

Electricity Specification 400 J33

Issue 4 December 2025

33kV Solid Insulated Cable Accessories

Amendment Summary

ISSUE NO. DATE	DESCRIPTION
Issue 2 June 2021	Restructure and reformatting of Model Electricity Specification. This 2021 issue constitutes a complete revision and re-issue of Model Electricity Specification in its entirety. Prepared by: Philip Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering and Technical Director
Issue 3 July 2022	Addition of XLPE Branch joint, Oil Barrier termination & Inner Cone Plug termination Addition of PILC straight joint, bottle ends, and heat shrink outer sleeve options Clarification on kits not having phase lugs/connectors Clarification on Cold weather and joint body Radial Pressure withstand testing Clarification of shell thickness requirements Update of clause to make split type connector mandatory for all joint types Various minor formatting and updates Prepared by: Philip Howell Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, DSO Director
Issue 4 December 2025	<u>Update of the size range of terminations and joints to cover polymeric cables up to (and including) 1000mm² cross sections.</u> <u>Removal of Heat Shrink as an option for termination.</u> <u>Appendices detailing the ranges required consolidated down to Appendix A for terminations and Appendix B for joints.</u> Prepared by: Philip Howell Approved by: Policy Approval Panel and signed on its behalf by Paul Turner, PAP Chairperson

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1 Scope

This specification details 33kV Solid Insulation Cable Joints, Cable Terminations and associated Components employed on the electricity distribution network owned by Electricity North West Limited (known as SP Electricity North West).

This specification does not cover accessories for gas or oil assisted cables.

Jointing of 33kV cables is a key activity undertaken by SP Electricity North West and is carried out for a variety of reasons including construction and extension of the Grid and Primary network, to allow for the diversion and re-positioning of established cables and during repairs to existing systems.

All cable joints and terminations shall be installed on the SP Electricity North West network in accordance with ES400 E5 – specification for the installation and repair of 33kV and 132kV cable circuits.

2 Definitions

ABS	Acrylonitrile Butadiene Styrene
Approval	Sanction by the SP Electricity North West Circuits Manager that specified criteria have been satisfied.
Contract	The agreement between SP Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
HIPS	High Impact Polystyrene
PET-G	Polyester Terephthalate Glycol
PILC	Paper Insulated Lead Covered (sheathed) cable
PILCSWA	Paper Insulated Lead Covered, Steel Wire Armoured cable
Specification	The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
Supplier	Any person or person's firm or company who supplies goods to SP Electricity North West or to its Contractor.
Tender	An offer in writing to execute work or supply goods at a fixed price.
Tenderer	The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by SP Electricity North West to submit a Tender.
XLPE	Cross Linked Polyethylene

3 General Requirements for Approvals and Testing

3.1 Product not to be Changed

Compliance with this clause shall be in accordance with ES001.

3.2 SP Electricity North West Limited Technical Approval

Compliance with this clause shall be in accordance with ES001.

3.3 Quality Assurance

Compliance with this clause shall be in accordance with ES001.

3.4 Formulation

Compliance with this clause shall be in accordance with ES001.

3.5 Identification Markings

Compliance with this clause shall be in accordance with ES001.

3.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this Specification is 60 years.

3.7 Product Conformity

Compliance with this clause shall be in accordance with ES001.

3.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in [Appendix C](#).

Failure to complete these declaration sheets may result in an unacceptable bid.

4 Requirements for Type and Routine Testing

Compliance with this clause shall be in accordance with ES001.

4.1 Requirement for Type Tests at Suppliers Premises

Compliance with this clause shall be in accordance with ES001.

4.2 Requirement for Routine Tests at the Supplier's Premises

Compliance with this clause shall be in accordance with ES001

5 Technical Requirements

5.1 Installation Conditions

33kV Cable circuits shall be available for continuous operation at their stated design loading for 365 days a year, 24 hours per day. A service life of up to 60 years is expected for all components including the joints and terminations.

33kV cables and their joints may be surrounded by ground water for most of their operating lives. Cables installed above ground and any exposed terminations may be exposed to direct sunlight for significant periods.

To meet our obligations for network reliability and availability, it is vital that any disruption of service to our customers is minimised. Therefore, the speed with which joints for repairs can be completed to restore disrupted supplies is an important consideration in the choice of any jointing system.

The components listed in this Specification are for use in power cable terminations and cable joints used on non-effectively earthed electrical systems having a normal working voltage of 19/33kV ($U_m = 36$ kV).

Joints and terminations shall be designed to cater for thermal and mechanical forces which will be developed during maximum three-phase fault currents of up to 17.5kA Symmetrical, 44.1kA Asymmetrical.

Assembled components forming part of a cable system shall be capable of operating under the normal and fault temperature conditions specified in the relevant cable specifications to which they are installed on.

They shall be suitable for indoor, outdoor and underground locations as applicable, unless otherwise specified.

Components used in Cable Joints or Cable Terminations shall not be adversely affected when they come into contact with materials that are used in the construction of any Cable or Resins, Mastics and Other Sundry Materials used in preparation and jointing of cables, as listed in [Section 5.4](#).

5.2 Operational Requirements

Joint and termination kits shall be designed to offer the full range of requirements detailed in the Appendices of this specification.

The jointing and termination system shall be designed to provide an easily constructed and clearly understood method of installation. Key components shall be available as spare parts. These components will, on occasion, be required and should be offered as part of any tender response.

A modular approach is preferred using range taking base kits to reduce the overall number of stocked items. All kits shall have their own unique SP ENW Commodity Code to aid identification and selection.

Construction of the joints and terminations shall be as described in [Section 5.14](#) and [Section 5.15](#). Tenderers may offer, as an alternative, deviations to the described construction and components, however a full justification of any benefits of the alternative system shall be fully detailed including all relevant testing data.

The joint kits shall include all materials required to construct the joint except for resin encapsulation material. To reduce number of kits to be stocked, any connectors may be offered as separate items.

The termination kits shall include all materials required to construct the cable termination. To reduce number of kits to be stocked, lugs for phase and earth screens may be offered as separate items.

It is SP Electricity North West's policy to use only mechanical shear-bolt connectors in cable joints, and where practicable, only mechanical shear bolt lugs in cable terminations.

Any connectors and lugs which are supplied as separate items shall be packaged and labelled with their own unique SP Electricity North West commodity codes.

All joints and termination kits shall have a minimum life (shelf life) of 2 years from date of receipt into SP Electricity North West stores.

5.3 Compatibility with materials used in cable preparation and jointing

All components specified shall be compatible with the following:

- (a) Methacrylate resins (e.g. Prysmian JEM 9X)
- (b) Polyurethane resins (e.g. Henley Mk6)
- (c) Mastics and Tapes that are typically used in cable preparation for jointing
- (d) Installation greases – e.g. silicone types
- (e) Pre-soaked PF Solvent Bucket Wipes

5.4 Type Test Requirements

All components supplied to this Specification shall have certification to prove that they meet or exceed all the requirements of all the relevant type tests included in [CENELEC HD 629](#) or an equivalent recognised specification.

5.5 Component Identification

All components shall have a production batch number marked on them, or their immediate packaging to allow full product traceability.

Extruded and moulded heat shrinkable components such as tubing's, breakouts and wraparounds shall additionally be marked with the expanded and fully recovered diameters or equivalent information.

Electrically conductive components shall be marked to indicate that the materials are conductive. This requirement does not apply to composite components comprising both conductive and insulating materials.

Components with a shelf life shall have their expiry date prominently and indelibly displayed on their immediate packaging.

All component parts shall be detailed on a kit contents list to be included in each joint, termination or conversion module packaging.

5.6 Packaging

Packaging shall be designed to protect against mechanical damage and the ingress of dirt and moisture. All packaging shall be labelled with the information described under [Section 5.7](#) below.

Cardboard box packaging is preferred for main kits comprising of multiple components. Boxes should be clearly printed with warning statements such as “*This side up*” and/or “*Do not open with knife*” at the relevant positions to prevent any damage to components upon opening. In addition, suitable symbols for storage temperature or methods can be used. Heavy boxes should have some form of supporting handling straps fitted around the box for ease of handling and should be marked with a warning text to inform the box is heavy and should be handled appropriately.

Components supplied with pressure activated sealant coating shall be packed in such a manner that coated surfaces cannot stick to each other (or other measures shall be taken to ensure that this does not occur).

5.7 Labelling

Each package of joint, termination or conversion module shall have a label in a prominent position providing the details listed below:

- SP Electricity North West product Commodity Code (displayed in largest font at or near top)
- Manufacturers name/logo
- Electricity North West name/logo
- Product Description (including any size range details)
- Amount of resin required (if relevant, and expressed as amount to fill empty shell without cables in litres)
- Manufacturers Part Number or Product Code
- Product Expiry date (month / year)
- Date of manufacture
- Product batch number or works order number (for traceability)
- Gross weight of package
- Any relevant storage information for the packaging

5.8 Storage Requirements

Components shall be capable of being stored in a dry environment without deterioration within a temperature range between -10°C to +40°C when protected from direct sunlight.

5.9 Instructions

The Supplier shall provide detailed step by step jointing instructions for all required joints / terminations. These instructions shall clearly show all cable stripping dimensions and where necessary shrinking dimensions for all tube sets, etc. To supplement the written description, a drawing shall also be provided for each jointing step. The instruction set shall include a selection matrix for each combination of joint or termination to be used for each size range applicable that lists both the approved SP Electricity North West commodity code and supplier kit reference.

The instruction should include a dated issue number with revision history covering any amendments.

The jointing instructions shall be provided in an editable word document in SP Electricity North West approved format. Instructions shall have coloured diagrams, drawings and any selection charts where any ambiguity would be created from black and white versions. Each instruction shall be signed off and approved by the SP Electricity North Underground Circuits Manager prior to inclusion in SP Electricity North West 33kV cable jointing manual CP412.

A copy of the approved instruction will normally not be required in each supplied kit, however at the request of SP Electricity North West, some specific kits may be required to be supplied with copies of the approved instruction included.

5.10 Technical Support

During the Contract period questions will arise regarding unusual or non-standard applications where advice will be required on matters such as jointing non-standard cable types etc. The successful Tenderer(s) shall be expected to support SP Electricity North West with technical advice on these matters.

In addition, the successful Tenderer(s) may be called upon to participate in the development of joints and terminations which may be required for any unique or special cable application (e.g. cross sections greater than 630mm², branch type joints or submerged cable applications) that may arise during the contract period.

Tenderers should provide full details of their proposed technical service and support functions, locations and experience of key personnel and timescales that could be expected for requests from SP Electricity North West.

5.11 Joint and Termination Failures

SP Electricity North West manages an electricity distribution network that has a supply utilisation availability of over 99.99% and are striving to improve on this figure. Therefore, jointing and termination systems shall have reliability greater than this figure. Any joints or termination failures which may occur throughout the life of the Contract shall be fully investigated at the request of the SP Electricity North West Circuits Policy Manager.

A full report, by the Supplier, shall be issued within two weeks of the date of the failure of the termination or joint clearly detailing the failure mode.

5.12 Spare Parts

Tenderers shall provide details of any spare parts such as joint bodies or other items which may be required.

5.13 Samples

As part of the Tender evaluation process, samples of each kit and any associated conversion kits and other components shall be submitted upon request.

5.14 33kV Cable Terminations

5.14.1 Range for Cable Terminations

Cable termination kits specified (except for oil barrier terminations) shall be suitable for use with cross-linked polyethylene (XLPE) insulated cables complying with the following specifications:

- Modern single core cables to BS 7870-4.10 with a copper wire screen of 50mm² cross section and an equalising tape or wire, with conductors of stranded aluminium or stranded copper and cross-sectional areas between 95mm² and 1000mm² (see also SP Electricity North West Specification ES400C10).

5.14.2 Types of Terminations

The following Cable Terminations are required (refer to [Appendix A](#) for specific size ranges required):

- Single Core XLPE Indoor/Outdoor Termination.
- Single Core XLPE Oil Barrier Terminations for legacy compound filled cable boxes.
- Single Core XLPE 630A / 1250A Outer Cone Screened Separable Termination.
- Single Core XLPE 1250A Inner Cone Termination.

5.14.3 Indoor/Outdoor Termination Kits

33kV Termination kits shall be supplied as a set of three phases.

Cable terminations for dry box indoor, or pole mounted outdoor applications shall be cold applied, and preference will be given to the “one piece” types which are designed to have a means of stress control and have water ingress protection applied to the body of the termination at manufacture.

The termination body shall have a spiral hold-out collapsable tube.

For outdoor applications, creepage sheds shall be part of the one-piece body. To reduce range of termination kits to be stocked, a combined termination kit suitable for both indoor and outdoor applications is preferred.

The large variation of switchgear and copper work connections on the network make it impractical to include specific lugs in the termination kits for the phase conductors. Therefore, termination kits shall be supplied without phase lugs which will be supplied as separate items.

5.14.4 Phase Mechanical Lugs

The lugs shall be mechanical shear bolt type for conductor sizes up to and including 630mm². For conductor cross sections greater than 630mm², compression type lugs may also be used. All lugs shall be water blocked.

Indoor lugs shall be either tinned copper or tinned aluminium. Indoor lugs will have either M12, M16 or M20 clearance holes as specified.

Outdoor termination lugs shall be either brass or tinned copper and shall use a 3-hole palm suitable for M12 connection studs. The bottom hole should be slotted.

All lugs shall be type tested with the termination body.

Centralised bores are preferred to off-set bores in the lug barrel, since this equalises the hoop stress of the cold applied termination body. The bore of the lug shall be serrated and shall have a tapered lead-in. The ends of the lug shall have a minimum radius of 3mm.

Mechanical shear bolt type lugs shall have a minimum of two brass (or brass tipped) shear-off connection bolts. When sheared, these bolts shall not protrude higher than the lug body when installed on any conductor in the stated range of the lug. They shall also not produce any sharp edges which may eventually damage the cold applied joint body. The shear off bolts shall have a 1.5mm pitch thread

Mechanical lugs shall comply with the requirements of BS EN 61238-1-3. Lugs which have passed older type specifications shall be deemed to be acceptable if full Type Approval documentation can be provided along with satisfactory service performance.

Tinned aluminium lugs shall be manufactured from one of the following aluminium grades: 6082; 6063; 6005 or 6060. They shall be heat treated to T6. Lugs manufactured from pressed aluminium or brass tubing are not permitted.

Tinned copper lugs shall be manufactured from copper grade CW118C.

Brass lugs and bolts shall be manufactured from brass grade CZ121.

Tenderers to provide details of all tools required to install the lugs. The lug bolts should be able to be tightened and sheared using standard tools that would be readily available. If any special tooling is required for installing either terminations or lugs, then details of the availability of the item shall be provided.

5.14.5 Screen/Earth Connections

For outdoor and indoor terminations, the 50mm² copper screen wires of the XLPE single core cables shall be terminated into one mechanical brass lug. The screen/earth or sheath connection shall be capable of carrying without any increase in contact resistance an earth fault current of 4.2kA for three seconds. Evidence shall be provided that all connections can carry this amount of current for the duration stated.

The screen lug may be connected to either M12 or M16 threaded studs, and a suitable transition washer or other method shall be provided to cover both eventualities.

The screen wire lugs shall normally be supplied as separate items unless specified in any price schedules.

5.14.6 Oil Barrier Termination Kits

Oil Barrier Termination Kits shall be supplied with all suitable heat shrink tubing, sealing mastic tapes and other items which are compatible with insulating oils and compounds used in legacy cable boxes on paper insulated cables. The kits shall be supplied as a three-phase kit.

All heat shrink tubing shall conform to ENA TS 09-13.

5.14.7 630A and 1250A Outer Cone Separable Elbow Connectors

Separable connectors shall be supplied as a set of three phases and be referred to as a complete kit including phase lugs.

These shall be manufactured from EPDM or silicone rubber and shall be suitable for connection to M16 bolted Type C Outer Cone interface bushings. They shall be designed to connect XLPE insulated cable to transformers,

switchgear, etc., and shall meet the requirements of HD629.1 S1, IEC 60502-4 and BS EN 50180 Type C1 or BS EN 50181 Type C2.

Lugs shall be provided in the kits and shall be mechanical shear off type and be water blocked. The shear off bolts shall have a 1.5mm pitch thread.

Mechanical lugs shall have a minimum of two shear-off connection bolts. When sheared, these bolts shall not protrude higher than the lug body. They shall also not produce any sharp edges which may eventually damage the cold applied rubber components.

Mechanical lugs shall comply with the requirements of BS EN 61238-1.

Lugs shall be manufactured from one of the following aluminium grades: 6082; 6063; 6056, 6005 or 6060. They shall be heat treated to T6.

Separable connector Kits for branch connections (Piggy Back) shall be available as an additional kit of three phases to be used in conjunction with the standard separable connector to allow more than one cable to be connected to one equipment bushing connection.

Tenderers to provide details of all tools required to install the separable connectors. The kit should be able to be installed using standard tools that would be readily available. If any special tooling is required for installing, then details of the availability of the item shall be provided.

5.14.8 Inner Cone Plug Terminations

Inner Cone Terminations shall be suitable for terminating XLPE insulated cables into inner cone profiles to BS EN 50180 / BS EN 50181.

Size 3 (1250A) versions shall normally be required, however there may be occasional need for Size 2 (800A).

Inner Cone Terminations shall be supplied as sets of three phases as one complete kit.

5.15 33kV Cable Joints

5.15.1 Range for Cable Joints

33kV cable joints shall be compatible with all legacy and modern XLPE and paper insulated cable designs found on the SP Electricity North West network.

5.15.2 XLPE-Insulated Cables

The relevant cable joint kits as detailed in Appendix B shall be suitable for use with cross-linked polyethylene (XLPE) insulated cables complying with the following specifications:

- Modern single core cables to BS 7870-4.10 with a copper wire screen of 50mm² cross section and an equalising tape or wire with conductors of stranded aluminium or copper and cross-sectional areas between 95mm² and 1000mm² (see also SP ENW Specification ES400C10).
- On occasions, other single and three core polymeric insulated cables may be required to be joined to other specifications such as BS 6622, ENA TS 09-17 , ENA TS 09-20, HD 620 , IEC 60502-2. The jointing system shall be suitable to be used on these cables with minimum, or no adaptation to the kits.

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5.15.3 Paper-Insulated Cables

The relevant cable joint kits as detailed in [Appendix B](#) shall be suitable for use with impregnated paper-insulated cables complying with the following Specifications –

- Single and Three core cables to BS 6480 , BS 480 , ENA TS 09-12 , HD 621 , with stranded copper or aluminium conductors with cross sections between 70mm² and 630mm² (or their nearest imperial equivalents. Conductors may be round or oval shaped.
- Three core cables will have overall (H Type) , or single (HSL Type) lead sheaths and steel wire armouring and hessian or plastic sheathing.
- Single core cables will be unarmoured with a lead alloy sheath over the paper insulation.

5.15.4 Types of Cable Joints

The following joints are required (refer to the [Appendix B](#)):

Single Core XLPE insulated Cable Joints

- Single Core XLPE to Single Core XLPE Straight Joint
- Single Core XLPE Bottle End Joint
- Single Core XLPE Branch Joint

Transition Cable Joints (XLPE to Paper)

- Single Core XLPE to Single Core Unarmoured Paper Joint
- Single Core XLPE to Three Core H Type Paper Straight Joint

- Single Core XLPE to Three Core HSL Type Paper Straight Joint

Paper Insulated Cable Joints

- Single Core Paper to Paper Straight Joint
- Single Core Paper Bottle End Joint
- Three Core H Type Paper Bottle End Joint
- Three Core HSL Type Paper Bottle End Joint

Heat Shrink Wraparound Sleeve Kit (alternative to resin encapsulation)

- Heat Shrink Wraparound Outer Sleeve Kit for Three Core Transition Joints (H or HSL Type)
- Heat Shrink Wraparound Outer Sleeve Kit for Single Core Joints

5.15.5 General

33kV Cable joints shall be cold applied, heat applied or a mixture of both technologies. However, the primary means of stress control and insulation which is directly applied over the connector shall be cold applied.

The cold applied joint body shall be provided with a conductive faraday cage that shall be designed to cover and overlap the phase connector. The joint body shall also have geometric-stress cones or other methods of stress control which shall be designed to make contact with the cable semi-conducting screen at either end of the cable joint. The joint body shall have a spiral hold-out, or other means of collapsing the tube, e.g. self-eject carriers.

For any joint bodies that require special tools for collapsing or installation, these tools must be included within the kits

For joints bodies using a spiral hold out, a label or marking with an arrow shall be provided on the joint body close to the position of the release mechanism to indicate the direction or rotation required to begin the collapsing process.

The joint bodies shall be capable of providing a high radial pressure around the prepared cable and connector to maintain electrical stress control and resistance to moisture penetration. To prove this, the following radial pressure withstand test must be performed on the joint body. A static radial pressure of 1 bar is applied internally for a duration of 100 hours at ambient temperature to a joint body recovered down to a diameter in the middle of its stated operating range. The joint body shall hold the internal pressure without any leakage. A record and method statement of how the pressure has been applied and measured shall, upon request, be demonstrated to the satisfaction of the SP Electricity North West Circuits Policy Manager at the supplier's premises and cost.

Joint bodies must be protected with suitable packaging to prevent damage whilst in transit or storage.

Heat shrink or cold applied modules shall be used for paper cable preparation and shall include a break out glove for the crutch area. No keeper sleeves will be accepted in the crutch area.

The joint must have a suitable seal to prevent moisture ingress along the cable sheaths. For polymeric cable sheaths this is achieved by mechanical abrasion of the sheath for a length of no less than 100mm. For cables with a lead sheath, the seal is achieved with a mastic barrier tape applied for a length of minimum 40mm. The mastic tape must be suitable for application in all temperatures range that are likely to be encountered with no loss of performance.

5.15.6 Mechanical Connectors

The ends of the connector shall have a minimum radius of 3mm.

Mechanical connectors shall comply with the requirements of BS EN 61238-1-3.

All phase connectors shall be mechanical shear bolt type with a centre water blocked bore. Centralised bores are preferred to off-set bores since this equalises the hoop stress of the cold applied joint bodies. They shall be suitable for round, sectoral shaped stranded copper and aluminium conductors within their stated range. The connectors shall be designed to offer cable range taking facility to minimise the number of items stocked.

The bores of the connector shall be serrated and shall have a tapered lead-in. To accommodate cables smaller than 95mm² (or imperial equivalent), a centralising insert shall be provided with the connector. This insert shall be capable of being locked into the bore of the connector or it can be of the crushable type. Any additional build up/or centralising sleeves shall have relevant information size range marked on the sleeve and any special fitting instructions shall be included with them.

Each side of the connector shall have a minimum of two brass shear-off connection bolts. The shear off bolts shall have a 1.5mm pitch thread. When sheared, these bolts shall not protrude higher than the connector body. Nor shall they produce any sharp edges which may eventually damage the cold applied joint body.

All bolts should be able to be tightened using the following standard tools; 13mm, 17mm or 19mm AF hexagon sockets. If any additional tool is required to achieve this, then it should be included in the kit.

The connectors should allow for a gap of between 25 and 30mm in the joint centre line when stripping cables and the exact value should be included in any installation instruction.

For all joints covering cables up to 630mm² cross section, the connectors shall be a split design with a centre bolt connecting the two halves of the connector together. The centre bolt shall be capable of removal after shearing off using a suitable tool. A replacement centre bolt shall be available as a spare part.

Preference will be for split connectors where the two halves mate together in a “jig-saw” or similar profile such that they interlock radially and longitudinally when bolted together.

For any joint covering cables with cross sections of 800mm² or greater, either a split connector, or a solid (non-split) connector can be used.

Aluminium connectors shall be manufactured from one of the following aluminium grades: 6082; 6063; 6005 or 6060. They shall be heat treated to T6.

Bolts shall be manufactured from brass grade CZ121.

5.15.7 Screen/Earth Connections

The screen/earth connections shall be capable of carrying, without any increase in contact resistance, an earth fault current of 4.2kA for 3seconds. Evidence shall be provided that all connections can carry this amount of current for the duration stated.

For XLPE-to-XLPE joints, the design shall allow for over stripping of the cables to provide the earth continuity using the copper wire screens connected with a suitable brass tunnel mechanical connector.

Tinned Copper interwoven braids shall be provided to carry the screen/earth connection across all transition cable joints. The minimum size of the braid for single core joints is 50mm² and for trifurcating joints the minimum size is three braids, each of 50mm². The braid shall be provided with three swaged and soldered ends to allow easily connection to brass tunnel connectors. The braids shall be water blocked by solder.

The tinned copper braid shall be used in conjunction with suitable brass mechanical connectors and/or constant force roll springs to make a continuous connection between the screen wires and/or metallic sheath of the cables being jointed.

For any connection onto lead sheaths, suitable lengths of tinned copper knitted mesh shall be included in the kit to provide a reliable contact interface between the lead and copper braids.

5.15.8 Mesh screen layer

Joints should be over taped with layers of a suitable tinned copper knitted mesh tape across their length. Joint kits shall include adequate rolls of the mesh to allow coverage of the entire joint length when applied with a 20% overlap.

The knitted mesh shall have a loose enough weave to allow the Approved encapsulation resin to penetrate the mesh layer.

5.15.9 Paper Cable Preparation

Paper insulated cables shall be fully screened by using a conductive heat shrinkable break-out in the crutch of the cable in conjunction with conductive tubes over each core. Effectively, this modifies the paper cable to represent a screened XLPE cable. For belted cables, additional insulation tubes will be required over all three cores prior to fitting of the conductive tubes. A void filling stress relieving mastic shall be provided to fill the crutch area prior to fitting the conductive break-out.

Alternative arrangements using cold applied mouldings, tubing and tapes will be considered provided they are suitably range taking, easy to install and satisfactory test evidence is provided.

5.15.10 Resin Encapsulation

All standard joints shall be encapsulated in the Approved resin compound for mechanical protection.

A heat shrink wraparound sleeve shall be offered as a separate module to be used with standard joint kits in certain circumstances where technical restrictions mean use of shells and resin would be difficult.

The joint shell shall provide a minimum radial covering of 10mm of resin over the completed joint.

Joint shells shall be manufactured in two halves, horizontally split, unless agreed otherwise, incorporating an opening or openings of sufficient size to allow the shell to be readily filled with Approved cold pour resin. The filling port openings shall be covered by suitable supplied lids to provide strength at these positions.

The joint shells shall have a suitable sealing material between flanges and suitably secured by adequate metal clips prior to resin filling. Preference will be given to a hook and loop (Velcro) fastening to assist with assembly.

Shells shall be in transparent (clear) material for visual indication of correct filling of resin and alignment of shell.

The joint shells shall be manufactured from a plastic material such as Virgin ABS, PETG or other similar material suitable for use with Methacrylate and Polyurethane resins. The joint shells shall be suitably contoured and free from sharp edges which may give rise to undue thinning of the material.

The manufacturers reference code for the shell size shall be moulded into the top shell part.

Shells which are injection moulded shall be 1.5mm minimum thickness.

Vacuum formed shells which have an empty resin volume of less than 10 litres shall be made from sheets of Virgin HIPS, Virgin ABS or PETG which are minimum 2mm thick. Vacuum formed shells which have an empty resin volume of 10 litres or greater shall be made from sheets of Virgin HIPS, Virgin ABS or PETG which are minimum 3mm thick.

The joint shells supplied shall be manufactured using material of sufficient wall thickness and formed using adequate reinforcement ribs to withstand the weight of the encapsulating resin without significant deformation.

For long shells, additional strengthening pieces which can be slotted or fitted onto the shell to prevent bowing or sagging are acceptable.

Preference will be given for shells that have vent hole positions that can be cut open to allow air to evacuate whilst filling with resin.

The joint shell shall be able to withstand the forces endured from immediate reinstatement of the joint hole after filling with resin.

The resin volume required for each joint kit shall be declared, the volume quoted shall represent the volume of the empty shell without cables or joint components.

To prevent resin leaks the sealing of the cable entries in to the shells, a suitable putty shall be used. Sufficient putty shall be provided in the kits to enable coverage of all cables.

Where applicable, trifurcating joint options shall include a suitable foam or plastic sealing flange which can be slotted into the shell end to allow various combinations of three single core trefoil cables to be sealed.

The joint shells shall pass the Cold Weather Test as described below:

All plastic joint shells used in the tendered jointing system shall be tested to prove they are compatible with the Company's current Approved encapsulation resin during cold weather and will not split in these conditions due to Environmental Stress Cracking. The tendered shells and

Approved resin should be put into an environmental chamber and left for minimum 12 hours to chill to -20°C. Once the materials have fully acclimatised to -20°C, the resin shall be mixed, and the shells filled while still inside the environmental chamber. During the mixing, pouring and waiting stage the temperature shall be kept between -5° and -10°C.

The shells shall be left for 2 hours after filling and then inspected. No evidence of any cracking or other damage to the shells shall be observed.

The Tenderer shall provide a test report detailing the result of the Cold Weather Test for each shell offered, including details of any independent witnesses, at the time of Tender.

5.15.11 33kV Bottle End Joints

Bottle end joints are required for XLPE and paper insulated cables as described in [Appendix B](#). The Bottle End joint kits can be a standalone kit or achieved using a straight joint kit together with suitable plastic rods offered as a conversion kit.

5.15.12 XLPE Branch Joint

Tenderers shall offer a suitable product for providing a branched joint arrangement for XLPE single core cables. This does not have to follow requirements detailed in clauses 5.12.4 to 5.12.10.

Suitable arrangements may consist of a connection box where inner cone, or other connector types can be “plugged in”. It must be suitable for buried application.

5.15.13 Heat Shrink Wraparound Sleeve Option

A heat shrinkable wraparound sleeve kit shall be offered as an option for outer protection for joints where resin encapsulated shells cannot be used due to technical difficulties.

All heat shrinkable components shall conform to ENA TS 09-13.

Two heat-shrink sleeve kits shall be provided.

- Single Core straight Joints – kit comprising of a suitable reinforced heat shrink, hot melt adhesive lined wraparound sleeve and mastic sealing tapes. The kit shall be suitable to cover all sizes and type of single core joints.
- Trifurcating Joints – kit comprising of a suitable reinforced heat shrink, hot melt adhesive lined wraparound sleeve, heat shrinkable, hot melt adhesive lined 3 finger breakout moulding, mastic sealing tapes and adequate extra rolls of tinned copper mesh (to supplement any included in base kit) to cover all joint configurations and sizes.

6 Documents Referenced

DOCUMENTS REFERENCED	
Health and Safety at Work Act 1974	
Control of Substances Hazardous to Health Regulations 2002	
Manual Handling Operations Regulations 1992	
BS EN ISO 9000	Quality Management Systems
BS EN ISO 14001	Environmental Management Systems
BS EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
BS EN 61238-1-3	Compression and mechanical connectors for power cables. Part 1-3: Test methods and requirements for compression and mechanical connectors for power cables for rated voltages above 1 kV ($U_m = 1,2 \text{ kV}$) up to 36 kV ($U_m = 42 \text{ kV}$) tested on non-insulated conductors.
BS 480	Impregnated paper-insulated cables for electricity supply for working voltages up to and including 33 kV
BS 4579-1: 1970	Specification for performance of mechanical and compression joints in electric cable and wire connectors. Compression joints in copper conductors.
BS 4579-3: 1976	Specification for performance of mechanical and compression joints in electric cable and wire connectors. Mechanical and compression joints in aluminium conductors.
BS EN 50180	Bushings above 1 kV up to 52 kV and from 250 A to 3,15 kA for liquid filled transformers
BS EN 50181	Plug-in type bushings above 1 kV up to 52 kV and from 250 A to 2,50 kA for equipment other than liquid filled transformers

BS 6622	Specification for cables with extruded cross-linked polyethylene or ethylene propylene rubber insulation for rated voltages from 3,800/ 6,600 V up to 19,000/ 33,000 V.
BS 6480	Specification for impregnated paper-insulated lead or lead alloy sheathed electric cables of rated voltages up to and including 33,000 V.
BS 7870	LV and MV polymeric insulated cables for use by distribution and generation utilities.
CENELEC HD 620	Distribution cables with extruded insulation for rated voltages from 3.6/6(7.2) kV up to and including 20.8/36(42) kV.
CENELEC HD 629	Test requirements on accessories for use on Power Cables of Rated Voltage from 3.6/6(7, 2) kV up to 20.8/36(42) kV).
IEC 60502-2	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - Part 2: Cables for rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV).
IEC 60502-4	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - Part 4: Test requirements on accessories for cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
ENA TS 09-13	Performance Specification for High Voltage Heat-Shrinkable Components for use with High Voltage Solid Type Cables up to and Including 33 000 Volts
ENA TS 09-17	Single core cables for use in substations having extruded insulation and rated voltages of 6350/11000 volts, and 19000/33 000 volts.
ENA TS 09-20	Single core cable having cross linked polyethylene insulation and lead sheath for rated voltage 19000/33000 volts ($U_m = 36$ 000 volts).
ENA ER C79	Type Approval Tests for Connection and Terminations for Aluminium Conductors of Insulated Power Cables
ES001	Main Specifications
ES400C10	33kV Distribution Cables
ES400E5	Installation, Commissioning and Repair of Underground Cables Operating at 33kV and 132kV, and the Restoration of Excavated Areas

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Equipment Approval Process

Appendix A – Cable Terminations

Tenderers to complete tables below, detailing any range taking ability of each kit (preference will be given to solutions which use least number of stock items).

Tenderers to provide details of any conversion kits, additional components or other comments as appropriate.

A1 – Indoor / Outdoor Cable Termination Kits

CABLE SIZE (mm ²)	Termination Kit Reference	Phase Lug reference	Screen Wire Lug Reference
95			
185			
240			
300			
400			
500			
630			
800			
1000			

A2 – Oil Barrier Termination Kits

CABLE SIZE (mm ² / in ²)	Oil Barrier Termination Kit Reference
95 / 0.15"	
120 / 0.2"	
185 / 0.3"	
240 / 0.4"	
300 / 0.5"	
400 / 0.6"	
500 / 0.75"	
630 / 1"	

A3 – Separable Connectors for Interface C bushings

CABLE SIZE (mm ²)	Separable Connector Kit Reference	Branch Connector (Piggy Back) Reference	Screen Wire Lug Reference
95			
185			
240			
300			
400			
500			
630			
800			
1000			

A4 – Inner Cone Termination Kits

XLPE CABLE SIZE (mm ²)	Inner Cone Termination Size 3 (1250A)	Inner Cone Termination Size 2 (800A)	Screen Wire Lug Reference
95			
185			
240			
300			
400			
500			
630			
800			

Appendix B – Cable Joints

Tenderers to complete tables below, detailing any range taking ability of each kit (preference will be given to solutions which use least number of stock items).

Tenderers to provide details of any conversion kits, additional components or other comments as appropriate.

B1 – XLPE Straight Joint

CABLE SIZE (mm ²)	Joint Kit Reference	Phase Connector Reference	Resin Volume
95			
185			
240			
300			
400			
500			
630			
800			
1000			

B2 – XLPE Bottle End Joint

CABLE SIZE (mm ²)	Joint Kit Reference	Any conversion or additional parts required	Resin Volume
95			
185			
240			
300			
400			
500			
630			
800			

1000
B2 – XLPE Branch Joint Kit

CABLE SIZE (mm ²)	Joint Kit Reference	Any conversion or additional parts required	Resin Volume (if applicable)
95			
185			
240			
300			
400			
500			
630			

B3 - Single Core XLPE to Single Core Paper Insulated Straight Joint

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Phase Connector Kit reference	Resin Volume
95 / 0.15"			
120 / 0.2"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

B4 - Single Core XLPE to Three Core Paper H Type Straight Joint

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Phase Connector Kit reference	Resin Volume
95 / 0.15"			
120 / 0.185"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

B5 - Single Core XLPE to Three Core Paper HSL Straight Joint

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Phase Connector Kit reference	Resin Volume
95 / 0.15"			
120 / 0.2"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

B6 - Single Core PILC Cable Straight Joint

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Phase Connector Kit reference	Resin Volume
95 / 0.15"			
120 / 0.2"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

B7 - Single Core PILC Bottle End Joint Kit

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Any conversion or additional parts required	Resin Volume
95 / 0.15"			
120 / 0.2"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

B8 - Three Core Paper Insulated H Type Cable Bottle End Joint

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Any conversion or additional parts required	Resin Volume
95 / 0.15"			
120 / 0.2"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

B9 - Three Core Paper Insulated HSL Type Bottle End Joint Kit

CABLE SIZE (mm ² /in ²)	Joint Kit Reference	Any conversion or additional parts required	Resin Volume
95 / 0.15"			
120 / 0.2"			
185 / 0.3"			
240 / 0.4"			
300 / 0.5"			
400 / 0.6"			
500 / 0.75"			
630 / 1"			

Appendix C – Conformance Declaration

SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/ service or range of products/ services, section-by-section, using the following Conformance Declaration Codes.

Conformance Declaration Codes:

N/A =	Clause is not applicable/appropriate to the product/service.
C1 =	The product/service conforms fully with the requirements of this clause.
C2 =	The product/service conforms partially with the requirements of this clause.
C3 =	The product/service does not conform to the requirements of this clause.
C4 =	The product/service does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

Manufacturer:

Product/Service Description:

Product/Service Reference:

Name:

Company:

Signature:

SECTION-BY-SECTION CONFORMANCE

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
3.1	<u>Product not to be Changed</u>		
3.2	<u>SP Electricity North West Technical Approval</u>		
3.3	<u>Quality Assurance</u>		
3.4	<u>Formulation</u>		
3.5	<u>Identification Markings</u>		
3.6	<u>Minimum Life Expectancy</u>		
3.7	<u>Product Conformity</u>		
3.8	<u>Confirmation of Conformance</u>		
4.1	<u>Requirements for Type Tests at the Supplier's Premises</u>		
4.2	<u>Requirement for Routine Tests at the Supplier's Premises</u>		
5.1	<u>Installation Conditions</u>		
5.2	<u>Operational Requirements</u>		
5.3	<u>Compatibility with materials</u>		
5.4	<u>Type Test Requirements</u>		
5.5	<u>Component Identification</u>		
5.6	<u>Packaging</u>		
5.7	<u>Labelling</u>		
5.8	<u>Storage Requirements</u>		

5.9	<u>Instructions</u>		
5.10	<u>Technical Support</u>		
5.11	<u>Joint & Termination Failures</u>		
5.12	<u>Spare Parts</u>		
5.13	<u>Samples</u>		
5.14.1	<u>Range for Cable Terminations</u>		
5.14.2	<u>Types of Terminations</u>		
5.14.3	<u>Indoor/Outdoor Termination Kits</u>		
5.14.4	<u>Phase Mechanical Lugs</u>		
5.14.5	<u>Screen/Earth Connections</u>		
5.14.6	<u>Oil Barrier Termination Kits</u>		
5.14.7	<u>Separable Connectors</u>		
5.14.8	<u>Inner Cone Terminations</u>		
5.15.1	<u>Range for cable joints</u>		
5.15.4	<u>Types of Cable Joints</u>		
5.15.5	<u>General</u>		
5.15.6	<u>Mechanical Connectors</u>		
5.15.7	<u>Screen / Earth Connections</u>		
5.15.8	<u>Mesh Screen Layer</u>		
5.15.9	<u>Paper Cable Preparation</u>		
5.15.10	<u>Resin Encapsulation</u>		
5.15.11	<u>33kV Bottle End Joints</u>		

5.15.12	XLPE Branch Joints		
5.15.13	Heat Shrink Wraparound Sleeves		
Appendix A	Completion of Range tables		
Appendix B	Completion of Range tables		

* Applicable specifications shall be stated in the Remarks column where alternatives are quoted within a section. The Remarks column shall also be used to indicate cases where the products or services exceed the quoted specifications.

Additional Notes: