAL

3.1.1 Scope of section

This Section specifies the material requirements for polyethylene (PE) compound intended for insulation and for PE insulation taken from the completed cable or, where specified, during manufacture.

3.1.2 Material selection

The highest performance required of insulation material is from installed cable in long service life (greater than 20 years) applications, jointed in outdoor above-ground enclosures that are subject to a severe thermal environment ('more severe condition'). In such circumstances the entire cable may be designed to survive conditions that only the terminated ends will experience. Due to the need for ease of re-entry, and standardized work practices, there are applications that cannot avoid such conditions, and therefore require the performance of materials and rigour of testing to prove suitability of purpose. However, with lesser service requirements and more protective methods of termination, alternative materials and tests for suitability are presented ('less severe condition' and 'other cables').

3.1.3 Cables jointed outdoors

There are two applications for 'cables jointed outdoors' in Tables 3.1 and 3.2: 'less severe condition' and 'more severe condition'. The minimum performance specifications that shall be adopted are the following:

- (a) *Less severe condition* Based on EN 50290-2-23.
- (b) *More severe condition* Based on the Telcordia (formally Bellcore) Pedestal and OIT tests from GR 421-CORE. The Telcordia Pedestal test is referred to in AS 1049.2 as the 'environmental ageing method' (Appendix FF). This test shall be conducted for initial qualification. Filled cables generally degrade faster than similar insulation used in dry core cables, so testing a filled cable will qualify a dry core cable. 'The environmental ageing method' test shall be conducted on the smallest insulation radial, and this will qualify the full range of insulation sizes for the same insulation material.

By default, cables meeting the requirements of the 'more severe condition' shall be deemed suitable for use in the 'less severe condition'.

3.2 COMPOUND

3.2.1 General

The requirement of the compounds in this Clause (3.2) forms the basis of the quality control program for the unprocessed PE.

All testing specified refers to PE in pellet form appropriately selected from material as supplied to the cable manufacturer.

3.2.2 Compound characteristics

Compounds intended for solid or cellular insulation on metal conductors shall be manufactured from PE plastics of density and MFI within the ranges defined in this Standard.

The PE compound shall not contain any reprocessed, reworked or recycled plastics.