

Cables for Railway Signalling Applications – General Requirements

ESA-11-01

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2.0	24 Oct 18	Various	Update of approved cable types including revised appendices, new cable comparison table, various amendment to most sections and references, Inclusion of SMOF cables.
2.1	13 May 19	Various	Update to various appendices to clarify cable requirements.
2.2	08 Jul 19	27.2	Inclusion of screen and drain wire within cable construction requirements section.

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Amendment Version #	Date Reviewed	Clause	Description of Amendment
2.3	09 Aug 19	20.2, 21.2, 22.2, 23.2, 24.2, 26.2, 27.2	Removal of sacrificial sheathing and termite barrier requirement from some indoor cable types. Clarification on drain wire material type added to some construction requirements.
2.4	08 Nov 22	1.5, 1.6, 1.7, 2.5, 2.6, 3.2, 3.8, 28, 29 and 30	Added flexible power cables for low voltage applications. Updated requirements for Signal Mode Fibre Optic (SMFO) cables. Added the flexible signal cable for Microlok Computer based Interlocking

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1 Introduction

1.1 Purpose

This standard sets the cable requirements and configurations permitted for signalling applications on the ARTC network.

1.2 Scope

The Standard covers construction and testing of railway signal cables designed for working voltages up to and including 600V to earth and for Single Mode Optical Fibre cables.

A purchasing guideline is included in Appendix 15: Purchasing Guidelines.

1.3 Standard Owner

The General Manager Technical Standards is the document owner. Queries should be directed to standards@artc.com.au in the first instance.

1.4 Responsibilities

The supplier is responsible for compliance and confirmation to this specification and applicable Australian Standards.

Project and business unit is responsible to ensure that cables being installed on ARTC network complies to this specification.

1.4.1 Signal Maintenance Engineer Responsibilities

Signal Maintenance Engineers are responsible for use of cables in accordance with this standard.

1.5 Reference Documents

1.5.1 Australian Standards

AS/NZS 1049	Telecommunications Cables, installation, sheath and jacket
AS/NZS 1125	Conductors in Insulated Electric Cables and Flexible Cords
AS/NZS 1660.3	Test Methods for Electric Cables, cords and Conductors – Electrical Tests
AS/NZS 2700	Colour Standard for General Purposes
AS/NZS 3000	Electrical Installation
AS 3808	Insulating and Sheathing Materials for Electric Cables
AS/NZS 3080	Telecommunications installations – generic cabling for commercial premises
AS/NZS 3100	Approvals and Test Specification – Definitions and General Requirements for Electrical Equipment
AS/NZS 3191	Approval & Test Specification – Electric Flexible Cords
AS/NZS 5000.1	Electric Cables – Polymeric insulated – for working voltages up to and including 0.6/1kV
AS/NZS 5000.3	Electric Cables – Polymeric insulated – Multicore control cables – 450/750V
AS/NZS ISO 9001	Quality system – Model for quality assurance in design development, production, installation and servicing
AS/CA S008	Requirements for authorised Cabling Products (Fibre Optic Cable)
AS/NZS 5000	Electric cables – Polymeric insulated for working voltages up to and including 0.6/1kV

ITU Recommendations G.652 Characteristics of a single mode optical fibre and cable.

1.5.2 ARTC Standards

ESC-11-01	Construction of Cable Route and Associated Civil Works
ESG-00-15	ARTC Quality Controlled Supplier

1.6 Definitions and Abbreviations

The RISSB Glossary of Terms is the general reference for the meaning of terms included in this standard.

The following specific terms and acronyms are used within this document

Term or acronym	Description
Core of cable	The conductor with its insulation but not including any protective covering
Fire safe cable	A cable having characteristics of low smoke emission and low flame propagation properties in fire conditions and meeting the performance requirements of AS5000.1 for fire safe cables
Flexible Cable	A cable with conductors, insulation and covering that afford flexibility. The conductors of any cross-sectional area comprise a substantial number of wires of small diameter. These types of cables are designed to have higher current carrying capacities than equivalent 'standard' or 'mains' type cables and are more suitable for low voltage / high current applications.
LSZH	Low Smoke Zero Halogen
Multi-conductor cable	A cable comprising more than three cores
Non-Hygroscopic	A material after being preconditioned in an oven for 24 + 1 h at 50°C and allowed to cool in a desiccator, does not absorb more than 5 percent by weight of moisture during a 48h treatment in humidity of 95 percent at a temperature of 20 + 5°C
PO	Polyolefin
SMOF	Single Mode Optical Fibre
Type Approval	A process for evaluating an item of equipment from a supplier and issuing an approval certificate with conditions.

2 Cable Types

2.1 General Usage single core and multicore (outdoor – including direct buried)

The following cable type (a) shall be used for outdoor applications including direct buried:

- a. Type X-90 XLPE insulated conductor with 5V-90 PVC multicore sheathed including termite barrier and a sacrificial sheath.

The following cable types (b & c) may be used but require agreement by the Signal Maintenance Engineer prior to their application:

- a. Type V-90 PVC insulated conductor with 5V-90 PVC multicore sheathed including termite barrier and a sacrificial sheath.
- b. Type V-75 PVC insulated conductor with 4V-75 PVC multicore sheathed including termite barrier and a sacrificial sheath.

2.2 Fire Safe Cables

Type X-90 XLPE insulated and HFS-90-TP multicore sheathed.

HFS-90-TP sheathed cables are specifically designed for installation where fire safe cables are required (e.g. for installation in an underground railway tunnel).

Fire safe cables are not permitted for burial in ground or use in permanently wet locations.

2.3 Data cables

Data cables are used for specific purposes on railway signalling projects e.g. indication diagrams, high speed data transmission etc.

2.4 Single core cable (indoor use)

Single core flexible wiring is used mainly for wiring of equipment mounted on racks in equipment rooms, huts or apparatus cases.

2.5 Single Mode Optic Fibre cable

Optical fibre cables are primarily used for telecommunications/high speed data transfer on railway signalling projects. The construction and colour coding of the fibres and tubes shall be constructed entirely of non-conductive materials and must meet the standards as set out in Australian Standard AS/CA S008.

These cables may have additional external protection and stiffening layers to enable them to be direct buried by mole plough or similar installation methods.

2.6 Flexible Cables

Flexible cables are primarily used for low voltage applications where higher currents exist and issues with voltage drop need to be more thoroughly considered to ensure correct equipment operation at the ends of longer cable runs.

Insulation shall be X-HF-110 and available as Insulated (X-HF-110) or Insulated (X-HF-110) and sheathed in HFS-110-TP.

3 Cable Construction

3.1 Conductors

Multi-core signalling cable shall be of minimum seven wire strand plain annealed copper with a nominal cross-sectional area of:

1. 1.5mm² (7/0.50mm) – NSW, VIC and Queensland jurisdictions.
2. 2.5mm² (50/0.25mm/7/0.67mm) – SA jurisdiction.

and be in accordance with the appropriate appendices of this Standard

Note: These cables may be used for power reticulation and the sacrificial sheath shall be Orange in colour (refer section 3.7) in accordance with AS/NZS 3000.

Data cable conductors shall be in accordance with the appropriate appendices included in this Standard. These cables shall have a termite barrier and a sacrificial sheath coloured as per section 3.7.

Fibre Optic cables shall be constructed using 9/125 micron Single Mode Optical Fibre in a loose tube configuration in accordance with AS/CA S008. The sacrificial sheath, where used, shall be coloured as per section 3.7.

3.1.1 Cable joints

Joints are permitted in accordance with AS/NZS 1125 and ARTC type approved jointing kits.

3.2 Insulation

Each conductor of multicore cables shall be individually insulated V-75, V-90 or X-90 compound having a radial thickness as laid down in AS/NZS 5000.1.

Where fire safe cables are specified, conductor insulation shall be X-90 to AS/NZS 5000.1. The radial thickness shall be as laid down in AS/NZS 5000.1.

Single conductor wiring shall have V-75, V-90, or X-90 insulation with their respective outer sheath of 4V-75 PVC or 5V-90 PVC, with radial thickness as prescribed within AS/NZS 5000.1.1.

Fire safe single conductor wiring shall have an insulation of type X-90 to AS/NZS 5000.1 having a minimum average radial thickness of 0.50mm. The outer sheath shall be of HFS-90-TP to AS/NZS 5000.1 having a radial thickness of not less than 0.40mm.

Flexible cables shall have an insulation of type X-HF-110 – Cross-linked Polyolefin (PO), LSZH, fire retardant, UV stabilised having a minimum nominal thickness of 0.7mm. Where versions are chosen that require an outer sheath, this shall have insulation of type HFS-110-TP – Cross-linked PO, LSZH, fire retardant, UV stabilised.

3.3 Lay Up of Cores

Except in the case of a single core in the centre of a core assembly, the cores shall be laid up helically into a tight cylindrical form (with a length of lay such as to ensure good construction).

Adjacent layers shall alternate in lay direction and the length of lay shall differ by at least 15mm. Distinctively numbered cores shall be laid-up sequentially starting from the centre of the cable and the numbering in all layers shall be in the same rotational sequence (The rotation of the numbers at the running end of the delivery drum shall be anti-clockwise from the lowest to highest number).

Quad cables shall be arranged in a star quad configuration. Any necessary filling shall be of suitable non-hygroscopic materials compatible with the qualities of the insulation.

3.4 Binder Tape

A non-hygroscopic binder whose qualities are compatible with the insulation may be helically applied with an overlap over the laid-up core assembly.

3.5 Inner Sheath

An inner sheath of 4V-75 or 5V-90 PVC shall be applied over the laid-up assembly.

For fire safe cables the inner sheath shall be of type HFS-90-TP to AS/NZS 5000.1.

The minimum average radial thickness of the inner sheath shall be as per the requirements of AS/NZS 5000.1 with a minimum size of 1.8mm and coloured black.

3.6 Termite Barrier

A black ultra violet stabilised polyamide type 12 covering shall be applied over the inner sheath for termite protection.

The polyamide insect resistant covering shall have a nominal radial thickness of:

1. 0.4mm for cables ≤25mm overall diameter
2. 0.5mm for cables with overall diameters >25mm

The termite barrier shall be omitted for fire safe cables.

3.7 Sacrificial Sheath

A 4V-75 PVC, 5V-90 PVC or equivalent sacrificial outer sheath of minimum radial thickness 1.0mm shall be applied over the polyamide covering. The colour of the sacrificial sheath shall be:

1. Black - signalling and data cables
2. Orange - In situations where cables are used for power reticulation of >120V AC
3. Blue - fibre-optic cables

3.8 Cable configurations

Cable types and nominal drum lengths should be in accordance with the following table. Cable supplied to ARTC shall meet the compliance to relevant applicable standards listed in section 1.6 of this document.

Item No.	Cable Type	Min. Drum Lengths (m)	Appendix No.
1.	2 CORE 7/0.85mm U/G POWER CABLE	1000	1
2	2 CORE 7/1.04mm U/G POWER CABLE	500 -1000	1
3	2 CORE 7/1.35mm U/G POWER CABLE	500	1
4	2 CORE 7/1.70mm U/G POWER CABLE	500	1
5	2 CORE 19/1.35mm U/G POWER CABLE	500	1
6	3 CORE 7/0.85mm U/G POWER CABLE	500	2

Item No.	Cable Type	Min. Drum Lengths (m)	Appendix No.
7	4 CORE 7/0.85mm U/G POWER CABLE	500	2
8	4 CORE 7/1.35mm U/G POWER CABLE	500	2
9	5 CORE 7/1.04mm U/G POWER CABLE	500 -1000	2
10	5 CORE 7/1.70mm U/G POWER CABLE	500	2
11	4 CORE 7/0.50mm U/G SIGNAL CABLE	1000	3
12	6 CORE 7/0.50mm U/G SIGNAL CABLE	1000	3
13	10 CORE 7/0.50mm U/G SIGNAL CABLE	500	3
14	15 CORE 7/0.50mm U/G SIGNAL CABLE	1000	3
15	25 CORE 7/0.50mm U/G SIGNAL CABLE	500 -1000	3
16	50 CORE 7/0.50mm U/G SIGNAL CABLE	500	3
17	10 CORE 7/0.67mm U/G SIGNAL CABLE	1000	3
18	20 CORE 7/0.67mm U/G SIGNAL CABLE	500 -1000	3
19	30 CORE 7/0.67mm U/G SIGNAL CABLE	500	3
20	4 CORE 7/0.85mm U/G SIGNAL CABLE	500	3
21	8 CORE 7/0.85mm U/G SIGNAL CABLE	500	3
22	SINGLE CORE 7/0.85mm U/G POWER CABLE	500	4
23	SINGLE CORE 7/1.04mm U/G POWER CABLE	500	4
24	SINGLE CORE 7/1.35mm U/G POWER CABLE	500	4
25	SINGLE CORE 7/1.70mm U/G POWER CABLE	500	4
26	SINGLE CORE 19/1.35mm U/G POWER CABLE	500	4
27	SINGLE CORE 19/1.78mm U/G POWER CABLE	500	4
28	SINGLE CORE 37/1.78mm U/G POWER CABLE	500	4
29	1 PAIR 1.27mm ² U/G SSI DATA CABLE	1000	5
30	SINGLE CORE 24/0.20mm FLEXIBLE SIGNAL CABLE	1000	6
31	SINGLE CORE 7/0.40mm FLEXIBLE SIGNAL CABLE	1000	7
32	SINGLE CORE 56/0.30mm FLEXIBLE SIGNAL CABLE	1000	8
33	SINGLE CORE 84/0.30mm FLEXIBLE SIGNAL CABLE	1000	9
34	SINGLE CORE 126/0.40mm FLEXIBLE SIGNAL CABLE	1000	10
35	4 PAIR 7/0.50mm U/G SIGNAL CABLE	1000	11
36	8 PAIR 7/0.50mm U/G SIGNAL CABLE	1000	11
37	12 PAIR 7/0.50mm U/G SIGNAL CABLE	1000	11
38	24 PAIR 7/0.50mm U/G SIGNAL CABLE	500 -1000	11
39	1 PAIR 7/0.85mm U/G SIGNAL CABLE	500	11
40	4 PAIR 7/0.85mm U/G SIGNAL CABLE	500	11
41	8 PAIR 7/0.85mm U/G SIGNAL CABLE	500	11
42	HF SCREENED TRACK CIRCUIT CABLES	500	12

Item No.	Cable Type	Min. Drum Lengths (m)	Appendix No.
43	4 Core Star Quad Cable	500	13
44	12 core Single Mode Fibre Optic	500	14
45	24 core Single Mode Fibre Optic	500	14
46	2 – 144 core Teflon Enhanced High Strength Underground Single Mode Fibre Optic	4000	14
47	6 – 144 core CST Armoured Loose Tube Single Mode Fibre Optic	4000	14
48	SINGLE CORE 224/0.30mm FLEXIBLE POWER CABLE (16mm ²)	100	15
49	SINGLE CORE 350/0.30mm FLEXIBLE POWER CABLE (25mm ²)	100	15
50	SINGLE CORE 494/0.30mm FLEXIBLE POWER CABLE (35mm ²)	100	15
51	SINGLE CORE 684/0.30mm FLEXIBLE POWER CABLE (50mm ²)	100	15
52	SINGLE CORE 969/0.30mm FLEXIBLE POWER CABLE (70mm ²)	100	15
53	SINGLE CORE 1292/0.30mm FLEXIBLE POWER CABLE (90mm ²)	100	15
54	SINGLE CORE 1653/0.30mm FLEXIBLE POWER CABLE (120mm ²)	100	15
55	SINGLE CORE 224/0.30mm FLEXIBLE SHEATHED POWER CABLE (16mm ²)	100	15
56	SINGLE CORE 350/0.30mm FLEXIBLE SHEATHED POWER CABLE (25mm ²)	100	15
57	SINGLE CORE 494/0.30mm FLEXIBLE SHEATHED POWER CABLE (35mm ²)	100	15
58	SINGLE CORE 684/0.30mm FLEXIBLE SHEATHED POWER CABLE (50mm ²)	100	15
59	SINGLE CORE 969/0.30mm FLEXIBLE SHEATHED POWER CABLE (70mm ²)	100	15
60	SINGLE CORE 1292/0.30mm FLEXIBLE SHEATHED POWER CABLE (95mm ²)	100	15
61	ETFE Teflon insulated cable (wire) for Microlok II interface. Single core flexible cable (wire) 19/29 AWG, 1.23mm ² .	500	16
62	ETFE Teflon insulated cable (wire) for Microlok II interface. Single core flexible cable (wire) 19/34 AWG, 0.4mm ² .	500	16

Table 1

Some cable manufacturers may have an equivalent conductor cross sectional area with alternative stranding complying to AS 1125. Such equivalent cables are acceptable.

Nominal tolerance for drum lengths shall be + 10 metres for all cable sizes.

3.9 Special Cable Configurations

There may be a need for special cable configurations in specific applications, it is permitted to use a cable with a:

1. larger copper conductor to handle more current or reduce voltage drop,
2. different number of cores in the cable.

Consideration shall be given to future maintenance requirements and the ability to undertake repairs to a cable with a non-standard number of cores or increase of the copper conductor size. The project in consultation with the ARTC signals maintainer for the corridor may request approval for the use of non-standard cables.

In all cases all other aspects of the cable construction shall be as per the requirements as detailed within this standard.

3.10 Custom Cable Lengths

Where a project is able to accurately determine the lengths of cable required between signalling locations/equipment, it is permitted to use custom cable lengths that are different from those detailed in Table 1. This shall assist in minimising cable wastage or leftover lengths of cable.

The determination of cable lengths shall fully consider the provision of loops of the cable in cable pits, all straight runs and bends in the cable route. It shall also make adequate provision for running the cable into the location and the treeing of the cable on termination racks.

3.11 Outdoor cable classification

Outdoor cables are generally installed as follows and in accordance with ESC-11-01 Construction of Cable Route and Associated Civil Works:

1. Laid directly on the ground, buried in the ground, ash, ballast or concrete.
2. Laid in PVC under-ground conduit at various depths at the side of and under railway tracks.
3. Laid in Galvanised Steel, PVC or concrete ducts.
4. Exposed to atmospheric conditions at rail level or at the tops of poles where jointed to aerial cables.

3.12 Indoor cable classification

Indoor cables are generally installed as follows:

1. Laid indoors in steel cable trays, concrete or PVC ducts.
2. Exposed to atmospheric conditions including indirect sunlight and the various substances present in industrial and seaside areas.

4 Cable Identification

4.1 Marking on cables

Cables shall be marked with information in accordance with AS7663.

On cables less than 9mm in overall diameter the metre marking is not required unless otherwise requested.

SMOF cables shall be as below – refer section 4.2:

ARTC <product code> <description> <MMM YYYY> <cable number> <length marking> M

Format Item	Description
<product code>	Supplier to provide details, includes supplier name or identifier
<description>	Cable description e.g. "12 SMOF"
<MMM YYYY>	Date of manufacture: month & year e.g. NOV 2017
<cable number>	A unique cable identification number provided by the cable manufacturer
<length marking>	Sequential length mark in meters starting at zero (0000) at the inner end of the drum e.g. 0250 M

4.2 Marking on individual cores

All cores of electrical and signalling multi core cables shall be durably marked at intervals not exceeding 200mm in ≥ 2 mm contrasting numerals and words with the identifying numeral '1' 'one' at the centre of the inner cable layer and then in accordance with section 3.3

SMOF cable cores shall be colour coded as defined in standard TIA/EIA-598-A.

4.3 Marking on paired cores

Each set of paired cores shall be durably marked at intervals not exceeding 200mm.

≥ 2 mm contrasting identifying words stating 'Pair' followed by incrementing numbers starting at '1' shall be used to identify the paired cores.

5 Cable Drums

Cable shall be supplied on wooden or plastic drums with lagging.

Shrink-wrapped metal spools may be used for smaller sizes of cables.

Lagging shall be provided and securely fastened on all drums to protect the cables during transportation and storage. Lagging shall preferably be full wooden battens with two steel straps. Three steel straps are required on drums wider than 900mm or of gross weight greater than 1 tonne.

Polypropylene (corrugated) continuous sheet, or 3.2mm Masonite sheeting, with 1 steel strap shall be used on drums not exceeding 750mm in diameter or 500mm in width.

A minimum 300mm of the inner end of each length of cable shall be brought out and firmly clamped out to facilitate testing, this end shall be carefully and effectively protected from damage during transport. The outer end shall be firmly clamped in position for testing and position marked on the outside of the drum.

The maximum dimensions of drums shall be no more than 1900mm diameter and 1000mm width.

5.1 Marking on Cable Drums

The following information shall be clearly marked on the side of the cable drum. Nailed on tags are not permitted. Printed weatherproof labels shall be used (refer Figure 1 example). These shall be stapled to the drum using staples that do not penetrate completely through the flange of the drum and shall include the following information:

1. Manufacturer’s name, month and year of manufacture of the cable and the manufacturer’s identification of the drum.
2. Type of cable (number of cores and conductor size).
3. The inscription “RAILWAY – SIGNALS” (Not applicable to Fibre Optic cable).
4. Railway Authority order number or Signalling Contractors Name & Contract No.
5. The length of cable on the drum.
6. Weight of cable and drum.

Drums holding fire safe cables shall additionally be labelled “Fire Safe Railway Signalling Cable”.

A distinctive arrow shall be marked on each side of the drum indicating the direction in which the drum must be rotated when being rolled from one location to another.

Railway Signalling CABLES Pty Ltd	Sept 2003
Manufacturer Code:	
50 core 1/1.5mm ² Signal Cable	
Manufactured for “Railway – Signals”	
Order No (Authority/Contractor)	
	Quantity = 1000 Metres
	Gross Weight = 1000 Kg

Figure 1

6 Common Cable Size Comparison Table

Cable size (mm)	Cross sectional area (mm ²)	AWG
7/0.40 or 24/0.20	1	17
126/0.40		16
7/0.50	1.5	15
1/1.78 or 50/0.25	2.5	13
7/0.85	4	11
56/0.30	4	11
7/1.04	6	9
84/0.30	6	9
7/1.35	10	7
7/1.70	16	5
19/1.35	25	3
19/1.78	50	0
37/1.78	95	0000

7 Environmental Conditions

Cables shall be suitable for use under the following environmental conditions:

1. Humidity: RH up to 100%
2. Temperature: -10°C to + 75°C
3. Cables shall be suitable for a continuous operating temperature of 75°C.
4. Direct exposure to UV radiation in certain applications as specified in the Appendices.

8 Testing

The Manufacturer shall perform type tests in accordance with AS/NZS 5000.1, AS 1660 and AS/CA S008, on samples of insulation material, and insulated core and sheath material as applicable. Type test certificates from a NATA or equivalent laboratory approved for such tests shall be available on request.

During the course of manufacture and/or final testing of the cable, all relevant tests specified as routine, in AS/NZS 5000.1, shall be performed on each length of cable. In addition, Insulation Resistance at 20°C shall be performed as a routine test.

9 Test Certificates

Each drum of cable shall be delivered with a test certificate attached. Copies of all test certificates shall be sent to the owner under separate cover.

The Test Certificate shall include as a minimum the details below:

1. Test certificate number and cable identification drum No.
2. Description of the cable.

3. Relevant ARTC / Contractors order number and company works codes.
4. Conductors resistance tested (or corrected) at 20°C.
5. High voltage test and duration.
6. Spark test on cores
7. Insulation resistance as applicable:
 - ii. Between Cores.
 - iii. Between Cores and Earth.
8. Core numbering test (for multi-conductor cables)

In the case of Fibre Optic Cable, the test certificates shall include as a minimum the details shown below:

1. Test certificate number and cable identification drum No.
2. Description of the cable.
3. Relevant ARTC / Contractors order number and company works codes.
4. Overall end-to-end insertion loss.

10 Supplier Test and Certification Agreement

All inspections and certification of cables covered by this Standard and relevant Australian Standards shall be carried out by the Manufacturer.

11 Quality Assurance

The Manufacturer shall be either accredited to ISO 9000 Quality Assurance or agree to ARTC standard ESG-00-15 ARTC Quality Controlled Supplier.

12 Audit

The purchaser or nominated representative shall have such access to the works of the manufacturer as is reasonable and necessary to enable him to determine the quality of the material and workmanship and audit the manufacturers quality system.

13 Information to be Provided by Manufacturers

Manufacturers shall supply complete technical details on the cable offered.

Any component of the cable not mentioned in the Standard shall be fully detailed regarding type, composition, dimensions, tolerance and minimum thickness.

14 Warranty

With the exception of CSP insulated cables the manufacturer shall guarantee that the Insulation Resistance when measured with an insulation tester with applied voltage of 500 Volt DC, shall not be less than the values and in the format indicated in Table 2.

Cable Type	Insulation Resistance @ 20°C	
	Core-Core Mohm/Km	Core-Earth Mohm/Km
<u>2, 3 & Multi-Conductor</u>		
New Cable	60	60
After 10 years	40	40
<u>Single Conductor</u>		
New Cable		10
After 10 years		5

Table 2

The manufacturer shall guarantee that the installed cable meets this requirement for a period of 10 years from despatch of the cable. Where the insulation resistance of the materials used is temperature dependant the manufacturer shall indicate the temperature correction required to convert measured readings to a standardised reading at 20°C.

15 Appendix 1: 2 core underground power cable

15.1 Description

2 Core cable as indicated in Table 1.

15.2 Construction

Conductor size as indicated in Table 1 for items 1 to 5 inclusive.

Each core shall be insulated to the requirements of section 3.2.

The core insulation colours shall be red (positive or active) and black (negative or common).

Inner Sheath (refer section 3.5) and Termite Barrier (refer section 3.6) shall be applied across the cores.

Sacrificial Sheath shall be applied over the cores in accordance with section 3.7.

15.3 Identification

Cables shall include marking as specified in c on the outer sheath.

15.4 Tests

A representative drum for each production of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

15.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

16 Appendix 2: Multi core underground power cable

16.1 Description

Multi Core cable as indicated in Table 1 item 6-10.

16.2 Construction

Conductor size as indicated in Table 1 for item 6-10.

Each core shall be insulated in accordance with section 3.2.

Inner Sheath (refer section 3.5) and Termite Barrier (refer section 3.6) shall be applied across the cores. Sacrificial Sheathing shall be applied over the cores in accordance with section 3.7.

16.3 Identification

Cables shall include marking on the outer sheath as specified in section 4.

16.4 Tests

A representative drum for each production of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

16.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

17 Appendix 3: Multi core underground signal cable

17.1 Description

Multi-conductor underground signalling cable with number of cores as indicated in Table 1 for items 11 to 21 and 35 to 41 inclusive.

17.2 Construction

Conductor size – refer section 3.1

Each conductor shall be insulated in accordance with section 3.2.

Inner Sheath (refer section 3.5) and Termite Barrier (refer section 3.6) shall be applied across the cores.

Sacrificial Sheathing shall be applied over the cores in accordance with section 3.7.

17.3 Identification

Cables shall include marking on the outer sheath in accordance with section 4.

17.4 Tests

A representative drum for each production of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

17.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

18 Appendix 4: Single core underground power cable

18.1 Description

Single core cable as indicated in Table 1.

18.2 Construction

Conductor size as indicated in Table 1 for items 22 to 28 inclusive.

Each core shall be insulated to the requirements of section 3.2.

The core insulation colours shall be red (positive) and black (negative).

Inner Sheath (refer section 3.5) and Termite Barrier (refer section 3.6) shall be applied across the cores.

Sacrificial Sheathing shall be applied over the cores in accordance with section 3.7.

18.3 Identification

Cables shall include markings as specified in section 4 on the outer sheath.

18.4 Tests

A representative drum for each production of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

18.5 Special Requirements

Where fire safe cables are required, the construction materials shall comply with section 3.2.

19 Appendix 5: 1 pair underground SSI data cable

19.1 Description

One (1) pair Data Link cable, for SSI Railway Signalling as indicated in Table 1 item 29.

19.2 Construction

Polyethylene insulated 1.27mm² copper conductors with a paired conductors lay length of 150mm. The conductor insulation shall be one of red and one of blue.

An aluminium foil of nominal thickness 0.15mm shall be bonded to the inner side of a polyethylene sheath to form an overall moisture barrier of minimum radial thickness 2.5mm.

The Austel Regulations TS008 for Telecommunications cable construction and testing shall be the minimum requirements for this cable.

19.3 Electrical Characteristics

Characteristic impedance of 100ohms + 10% at 10 MHz.

Mutual Capacitance: not greater than 55pF/m at 10 KHz.

Conductor resistance: maximum average 14 ohms/km at 20°C.

Capacitance between each conductor and moisture barrier shall be balanced within 4p/Fm.

19.4 Identification

In addition to the standard outer sheath markings as specified in section 4 the words, "SSI DATA" shall be included.

The colour of the outer sheath shall be blue.

19.5 Tests

A representative drum for each production of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

19.6 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

20 Appendix 6: Cable indoor single conductor 24/0.20mm – Signal Cable

20.1 Description

Cable, flexible single core tinned annealed copper 24/0.20mm PVC insulated, Polyamide jacket as indicated in Table 1 item 30.

20.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 3.2.

Overall core diameter shall be within the limits of 2.80mm – 3.10mm.

Conductor shall be flexible bunched type complying with AS/NZS 1125 Class 5.

20.3 Identification

The colour of insulation and sheath shall be black.

20.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

20.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

21 Appendix 7: Cable indoor single conductor 7/0.40mm – Signal cable

21.1 Description

Cable, flexible single core tinned annealed copper 7/0.40mm PVC insulated, Polyamide jacket as indicated in Table 1 item 31.

21.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 3.2.

Overall core diameter including insulation and nylon sheath shall not exceed 3.20mm.

Conductor shall be flexible bunched type complying with AS/NZS 1125 Class 5.

21.3 Identification

The colour of insulation shall be white and sheath shall be black.

21.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

21.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

22 Appendix 8: Cable indoor single conductor 56/0.30mm – Signal cable

22.1 Description

Cable, flexible single core tinned annealed copper 56/0.30mm PVC insulated, Polyamide jacket as indicated in Table 1 item 32.

22.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 3.2.

Overall core diameter including insulation and nylon sheath shall not exceed 4.80mm.

Conductor shall be flexible bunched type complying with AS/NZS 1125 Class 5.

22.3 Identification

The colour of insulation and sheath shall be black.

22.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

22.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

23 Appendix 9: Cable indoor single conductor 84/0.30mm – Signal cable

23.1 Description

Cable, flexible single core tinned annealed copper 84/0.30mm PVC insulated, Polyamide jacket as indicated in Table 1 item 33.

23.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 3.2.

Overall core diameter including insulation and nylon sheath shall not exceed 5.70mm.

Conductor shall be flexible bunched type complying with AS/NZS 1125 Class 5.

23.3 Identification

The colour of insulation and sheath shall be black.

23.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

23.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

24 Appendix 10: Cable indoor single conductor 126/0.40mm – Signal cable

24.1 Description

Cable, flexible single core tinned annealed copper 126/0.40mm PVC insulated, Polyamide jacket as indicated in Table 1 item 34.

24.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 3.2.

Overall core diameter including insulation and nylon sheath shall not exceed 8.30mm.

Conductor shall be flexible bunched type complying with AS/NZS 1125 Class 5.

24.3 Identification

The colour of insulation and sheath shall be black.

24.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

24.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

25 Appendix 11: Multi Pair Signal Cables

25.1 Description

Multi-Pair underground signalling cable with number of cores as indicated in Table 1 for items 35 to 41 inclusive.

25.2 Construction

Conductor size – refer section 3.1.

Each twisted pair comprises a white and black insulated wire with the twist maintained throughout the length of the cable.

Each core shall be insulated to the requirements of section 3.2.

Termite Barrier (refer section 3.6) shall be applied across the cores.

Sacrificial Sheathing shall be applied over the cores in accordance with section 3.7. Insulation

25.3 Identification

Cables shall include marking on the outer sheath in accordance with section 4.3.

25.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

25.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

26 Appendix 12: High Frequency Screened Track Circuit Cables (Shielded Twin Twist)

26.1 Description

A twin twist shielded cable suitable for High frequency track circuit applications as indicated in Table 1 item 42.

26.2 Construction

PVC insulated 2 x 7/0.50mm annealed high conductivity copper conductors in a twisted paired lay length between 25 & 45mm. The conductor insulation shall be V75 or V90 PVC, nominal radial thickness 0.8mm, one conductor coloured white the other black.

The inner conductors shall be surrounded by a polyester backed (Mylar) aluminium tape of 0.05mm thickness giving 100% coverage at prescribed minimum bending radius.

A tinned copper drain wire consisting of 7 strands of 0.25mm² shall be provided & shall maintain contact with the aluminium tape continuously throughout the cable length.

Non hygroscopic cable filler may be used if required.

Supplementary insulation shall be black V75 or V90 PVC with a nominal thickness of 2mm but not less than 1.8mm.

Sheaths shall be applied over the cores in accordance with clause 3.6 & 3.7.

26.3 Identification

Insulation colour shall be as specified above and the sheath shall be black.

26.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

26.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with section 3.2.

27 Appendix 13: Signal Cables – Axle Counter

27.1 Description

Underground signalling cable with number of cores as indicated in Table 1 item 43.

27.2 Construction

Conductor size shall be nominally:

1. 1.0mm² (7/0.40mm) in NSW, SA and WA
2. 4mm² (7/0.85mm) in Victoria.

Each core shall be insulated to the requirements of section 3.2. Conductor insulation to be Blue/White and Red/Black.

The inner conductors shall be surrounded by a polyester backed (Mylar) aluminium tape of 0.05mm thickness giving 100% coverage at prescribed minimum bending radius.

A tinned copper drain wire consisting of 7 strands of 0.25mm² shall be provided and shall maintain contact with the aluminium tape continuously throughout the cable length.

Termite Barrier (refer section 3.6) shall be applied across the cores.

Sacrificial Sheathing shall be applied over the cores in accordance with section 3.7.

Insulation Total Loop resistance shall be <250Ω

Total mutual capacitance shall be <500nF

Insulation voltage <2500V

Insulation resistance <1GΩkm

27.3 Identification

Cables shall include marking on the outer sheath in accordance with section 4.

27.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

27.5 Special Requirements

Where fire cables are required the construction materials shall comply with section 3.2.

28 Appendix 14: SMOF cable

28.1 Description

SMOF cable with number of cores as indicated in Table 1 item 44, 45, 46 and 47.

28.2 Construction

SMOF cable construction shall include the following elements:

1. A central strength member
2. The specified quantity of SMOF cores to G652.D
3. Loose tubes containing either 6 or 12 fibres per tube
4. Solid fillers replacing loose tubes where there are less than the full cable capacity of fibres
5. Core blocking to prevent the migration of water along the cable core
6. A black polyethylene inner sheath
7. A rodent resistant layer of glass yarns or GRP or similar material
8. Sacrificial Sheath (refer section 3.7) and Termite Barrier (Polyamide jacket termite resistance PA12 or PA11) shall be applied across the cores.

SMOF cable construction shall include the following additional elements when being installed by direct burial

1. Additional outer layers of steel tape or UV stabilised polyamide (Nylon) in compliance with AS1049 integrally bonded to the inner sheath or other approved arrangement to allow the cable to be direct buried into the ground via mechanical means.

28.2.1 Optical Characteristics

Parameter	Requirement
Standards/References	AS/NZ 3080 – OS1 ITU-T Rec G652.D IEC 60793-2 type B1.3
Mode Field Diameter	9.2 + 1.5 μm at 1310nm
Cladding diameter	125 + 0.7 μm
Core/Cladding Concentricity Error	< 0.6 μm
Cladding Non-circularity	< 1 %
Cut-off wavelength of cabled fibre	< 1260 nm
Bending Performance	100 turns, 60 mm diameter < 0.10 db 1625nm
Proof stress	< 0.69 GPa (100kpsi)
Zero Chromatic Dispersion Wavelength	1300nm < λ_0 < 1324nm
Maximum Zero dispersion slope	0.092 ps/nm ² .km

Parameter	Requirement
Coating strip force	1.3 ~ 8.9 N
Attenuation coefficient of Fibre in finished cable	< 0.35 dB/km @1310 < 0.35 dB/km @1383 < 0.22 dB/km @1550
Maximum localised Attenuation discontinuity	<0.05db @ 1310nm <0.05 db @ 1550 nm
Polarization Mode Dispersion	< 0.2 ps/√km, q=0.01%, m=20
Refractive index for OTDR Calibration	Supplier shall advise

28.3 Identification

Cables cores shall be identified in accordance with section 4.2.

28.4 Tests

A representative drum for each production run of cable shall be subjected to Insertion testing, as required by AS/NZS 2967

28.5 Special Requirements

Where fire cables are required the construction materials shall comply with section 3.2.

29 Appendix 15: Flexible Power Cable

29.1 Description

Cable, flexible single core tinned annealed copper wire (class 5) X-HF-110 – Cross-linked PO, LSZH, fire retardant, UV stabilised insulated, indicated in Table 1 items 48 to 54 inclusive.

Cable, flexible single core tinned annealed copper wire (class 5) X-HF-110 – Cross-linked PO, LSZH, fire retardant, UV stabilised insulated and sheathed (HFS-110-TP – Cross-linked PO, LSZH, fire retardant, UV stabilised), indicated in Table 1 items 55 to 60 inclusive.

29.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 3.2.

Overall core diameter including insulation and sheath shall not exceed 15mm.

Conductor shall be flexible bunched type complying with AS/NZS 1125 Class 5.

29.3 Identification

The colour of insulation shall be black, red, orange, white, blue, earth.

The colour of sheath shall be black, red, orange, white, blue, Green/Yellow for earth.

29.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

During the course of manufacture spark testing in accordance with AS 1660 and AS/NZS 5000.1 shall be carried out.

30 Appendix 16: Flexible Signal Cable (Wire) – Microlok II

30.1 Description

Where a Microlok II CBI system is being used, the interface wiring must be ETFE Teflon insulated wire for interface wiring due to problems with the thickness of insulation and the possibility of leaking plasticiser from the nylon jacketed PVC wire.

The 2 sizes used are as follows.

- 19/29 AWG, 1.23mm². The ETFE Teflon cable (wire) is as per USA Military Standard Mil-W-22759/16-16-000, ETFE Insulated, 600 V, Medium Weight, Tin Coated Copper Conductors, 150°C,
 - It is accepted for termination in general terminals, the 48 way connectors for the Microlok II card file, and Q relay crimps.
 - It also available as black and white twisted pair. Twisted at greater than 15 twists per metre.
- 19/34 AWG, 0.4 mm². The ETFE Teflon cable (wire) is as per USA Military Standard is Mil-W-22759/16-22. ETFE Insulated, 600 V, Medium Weight, Tin Coated Copper Conductors, 150°C,
 - It is accepted for termination in the 96 way connectors.

30.2 Core, Insulation and Sheath

Each core shall be insulated to the requirements of section 30.1.

30.3 Identification

The colour of insulation shall be black or white.

30.4 Tests

A representative drum for each production run of cable shall be subjected to Voltage, Insulation Resistance and Conductor Resistance Tests as required by AS/NZS 5000.1.

31 Purchasing Guidelines

31.1 Purchasing Guidelines

INFORMATION TO BE SUPPLIED WITH ENQUIRY OR ORDER

The purchaser shall supply the following information with an enquiry or order cables to this Standard.

1. The item number from Table 1 of this Standard, i.e. ARTC Item ***
2. The applicable appendix
3. Number and size of cores
4. Any special requirement e.g. Fire Safe, screening, specified lengths etc.
5. Any Variation