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Specification for Cable Jointing Material

ESA-11-03

Applicability

Network Wide	SMS

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SPS 41

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Amendment Version #	Date Reviewed	Clause	Description of Amendment
1.0	04 Apr 23	All	Document renumbered from SPS 41 and updated to capture the current developments in the technology of cable jointing kits and materials. Applicable Network Wide

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1 Introduction

1.1 Purpose

The purpose of this specification is to describe the requirements of cable jointing material.

1.2 Scope

This document covers the specification for PVC cable jointing kits for signalling applications on ARTC network.

1.3 Document Owner

The Head of Engineering Standards is the Document Owner. Queries should be directed to standards@artc.com.au in the first instance.

1.4 Responsibilities

The Project Manager or Responsible Asset Manager or Signal Maintenance Engineer is accountable for implementation of this specification.

The installer or contractor is responsible for compliance and confirmation that materials and kits conform to the requirements of this specification.

The Project Manager or Responsible Asset manager are responsible for consultation and agreement with the relevant Signal Maintenance Engineer. This is necessary to ensure consistency, maintainability and reliability of the signalling system.

1.5 Reference Documents

The following documents support this specification:

- AS/NZS 1125:2001 - Conductors in insulated electric cables and flexible cords
- ESA-11-01 – Cables for Railway Signalling Applications
- ESG-00-15 – ARTC Quality Controlled Supplier
- AS/NZS ISO 9001 – Quality system
- AS 1049.1 – Telecommunication cables - Insulation, sheath and jacket Materials
- AS/ACIF S009 - Installation requirements for customer cabling

1.6 Definitions

The following terms and acronyms are used within this document:

Term or acronym	Description
ACA	Australian Communication Authority
ACMA	Australian Communications and Media Authority
ARTC	Australian Rail Track Corporation Ltd.
Heavy Wall	Heavy-wall (sleeve) over-sheath tubing for insulating and sealing
PVC	Polyvinyl Chloride
Sleeve	A protective closure layer placed over insulation

Term or acronym	Description
SME	Signal Maintenance Engineer
Wraparound (Sleeve)	A wraparound protective closure layer placed over insulation

2 Cable Jointing Material Requirements

2.1 Sleeve Requirements

All sleeves used for jointing or repair shall:

- be heat shrinkable reinforced composite material appropriate for use with Polyethylene and metal jacket cables.
- be installable at temperatures between -10ºC and +45ºC,
- be provided with printed product name at no more than 200mm intervals,
- be provided with hot melt adhesive (not mastic type) that shall seal the closure,
- have a minimum dielectric strength of 140 KV/cm,
- be suitable for use in humidity RH up to 100%
- be suitable for use in temperatures between -10ºC and +70ºC,
- be suitable for direct exposure to UV radiation (where required)
- provide termite and vermin protection

2.2 Storage Requirements

The closure system shall be capable of being stored at temperatures between -30ºC and +60ºC without deterioration of the product performance.

2.3 Kit Instruction Requirements

Each kit, where a kit is provided, shall be supplied with a detailed installation instruction. Kits shall include the following information:

- Suppliers Name
- Product Description
- Batch Number

2.4 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.

2.5 Installation

Manufacturer instructions are to be followed when installing or repairing closure systems (joints).

2.6 Dielectric Strength

The completed closure shall have a minimum dielectric strength of 120 KV/cm.

3 Multicore Signal Cable

The closure system used for jointing signalling multicore cables shall meet the minimum requirements outlined in this section.

3.1 Closure System (Product Selection) – Multicore Only

The size of the closure system used is typically based on the number of cores within the cable. Based on the number of cores, the typical sheath opening and splice bundle diameter requirements is listed in Table 1. If the internal joint components do not fit in the typical space provided, then the next larger closure system should be used.

Number of Cores	Typical Size Requirements (Multicore Only)
04 to 15	300mm sheath opening length 43mm splice bundle diameter
16 to 63	400mm sheath opening length 57mm splice bundle diameter

Table 1 - Closure System Size Requirements by Number of Cores

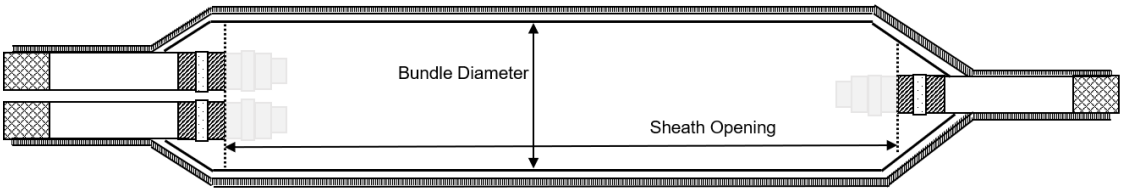

Figure 1 - Closure System Size Guide

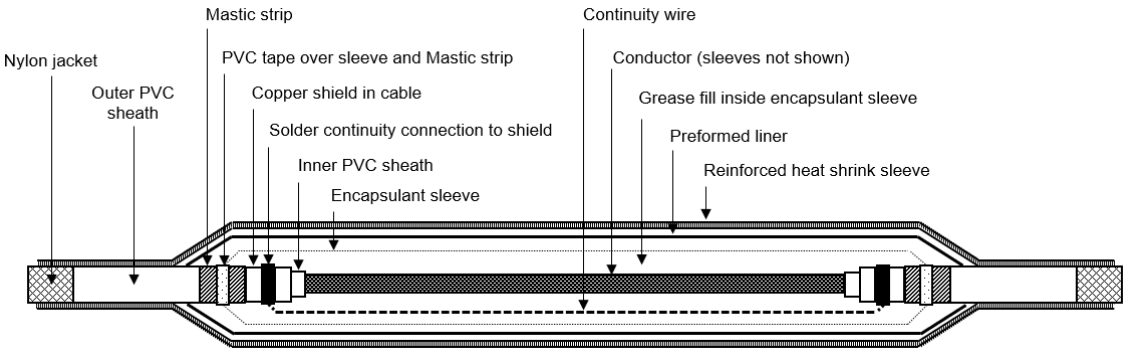

Figure 2 - Closure System for Multicore Cables

3.1.1 Joint method

Standard crimp sleeves shall be used with an approved crimping tool – see section 8

3.1.2 Sleeve – Multicore

The sleeve shall be a heat-shrinkable reinforced wraparound sleeve.

The sleeve shall be secured over the liner and around the joint by means of a flexible stainless-steel channel and installed with soft flame gas torch.

The sleeve shall be provided with temperature sensitive paint on the outer surface of the sleeve as an indicator at the time of installation only. The indicators shall exist so as to assist the installer in assessing the correct amount of heat to apply.

The sleeve shall be provided with hot melt adhesive that shall seal the closure seam and bond the sleeve to the liner and the closure outlets to the cable sheaths during installation.

3.1.3 Liner

A preformed liner shall be provided with the closure which shall be fitted prior to installing the closure. This liner shall assist in providing mechanical protection, maintaining the joint uniform and also act as a heat barrier during installation. It shall provide adequate structural strength to preclude collapse during installation

3.1.4 Channel

The channel shall be of flexible stainless steel manufactured in accordance with EU/EN X5CrNi18-10 (DIN 1.4301) or AISI 304

3.1.5 Testing

Refer Appendix A.

3.1.6 Joint Filling Kit

A kit containing mastic or plastic sheets will be required to hold the joint filling compound (encapsulant).

4 Jointing of Power Cable – Single Conductors

4.1 Closure System

Heatshrink arrangement shall be as detailed in Figure 3 below.

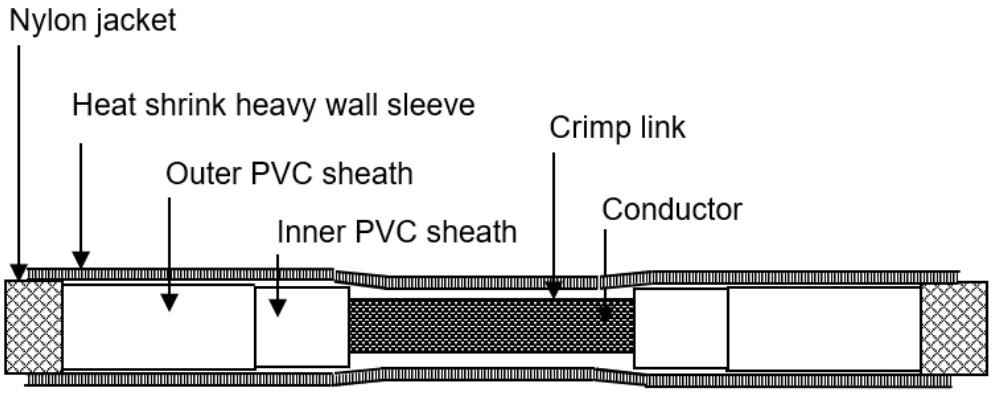

Figure 3 - Closure System for Power Cables

4.1.1 Joint method

Standard crimp sleeves shall be used with an approved crimping tool – see section 8

4.1.2 Sleeve – Single Core

Heat shrink sleeve shall be heavy wall heat-shrink.

4.1.3 Testing

Refer Appendix A.

5 Jointing of Power Cable – Twin Core Shielded

5.1 Closure System

Heatshrink arrangement shall be as detailed in Figure 4 below.

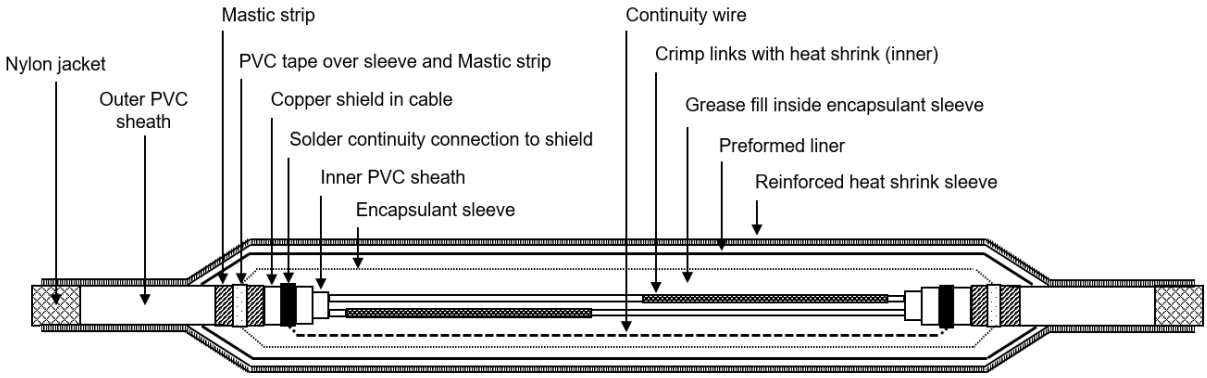

Figure 4 - Closure System for Power Cables or Twin Core Shielded

5.1.1 Joint method

Standard crimp sleeves shall be used with an approved crimping tool – see section 8

5.1.2 Sleeve – Twin Core

5.1.2.1 Inner Sleeve

The inner sleeve shall be appropriately sized heavy wall heat-shrink.

5.1.2.2 Outer Sleeve

The outer sleeve shall be as per section 3.1 Multicore Signal Cable, including subsections.

6 Jacket or Outer Sheath Repair of PVC Signal and Power Cable

6.1 Closure System

The sleeve shall be a heat shrinkable reinforced wraparound sleeve as detailed in Figure 5 below.

Cable with an outside diameter of less than 12mm will require cutting out with the damaged section removed and the cable re-joined.

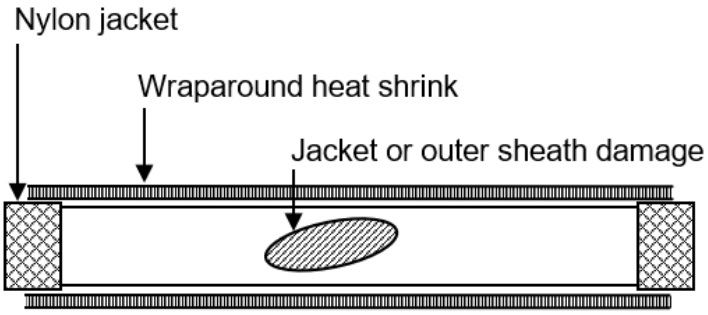

Figure 5 - Jacket or Outer Sheath Repair of PVC Signal and Power Cable

6.2 Joint method

Standard crimp sleeves shall be used with an approved crimping tool – see section 8

6.3 Sleeve – Repair

The sleeve shall be a heat shrinkable wraparound cable jacket repair sleeve for cable with an outside diameter of greater than 12mm.

6.4 Testing

Refer Appendix A.

7 Jointing of Screened High Frequency Track Circuit or Axle Counter Cable

7.1 Closure System

Heat-shrink arrangement shall be as detailed in Figure 6 below.

For cables with a diameter of 6mm to 12mm after the removal of the sacrificial sheath and nylon jacket the heat-shrink sleeve shall be heavy wall heat-shrink as per section 3.3.1 – Inner Sleeve.

For cables with a diameter greater than 12mm after the removal of the sacrificial sheath and nylon jacket the closure shall be as per section 3.1 Multicore Signal Cable.

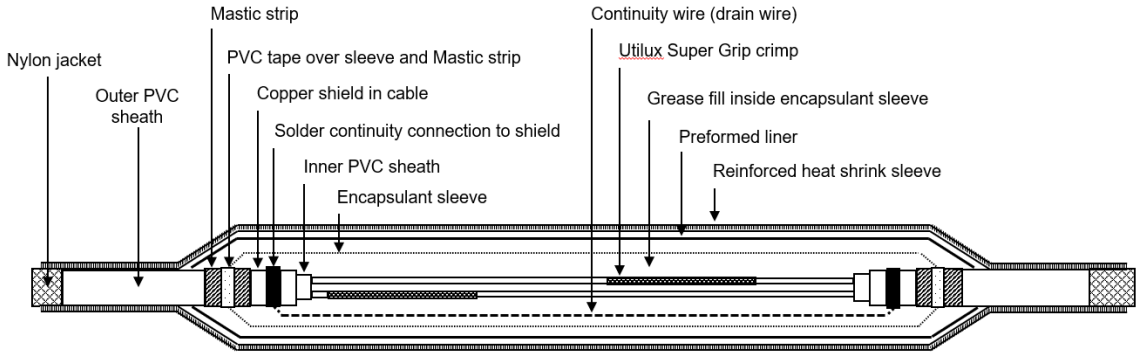

Figure 6 - Screen High Frequency Track Circuit or Axle Counter Cable - 12mm or greater

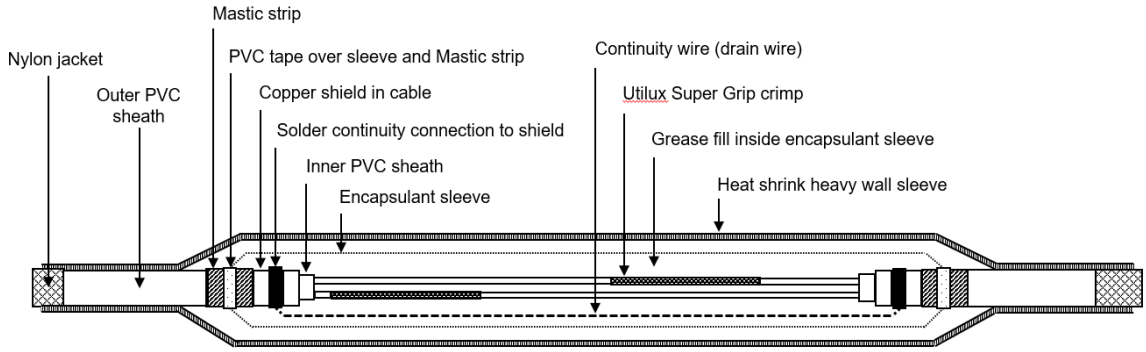

Figure 7 - Screened High Frequency Track Circuit or Axle Counter Cable - Less than 12mm

7.2 Joint method

The conductors and screen drain wire shall be joined by approved procedure, i.e. standard crimping tools as described in section 8.

7.2.1 Pre-Insulated Crimps

Conductors are to be crimped with pre-insulated crimps.

7.3 Sleeve

7.3.1 Cables 6mm to 12mm in Diameter

For cables 6mm to 12mm they shall use sleeves as per section 3.3.3.1 – Inner Sleeve

7.3.2 Cables greater than 12mm

For cables greater than 12mm they shall use sleeves as per section 3.1 Multicore Signal Cable, including subsections.

7.4 Testing

Refer Appendix A.

8 Crimp Sleeves and Crimping Tools

8.1 General

PVC Signal and mains cables shall be jointed using the cold welding process of individual conductors with crimp type sleeves. All concerned should be aware that the use of the correct sleeve and crimping tool is essential in maintaining the integrity of the crimp sleeve over a long period.

The use of worn crimping tools must be avoided as any pivot wear substantially reduces the crimping force. The fact that a test crimp cannot be pulled apart is no guarantee that the joint is satisfactory.

8.2 Signal Cable, High Frequency Screened Track Cable and Axle Counter Cable

Crimp sleeves shall be Utilux H2071 or Utilux H3910 or equivalent crimped with Utilux tool 11C or equivalent.

8.3 Power Cable

The following table shall be followed when choosing which crimp link or crimping tool to use:

Conductor Size	(mm^2)	Utilux Catalogue Number	Crimping Tool	Crimping Die
7/0.50	(1.5)	(Supergrip) H3910	11C	Red
7/0.85	(4)	(Supergrip) H3912	13B	Yellow
7/1.70	(16)	H1455	38A	38-63CU
19/1.35	(25)	H1458	38A	38-77CU
19/1.53	(35)	H1488	38A	38-92CU
19/1.78	(50)	H1460	38A	38-104CU
19/2.14	(70)	H1461	38A	38-115CU
37/1.78	(95)	H1462	38A	38-142CU
37/2.03	(120)	H1492	38A	38-165CU

Table 2 - Crimp Selection

The use of any other type of crimp link or crimping tool will require type approval.

9 Appendix A: Signal Cable Closure System – Acceptance Test Requirements

9.1 Introduction

These tests may be required to be undertaken where a cable jointing closure may not meet all requirements of this specification, or, where a cable joint closure has failed and is being investigated.

9.2 Requirements

1. The closure shall exhibit a very high degree of split resistance and shall comply with the following test:

   A 5mm cut shall be made on one edge of the sleeve prior to installation over the maximum application diameter of the sleeve.

   The sleeve can be installed with a torch or in an oven at 200^{o}C for 15 minutes.

   There shall be no significant propagation of the cut, as determined by examination with the naked eye.

2. The tightness of installed closures shall be checked by pressurizing to 40kpa for a period of 15 minutes while immersed in water at room temperature.

   A sample shall be considered tight if there is no continuous stream of air bubbles escaping from it.

3. The closure shall be capable of withstanding installation using strong torches.

   After installing the sleeve according to standard procedures use an approved torch with a gas pressure of 150kpa and allow the yellow tip to impinge the surface for 10 seconds.

   The sleeve shall then pass examination with the naked eye and be subjected to the tightness test as described in A2.

4. Longitudinal shrinkage of the closure shall be less than 5% so as to ensure a consistent bond length and enhance reliability.

   The length of the shortest sleeve sample as delivered shall be determined to the nearest millimetre, (mean of 4 measurements taken across sleeve). The sleeve shall then be shrunk onto an aluminium tube with an outside diameter equivalent to the maximum applicable diameter tube shall not exceed 3mm and its outside surface shall be treated with a release agent. The minimum length of the sleeve shall be determined after the sample has cooled to room temperature.

   The percentage longitudinal shrinkage shall be calculated as follows:

$$\frac{\text{mean length shrunk - mean length as delivered}}{\text{mean length as delivered}} \times 100$$

5. Closures shall have to withstand two types of mechanical testing (i.e. impact test and blunt blade test). For the duration of these tests the closures shall be internally pressurized to 40kpa.

   The impact test shall consist of the closure being placed on a smooth, flat, horizontal surface with the seam rotated 90o from the point of impact.

A steel ball weighing 1kg shall be suspended at a height of 2m above the centre of the test specimen. The weight shall be allowed to fall under gravity, striking the test specimen at the apex of the curvature.

After inspection with the naked eye, the closure shall be subjected to the tightness test as described in A2.

The blunt blade test shall be performed by placing the closure on a 5cm layer of dry sand. The closure shall be positioned such that the impacts do not occur on the channel or clip.

After inspection with the naked eye, the closure shall be subjected to the tightness test as described in A2.