

Equipment Technical Specification

11 kV and 22 kV distribution cable joints and terminations

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Equipment Technical Specification

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ETS 0084 11 kV and 22 kV distribution cable joints and termination

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1.0 PURPOSE

To specify the technical requirements for 11 kV and 22 kV distribution cable (including NMSHVABC) joints and terminations used on the Endeavour Energy underground distribution network.

2.0 SCOPE

This specification covers the design, engineering, manufacture, testing, supply and delivery of 11 kV and 22 kV joints and terminations to be used in Endeavour Energy's distribution network.

The joints and terminations offered in response to this specification shall be manufactured and tested to the Standards with the year of publication listed below. Joints and terminations manufactured and tested to previous or later versions of the standards shall not be accepted.

Where this Specification conflicts with a standard, this Specification will prevail. However, significant inconsistencies should be referred to Network Mains Manager for resolution.

3.0 REFERENCES

- Company Policy 9.1.6 – Approved materials list
- Company Policy 9.2.5 - Network Asset Design
- Network Management Plan December 2013 Review
- Branch form FAE 3151 – 11 kV 22 kV terminations for distribution XLPE cables - Product approval and audit form
- Branch form FAE 3152 – 11 kV 22 kV straight through joints for distribution XLPE cables - Product approval and audit form
- ENA National Electricity Network Safety Code (Doc 01-2008)
- AS/NZS 1026:2004 – Electric cables – Impregnated paper insulated – For working voltages up to and including 19/33 (36) kV
- IEC 61442:2005 – Test methods for accessories for power cables with rated voltages from 6 kV ($U_m = 7.2$ kV) up to 30 kV ($U_m = 36$ kV)
- AS/NZS 4325.1:1995 – Compression and mechanical connectors for power cables with copper or aluminium conductors
- AS/NZS 4805.1:2007 – Accessories for electric cables – Test requirements Part 1: Power cables with extruded insulation for rated voltages from 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV
- AS/NZS 4805.2:2007 - Accessories for electric cables – Test requirements Part 2: Impregnated paper insulated metal sheathed cables for rated voltages from 1.9/3.3 (3.6) kV up to and including 19/33 (36) kV (excluding gas pressure and oil-filled cables)

4.0 DEFINITIONS AND ABBREVIATIONS

3C

Three core

Al

Aluminium

Cu

Copper

EPR

Ethylene propylene rubber

HDPE

High density polyethylene

HV

High voltage

MIND

Mass impregnated non-drain

MSDS

Material safety data sheet

NATA

National Association of Testing Authorities

NMSHVABC

Non-metallic screened high voltage aerial bundled cable

PE

Polyethylene

PILCMIND

Paper insulated lead covered mass impregnated non-drain

PLY

Paper insulated lead alloy sheathed

PLYSWS

Paper insulated lead alloy sheathed steel wire armoured and served

PVC

Polyvinyl chloride

U

The r.m.s. power frequency voltage between phases

 U_0

The rated r.m.s. power frequency voltage between each conductor and screen or sheath for which the accessories are designed.

 U_m

The maximum r.m.s. power frequency voltage between any two phase conductors for which the accessories are designed.

UV

Ultra violet

VDS

Voltage detecting system

XLPE

Cross linked polyethylene

5.0 ACTIONS

All 11 kV and 22 kV cable joints and terminations used on the Endeavour Energy HV distribution cable network shall comply with the requirements of this specification.

All items within the scope of this document shall be approved by Network Mains Manager before being installed in the network.

5.1 Details of cables in the HV distribution network

All HV distribution cables in the network are either three or single core, XLPE or paper insulated (PILCMIND and PLYSWS) and HDPE or bitumen coated clothed over sheathed. Additionally joints for two sizes of 11 kV NMSHVABC are also included in Table 3 of this document. The conductors of all cables are stranded, compacted aluminium or compacted copper and circular or sector in shape. The dimensional details of cables in Table 1, Table 2 and Table 3 are approximate values only.

The short-circuit rating of the metallic screen of single core cables having cross-section area above 300 mm² is 20 kA/1 s whereas for all other cables listed in Table 1 shall be considered to have 13.1 kA/1 s rated metallic screen.

Dimensional details of the standard XLPE insulated cables used on the HV distribution network, are shown in Table 1 below.

Table 1: Standard UG cables in the distribution HV network and their dimensions

#	Nominal Voltage (kV)	# of cores	Conductor	CSA (mm ²)	Nominal Conductor diameter (mm)	Nominal diameter over insulation (mm)	Nominal diameter over insulation screen (mm)	Nominal overall diameter (mm)
1	11	1	Circular Al	240	18.1	26.1	27.8	35.8
2			Circular Cu	25	6.09	14.09	15.8	21.8
3				70	9.8	17.8	19.5	27.5
4				240	18.2	26.2	27.9	35.9
5				300	20.6	28.8	30.5	38.4
6				800	34.4	43.5	45	58
7				1200	42.8	54.8	56.3	66.3
8		3	Circular Al	240	18.1	26.1	27.8	70.3
9			Circular Cu	240	18.2	26.2	27.9	70.6
10				300	20.6	28.8	30.5	76.5

#	Nominal Voltage (kV)	# of cores	Conductor	CSA (mm ²)	Nominal Conductor diameter (mm)	Nominal diameter over insulation (mm)	Nominal diameter over insulation screen (mm)	Nominal overall diameter (mm)
11	22	1	Circular Cu	25	6.1	18.3	20	26.5
12				70	9.8	22	23.7	33.1
13				630	30.3	43.2	44.9	56.1
14				800	34.4	47.7	49.2	62
15		3	Circular Al	240	18.1	30.3	32	80.2
16			Circular Cu	240	18.2	30.4	32.1	80.5

Details of the predominant non-standard cables servicing the HV distribution network are shown in Table 2 below.

Table 2: Details of non-standard cable in the distribution HV network

#	Insulation	Nominal Voltage	# of cores	Conductor Size	Conductor Material	Type of construction
1	Paper	11 kV	3C	26 mm ² (0.04 in ²)	Cu	PLYSWS (Belted)
2				39 mm ² (0.06 in ²)	Cu	PLYSWS
3				50 mm ²	Cu	PLYSWS
4				65 mm ² (0.1 in ²)	Al	PLYSWS
5					Cu	
6				95 mm ²	Al	PLYSWS
7				97 mm ² (0.15 in ²)	Cu	PLYSWS
8					Al	
9				120 mm ²	Al	PLYSWS
10					Al	
11				129 mm ² (0.2 in ²)	Cu	PLYSWS
12					Al	
13				150 mm ²	Cu	PLY/PVC
14				185 mm ²	Cu	PLY/PVC
15					Cu	PLYSWS
16					Al	
17				194 mm ² (0.3 in ²)	Al	PLYSWPVC
18					Cu	PLYSWS
19					Al	

#	Insulation	Nominal Voltage	# of cores	Conductor Size	Conductor Material	Type of construction
20				240 mm ²	Al	PLY/HDPE
21					Al	PLYSWPVC
22					Cu	PLYSWS
23					Al	
24				300 mm ²	Cu	PLY/HDPE
25					Al	
26					Cu	PLYSWPVC
27					Al	
28					Cu	PLYSWS
29					Al	
30				323 mm ² (0.5 in ²)	Cu	PLYSWS
31					Al	
32	XLPE	11 kV	1C	150 mm ²	Al	XLPE/PVC/HDPE
33					Cu	
34			3C	185 mm ²	Al	
35			1C		Al	
36			3C		Al	
37		22 kV	3C	150 mm ²	Al	

Dimensional details of the standard NMSHVABC cables servicing the HV distribution network are shown in Table 3 below.

Table 3: Standard NMSHVABC in the HV distribution network and their dimensions

#	Nominal Voltage (kV)	# of cores	Conductor	CSA (mm ²)	Nominal Conductor diameter (mm)	Nominal diameter over insulation (mm)	Nominal diameter over insulation screen (mm)	Nominal overall diameter (mm)
1	11	3	Circular Al	50	8	16.8	18	20.4
2				150	14.5	23.3	24.5	26.9

5.2 Joints and terminations

5.2.1 General

In general the cable joints and terminations kits shall be suitable to join and terminate cables in Endeavour Energy distribution HV network which have an effectively earthed neutral. Each kit shall be supplied with sufficient components to join/terminate all three phases of the circuit.

The suppliers shall cover the entire range of conductor sizes in Table 1, Table 2 and Table 3, with the least number of joint and termination kits of each category as far as possible. Preference shall be given to the suppliers who offer the smallest number of joints/terminations (except elbow terminations) to cover the entire range of conductor sizes in each category. The categories are;

- 11 kV XLPE cable to XLPE cable joint,

- 22 kV XLPE cable to XLPE cable joint,
- 11 kV XLPE cable to Paper insulated cable transition joint,
- 11 kV XLPE insulated cable termination,
- 11 kV Paper insulated cable termination, and,
- 22 kV XLPE insulated cable termination.

Therefore all kits, except termination kits for cables with conductor cross-sectional area equal to or greater than 630 mm², shall be complete with range taking shear bolt mechanical connectors/lugs to suit aluminium or copper conductors of the range of cable sizes for which each kit is designed and tested for.

The cables with conductor cross-sectional area equal or greater than 630 mm² shall be run between substation switchgear and transformer secondary side air filled cable boxes in transmission/zone substations. The termination kits for such cables shall be supplied without terminal palms as the matching terminal palms suitable for variety of transmission/zone substation switchgears and transformer cable boxes shall be sourced from elsewhere.

Heat applied and cold applied joints and terminations shall be required to join and terminate cables listed in Table 1 and NMSHVABC listed in Table 3. Cold applied joints and terminations with pre-expanded components having a shelf life less than 18 months, are not acceptable.

Each joint kit and termination kit shall be accompanied with a set of installation instructions. The instructions shall be sequential and well detailed with dimensions and graphics illustrating each stage of assembling each of the components of the kit on to the cable. A component list with references to the identity of each component shall be included in the beginning of the installation instruction. The identity of each component referred to in the component list shall appear on the relevant component(s) or on the packing of each component.

Minimum allowable settlement time after completion of the joint, shall be clearly specified in the installation instruction (refer to clause 5.3.2.8). A copy of the installation instruction shall be included in the offer for each item.

Endeavour Energy reserve the right to request the supplier to modify the installation instructions in any or all of the kits. Any such modifications shall be carried out in consultation with the manufacturer. After review and approval by the Network Mains Manager, no changes shall be made to any of components / installation instructions in the kit without prior approval from the Network Mains Manager.

It is desirable that the product(s) will withstand contamination by transformer oil. The performance of the product(s) when subjected to contamination of transformer oil shall be provided along with any submission.

5.2.1.1 Packaging

Each kit shall be packaged with the correct components required to complete the installation of the joint or termination. Each component in each kit shall be suitably labelled for easy identification. Each kit shall include an itemised check list of components with reference to the identity and quantities of each component that are required to complete the installation of the joint or termination. The list shall also provide additional information including the part number and manufacturer. The terminology used for labelling shall be consistent with the identity used in the itemised list and the installation instructions relevant to the item.

The following information shall clearly be displayed on the box of each kit:

- Supplier's name and logo;
- Manufacturer's name; (if different from the supplier),
- Manufacturer's part number;

- Short description of the kit which specifies the category (category as defined in Clause 5.2.1) of the kit and the application range of the kit;
- Date of manufacture;
- Date of expiry (if the product has a limited shelf life);
- Special storage requirement (if applicable only); and,
- A short description of the product providing the range taking capability (that is range of conductor cross sections, insulation diameters and cable overall diameters)

The packaging shall protect the contents against dust and moisture, and shall be robust enough to protect the enclosed components against potential damages that could occur during delivery and handling.

5.2.1.2 Terminations

All terminations (including the screened elbow terminations) shall facilitate cable sheath testing without disassembling or disconnecting any component of the termination other than the earth connection of the wire screen or metallic sheath of the cable at the termination.

Terminations are required in the following two types:

- heat applied
- cold applied pre-moulded/expandable/slip-on

Terminations (except screened elbow terminations) are required for connecting the cables listed in Table 1 onto HV switchgear (indoor – refer to Clause 5.3.3.2) or to overhead lines (outdoor UGOH – refer to Clause 5.3.3.1). Terminations are also required to connect the NMSHVABC listed in Table 3 onto bare overhead lines or to UGOH terminations. The terminal palms of indoor terminations shall have a single hole and outdoor terminations shall have two slotted holes with a minimum 32 mm between the centres to accommodate 12 mm bolts.

Additionally a set of three animal guards shall be included in each outdoor termination kit.

The normal service conditions of the terminations are as follows:

- the ambient air temperature does not exceed 45°C, and its average value measured over a period of 24 hours does not exceed 40°C;
- the ambient air temperature is not less than -10°C;
- the terminations installed in transformer cubicles, the maximum temperature due to sunlight/other heat sources such as transformers in the cubical does not exceed 80°C;
- maximum continuous cable conductor temperature 90°C;
- maximum emergency rating of the cable 105°C; and,
- the altitude does not exceed 1000 m.

Technical requirements for all terminations are set out in Clause 5.3.

5.2.1.3 Straight through Joints

The joints shall be supplied to join any combination of two cables out of the cables listed in Table 1 with the same operating voltage designation (except the 25 mm² and 70 mm² cables). Joints shall also be supplied to join any polymeric insulated cable listed in Table 2 with XLPE insulation to any cable with the same operating voltage designation listed in Table 1. An aerial bundle cable (ABC) shall be joined only to another NMSHVABC of the same operating voltage only.

XLPE insulated cables will be used to replace/repair cables insulated with other insulation materials such as paper. Straight through transition joints are required to join the paper insulated cables listed in Table 2 to any cable with same nominal operating voltage listed in Table 1.

Joint kits shall also be required to join paper insulated cable to paper insulated cable when repairing cable faults. A minimum number of paper to paper three core cable joint kits that cover the widest range of cable sizes provided in the Table 2, is preferred for this purpose.

All joints shall be straight through joints. Stub and/or tee joints are not required.

Joints are required in the following two types:

- heat applied
- cold applied pre-moulded/expandable/slip-on or resin filled.

All joints shall be suitable for installing in environments such as waterlogged outdoor cable trenches, partially covered pits or indoor cable basements. The ambient temperature and humidity may reach 50°C and 100% respectively.

Technical requirements for all straight through joints are set out in Clause 5.3

5.2.1.4 Trifurcation kits

A separate trifurcation kit suitable for trifurcating all three core cables listed in Table 1 shall be supplied. These trifurcation kits shall be used when terminating three core cables. The following two types of trifurcation kits are required with varying lengths of re-jacketing:

- Type 1 – 3200 mm lengths of re-jacketing (for terminations at indoor/outdoor switchgear); and,
- Type 2 – 600 mm lengths of re-jacketing (for UGOH terminations).

The technical details of the Type 1 and Type 2 trifurcation kits are provided in Clause 5.3.4.

Each trifurcation kit shall consist of a suitable glove, mastic tapes and three heavy duty (after recovery wall thickness not less than 2.2 mm) re-jacketing tubes as required by Clause 5.3.4.

5.3 Technical requirements

Technical requirements for all cable joints and terminations shall be as described below.

5.3.1 Compatibility of materials

The materials and installation techniques of the joints and terminations shall be physically, chemically, electrically and thermally compatible with the relevant cable material including materials used in trifurcation kits supplied by other manufacturers. If the materials of the joints and terminations offered are not compatible with any other joint materials used in the industry, the supplier shall specifically identify such materials with the offer. Preference shall be given for the offers with unrestricted compatibility.

5.3.2 Joint kits

All joints shall be range taking with shear bolt mechanical connectors that are suitable to join aluminium or copper conductors so that the joint kits required covering the entire range of cables, can be minimised.

Separate transition joint kits shall be provided for joining two cables having insulation different to each other (for example, kit for joining XLPE insulated cable to paper insulated cable).

5.3.2.1 *Metallic screening*

All joints, except for NMSHVABC cables, shall include a full metallic screening for the entire length of the joint. The metallic screen of the joint shall solidly connect to the copper wire screen or metallic sheath. The short-circuit rating of the metallic screen for the joints shall comply with the short-circuit rating of the metallic screen of the cable where the accessory is intended to be used (i.e. 13.1 kA/1 s or 20 kA/1 s as applicable).

The metallic screen shall be insulated from the external environment and shall be well protected against possible galvanic corrosion. Except for armoured cables or cables with jute clothed serving, the insulation of the screen shall be capable of withstanding multiple tests of 5 kV d.c. for one minute over the life of the termination. Therefore the rated insulation level of all materials used to insulate the screen shall withstand 10 kV d.c. for one minute. The test reports shall demonstrate the compliance to this requirement.

5.3.2.2 *Joints for armoured paper insulated cable*

The cable joint design for armoured paper insulated cables shall provide an electrical connection between armour wires and the metallic sheath of the cable. The physical continuity of armour across the joint is not essential. It is currently standard to plumb the armour wire to the metallic sheath and the copper wire mesh braid across the joint, at both ends so that the electrical continuity of the armour wires is maintained. Alternative methods such as mechanical connections shall also be provided for consideration if supported by relevant test certificates from accredited testing facility (refer Clause 5.4 for accreditation requirement).

5.3.2.3 *Joints for un-armoured paper insulated cable*

The metallic sheaths of cables shall be electrically connected across the joint using suitable tinned copper braid/wires via a mechanical connector (that has been suitably tested to the full fault current or kA²s equivalent) and not via wiping or plumbing onto the metallic sheath.

5.3.2.4 *Transition joints*

The design of transition joints involving combination of MIND and polymeric cables shall incorporate an effective and durable MIND compound block ensuring that the MIND compound does not migrate to the polymeric insulation under the allowable operating conditions of cables. This is a critical requirement as the impregnating compounds of the paper insulated cables have a damaging effect on the mechanical and electrical properties of the polymeric insulation.

5.3.2.5 *Connectors for connecting cores*

Each joint kit shall be provided with range taking mechanical connectors (links) with shear bolts that can be used to connect any two aluminium or copper cores. The connectors shall be type tested to satisfy the Class A requirements specified in AS/NZS 4325.1 and the type test reports with the certificate shall be provided in accordance with Clause 5.4.

The connectors shall be centrally blocked preventing any form of liquid migrating through the connector under all conditions of operation. Unless the connectors are machined from a solid bar without through drilling, the connectors shall be type tested similar to method described in Appendix B of AS/NZS 4805.2 to prove that they are hydraulically blocked and the type test certificates shall be provided.

Where a single connector to cover the full range is not available, a maximum of two connectors may be included in the kit.

The connectors used within the accessories shall be correctly identified in the assembly instructions with respect of the following;

- size range of the connector;
- assembly technique;
- tooling and necessary setting;
- preparation of contact surfaces; and,
- type, reference number and any other identification of the connector.

5.3.2.6 *Water blocking capability of joints and terminations*

Water migrated into the cable can travel along the cable through the interstices between strands of the conductor or interstices around screen wires or through the fillers of three core cables or various layers of sheathing material. All cable joints shall be capable of blocking the water transmission through the joint as well as any migration of water from the environment into the joint. Where necessary, mastic tapes shall be used to prevent water migration into the joint.

As a minimum, a suitable glove shall be installed at the crutch of the three core cable of the joint in a manner so that any water present in the cable shall be effectively blocked, therefore preventing water migration into the joint. Cables with more than one layer of sheathing material shall be stripped such that a step is created between different layers of sheathing and at each step a suitable sealant material such as mastic tapes shall be applied prior to installation of the glove.

All joints and elbow terminations shall be subjected to heat cycle test under water, as set out in Test 5 and Test 8 of Table 8 and Table 9 respectively.

5.3.2.7 *Other requirements*

All three core cable joints shall be capable of accommodating a phase cross over or phase roll within the space of the joint. Therefore, longer striping dimensions may be required on at least one side of the joint from the centre of the joint in order to allow the phase cross to be completed within the screened area of the cores. The transition joints shall be designed so that the cross-over occurs on the XLPE insulated cable.

The joint kits (transition) designed for paper insulated cables shall be suitable for both screened and belted cables.

5.3.2.8 *Environmental conditions of installation*

All joints shall be suitable for installation in outdoor pits or direct in stable but wet ground. The joint shall be able to be direct buried after being lowered to its final resting position within a reasonable settlement time. The settlement time shall not exceed one hour from the completion of the assembly work of the joint and shall be clearly specified in the installation instruction.

5.3.3 *Termination kit*

All terminations shall be range taking with shear bolt mechanical terminal palms so that one terminating kit can be capable of terminating as many cable sizes as possible listed in Table 1 and Table 2. The lists consist of a range of cables having conductor cross sectional areas from 26 mm² to 1200 mm² in aluminium or copper conductor material. However separate terminating kit may be offered for different cable insulation/construction types. All components of the termination shall be designed so that the terminations shall not impair the maximum current rating of the largest cable in the range nominated for the termination.

The termination kits for cables with conductor cross-sectional area equal to or greater than 630 mm² which are used in transmission/zone substations shall be supplied without terminal palms as the matching terminal palms suitable for variety of transmission/zone substation switchgears and transformer cable boxes shall be sourced from elsewhere.

The components of the termination kit that will be exposed to the sunlight when installed, shall be UV stabilised. The feature shall be supported with documentary evidences such as reports of tests conducted to Australian or International standards.

Three core cables shall be trifurcated using appropriate trifurcation kits prior to installation of terminations as described in clause 5.2.1.4.

The following three types of termination kits are required;

- outdoor termination - Outdoor UGOH terminations are required to connect the three core underground cables listed in Table 1 and Table 2 onto bare overhead lines through suitable bonds. Outdoor terminations are also required to connect NMSHVABC cables listed in Table 3, onto bare overhead lines through suitable bonds or onto UGOH termination directly;
- unscreened indoor termination - Indoor terminations are required to connect the underground cables listed in Table 1 onto indoor high voltage switchgear/air insulated transformer box. Indoor terminations are not required for paper insulated cables; and,
- screened elbow termination - Indoor screened elbow terminations are required to connect the underground cables listed in Table 1 onto high voltage transformer bushing of indoor/padmount transformers. Screened elbow terminations are not required for paper insulated cables and cables with conductor cross sectional area equal to or greater than 630 mm².

Each termination kit shall comprise of three terminations (i.e. one for each phase). One set of three cold applied insulating boots shall also be included in the unscreened indoor termination kit. The three core termination kits, where heatshrink or coldshrink technology is offered, shall be installed in combination with a relevant trifurcation kit, i.e. Type 1 or Type 2 as described in clause 5.2.1.4, when terminating a three core cable.

The pollution levels for determination of creepage distance of indoor and outdoor terminations shall be considered as medium and heavy respectively. Currently 22 kV indoor terminations are not used in Southern Region network of Endeavour Energy where the network is exposed to the wind from sea. Therefore the pollution level for 22 kV indoor terminations shall be considered as light.

Accordingly, the minimum nominal specific creepage distances for 11 kV indoor and outdoor terminations shall be 240 mm and 300 mm respectively, whereas for 22 kV indoor and outdoor terminations the creepage distances shall be 384 mm and 600 mm respectively. The creepage distances are based on the minimum nominal specific creepage distances recommended in Table II of AS4436 and Table 1 of IEC 60071-2.

The unscreened indoor terminations are required to be covered by a flexible cold applied boot to insulate (to the phase to phase voltage of the termination) the unscreened portion of the cable, bushing and the connection to the bushing. For terminations that incorporate sheds the boot is only required to cover the bushing and connection to the bushing (for example, not over the sheds).

The boots shall have anti-tracking properties and are to be made out of an EPR or Silicon compound and shall be compatible with the materials in the termination.

The insulating boots shall be rated to match the rated insulating voltage and the impulse withstand voltage of the termination and shall be substantiated by a separate type test report unless the type tests on termination are carried out with the boots on.

The minimum impulse-withstand voltage for the 11 and 22 kV terminations shall be of 95 and 150 kV respectively.

Each outdoor termination kit shall consist of three animal protection guards that cover all exposed conductive parts at the terminal palm when the terminal palm is connected to overhead line using an overhead bond covered with a suitable insulation. The guard should be able to accommodate the insulated overhead bond with outer diameter ranging from 12 mm to 29 mm. The material of the animal guard shall be UV protected and compatible with the insulation material used in the termination. When the animal guard is installed, the guard shall be reasonably tight to the termination and no rainwater shall be accumulated inside the guard. The animal guard shall not impair the creepage distance or any other insulation properties of the termination.

5.3.3.1 Outdoor UGOH termination kit

A typical arrangement of 11 kV or 22 kV UGOH termination is illustrated in Figure 1.

The terminal palms of outdoor terminations shall have two (2) slotted holes with a minimum centre separation of 32 mm that is suitable for 12 mm bolts. The outdoor terminating kit shall be installed in combination with Type 2 trifurcation kit (refer to clause 5.3.4). The length of the heavy duty (with thicker wall) re-jacketing tubes shall be not less than 600 mm which facilitate possible cross-over of the cores during phasing of the cable.

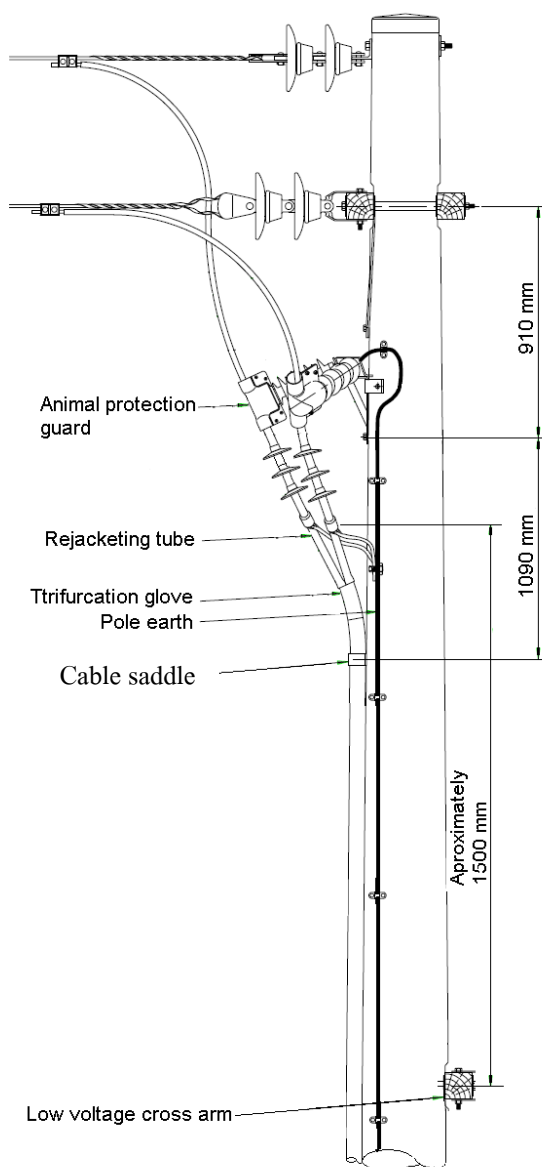


Figure 1 – Typical 11 or 22 kV UGOH termination

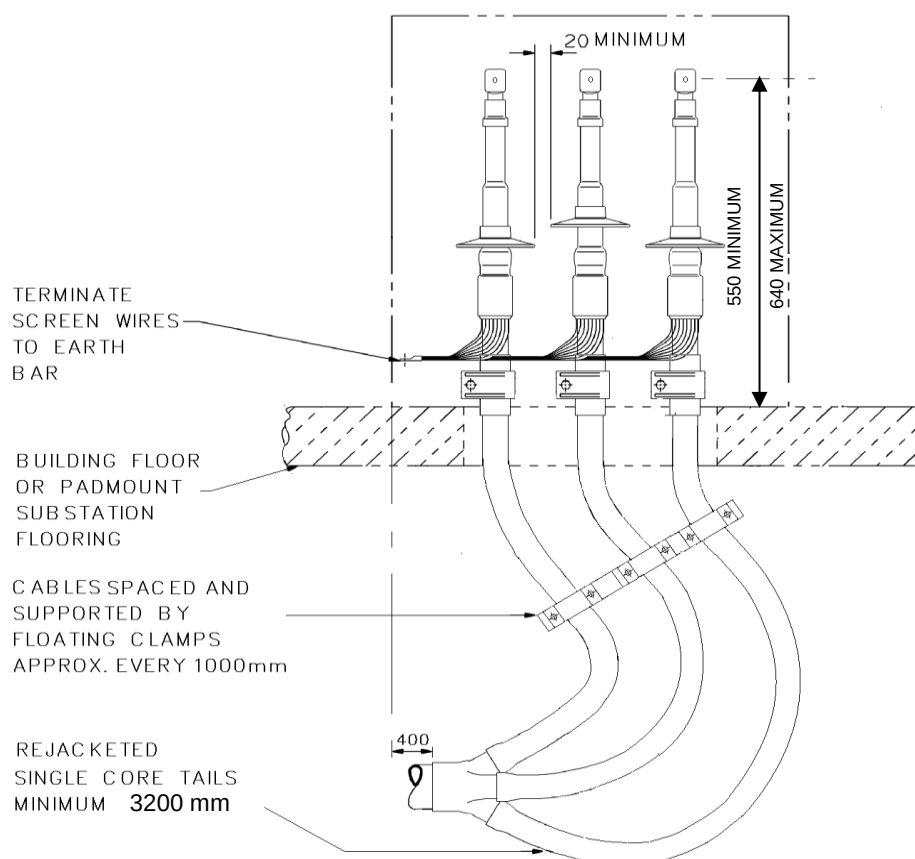
5.3.3.2 Indoor termination kit

A typical arrangement of a 22 kV indoor termination is illustrated in Figure 2. The terminations shall be suitable for connecting cables to the switchgear bushing which have only 100 mm phase separation between centres of the bushings (for 11 kV and 22 kV units). Flexible insulated boots are required to be installed (as specified in clause 5.3.3) to conceal the exposed live parts and part of the termination and the switchgear bushing in order to provide phase to phase insulation between phases.

The indoor termination shall be installed in combination with Type 1 trifurcation kit. The trifurcation glove and the re-jacketing insulating tubes of indoor termination kits shall be of heavy duty type (after recovery wall thickness not less than 2.2 mm). The length of the re-jacketing tubes shall be not less than 3200 mm.

The cables shall be trifurcated at the bottom of the culvert and heavy duty (after recovery wall thickness not less than 2.2 mm) re-jacketing tubes shall be installed on the individual cores over the wire screens without disturbing the wire screen which facilitates the installation of three individual single core terminations as illustrated in Figure 2.

The terminal palms of indoor terminations shall comprise of a single hole suitable for a 12 mm bolt except for cables with conductor cross sectional area equal or greater than 630 mm².



Note: All dimensions are in mm

Figure 2 – Indoor termination

5.3.3.3 Screened elbow termination (screened dead-break separable connectors)

The screened elbow terminations are used only on XLPE insulated cables.

The screened elbow terminations shall be dead break type rated at 24 kV and shall meet all the requirements including testing specified in AS/NZS 4805.1: 2007 based on which the following details are provided.

The elbow termination shall have an electrically conductive shield (screen) which is capable of collecting and discharging the surface charges to earth. Therefore, the termination shall have provisions for connecting an external earth connection to the shield. The shield earth connection should be able to disconnect or isolate without disconnecting or disassembling of the elbow termination in order to facilitate repeated cable sheath testing using 5 kV d.c. for one minute.

The termination shall be equipped with an integrated voltage detecting system (VDS) (for example, a capacitive test cap). Endeavour Energy relies on this device in their switching process to confirm the presence of any voltage on the incoming cables and therefore it is mandatory that the unit is of a failsafe design. The unit shall be able to be tested while in service, or out of service, to confirm that all of its components are functioning correctly including the wiring and connections to the capacitive coupling.

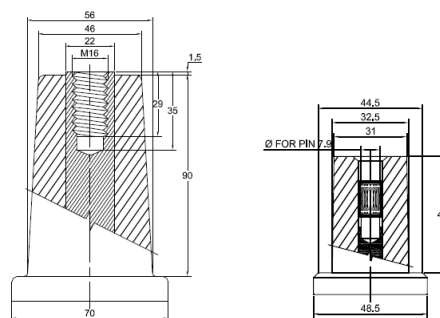
The VDS shall comply with IEC 61243-5 and shall be provided within all functional units to test the presence or absence of voltage in the cables. The VDS shall provide test points at the rear of the elbow termination to enable use of an external test device, such as a voltmeter or an indication lamp to check voltage presence or absence.

The connector materials shall be suitable for continuous service at conductor temperature of 90°C and the connectors shall be capable of carrying rated normal current and rated short time withstand through fault current under the normal service conditions specified in Clause 5.2.1.2, without;

- causing separation of mating contacts;
- causing flashover;
- experiencing a temperature rise likely to damage insulating material or other components when the short-time current is applied to a connector which has been continuously carrying rated normal current; and,
- impairing their ability to comply with the other requirements of this specification.

Stainless steel hold down bails shall be provided to non-bolted type elbows. Provision shall be made for the hold down bail to be effectively earthed either by virtue of its mounting or by separate connection.

The screened elbow terminations are used in terminating trifurcated cores (in case of three core cables) or single core cables onto 11 or 22 kV transformer bushings or bushings of metal-clad switchgear. The trifurcation kit Type 1 shall be selected when terminating a three core cable onto the bushings of transformer or metal-clad switchgear using elbow terminations. The elbow connections on transformers shall be secured by a hold down bail against the forces that can occur due to the rated fault current. The screened elbow shall suitably mate with dead break bushing Interface A or Interface C shown in Figure 3 below.



Interface Type C

Interface Type A

Figure 3 – Standard bushing Interfaces

Elbow terminations for Interface Type A shall have continuous rating not less than 200 A (which is the rated current of Type A bushing) and short time withstand through current rating of 4 kA/1 s. These terminations shall be suitable for connecting cables with cross sectional area 25 mm² or 70 mm² of copper conductors to transformer with Type A bushing where fuse/circuit breaker protection is provided.

Elbow terminations for interface Type C bushings shall have continuous rating not less than 630 A (same as the rating of Type C bushing) and minimum short time withstand through current rating of 13.1 kA/ 1 s. The terminations are secured and connected to the bushing using 16 mm bolt. These terminations shall be suitable for terminating cables with cross sectional area from 185 mm² to 300 mm², aluminium or copper conductor onto a Type C bushing. A typical bolted type elbow termination connection is shown on Figure 4 below.

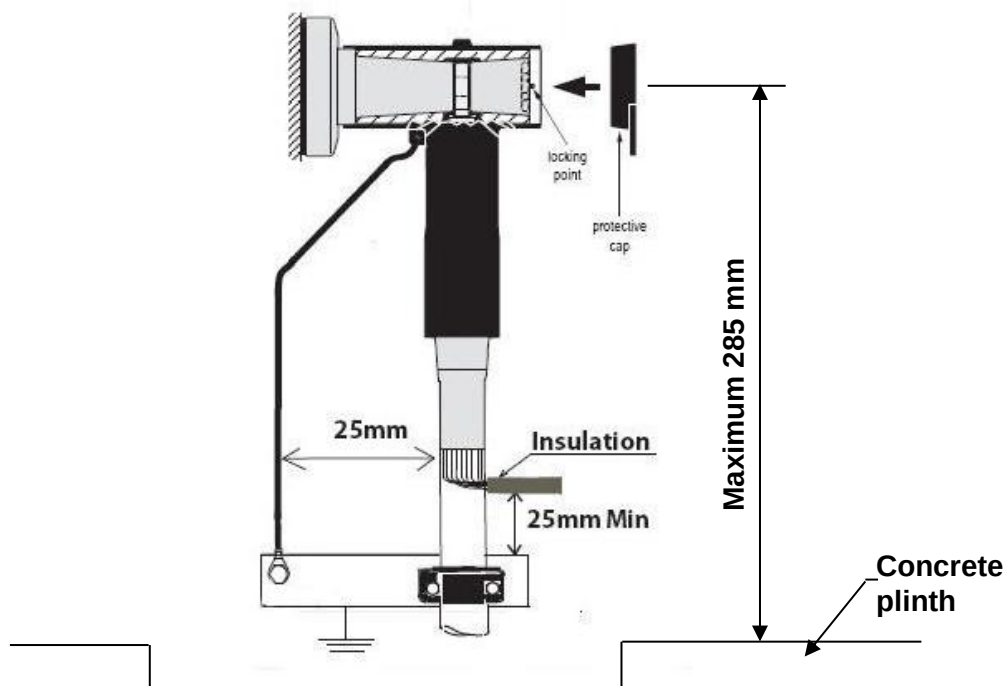


Figure 4 – Typical bolted type elbow termination with screen wires not earthed

5.3.4 Trifurcation kit

A trifurcation kit shall comprise of;

- a suitable trifurcation glove which shall be installed at the crutch of the three core cable of the termination;

- sealant material such as mastic tapes; and,
- three suitable insulating tubes (re-jacketing tubes having after recovery wall thickness not less than 2.2 mm) which shall be installed over the screen wires of the individual cores, after the trifurcation.

The inner surfaces of all openings of the glove shall be lined with glue/mastic that prevents ingress of moisture into the cable. Cables with more than one layer of sheathing material shall be stripped such that a step is created between different layers of sheathing and at each step a suitable sealant material such as mastic tapes shall be applied prior to installation of the glove.

Prior to installation of insulation tubing over individual cores, a suitable sealant material, such as mastic tapes, shall be applied over the fingers of the trifurcation glove or alternatively a coating of sealant material on the inner surface of the end of the re-jacketing tubes shall be provided;

The kits shall be capable of withstanding multiple tests of 5 kV d.c. for one minute over the life of the termination. Therefore the rated insulation level of all materials used to insulate the screen shall withstand 10 kV d.c. for one minute. The trifurcation kit shall be used in combination with indoor, outdoor or screened elbow terminations. There shall be two types of trifurcation kits as described below.

- Type 1 trifurcation kit

Type 1 trifurcation kit shall constitute of a heavy duty three fingered trifurcation glove, three (3) heavy duty (after recovery wall thickness not less than 2.2 mm) re-jacketing tubes each not less than 3200 mm long and mastic tapes as required. The application is set out in Clause 5.3.3.2.

- Type 2 trifurcation kit

Type 2 trifurcation kit shall constitute of a heavy duty three fingered trifurcation glove, three (3) heavy duty (after recovery wall thickness not less than 2.2 mm) re-jacketing tubes each not less than 600 mm long and mastic tapes as required. The application is as set out in Clause 5.3.3.1.

5.4 Testing and supporting evidence

All tests except in-house tests, specified within this specification are type tests.

All costs associated with type, sample (batch) or routine tests shall be borne by the manufacture/supplier. Endeavour Energy shall not be held responsible for any costs associated with testing and Endeavour Energy will not be paying or reimbursing the manufacturer/supplier for the cost associated with testing or any other costs associated with the submission.

Several categories of products included in this specification require a series of tests in accordance with relevant Australian standards. Where the product offered has been tested to different international/industry standards, the supplier shall detail the differences between the two standards and provide a copy of the relevant standard, in English, to which the product has been tested. Any test found to be inferior to the test specified in the relevant Australian standards, the test shall not be acceptable.

All the technical information relevant to the product offered, not limiting to the information requested in this document, shall be provided.

All joints, terminations and their accessories shall be type tested appropriately as specified in this clause, which is prepared in accordance with this standard, AS/NZS 4805.1, AS/NZS 4805.2, IEC 61442 and AS/NZS 4325.1. Acceptance of the test results is independent of conductor material. However, approval of range of conductor cross-sectional areas shall be as specified in Clause 5.5 of this document.

The assembly of accessories to be tested shall comply with all the requirements specified in Section 2 of AS/NZS 4805.1 (accessories for polymeric insulated cables) and AS/NZS 4805.2 (accessories for paper insulated cables), as applicable.

Tests performed on three core accessories shall be deemed to cover single core accessories of the same design. The converse shall not apply. Tests performed on accessories installed on cables having shaped conductors shall be deemed to cover the same type of accessory when used on cables having circular conductors but the converse shall not apply.

The type tests of accessories proposed for polymeric insulated cables shall be carried out on terminations, joints and elbow terminations as set out in Table 6, Table 8, Table 9, Table 12, Table 14 and Table 15 of this specification as appropriate which are prepared according to AS/NZS 4805.1, IEC 61442 and AS/NZS 4325.1. The cables used for testing shall comply with AS/NZS 1429.1 or IEC 60502-2 and shall be of the same voltage as the accessories to be tested. The cables shall be correctly identified as in Appendix A of AS/NZS 4805.1:2007.

The type tests of accessories for paper insulated cables including transition joints shall be carried out as set out in Table 7, Table 11 and Table 12 of this specification as appropriate which are prepared according to AS/NZS 4805.2, IEC 61442 and AS/NZS 4325.1. The cables used for testing shall comply with AS/NZS 1026 or IEC 60055-1. The cables shall be correctly identified in accordance with Appendix A of AS/NZS 4805.2:2007, Paragraph A1 for paper insulated cables and Paragraphs A1 and A2 for the purpose of transition joints.

The conductor temperature in normal (continuous) operation and short circuit operations shall be as specified in AS/NZS 1026 and AS/NZS 1429.1 for cables with impregnated paper insulation and extruded insulation respectively.

The type tests on transition joints shall be carried out as set out on Table 11 and Table 12 of this specification which is prepared according to AS/NZS 4805.2 and AS/NZS 4325.1.

All type tests shall be carried out according to the sequence of the tests in the above tables. Each outdoor termination kit shall consist of three animal protection guards, but the tests may be carried out without the guards.

All product approval/testings forms such as FAE 3151 and FAE 3152, referenced in Clause 3.0 shall be completed and submitted to Endeavour Energy's Network Mains Manager for review/approval.

All type tests shall be carried out by a testing authority holding accreditation:

- by NATA Australia; or,
- by an accreditation authority recognised by NATA Australia.

Tests from other testing authorities, such as KEMA, may be accepted at the discretion of Network Mains Manager.

All type test reports shall be accompanied by copies of the accreditation certificate(s) issued to the testing laboratory. The accreditation certificate(s) shall be valid for the relevant test(s) and for the duration of the test(s).

Type tests shall be less than five (5) years old. Type tests beyond this limit may be acceptable at the discretion of the Network Mains Manager, if sufficient information can be provided to show that the manufacturing process, raw materials, design and quality control processes have not significantly changed since the original test date.

Reports / Tests written in any language other than English shall not be accepted unless the reports are translated into English by a sworn translator.

The samples supplied by the supplier as required by Clause 5.10, shall be subjected to an in-house testing described in Clause 5.4.2 in this document, prior to approval of the product. The products shall be installed on a piece of cable by a qualified cable jointer nominated by Endeavour Energy at Hoxton Park Training facility under the supervision of the supplier/manufacturer. Endeavour Energy testing staff shall carry out the tests.

5.4.1 Designation of voltages

The following values for U_m , U_0 and U corresponding to the given nominal system voltages shall be used for determining test voltages.

Table 4: Designation of voltages for test purposes

Nominal system voltage (kV)	U_m (kV)	U_0 (kV)	U (kV)
6.35/11	12	6	10
12.7/22	24	12	20

5.4.2 In-house testing

As a part of the approval process, a joint from each type shall be subjected to a series of in-house testing described below. The applicant/supplier shall supply a non-returnable sample from each type of joints and terminations offered as required by the Clause 5.10 which shall be installed on a cable and the following tests in Table 5 will be carried out;

Table 5: Sequence of in-house testing

Sequence	Test	Description	Criteria
1	Insulation resistance measurement prior to joining.	Each end of the two cables proposed for the joint shall be stripped and prepared for joining as per the joint instructions supplied with the sample. The insulation resistance between conductors and each conductor/screen wires to earth on each cable piece shall be measured, after cleaning of the exposed insulation of the cables. During each measurement all free cores/screen wires shall be electrically connected together to screen wires.	Values shall be recorded for comparison purposes.
2	Insulation resistance measurement after joining.	The joint shall be completed strictly to the joint instructions accompanied with the sample. At the end of the minimum allowable settlement time given in the joint instruction, the insulation resistance between conductors and each conductor to screen wires of joined cable shall be measured. The outside temperature of the joint shall also be recorded. During each measurement all free cores/ shall be electrically connected together to the screen wires.	Values shall be within 10% that of Sequence 1 when converted to 20°C and no abnormal difference are found with the values of individual core insulations.

Sequence	Test	Description	Criteria
3	Insulation resistance measurement of the completed joint immersed in water.	Immediately after the measurements in Sequence 2, the completed joint shall be laid horizontally immersed in water to a minimum depth of 300 mm to the top of the joint and the insulation resistance between conductors and each conductor/screen wires to earth (the body of water) shall be measured. The water temperature shall also be recorded. During each measurement all free cores/screen wires shall be electrically connected together to earth.	Values shall be within 5% that of Sequence 2 when converted to 20°C and no abnormal difference are found with the values of individual core insulations.
4	Insulation resistance measurement of the completed joint immersed in water for seven days.	The joint shall be left immersed in water for a minimum period of seven days and the insulation resistance shall be measured as described in Sequence 3 above.	Values shall be within 5% that of Sequence 3 when converted to 20°C and no abnormal difference are found with the values of individual core insulations.
5	Visual inspection test for migration of water in to the joint	The joint shall be taken out of the water and make free of water droplets. The joint shall be carefully dismantled while examining for any ingress of water/moisture inside the joint.	There shall be no water/moisture inside the joint.

Note: The insulation resistance shall be measured using 10 kV Meggar and the same Meggar shall be used for measurement of insulation in all four Sequences.

5.4.3 Type tests on terminations for extruded insulated cables (not including elbow)

The following type tests in Table 6, which is prepared based on the information provided in Table 4 of AS/NZS 4805.1:2007, shall be carried out on polymeric insulated cable terminations, except elbow terminations, installed on a cable having conductor cross-sectional area of either 120 mm², 150 mm² or 185 mm².

Unless otherwise specified in the Test description/criteria column of the table, all tests shall be carried out at ambient temperature. All tests shall be carried out to the relevant method described in IEC 61442.

Table 6: The sequence and requirements for type tests on terminations for cables with extruded insulation, except elbow terminations

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 4 Test 1	Voltage withstand	Shall withstand $4.5U_0$ a.c. for 5 min. or $4U_0$ d.c. for 15 min. The test arrangement and sequence shall be as given in sequence 1.1, 1.2 and 1.3 of Figure 1 of AS/NZS4805.1
	Voltage withstand wet	This test is for outdoor terminations only. Shall withstand $4U_0$ a.c. for 1 min. The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS4805.1
AS/NZS 4805.1 Table 4 Test 2	Partial discharge	This test is not required for terminations installed on cables having unscreened insulation. 10pC maximum at $1.73U_0$. The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS4805.1
AS/NZS 4805.1 Table 4 Test 3	Impulse test at maximum cable conductor temperature in normal operation +5 K to +10 K	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for terminations rated at 11 kV and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS4805.1
AS/NZS 4805.1 Table 4 Test 4	Heating cycles in air.	Shall withstand when subjected to 60 heating cycles at $2.5U_0$. The heating cycle in air shall be of at least eight (8) hour duration with at least two (2) hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442). The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 5	Partial discharge at maximum cable conductor temperature in normal operation +5 K to +10 K and at ambient temperature.	This test is not required for terminations installed on cables having unscreened insulation. 10 pC maximum at $1.73U_0$. Partial discharge at elevated temperature is measured at the end of the heating period. The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 4 Test 6	Thermal short circuit (screen)	Two short circuits at the short-circuit rating of the wire screen of the cable that the accessory is intended to be used (i.e. at least at 13.1 kA for 1 sec or 20 kA for 1 sec as applicable). Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 1.2 and 1.3 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 7	Thermal short circuit (conductor)	Two (2) short circuits to raise the conductor to maximum permissible short circuit temperature of the conductor. Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 1.2 and 1.3 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 8	Dynamic short circuit	This test is a three phase test and only required for single core cable terminations design for initial peak currents larger than 80 kA and for three core cable terminations design for initial peak currents of larger than 63 kA. One (1) short circuit at short circuit current (initial peak value) in the conductor. The value shall be declared by the manufacturer. No visible deterioration. The test arrangement and sequence shall be as given in sequence 1.3 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 9	Impulse	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 and 150 kV for terminations rated at 11 and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 1.1, 1.2 and 1.3 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 10	a.c. Voltage withstand	Shall withstand $2.5U_0$ a.c. for 15 min. The test arrangement and sequence shall be as given in sequence 1.1, 1.2 and 1.3 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 11	Humidity	This test is for indoor terminations only. Shall be subjected to $1.25U_0$ a.c. for 300 hours minimum. The test arrangement and sequence shall be as given in sequence 1.4 of Figure 1 of AS/NZS 4805.1 No breakdown or flashover. No more than three trippings. No substantial damage as per the details of assessment provided in Table 13 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 4 Test 12	Salt fog	This test is for outdoor terminations only. Shall be subjected to $1.25U_0$ a.c. for 1000 hours minimum. The test arrangement and sequence shall be as given in sequence 1.5 of Figure 1 of AS/NZS 4805.1 No breakdown or flashover. No more than three trippings. No substantial damage as per the details of assessment provided in Table 13 of AS/NZS 4805.1
AS/NZS 4805.1 Table 4 Test 13	Examination	Accessory is examined for signs of; • cracking in the filling media and/or tape or tube component; and/or • a moisture path across a primary seal; and/or • corrosion and/or tracking and/or erosion which could, in time, lead to failure of the accessory; and/or • leakage of any insulating material. The test arrangement and sequence shall be as given in sequence 1.1, 1.2, 1.3, 1.4 and 1.5 of Figure 1 of AS/NZS 4805.1

5.4.4 Type tests on terminations for paper insulated cables

The following type tests in Table 7, which is prepared based on the information provided in Table 2 of AS/NZS 4805.2:2007, shall be carried out on paper insulated cable terminations installed on a cable having conductor cross-sectional area of either 120 mm², 150 mm², 185 mm², 240 mm² or 300 mm².

Unless otherwise specified in the Test description/criteria column of the table, all tests shall be carried out at ambient temperature. All tests shall be carried out to the relevant method described in IEC 61442.

Table 7: Test sequence and requirements for type tests on terminations for paper insulated cables

Test reference	Test name	Test description/criteria
AS/NZS 4805.2 Table 2 Test 1	Voltage withstand	Shall withstand $4.5U_0$ a.c. for 5 min. or $6U_0$ d.c. for 15 min. The test arrangement and sequence shall be as given in sequence 1.1, 1.2 and 1.3 of Figure 1 of AS/NZS4805.2
	Voltage withstand wet	This test is for outdoor terminations only. Shall withstand $4U_0$ a.c. for 1 min. The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS4805.2
AS/NZS 4805.2 Table 2 Test 2	Impulse test at maximum cable conductor temperature in normal operation + 0K to +5 K	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV for terminations rated at 11 kV. The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS4805.2

Test reference	Test name	Test description/criteria
AS/NZS 4805.2 Table 2 Test 3	Heating cycles in air.	Shall withstand when subjected to 60 heating cycles at $1.5U_0$. The heating cycle in air shall be of at least eight (8) hour duration with at least two (2) hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442). The test arrangement and sequence shall be as given in sequence 1.1 of Figure 1 of AS/NZS 4805.2
AS/NZS 4805.2 Table 2 Test 4	Thermal short circuit (conductor)	Two (2) short circuits to raise the conductor to maximum permissible short circuit temperature of the conductor. Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 1.2 and 1.3 of Figure 1 of AS/NZS 4805.1
AS/NZS 4805.2 Table 2 Test 5	Dynamic short circuit	This test is a three phase test and only required for single core cable terminations design for initial peak currents larger than 80 kA and for three core cable terminations design for initial peak currents of larger than 63 kA. One (1) short circuit at short circuit current (initial peak value) in the conductor. The value of the short circuit current shall be declared by the manufacturer. No visible deterioration. The test arrangement and sequence shall be as given in sequence 1.3 of Figure 1 of AS/NZS 4805.2
AS/NZS 4805.2 Table 2 Test 6	Impulse	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 for terminations rated at 11 kV. The test arrangement and sequence shall be as given in sequence 1.1, 1.2 and 1.3 of Figure 1 of AS/NZS 4805.2
AS/NZS 4805.2 Table 2 Test 7	a.c. Voltage withstand	Shall withstand $2.5U_0$ a.c. for 15 min. The test arrangement and sequence shall be as given in sequence 1.1, 1.2 and 1.3 of Figure 1 of AS/NZS 4805.2
AS/NZS 4805.2 Table 2 Test 8	Humidity	This test is for indoor terminations only. Shall be subjected to $1.25U_0$ a.c. for 300 hours minimum. The test arrangement and sequence shall be as given in sequence 1.4 of Figure 1 of AS/NZS 4805.2. No breakdown or flashover. No more than three trippings. No substantial damage as per the details of assessment provided in Table 4 of AS/NZS 4805.2.

Test reference	Test name	Test description/criteria
AS/NZS 4805.2 Table 2 Test 9	Salt fog	This test is for outdoor terminations only. Shall be subjected to $1.25U_0$ a.c. for 1000 hours minimum. The test arrangement and sequence shall be as given in sequence 1.5 of Figure 1 of AS/NZS 4805.2. No breakdown or flashover. No more than three trippings. No substantial damage as per the details of assessment provided in Table 4 of AS/NZS 4805.2.
AS/NZS 4805.2 Table 2 Test 10	Hydraulic pressure	The test shall be carried out as detailed in Appendix C of AS/NZS 4805.2. There shall be no leakage of cable compound observed at either of the two terminations when the internal pressures of the cable is maintained at 400 kPa and at conductor temperature of $97\pm 2^\circ\text{C}$ for at least 1 hour.

5.4.5 Type tests on joints for polymeric insulated cables

The following type tests in Table 8, which is prepared based on the information provided in Table 5 of AS/NZS 4805.1, shall be carried out on polymeric insulated straight joints, except transition joints, installed on a cable having conductor cross-sectional area of either 120 mm², 150 mm² or 185 mm².

Unless otherwise specified in the Test description/criteria column of the table, all tests shall be carried out at ambient temperature. All tests shall be carried out to the relevant method described in IEC 61442.

Table 8: The sequence and requirements for type tests on joints for polymeric insulated cables except transition joints

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 5 Test 1	Voltage withstand	Shall withstand $4.5U_0$ a.c. for 5 min. or $4U_0$ d.c. for 15 min. The test arrangement and sequence shall be as given in sequence 2.1, 2.2 and 2.3 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 2	Partial discharge	This test is not required for joints installed on cables having unscreened insulation. 10 pC maximum at $1.73U_0$. The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 3	Impulse test at maximum cable conductor temperature in normal operation +5 K to +10 K	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for joints rated at 11 kV and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 5 Test 4	Heating cycles in air.	Shall withstand when subjected to 30 heating cycles at $2.5U_0$. The heating cycle in air shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442). The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 5	Heating cycles under water	Shall withstand when subjected to 30 heating cycles at $2.5U_0$. The heating cycle under 1.0m of water shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442). The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 6	Partial discharge at maximum cable conductor temperature in normal operation +5 K to +10 K and at ambient	This test is not required for joints installed on cables having unscreened insulation. 10 pC maximum at $1.73U_0$. Partial discharge at elevated temperature is measured at the end of the heating period. The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 7	Thermal short circuit (screen)	Two short circuits at the short-circuit rating of the wire screen of the cable that the accessory is intended to be used (i.e. at least at 13.1 kA for 1 sec or 20 kA for 1 sec as applicable). Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 2.2 and 2.3 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 8	Thermal short circuit (conductor)	Two short circuits to raise the conductor to maximum permissible short circuit temperature of the conductor. Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 2.2 and 2.3 of Figure 2 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 5 Test 9	Dynamic short circuit	One short circuit at short circuit current (initial peak value) in the conductor. The value shall be declared by the manufacturer. No visible deterioration. The test arrangement and sequence shall be as given in sequence 2.3 of Figure 2 of AS/NZS 4805.1 <i>Note: This test is a three phase test and only required for single core cable terminations design for initial peak currents larger than 80 kA and for three core cable terminations design for initial peak currents of larger than 63 kA. The peak short circuit current of the cable where the terminations are installed does not exceed these limits, the test is not required.</i>
AS/NZS 4805.1 Table 5 Test 10	Impulse	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for terminations rated at 11 kV and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 2.1, 2.2 and 2.3 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 11	a.c. Voltage withstand	Shall withstand $2.5U_0$ a.c. for 15 min. The test arrangement and sequence shall be as given in sequence 2.1, 2.2 and 2.3 of Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 5 Test 12	Examination	Accessory is examined for signs of; • cracking in the filling media and/or tape or tube component; and/or • a moisture path across a primary seal; and/or • corrosion and/or tracking and/or erosion which could, in time, lead to failure of the accessory; and/or • leakage of any insulating material. The test arrangement and sequence shall be as given in sequence 2.1, 2.2, and 2.3 of Figure 2 of AS/NZS 4805.1

5.4.6 Type tests on screened elbow terminations

The following type tests in Table 9, which is prepared based on the information provided in Table 7 of AS/NZS 4805.1:2007, shall be carried out on polymeric insulated elbow terminations installed on a cable having conductor cross-sectional area as indicated in Table 10 which has been prepared based on Table 1 of AS/NZS 4805.1:2007.

Unless otherwise specified in the Test description/criteria column of the table, all tests shall be carried out at ambient temperature. All tests shall be carried out to the relevant method described in IEC 61442.

Table 9: The sequence and requirements for Type tests on elbow terminations

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 7 Test 1	Voltage withstand	Shall withstand $4.5U_0$ a.c. for 5 min. or $4U_0$ d.c. for 15 min. The test arrangement and sequence shall be as given in sequence 4.1, 4.2 and 4.3 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 2	Partial discharge	10 pC maximum at $1.73U_0$. The test arrangement and sequence shall be as given in sequence 4.1 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 3	Impulse test at maximum cable conductor temperature in normal operation +5 K to +10 K	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for joints rated at 11 kV and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 4.1 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 4	Thermal short circuit (screen)	Two short circuits at the short-circuit rating of the wire screen of the cable that the accessory is intended to be used (i.e. at least at 13.1 kA for 1 sec or 20 kA for 1 sec as applicable). Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 4.2 and 4.3 of Figure 4 of AS/NZS 4805.1 <i>Note: If the purpose of the screen of the termination is only for draining of the surface charge to earth, this test is not mandatory</i>
AS/NZS 4805.1 Table 7 Test 5	Thermal short circuit (conductor)	Two short circuits to raise the conductor to maximum permissible short circuit temperature of the conductor. Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The test arrangement and sequence shall be as given in sequence 4.2 and 4.3 of Figure 4 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 7 Test 6	Dynamic short circuit	One short circuit at short circuit current (initial peak value) in the conductor. The value shall be declared by the manufacturer. No visible deterioration. The test arrangement and sequence shall be as given in sequence 4.3 of Figure 4 of AS/NZS 4805.1 <i>Note: This test is a three phase test and only required for single core cable terminations design for initial peak currents larger than 80 kA and for three core cable terminations design for initial peak currents of larger than 63 kA. The peak short circuit current of the cable where the termination is installed does not exceed these limits. Therefore the test is not required.</i>
AS/NZS 4805.1 Table 7 Test 7	Heating cycles in air.	Shall withstand when subjected to 30 heating cycles at $2.5U_0$. The heating cycle in air shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442:2005). The test arrangement and sequence shall be as given in sequence 4.1 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 8	Heating cycles under water	Shall withstand when subjected to 30 heating cycles at $2.5U_0$. The heating cycle under 1.0m of water shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442). The test arrangement and sequence shall be as given in sequence 4.1 of Figure 4 of AS/NZS 4805.1.
AS/NZS 4805.1 Table 7 Test 9	Disconnect/connect	Five times. No visible damage to contact. The test shall be carried out only when the cable is de energised. The test arrangement and sequence shall be as given in sequence 4.1, 4.2 and 4.3 of Figure 4 of AS/NZS 4805.1.
AS/NZS 4805.1 Table 7 Test 10	Partial discharge at maximum cable conductor temperature in normal operation +5 K to +10 K	10 pC maximum at $1.73U_0$. Measurement is made at the end of the heating period. The test arrangement and sequence shall be as given in sequence 4.1 of Figure 4 of AS/NZS 4805.1.

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 7 Test 11	Impulse	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for terminations rated at 11 kV and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 4.1, 4.2 and 4.3 of Figure 4 of AS/NZS 4805.1.
AS/NZS 4805.1 Table 7 Test 12	a.c. voltage withstand test	Shall withstand $2.5U_0$ a.c. for 15 min. The test arrangement and sequence shall be as given in sequence 4.1, 4.2 and 4.3 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test13	Operating eye	Shall withstand axial force of 1300 N and torque 14 Nm for 1 min. This test is only required for screened elbow terminations with sliding contact. Screen elbows with bolted connection are exempted. The test arrangement and sequence shall be as given in sequence 4.4 of Figure 4 of AS/NZS 4805.1.
AS/NZS 4805.1 Table 7 Test 14	Partial discharge	10 pC maximum at $1.73U_0$. The test arrangement and sequence shall be as given in sequence 4.4 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 15	Examination	Accessory is examined for signs of; • cracking in the filling media and/or tape or tube component; and/or • a moisture path across a primary seal; and/or • corrosion and/or tracking and/or erosion which could, in time, lead to failure of the accessory; and/or • leakage of any insulating material. The test arrangement and sequence shall be as given in sequence 4.1, 4.2, and 4.3 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 16	Screen resistance	Maximum 5000 Ω . The test is carried out on separate samples and no cable is required. The test arrangement and sequence shall be as given in sequence 4.1, 4.2, 4.3 and 4.4 of Figure 4 of AS/NZS 4805.1
AS/NZS 4805.1 Table 7 Test 17	Screen leakage current	Maximum of 0.5 mA at U_m . The test is carried out on separate sample and an appropriate cable length to be used. The test arrangement and sequence shall be as given in sequence 4.1, 4.2, 4.3 and 4.4 of Figure 4 of AS/NZS 4805.1.

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 7 Test 18	Fault current initiation	The test is carried out for solidly earth system and the fault initiation shall occur within 3 sec. This is interpreted as the initiation of the arc fault on the outer screen of the termination shall occur within 3 sec. from commencement of the fault current feeding to the faulted test piece. The test circuit is adjusted to impose fault current of 10 kA r.m.s. at phase to earth voltage no more than U_0 and having minimum current flow duration of 0.2 sec. during the two tests. The test is required for elbow terminations without metallic housing or with a removable metallic housing. The metallic housing shall be removed prior to the test. The test is carried out on separate sample and appropriate cable lengths are to be used. The test arrangement and sequence shall be as given in sequence 4.1, 4.2, 4.3 and 4.4 of Figure 4 of AS/NZS 4805.1: 2007.
AS/NZS 4805.1 Table 7 Test 19	Operating force	Force <900 N. This test is not required for elbow terminations with bolted connection. The test is carried out on separate samples and no cable is required. The test arrangement and sequence shall be as given in sequence 4.1, 4.2, 4.3 and 4.4 of Figure 4 of AS/NZS 4805.1.
AS/NZS 4805.1 Table 7 Test 20	Capacitive test point	Capacitance of test point to cable conductor; $C_{tc} > 1.0 \text{ pF}$. Ratio of capacitance of test point to earth (C_{te}) and C_{tc} shall be; $C_{te}/C_{tc} \leq 12.0$. The test is carried out on separate sample and an appropriate cable length to be used.

Table 10: Conductor cross-sectional area for testing of Elbow-terminations*

Elbow termination Rating (Amps)	Nominal cross-sectional area of conductor (mm ²)	
	Copper	Aluminium
200/250	50	70
400	95	150
600/630	185	300
800	300	400
1250	500	630

*

Notes:

1. The current value should be sufficient to achieve the specified conductor temperature relevant to the test
2. The use of these conductor cross-sectional areas may lead to overheating of the bushing while achieving the required conductor temperature. Under these circumstances, it is permissible to use a conductor cross-sectional area one size smaller. If a bushing failure occurs, the test should be declared void as set out in Clause 4.5.2 of AS 4805.1.

5.4.7 Type tests on transition joints or joints for paper insulated cables

The following type tests in Table 11, which is prepared based on the information provided in Table 3 of AS/NZS 4805.2:2007, shall be carried out on transition joints installed on a cable having conductor cross-sectional area of either 120 mm², 150 mm², 185 mm², 240 mm² or 300 mm². Approval is restricted to the electrical design and type of cable (that is, belted or screened draining or non-draining) on which tests have been conducted.

Unless otherwise specified in the test description/criteria column of the table, all tests shall be carried out at ambient temperature. All tests shall be carried out to the relevant method described in IEC 61442.

Table 11: The sequence and requirements for Type Tests on transition joints

Test reference	Test name	Test description/criteria
AS/NZS 4805.2 Table 3 Test 1	Voltage withstand	Shall withstand $4.5U_0$ a.c. for 5 min. or $6U_0$ d.c. for 15 min. The test arrangement and sequence shall be as given in sequence 2.1, 2.2 and 2.3 of Figure 2 of AS/NZS 4805.2
AS/NZS 4805.2 Table 3 Test 2	Impulse test at maximum cable conductor temperature in normal operation +5K to +10 K	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 and 150 kV for joints rated at 11 and 22 kV respectively. The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.2
AS/NZS 4805.2 Table 3 Test 3	Heating cycles in air.	Shall withstand when subjected to three heating cycles at $1.5U_0$. The heating cycle in air shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442:2005). The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.2

Test reference	Test name	Test description/criteria
AS/NZS 4805.2 Table 3 Test 4	Thermal cycles under water	Shall withstand when subjected to 60 heating cycles at $1.5U_0$. The heating cycle in air shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation $+5K$ to $+10 K$ followed by at least 3 hour of natural cooling to within $10 K$ of ambient temperature (refer to clause 9 of IEC 61442). For cables and joints with continuous metallic covering this test may be carried out in air. The test arrangement and sequence shall be as given in sequence 2.1 of Figure 2 of AS/NZS 4805.2
AS/NZS 4805.2 Table 3 Test 5	Thermal short circuit (conductor)	Two short circuits to raise the conductor to maximum permissible short circuit temperature of the conductor. Thermal short circuit may be combined with dynamic short circuit. No visible deterioration. The testing parameters of the cable shall be those for the lower temperature rated cable. The test arrangement and sequence shall be as given in sequence 2.2 and 2.3 of Figure 2 of AS/NZS 4805.2
AS/NZS 4805.2 Table 3 Test 6	Dynamic short circuit	This test is a three phase test and only required for single core cable terminations design for initial peak currents larger than $80 kA$ and for three core cable terminations design for initial peak currents of larger than $63 kA$. One (1) short circuit at short circuit current (initial peak value) in the conductor. The value shall be declared by the manufacturer. No visible deterioration. The test arrangement and sequence shall be as given in sequence 2.3 of Figure 2 of AS/NZS 4805.2
AS/NZS 4805.2 Table 3 Test 7	Impulse	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be $95 kV$ and $150 kV$ for terminations rated at $11 kV$ and $22 kV$ respectively. The test arrangement and sequence shall be as given in sequence 2.1, 2.2 and 2.3 of Figure 2 of AS/NZS 4805.2
AS/NZS 4805.2 Table 3 Test 8	a.c. Voltage withstand	Shall withstand $2.5U_0$ a.c. for 15 min. The test arrangement and sequence shall be as given in sequence 2.1, 2.2 and 2.3 of Figure 2 of AS/NZS 4805.2

5.4.8 Type tests on connectors/links and lugs for all joints and terminations.

The connectors/links and lugs shall be type tested to satisfy the Class A requirements specified in AS/NZS 4325.1. The following type tests in Table 12, which is prepared based on the information provided in AS/NZS 4325.1, shall be carried out on connectors/links and lugs.

All tests shall be carried out to the relevant method described in AS/NZS 4325.1.

Table 12: Type tests on connectors/links and lugs

Test reference	Test name	Test description/criteria
AS/NZS 4325.1 Clause 6	Electrical tests	Each parameter shall have maximum values given in Table 2 of AS/NZS 4325.1:1995 that relevant to mechanical connectors.
AS/NZS 4325.1 Clause 7	Mechanical tests	No slip shall occur during the one minute tensile test under the given condition; and the force applied as in Table 3 of AS/NZS 4325.1:1995.

5.5 Range of approval

5.5.1 Joints and terminations for cables with extruded insulation

The following conditions which have been prepared in accordance with the requirement specified in Clause 3 of AS/NZS 4805.1 shall apply:

- Approval of a range of conductor cross sectional areas from 95 mm² to 300 mm² of one type of accessory shall be obtained by successfully completing the full range of type tests specified in this standard, by installing the accessory deemed to test on a cable having nominal conductor cross section area 120 mm², 150 mm² or 185 mm². Extension of approval to a range wider than that given above shall be achieved by carrying out the additional tests listed in Clause 5.5.5 Table 14, which is prepared based on Table 10 in AS/NZS 4085.1, on the smallest and /or largest conductor cross-sectional area of the required range.
- Tests performed on accessories installed on cables having shaped conductors shall be deemed to cover the same type of accessory when used on cables having circular conductors. The converse shall not apply.
- Range of approval for elbow terminations with regard to a range of cable cross sectional areas shall be achieved by carrying out the tests as set out in Clause 5.5.2.
- The additional tests as specified in Clause 5.5.6 and Table 15, which is prepared based on Table 11 of AS/NZS 4805.1, shall be carried out to achieve extension of approval of the accessory for different types of cable insulation screen or different cable conductor shapes from the construction of the cable that used in testing of the accessory.
- Approval of an accessory tested for a specified U_0 shall extend to operation of the joint or the termination at a lower U_0 .
- The dimensions of separators nominated for testing of the accessory qualify the minimum clearance for application of the termination within the terminal box or adjacent to earthed surfaces and structures (including components of switchgear or transformers).

5.5.2 Elbow terminations for cables with extruded insulation

Approval of a range of conductor cross-sectional areas for elbow termination shall be obtained by successfully completing the full range of type test listed in Table 9 on a cable having cross-sectional area of the conductor (copper or aluminium) as indicated in Table 10 (relevant to each rating) and/or largest conductor cross-sectional area in the range.

The range of conductor cross-sectional areas currently required by Endeavour Energy is as indicated in Table 13 below;

Table 13: Required range of compliance for separable connectors

Rating of the separable connector (Amps)	Cable conductor CSA Range of compliance	
	Minimum (mm ²)	Maximum (mm ²)
200/250	25	70
600/630	185	300

5.5.3 Accessories for cables with paper insulation including transition joints

The following conditions which have been prepared in accordance with the requirement specified in Clause 3 of AS/NZS 4805.2: shall apply:

- Approval of accessories for entire range of conductor cross sectional areas as given in Table 11 to 19 of AS 1026 inclusive, shall be obtained by successfully completing the full range of type tests specified in this standard, by installing the accessory deemed to test on a cable having nominal conductor cross section area of either 120 mm², 150 mm², 185 mm², 240 mm² or 300 mm².
- Tests performed on accessories installed on cables having shaped conductors shall be deemed to cover the same type of accessory when used on cables having circular conductors. The converse shall not apply.
- Approval is restricted to the electrical design and type of cables (i.e. belted or screened, draining or non-draining) on which the tests have been conducted,
- Any joint or termination tested for a given rated voltage is considered to be approved for the same or lower voltages provided the same design criteria are used,
- The dimensions of separators nominated for testing of the accessory qualify the minimum clearance for application of the termination within the terminal box or adjacent to earthed surfaces and structures (including components of switchgear or transformers).

5.5.4 Connectors/links and lugs for all joints and terminations

The tests made on one type of connector (including a lug)/conductor combination applies to that arrangement only. However, as given in clause 5.3 of AS/NZS 4325.1, to limit the number of tests the following shall apply:

- A connector which covers a range of cross-sections shall be accepted, if satisfactory results are obtained on the smallest and largest sections (see note below).
- A connector which can be used on round conductors or sector shaped conductors that are to be rounded, is accepted for both types if satisfactory results are obtained on any one type of conductor
- If a connector is a through connector for two conductors of different sectional areas, shapes or materials and if the technique and the connector barrels used have already been tested separately for each cross-section, no additional test is

necessary. If not then additional tests shall be made using the smaller of the two conductors for the control.

Note: In case of connectors of which one or both sides are designed for a range of cross-sections, and a common clamping arrangement serves for the connection of the different cross sections, then a mechanical test on all area combinations is carried out according to clause 7 of AS/NZS 4325.1

5.5.5 Range extension – Cross-sectional areas of polymeric insulated cable

If one type of accessory has been successfully tested on a cable with cross sectional area 120 mm², 150 mm² or 185 mm², for the full range of relevant type tests, the accessory is approved to install on cables having cross sectional areas from 95 mm² to 300 mm². Extension of approval wider than the range that given above shall be achieved by carrying out the additional tests in the sequence, as indicated in Table 14 below which is prepared based on Table 10 in AS/NZS 4085.1, on the smallest and/or largest conductor cross-sectional area of the required range.

Table 14: Additional tests for smallest and largest conductor cross sectional areas

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 10 Test 1	Voltage withstand	Shall withstand 4.5U ₀ a.c. for 5 min. or 4U ₀ d.c. for 15 min. The test arrangement shall be; - for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; and, - for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 10 Test 2	Partial discharge	This test is not required for joints installed on cables having unscreened insulation. 10 pC maximum at 1.73U ₀ . The test arrangement shall be; - for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; and, - for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1
AS/NZS 4805.1 Table 10 Test 3	Impulse test at maximum cable conductor temperature in normal operation +5K to +10 K	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for joints rated at 11 kV and 22 kV respectively. The test arrangement shall be; - for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; and, - for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 10 Test 4	Examination	Accessory is examined for signs of; • cracking in the filling media and/or tape or tube component; and/or • a moisture path across a primary seal; and/or • corrosion and/or tracking and/or erosion which could, in time, lead to failure of the accessory; and/or • leakage of any insulating material. The test arrangement shall be; • for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; and, • for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1

5.5.6 Range extension – conductor shape/cable Insulation screen of polymeric insulated cable

In order to achieve extension of approval from round to sector shaped conductors or for a cable having a type of screen different to that of the cable used in the tests, additional tests shall be performed according to Table 15 using cable having the same construction of the conductor/screen. Table 15 is prepared based on Table 11 of AS/NZS 4805.1.

Unless otherwise specified in the Test description/criteria column of the table, all tests shall be carried out at ambient temperature. All tests shall be carried out to the relevant method described in IEC 61442.

Table 15: Additional tests for different types of cable insulation screen and approval from round to shaped conductors

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 11 Test 1	Voltage withstand	Shall withstand $4.5U_0$ a.c. for 5 min. or $4U_0$ d.c. for 15 min. The test arrangement shall be; • for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; • for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1; • for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1.

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 11 Test 2	Partial discharge	This test is not required for joints installed on cables having unscreened insulation. 10 pC maximum at $1.73U_0$. The test arrangement shall be; • for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; • for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1; • for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1
AS/NZS 4805.1 Table 11 Test 3	Heating cycle in air	Shall withstand when subjected to sixty heating cycles at $2.5U_0$. The heating cycle in air shall be of at least eight hour duration with at least two hour at a steady state temperature of maximum cable conductor temperature in normal operation +5 K to +10 K followed by at least 3 hour of natural cooling to within 10 K of ambient temperature (refer to clause 9 of IEC 61442:2005). The test arrangement shall be; • for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; • for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1; • for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1.

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 11 Test 4	Partial discharge	This test is not required for joints installed on cables having unscreened insulation. 10 pC maximum at $1.73U_0$. The test arrangement shall be; - for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; - for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1; - for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1.
AS/NZS 4805.1 Table 11 Test 5	Impulse	Shall withstand 10 impulses of each polarity. The peak voltage of impulses shall be 95 kV and 150 kV for terminations rated at 11 kV and 22 kV respectively. The test arrangement shall be; - for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; - for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1 - for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1
AS/NZS 4805.1 Table 11 Test 6	a.c. Voltage withstand	Shall withstand $2.5U_0$ a.c. for 15 min. The test arrangement shall be; - for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; - for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1 - for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1

Test reference	Test name	Test description/criteria
AS/NZS 4805.1 Table 11 Test 7	Examination	Accessory is examined for signs of; • cracking in the filling media and/or tape or tube component; and/or • a moisture path across a primary seal; and/or • corrosion and/or tracking and/or erosion which could, in time, lead to failure of the accessory; and/or • leakage of any insulating material. The test arrangement shall be; • for terminations – as set out in sequence 1.1, but testing half the number of samples given in Figure 1 of AS/NZS4805.1: 2007; • for joints – as set out in sequence 2.1, but testing half the number of samples given in Figure 2 of AS/NZS 4805.1 • for elbow terminations – as set out in sequence 4.1 – 5.1, but testing half the number of samples given in Figure 4 and 5 of AS/NZS 4805.1

5.6 Specialised tooling

Information on product specific specialised tooling required for installation of each joint/termination offered shall be provided. This shall include but not limited to:

- description, drawing or picture;
- appropriate quantity required to assemble a product;
- life expectancy of the item.

5.7 Product training and technical support

The supplier shall provide adequate training (including documentations) for installation of the products as and when required by the Network Mains Manager. The training will be carried out at Endeavour Energy training school at Hoxton Park, NSW.

The supplier shall also make training available to accredited service providers (ASPs) if the supplier chooses to supply the products to ASPs after obtaining a product approval from Endeavour Energy.

The supplier shall nominate a technical representative to be readily available for product failure investigations that are carried out at Endeavour Energy's training centre located at Hoxton Park.

The supplier's technical representative shall also assist Endeavour Energy employees in resolving any other product related issues that arise.

5.8 Occupational health and safety

Material safety data sheet (MSDS), where applicable, shall be supplied for each of the components that make up each kit. Safety precautions such as use of personal protective clothing and equipment relevant to the end user of offered products shall also be included in the installation instruction prominently.

Preference shall be given to products that are less hazardous and require less personal protective equipment.

5.9 Shelf life and requirement of special storage

Accessories shall not contain any component having shelf life less than 18 months.

If the product or any of the integral components of the product has a limited shelf life, the expiry or the use-by date for the kit shall be specified. Such information shall be provided on the labelling of the package.

Where special storage requirements such as temperature controlled environment are necessary, such information shall be clearly stated on outside of the packaging.

5.10 Product samples

At least one sample kit from each type of joints and terminations offered shall be provided free of charge to Endeavour Energy by the supplier when requested by Endeavour Energy. The samples shall be used in the evaluation process and will not be returned.

5.11 Disposal

If not recyclable, all products offered shall be suitable for disposal in regular land fill. If special disposal requirements exist for any product offered, details of such requirements shall be provided.

6.0 AUTHORITIES AND RESPONSIBILITIES

Chief Engineer has the authority and the responsibility for:

- approving technical specifications, including any variations;
- making all decisions concerning compliance with this specification;
- approving nominations of Endeavour Energy representative; and
- delegating any of these authorities and responsibilities to the Manager Primary Systems.

Manager Primary Systems has the authority and responsibility for:

- reviewing technical specifications and making recommendations to the Chief Engineer;
- making recommendations concerning compliance with this specification; and
- making nominations of Endeavour Energy representatives.

Network Mains Manager has the authority and responsibility for:

- assessing the manufacturing facilities and their capability to perform the specified tests;
- reviewing all test reports submitted and making recommendations to the Manager Primary Systems; and
- approving the product and allocating a product approval number.

Manager Logistics and Regional employees have the authority and responsibility for verifying that all joints/terminations purchased by Endeavour Energy comply with the requirements of this specification.

Contractor Operations Manager, Network Connections Branch has the authority and responsibility for verifying that all joints/terminations installed by Accredited Service Providers comply with the requirements of this instruction.

Manufacturers/suppliers have the authority and responsibility for:

- being aware of their responsibilities under this instruction;
- providing suitable training, on installation of joints and terminations, to whom they supply the items; and,
- using an effective quality auditing system.
- implementing this instruction and keeping Endeavour Energy or other responsible equivalent officers informed of any factors that may prevent them from accepting responsibility for its full implementation.

7.0 DOCUMENT CONTROL

Documentation content coordinator: Network Mains Manager

Documentation process coordinator: Standards Process Coordinator