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Cables for Railway Signalling Applications – General Requirements

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Applicability

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New South Wales		Victoria	

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1 Scope

This specification sets the requirements for Cables to be manufactured and supplied for Railway Signalling applications.

The specification covers construction and tests for railway signal cables, designed for working voltages up to and including 600V to earth.

The specification also provides general details in respect of Fibre optic cable.

Purchasing guidelines are included in Appendix 7.

2 Applicable Documents

2.1 Australian Standards

This Specification refers to the following 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/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/ACIF S008	Requirements for authorised Cabling Products (Fibre Optic Cable)

3 Definitions

The following definitions apply to this specification:

Core of cable	The conductor with its insulation but not including any protective covering.
Multi-conductor cable	A cable comprising more than three cores.
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.
Non-Hygroscopic	applied to a material, means that the 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 $20 \pm 5^{\circ}\text{C}$.

4 Types of Cables

This specification covers 2, 3 core and multi-conductor cables having PVC insulated conductors, laid up, with a PVC inner sheath, Polyamide jacket and finally covered with a **Black** coloured sacrificial outer sheath.

Special cables: fire safe cables, single conductor wiring and communication data cables are also included.

In situations where these cables are used for power reticulation of 120 volts AC and above, the sacrificial sheath shall be **Orange coloured**.

4.1 Ratings

Voltage rating shall be 0.6/1kV for power cables and 450/750V for multicore control cables.

4.2 Continuous Operating Temperature

Cables shall be suitable for a maximum continuous operating temperature of 75°C .

5 Construction of the Cable

5.1 General

Five basic types of construction are specified:

1. Type V-75 PVC insulated, 4V-75 PVC multicore sheathed including a termite barrier and a sacrificial sheath.
The V-75 PVC insulated cables are designed to be suitable for any indoor or outdoor (including direct burial in ground) installation encountered in railway track systems, other than where fire safe cables are required.
2. Type X-90 insulated and HFS-90-TP multicore sheathed.
The X-90 insulated cables are specifically designed for installation where fire safe cables are required (e.g. for installation in an underground railway tunnel). These cables, generally, are not recommended for burial in ground or use in permanently wet locations.
3. Data cables
Data cables are used for specific purposes on railway signalling projects e.g. indication diagrams, high speed data transmission etc.
4. Single core cable for indoor use.
Single core flexible wiring is used mainly for wiring of equipment mounted on racks in equipment rooms, hut or apparatus cases.
5. Single mode Fibre Optic 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/ACIF S008.

5.2 Conductors

Multi-conductor signalling cable shall be of seven wire strand plain annealed copper with a nominal cross-sectional area of 1.5mm^2 . In the case of the South Australian jurisdiction this nominal cross-sectional area shall be 2.5mm^2 . These multi-conductor signalling cables shall include a drain wire, being a bare tinned copper conductor of seven wires of at least 0.25 mm nominal diameter. This drain wire shall take a position in the outermost layer of the multi-conductors. These cables shall have a sacrificial sheath which is Black in colour.

Other cables, namely **2 core and 3 core** shall be of plain annealed copper with a minimum of 7 wires consistent with the details outlined in clause 5.9 and in accordance with the appropriate appendices included in this specification.

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

Data cable conductors shall be in accordance with the appropriate appendices included in this specification. These cables shall have a sacrificial sheath which is Black in colour.

In the case of **Fibre Optic cables** they shall be constructed using 9/125 micron single mode optical fibre in a loose tube configuration in accordance with AS/ACIF S008. The outer sheath shall be Blue in colour.

Joints are permitted in accordance with AS/NZS 1125.

5.3 Insulation

- a) Each conductor of multicore cables shall be individually insulated with white or natural V-75 compound having a radial thickness as laid down in AS/NZS 5000.1.
- b) 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.
- c) For cables in Appendices 1&2 the colour of the conductor insulation shall be as specified in these Appendices.
- d) Single conductor wiring shall have an insulation of V-75 compound having a minimum average radial thickness of 0.8mm and an outer sheath of 4V-75 PVC having a radial thickness of not less than 2.0mm.
- e) 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.

5.4 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).

Any necessary filling shall be of suitable non-hygroscopic materials compatible with the qualities of the insulation.

5.5 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.

5.6 Inner Sheath

An inner sheath of 4V-75 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.

5.7 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 0.4mm for cables up to and including 25mm overall diameter and a radial thickness of 0.5mm for the cables with overall diameters over 25mm.

The termite barrier shall be omitted for fire safe cables.

5.8 Sacrificial Sheath

A 4V-75PVC or equivalent sacrificial outer sheath of minimum radial thickness 2.5mm shall be applied over the polyamide covering. The colour of the sacrificial sheath shall be Black in the case of signalling cables and data cables and Orange in the case of power cables. The colour of the sacrificial sheath shall be Blue in the case of fibre-optic cables.

5.9 Cable Types

Cable types and nominal drum lengths shall be in accordance with the following table.

TABLE 1

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
7	4 CORE 7/0.5mm U/G SIGNAL CABLE	1000	3
8	6 CORE 7/0.5mm U/G SIGNAL CABLE	1000	3
9	15 CORE 7/0.5mm SIGNAL CABLE	1000	3
10	25 CORE 7/0.5mm SIGNAL CABLE	500-1000	3
11	50 CORE 7/0.5mm U/G SIGNAL CABLE	500	3
12	4 CORE 7/0.5mm U/G SIGNAL CABLE	1000	3
13	6 CORE 7/0.5mm U/G SIGNAL CABLE	1000	3
14	15 CORE 7/0.5mm SIGNAL CABLE	1000	3
15	25 CORE 7/0.5mm SIGNAL CABLE	500-1000	3
16	50 CORE 7/0.5mm U/G SIGNAL CABLE	500	3
17	12 CORE Composite U/G BOOM GATE CABLE	500	4
18	1 PAIR 1.27 mm U/G SSI DATA CABLE	1000	5
19	SINGLE CORE 32/0.20mm FLEXIBLE CABLE	200	6

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

5.10 Cable Suitable For Outdoor Use

Outdoor cables are generally installed as follows: -

- Laid directly on the ground, buried in the ground, ash, ballast or concrete at depths of approximately 600mm at the side of and under railway tracks.
- Laid in PVC under-ground conduit at various depths at the side of and under railway tracks.
- Laid in Galvanised Steel, PVC or concrete ducts.
- Exposed to atmospheric conditions at rail level or at the tops of poles where jointed to aerial cables

5.11 Cable Suitable For Indoor Use

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

6 Cable Marking

6.1 Marking on Cables

The following information shall be durably marked or embossed on the outer sheath of the cable in a legible format with letters not less than 3.0mm high at intervals not exceeding 1.0 metre.

- the manufacturer's name with the year of manufacture.
- the inscription "RAILWAY – SIGNALS" (Not applicable to Fibre Optic cable)
- the type and size of cable
- Fire Safe cables shall include the inscription "FIRE SAFE"

In addition to the above, cables shall be marked at 1 metre intervals on the outermost sheath or covering of the cable with the progressive length starting from the inner end on the drum.

Length marking shall be in a contrasting colour to the outer sheath colour- and Numerals shall not be less than 3mm in height.

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

6.2 Marking on Individual Cores

All cores of multi core cables shall be durably marked at intervals not exceeding 200mm in 2mm black numerals and words with the identifying numeral '1' 'one' at the centre of the inner cable layer and then in accordance with Clause 5.4.

7 Cable Drums

Cable shall be supplied on wooden drums with lagging which shall become the property of the purchaser.

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 may 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.

7.1 Marking on Cable Drums

The following information shall be clearly marked on the side of the cable drum. Nail on tags are not permitted. Printed weatherproof labels as approved by the Rail Authority may be used. 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:

- Manufacturer's name, month and year of manufacture of the cable and the manufacturer's identification of the drum.
- Type of cable (number of cores and conductor size)
- The inscription "RAILWAY – SIGNALS" (Not applicable to Fibre Optic cable)
- Railway Authority order number or Signalling Contractors Name & Contract No.
- The length of cable on the drum.
- 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.

An example of the label is as follows:

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

8 Environmental Conditions

Cables shall be suitable to be used under the following environmental conditions.

Humidity: RH up to 100%

Temperature: -10°C to + 75°C

Direct exposure to UV radiation in certain applications as specified in the particular Appendices.

9 Testing

The Manufacturer shall perform type tests in accordance with AS/NZS 5000.1, AS 1660 and AS/ACIF 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 must be available.

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

10 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.

Test Certificate shall include at least the details shown below:

- Test certificate number and cable identification drum No.
- Description of the cable.
- Relevant ARTC / Contractors order number and company works codes.
- Conductors resistance tested (or corrected) at 20°C.
- High voltage test and duration.
- Spark test on cores
- Insulation resistance as applicable:
 - i) Between Cores
 - ii) Between Cores and Earth
- Core numbering test (for multi-conductor cables)

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

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

11 Supplier Test and Certification Agreement

All inspections and certification of cables covered by this Specification will be carried out by the Manufacturer.

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 Specification shall be fully detailed regarding type, composition, dimensions, tolerance and minimum thickness.

14 Warranty

For cables, 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 below.

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

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 cable

15.1 Description

2 Core cable as indicated in clause 5.9.

15.2 Construction

Conductor size as indicated in clause 5.9 for items 1 to 5 inclusive.

Each core shall be insulated to the requirements of clause 5. The core insulation colours shall be red and black. Sheathing shall be applied over the cores in accordance with clause 5.

15.3 Identification

These cables shall include marking as specified in clause 6 on the outer sheath.

15.4 Special Requirements

Where fire safe cables are required the construction materials shall comply with clause 5.

SUPERSEDED

16 Appendix 2: 3 core underground cable

16.1 Description

3 Core cable as indicated in clause 5.9 item 6.

16.2 Construction

Conductor size as indicated in clause 5.9 for item 6.

Each core shall be insulated in accordance with clause 5. The core insulation colours shall be red, white and blue. Sheaths shall be applied over the cores in accordance with clause 5.

16.3 Identification

These cables shall include marking on the outer sheath as specified in clause 6.

16.4 Special Requirements

Where fire safe cables are required the construction materials shall comply with clause 5.

SUPERSEDED

17 Appendix 3: Multi-conductor cable

17.1 Description

Multi-conductor underground signalling cable with number of cores as indicated in Clause 5.9 for items 7 to 12 inclusive.

17.2 Construction

Conductor size shall be nominally 1.5mm² with the exception of the South Australian jurisdiction where 2.5mm² may be the requirement.

Each conductor shall be insulated in accordance with clause 5.

Sheaths shall be applied over the cores in accordance with clause 5.

17.3 Identification

These cables shall include marking on the outer sheath in accordance with clause 6.

17.4 Special Requirements

Where fire safe cables are required the construction materials shall comply with clause 5.

SUPERSEDED

18 Appendix 4: 12 core underground composite cable

18.1 Description

12 Core Underground composite cable for boom gate control as indicated in clause 5.9 item 13.

18.2 Construction

Core 1 and 2 7/1.04mm copper conductors

Core 3 to 12 7/0.85mm copper conductors

Each core shall be insulated in accordance with clause 5.

Sheaths shall be applied over the conductors in accordance with clause 5.

18.3 Identification

These cables shall include the marking as specified in clause 6 together with the words "Boom Gate Cable" on the outer sheath.

SUPERSEDED

19 Appendix 5: 1 pair SSI data cable

19.1 Description

One (1) pr Data Link cable, for SSI Railway Signalling as indicated in clause 5.9 item 17.

19.2 Construction

Polyethylene insulated 1.27mm 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 \pm 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 clause 6.0 the words, "SSI DATA" shall be included.

The colour of the outer sheath shall be blue.

19.5 Special Requirements

Where fire safe cables are required the construction materials shall comply with clause 5.

20 Appendix 6: Cable indoor single conductor 32/0.20mm

20.1 Description

Cable, flexible single core tinned annealed copper 32/0.20mm PVC insulated, Polyamide jacket as indicated in clause 5.9 item 15.

20.2 Core, Insulation and Sheath

Insulation and sheath shall be in accordance with Clause 5.3(d).

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 clause 5.3(e).

21 Appendix 7: Purchasing Guidelines

21.1 Purchasing Guidelines

INFORMATION TO BE SUPPLIED WITH ENQUIRY OR ORDER

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

- The item number from Table 1 of this Standard Specification, i.e. ARTC Item ***
- The applicable appendix
- Number and size of cores
- Any special requirement eg. Fire Safe, screening, specified lengths etc.

SUPERSEDED