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Engineering Standard - NSW

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Electrical

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Requirements for Cable Polymeric Terminations and Joints

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About This Standard

This document sets out the requirements for cable polymeric terminations and joints for use on existing and new 1500 Vdc traction cables and high voltage ac cables owned by ARTC.

The jointing systems in this document are applicable to underground cables and aerial bundled conductors.

Document History

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List of Amendments –

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1.1	05/01/2005		Reformatted to ARTC Standard
1.2	11/03/2005	Disclaimer	Minor editorial change

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1 Scope and Application

This document sets out the requirements for cable polymeric terminations and joints for use on existing and new 1500 Vdc traction cables and high voltage ac cables owned by ARTC.

These jointing systems are applicable to underground cables and aerial bundled conductors.

The requirements of this document apply to new terminations or to connections needing re-termination.

2 Definitions

Polymeric All common insulation which may be described as “plastic” or “rubber” or by appropriate polymer name.

XLPE Cross-linked polyethylene.

EPR Ethylene-propylene rubber.

MIND Mass impregnated non-draining.

PILC Paper insulated lead covered.

3 Introduction

With the development of new technologies, the method of terminating and jointing PILC, EPR and XLPE cables has resulted in the extensive use of polymeric cable terminating and jointing materials.

Prior to the use of polymeric terminating and jointing materials, cables were terminated and jointed using a variety of ceramic cable sealing ends, cast iron terminating boxes, cast iron trifurcating boxes and jointing arrangements. These cable terminating and jointing methods are more expensive, time and labour intensive than the polymeric cable terminating and jointing systems.

Cable polymeric terminations and joints are currently used on 1500 Vdc and high voltage ac PILC, EPR and XLPE cables owned by ARTC at voltages up to and including 33 kV.

4 General requirements

The insulation co-ordination of terminations and joints for 11 kV cables operating at lower system voltages shall be installed and maintained as if the cable was operating at rated voltage.

4.1 Cable polymeric terminations

4.1.1 Terminating thimble

Cable polymeric terminations shall be made using a solder sealed terminating thimble designed for outdoor terminations with a long palm and barrel. The long barrel length is required for effective sealing. If the palm of the terminating thimble is drilled to facilitate connections to equipment the terminating thimble must be solder sealed after drilling.

4.1.2 Provision of moisture seal on cables with copper wire screens

For applications where cable polymeric termination kits are used on cables having copper wire screens, the copper wire screen moisture seal must be prepared and installed strictly in accordance with the manufacturer's installation instructions and specifications.

4.1.3 Cable polymeric termination kits for outdoor use

- Polymeric cable terminations for outdoor use are to be UV stabilised.
- 11 kV outdoor termination support insulators/surge diverters are to be fitted with 11kV copolymer removable bushing covers to minimise disruptions caused by wild life. The cover must be fitted to enclose the exposed connection of the cable termination and drop from the aerial conductors.
 - 1) For aluminium aerial conductors the drop shall be aluminium single core 6.35/11kV covered conductor thick insulated cable or bare aluminium conductor enclosed with a 10mm I.D. 13kV rated line cover secured with nylon cable ties for a distance of not less than 500 mm from the insulated removable bushing cover.
 - 2) For bare copper conductors the drop shall be enclosed with a 10mm I.D. 13kV rated line cover secured with nylon cable ties for a distance of not less than 500 mm from the insulated removable bushing cover.

4.2 Terminations and joints - application

Cable polymeric termination and joint kits shall only be used on cables for which they have been deemed fit for use by the manufacturer. The termination and joint kits are to be installed strictly in accordance with the manufacturer's specifications and installation instructions.

5 Electrical requirements

The general requirements for compliance of cable polymeric terminations and joints have been derived from the standards and specifications listed below. Cable polymeric terminations and joints must meet the parameters set out in Table 1, "Electrical requirements for cable polymeric terminations and joints" when type tested in accordance with the listed standard.

Standard lightning impulse voltage

PDS 17 Insulation Co-ordination and Surge Arrester Selection.

AS 1824.1-1995 Insulation co-ordination, Part 1: Definitions, principles and rules.

Standard short duration power-frequency withstand voltage

PDS 17 Insulation Co-ordination and Surge Arrester Selection.

AS 1824.1-1995 Insulation co-ordination, Part 1: Definitions, principles and rules.

Partial discharge test

AS/NZS 1429.1-2000 Electric cables - Polymeric insulated, Part 1: For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV.

Partial discharge test before and after load cycling

AS/NZS 1429.1-2000 Electric cables - Polymeric insulated Part 1: For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV.

Load cycling

AS/NZS 1429.1-2000 Electric cables - Polymeric insulated Part 1: For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV.

Salt fog test

IEC 60507 Section 3 Artificial pollution tests on high voltage insulators to be used on ac systems.

Humidity and condensation test

AS 2264-1995 A.C. insulation-enclosed switch gear and control gear for rated voltages above 1 kV and up to and including 38 kV.

High voltage dc test

AS/NZS 1429.1-2000 Electric cables - Polymeric insulated Part 1: For working voltages 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV.

Electrical clearances in air

High voltage ac

AS2067-1984 Switch gear assemblies and ancillary equipment for alternating voltages above 1 kV.

1500 Vdc

RailCorp publication EP 08 00 00 02 SP Overhead Wiring Maintenance Standards.

Polymeric cable termination and joint characteristics	Cable nominal system voltage		
	1500 Vdc and 2.2 kVac	11 kVac	33 kVac
Standard lightning impulse voltage	60 kV (Peak)	95 kV (Peak) See note 1.	200 kV (Peak) See note 2.
Standard short duration power frequency withstand voltage	20 kV (rms)	28 kV (rms)	70 kV (rms)
Partial discharge test before and after load cycling	20 pC at 7.6 kV rms nor 5 pC at 5.7kV rms.	20 pC at 13 kV rms nor 5 pC at 10 kV rms.	20 pC at 38 kV rms nor 5 pC at 29 kV rms.
Load cycling	8 h cycle, 2 h @ 105 ⁰ C + 5 ⁰ C, 3 h cooling for 20 cycles.	8 h cycle, 2 h @ 105 ⁰ C + 5 ⁰ C, 3 h cooling for 20 cycles.	8 h cycle, 2 h @ 105 ⁰ C + 5 ⁰ C, 3 h cooling for 20 cycles.
High voltage dc test	15 kVdc for 15 min.	25 kVdc for 15 min.	75 kVdc for 15 min.
Terminations only			
Salt fog test	1 h at 4.2 kV salt concentration 224 kg/m ³ .	1 h at 6.9 kV salt concentration 224 kg/m ³ .	1 h at 20.8 kV salt concentration 224 kg/m ³ .
Humidity and condensation test	6.6 kV rms between phases. 3.8 kV rms phase to earth. 240 h, water resistivity 0.033 S/m, atomising 0.2 to 0.5 dm ³ /h.	11 kV rms between phases. 6.35 kV rms phase to earth. 240 h, water resistivity 0.033 S/m, atomising 0.2 to 0.5 dm ³ /h.	33 kV rms between phases. 19 kV rms phase to earth. 240 h, water resistivity 0.033 S/m, atomising 0.2 to 0.5 dm ³ /h.
Minimum outdoor air clearances at exposed terminals	150 mm positive to earth for 1500 Vdc. or for ac applications 105 mm phase to phase. 90 mm phase to earth.	185 mm phase to phase. 160 mm phase to earth.	440 mm phase to phase. 380 mm phase to earth.
Minimum air clearances at indoor terminations on equipment	In accordance with equipment manufacturers specifications.		

Table 1 - Electrical requirements for cable polymeric terminations and joints

Note:

- 1) *If all 11 kV feeders entering the substation are of cable construction for the first 0.5 km from the substation, and all equipment is indoor, a standard lightning impulse voltage of 75 kV is used for indoor cable terminations. Refer PDS 17 Insulation Co-ordination and Surge Arrester Selection.*
- 2) *If all 33 kV feeders entering the substation are of cable construction for the first 0.5 km from the substation, and all equipment is indoor, a standard lightning impulse voltage of 170 kV is used for indoor cable terminations. Refer PDS 17 Insulation Co-ordination and Surge Arrester Selection.*

6 Approved polymeric terminations

6.1 1500 Vdc cables

6.1.1 MIND paper lead cables

For indoor and outdoor applications, use heat shrink polymeric termination installed to the manufacturer's specifications.

6.1.2 XLPE and EPR insulated cables, screened and unscreened

For indoor and outdoor applications, use hot or cold shrink polymeric termination installed to the manufacturer's specifications.

6.2 2.2 kV cables

For indoor and outdoor applications on either two core concentric or three core cables, use heat shrink polymeric termination installed to the manufacturer's specifications.

6.3 11 kV cables

6.3.1 XLPE and MIND paper lead cables

For indoor applications on either single core or three core cables, use hot or cold shrink polymeric terminations installed to the manufacturer's specifications.

Note :

On MIND paper lead cables cold shrink polymeric terminations are not to be used on cables greater than 100 metres in length.

For outdoor applications on either single core or three core cables, use heat shrink polymeric termination installed to the manufacturer's specifications.

6.4 33 kV cables

6.4.1 XLPE and MIND paper lead cables

For indoor and outdoor applications on either single core or three core cables, use heat shrink polymeric termination installed to the manufacturer's specifications.

6.4.2 Gas paper lead cables

No approved cable polymeric terminations.

6.4.3 Gas paper aluminium cables

No approved cable polymeric terminations.

7 Approved polymeric joints

7.1 1500 Vdc cables

7.1.1 MIND paper lead cables

Heat shrink polymeric joint installed to the manufacturer's specification. The metallic shielding and earth screen bond must be plumbed (lead wiped) to the cable lead sheath on each side of the joint. Spring clips are not acceptable due to the low fault level provided by this clamping system.

7.1.2 XLPE and EPR insulated cables, screened and unscreened

Heat shrink polymeric joint installed to the manufacturer's specification.

7.2 2.2kV cables

For three core cables, use heat shrink polymeric joint installed to the manufacturer's specifications.

No approved polymeric joints for two core concentric cables.

7.3 11 kV cables

XLPE and MIND paper lead cables

For single core or three core cables, use heat shrink polymeric joint installed to the manufacturer's specifications.

7.4 33 kV cables

7.4.1 XLPE and MIND paper lead cables

For single core or three core cables, use heat shrink polymeric joint installed to the manufacturer's specifications.

7.4.2 Gas paper lead cables

No approved cable polymeric joints.

7.4.3 Gas paper aluminium cables

No approved cable polymeric joints.