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Electricity Specification 400 J33

Issue 3 July 2022

Joints, Terminations and Associated Components for use on 33kV Underground Networks (U_m = 36kV)

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

Contents

1 Introduction

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 (Electricity North West).

Jointing of 33kV cables is a key activity undertaken by 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.

Within the current economic environment set down by the industry regulators key aspects of customer service are incentivised to ensure that disruption of service to all customers is minimised. Therefore, the speed with which repairs can be completed in order to restore disrupted supplies is an important consideration in the choice of any jointing system.

Minimisation of the overall cost of cable jointing will include consideration of the combination of the major elements of contributory cost. These are the cost of the joints, the time to complete jointing work, the cost of excavating joint holes and the cost to reinstate the hole following completion of the jointing works.

Only the 33kV Joints, Terminations, Associated Sealants and Components listed in Appendices A to S of this specification shall be used on the Underground Distribution System, within the scope of this specification.

2 Scope

This specification covers all 33kV Cable Joints, Cable Terminations, and Associated Components to be used on the Underground Cable Distribution System for the purpose of constructing new networks or extending and repairing existing networks as detailed in ES400E5.

This specification does not cover accessories for gas or oil assisted cables. July 22

All jointing and termination kits shall include all necessary parts to complete the joint or termination except the connector or lugs, which shall be supplied separately to reduce the number of items stocked. For joints, the encapsulating resin shall not be included as this will be included under a separate contract.

Jointing instructions shall be provided for each kit and also for any conversion modules which cover all the sizes and types of cables that can be jointed by the kit. A copy of the instructions may need to be provided in the kits if requested by the Electricity North West Circuits Manager or included in the 33kV Code of Practice CP412.

3 Definitions

ABS	Acrylonitrile Butadiene Styrene.
Approval	Sanction by the Electricity North West Circuits Manager that specified criteria have been satisfied
Contract	The agreement between 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.
Contractor	The person or person's firm or company, including personal representatives, successors and permitted assigns, who's Tender has been accepted by Electricity North West.
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 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 Electricity North West to submit a Tender.
XLPE	Cross Linked Polyethylene.

4 General Requirements for Approvals and Testing

4.1 Product not to be Changed

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Circuits Manager, and receipt of a written agreement to the proposed change from the Electricity North West Circuits Manager.

4.2 Electricity North West Technical Approval

The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Circuits Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

Alternatively, technical reports and other data may be submitted that the Tenderer considers will demonstrate, to the satisfaction of the Electricity North West Circuits Manager, compliance with this Specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Circuits Manager but will not be unreasonably withheld.

Approval shall be 'factory specific' and is not transferable to another factory without the written Approval of the Electricity North West Circuits Manager.

The Supplier and product shall comply with all the relevant requirements of Electricity North West document CP311.

4.3 Quality Assurance

The Tenderer shall confirm whether or not Approval is held in accordance with a quality assurance scheme accredited under ISO 9000. If not, the Tenderer shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of Suppliers and Sub-Contractors.

The right is reserved for the repeat of such tests, from time to time, that the Electricity North West Circuits Manager may deem to be reasonably necessary to demonstrate continued compliance with the Specification.

The Tenderer shall submit, with the Tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Circuits Manager, fitness for installation and service.

The Tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Circuits Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Circuits Manager will confirm the requirement for samples at the time of Tendering.

The right is reserved for inspections to be made of Tenderer's facilities, from time to time, as deemed reasonably necessary by the Electricity North West Circuits Manager to ensure compliance with this Specification and any Contract of which it forms a part.

The Tenderer shall submit, with the Tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001 - Environmental Management Systems.

4.4 Formulation

The Tenderer shall submit, with the Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that it is to remain confidential, and the Electricity North West Circuits Manager will, if requested, confirm agreement to this prior to receipt of the information.

4.5 Identification Markings

The Tenderer shall submit, with the Tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Circuits Manager and shall in all cases include the Electricity North West approved description and commodity code number.

The Tenderer shall submit, with the Tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Circuits Manager.

4.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this Specification is 60 years. Evidence shall be provided to ensure the jointing system is robust and has proven longevity and service history. Tenderers shall supply a comprehensive service history for joints and terminations being offered.

4.7 Product Conformity

Preference will be given to those Suppliers who can provide suitable product conformity certification to a recognised or specified standard, or an equivalent certification.

4.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in Appendix T. Failure to complete these declaration sheets may result in an unacceptable bid.

5 Requirements for Type and Routine Testing

The Electricity North West Circuits Manager shall set out the requirement of the following tests to be carried out by the Supplier at the Supplier's cost.

5.1 Requirement for Type Tests at Suppliers Premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Circuits Manager.

These may or may not be destructive tests.

These tests may be requested to be undertaken to demonstrate the joint / termination is resistant to water penetration and provide mechanical protection. Expected results are expected to exceed Type tests described in HD 629 / IEC 60502-4.

5.2 Requirement for Routine Tests at the Supplier's Premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Circuits Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined by the Electricity North West Circuits Manager.

6 Technical Requirements

6.1 Operational Requirements

6.1.1 General

The components included 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 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.

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 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 6.1.4.

All joints / termination kits shall have a minimum life (shelf life) of 2 years from date of receipt in to Electricity North West stores warehouse.

A modular approach using range taking base kits is preferred to reduce the overall number of stocked items. Phase connectors and lugs shall be supplied as separate items packaged and labelled with their own commodity codes.

Cable Joints and Cable Terminations shall be capable of performing with mechanical shear-bolt connectors and lugs without any deleterious effect. It is Electricity North West's policy to use mechanical shear-bolt lugs and connectors in preference to other forms of connectors and lugs.

The jointing / termination system shall be designed to provide an easily constructed and clearly understood method of installation. Key components and accessories shall be available in a spare parts list. These components will, on occasion, be required. July 22

The ease of construction (labour costs) shall be taken into consideration along with the joint kit unit costs and the longevity of the joint to establish a lifetime cost.

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

The kits shall include all items and components required to construct the joint except for resin encapsulation material and lugs/connectors. These items shall include, but not limited to, the joint bodies, tubes, mastics, tapes, braids, earth screen wire connectors, shell sets, clips and shell sealing putty. July 22

6.1.2 Paper-Insulated Cables

Components specified shall be suitable for use with impregnated paper-insulated cables complying with the following Specifications:

(a) BS 6480

(b) BS 480

(c) ENA TS 09-12

(d) HD 621

6.1.3 XLPE-Insulated Cables

Components specified shall be suitable for use with cross-linked polyethylene (XLPE) insulated cables complying with the following Specifications:

(a) BS 6622

(b) BS 7870 (see also ES400C10)

(c) ENA TS 09-17

(d) ENA TS 09-20

(e) HD 620

(g) IEC 60502-2

The cables will have a copper wire screen of 50mm^2 cross section and an equalising tape or wire.ES400C10 gives full details of polymeric cable specifications used.

6.1.4 Resins, Mastics and Other Sundry Materials

All components specified shall be compatible with the following:

(a) Methacrylate resins (e.g. Prysmian JEM 9X)

(b) Polyurethane resins

(c) Mastics and Tapes

(d) Installation greases July 22

(e) Pre-soaked PF Solvent Bucket Wipes

6.2 Type Test Requirements

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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.

6.3 Identification and Packaging

6.3.1 Component Identification

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

Extruded and moulded components such as tubing's, breakouts and wrap-arounds 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.

6.3.2 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 6.3.3 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).

6.3.3 Labelling

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

- 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

6.4 33kV Cable Joints

6.4.1 General

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 mechanical 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 Electricity North West Circuits Manager at the supplier's premises and cost. July 22

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.

6.4.2 Mechanical Connectors

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Mechanical connectors shall be water blocked and be of the split-type to aid the jointing process. 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.

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.

The centre bolt connecting the two halves of the connector together shall be removable after shearing off. A replacement centre bolt shall be available as a spare part.

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

All bolts should be able to be tightened using the following standard tools; 13mm, 17mm or 19mm AF 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.

The bores of the connector shall be serrated and shall have a tapered lead-in. For cables smaller than 95mm^2, 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.

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.

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

6.4.3 Screen/Earth Connections

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 50mm^2 and for trifurcating joints the minimum size is three braids, each of 50mm^2. The tinned copper braid shall be used in conjunction with brass mechanical connectors and/or roll springs to make connection to the screen/earth or sheath of the cables being jointed. The braids shall be water-blocked.

Where single core XLPE cables are being jointed to a three-core paper cable, one end of the braid shall be provided with three swaged and soldered ends to allow easily connection to brass tunnel connectors. Where necessary the option for three individual braids shall be considered provided that the joint is similarly wrapped and enclosed.

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 brass tunnel connector.

The screen/earth connection 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 are capable of carrying this amount of current for the duration stated.

6.4.4 Mesh screen layer

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Joints should be over taped with layers of tinned copper mesh across the length of the joints. The joint kit shall include adequate rolls of mesh to allow coverage of the entire joint length when applied at 50% overlap.

6.4.5 Paper Cable Preparation

Paper 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.

6.4.6 Types of Cable Joints

The following joints are required (for sizes of Cables Joints needed, refer to the appropriate appendix):

Single Core XLPE insulated Cable Joints

- Single Core XLPE to Single Core XLPE Straight Joint (see Appendix A).
- Single Core XLPE Bottle End Joint (see Appendix B).
- Single Core XLPE Branch Joint (see Appendix C)

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Transition Cable Joints

- Single Core XLPE to Single Core Unarmoured Paper Joint (see Appendix D).
- Single Core XLPE to Three Core H Type Paper Straight Joint (see Appendix E).
- Single Core XLPE to Three Core HSL Type Paper Straight Joint (see Appendix F).

Paper Insulated Cable Joints

- Single Core Paper to Paper Straight Joint (see Appendix G)

- Single Core Paper Bottle End Joint (see Appendix H)
- Three Core H Type Paper Bottle End Joint (see Appendix J)
- Three Core HSL Type Paper Bottle End Joint (see Appendix K)

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Heat Shrink Wraparound Sleeve Kit (alternative to resin encapsulation for ENWL compound only)

- 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

6.4.7 Resin Encapsulation

All standard joints shall be encapsulated in the Approved resin compound for mechanical protection. For joints installed within Electricity North West compound locations or buried at depths of 900mm or greater, a heat shrink wraparound sleeve can be used as an alternative option. This shall be offered as a separate module to be used with standard joint kits.

The joint shell shall provide a minimum radial covering of 10mm of resin over the completed joint. The cable joint shells when filled with resin are for use on the 33kV three phase, 50Hz alternating current, standard and non-standard phase sequence distribution systems.

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 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.

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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. July 22

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 shell end to allow various combinations of three single core cables to be sealed. July 22

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 -20ºC. Once the materials have fully acclimatised to -20ºC, 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 -5º and -10ºC. 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.

6.5 Heat Shrink Wraparound Sleeve Option

For joints installed within Electricity North West compounds, or on a vertical plane, or at depths greater than 900mm, a heat shrinkable wraparound sleeve kit shall be offered as an option for outer protection.

All heat shrinkable components shall conform to ENA TS 09-13.
Two heat-shrink sleeve kits shall be provided;

- Single Core 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.

6.6 33kV Cable Terminations

6.6.1 General

Terminations are to be designed to be compatible single core cables to BS7870-4 with either stranded copper or stranded/solid aluminium conductors.

Indoor cable terminations shall be cold applied, and preference will be given to the “one piece” types which are designed to have 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.

Outdoor cable terminations shall be either heat shrinkable or cold applied depending on the environment. July 22

For outdoor cold applied terminations, creepage sheds shall be part of the one-piece body. The termination body shall have a spiral hold-out.

For outdoor heat shrink terminations, all tubing shall conform to ENA TS 09-13.

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 as without phase lugs and these supplied as separate items.

Screened separable termination kits should be supplied with mechanical phase lugs included.

All kits should include lugs for earth screen wire connection.

6.6.2 Mechanical Lugs

The lugs shall be either compression or mechanical shear bolt type. All lugs shall be water blocked.

Outdoor lugs shall be either brass or tinned copper. Indoor lugs shall be either tinned copper or tinned aluminium. Outdoor terminations shall use a 3-hole brass lug suitable for M12 connection studs. The bottom hole should be slotted.

Indoor lugs will have either M12, M16 or M20 clearance holes as specified.

All lugs shall be type tested with the termination body. For tender review purposes, the tenderer shall include an offset palm lug with a single M16 clearance (17mm hole) in any samples provided.

Mechanical lugs shall have a minimum of two brass 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 joint body.

Centralised bores are preferred to off-set bores, since this equalises the hoop stress of the cold or heat applied termination body. They shall be range taking in their material and construction. The shear off bolts shall have a 1.5mm pitch thread

The bolts should be able to be tightened using standard tools as follows;

- 13mm, 17mm or19mm AF socket – any additional tool that may be required to achieve this should be included in the kit.

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 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 as long as 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.

6.6.3 Screen/Earth Connections

For outdoor and indoor terminations, the 50mm^2 copper screen wires of the XLPE single core cables shall be terminated into one 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 3s. Evidence shall be provided that all connections are capable of carrying 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.

6.6.4 Types of Terminations

The following Cable Terminations are required (for sizes of Cable Terminations needed refer to the appropriate appendix):

- Single Core XLPE Cold Applied Indoor Termination (See Appendix L).
- Single Core XLPE Cold Applied Outdoor Termination (See Appendix M)
- Single Core XLPE Heat Shrink Outdoor Termination (See Appendix N)
- Single Core XLPE Oil Barrier Termination (See Appendix P) July 22
- Single Core XLPE 630A / 1250A Outer Cone Screened Separable Termination (See Appendix Q).
- Single Core XLPE 630A / 1250A Outer Cone Screened Separable Termination (See Appendix R).
- Single Core XLPE 1250A Inner Cone Termination (See Appendix S) July 22

6.6.5 Outdoor Cable Termination

Heat shrink terminations are preferred for resilience in poor environmental conditions or coastal areas.

Cold shrink terminations can be offered for standard operating conditions.

6.6.6 Oil Barrier Termination

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.

6.6.7 630A and 1250A Outer Cone Separable Elbow Connectors

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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.

They shall be available for conductor sizes ranging from 185mm^2 – 1000mm^2 stranded aluminium and 95mm^2 - 630mm^2 stranded copper.

The lugs provided in the kits shall be preferably mechanical shear off type. The mechanical lugs shall be water blocked. Centralised bores are preferred to off-set bores. They shall be suitable for round conductors. They shall be range taking in their material and construction. 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 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 lugs shall comply with the requirements of BS EN 61238-1.

The bolts should be able to be tightened using standard tools as listed below:

13mm, 17mm or 19mm AF socket and/or Allen key between 4mm and 8mm – any additional tool that may be required to achieve this should be included in the kit.

Lugs shall be manufactured from one of the following aluminium grades: 6082; 6063; 6056, 6005 or 6060. They shall be heat treated to T6. Lugs manufactured from pressed aluminium or brass tubing are not permitted. Brass lugs and bolts shall be manufactured from brass grade CZ121.

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

Kits for branch connections (Piggy Back) shall be available in additional kit of three phases to be used in conjunction with the standard separable connector to provide extra connections from one bushing.

6.6.8 1250A Inner Cone Plug Terminations

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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.

6.7 Cable Joints/Terminations 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 ENWL commodity code and supplier kit reference.

The instruction should include a dated issue number with revision history covering any amendments. July 22

The jointing instructions shall be provided in an editable word document in 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 Electricity North Underground Circuits Manager prior to inclusion to CP412

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

6.8 Material Safety Data Sheets

The Supplier shall provide latest copies of any MSDS for any components and materials which require them as part of COSHH regulations. Any updates to the MSDS during the lifetime of supply must be submitted promptly to the Electricity North West Circuits Policy Manager

6.9 Joint and Termination Failures

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 occur throughout the life of the Contract shall be fully investigated. 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.

6.10 Storage Requirements

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

6.11 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 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 630mm^2, 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 ENWL.

7 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: 2004	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 kV) up to 36 kV (U_m= 42 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 3800/6600 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 33000 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 TS 43-95	Steelwork for overhead lines.
ENA ER C79	Type Approval Tests for Connection and Terminations for Aluminium Conductors of Insulated Power Cables.
ES400C10	33kV Distribution Cables.

ES400E5	Installation, Commissioning and Repair of Underground Cables Operating at 33kV and 132kV, and the Restoration of Excavated Areas
CP311	Equipment Approval Process.

8 Keywords

33kV; joint; jointing; termination; kits

Appendix A – Single Core XLPE/CWS to Single Core XLPE/CWS Straight Joint

Table A (lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

CABLE SIZE (mm^2)	95	185	240	300	400	500	630	800	1000*
95	A1	A2	-	-	-	-	-	-	-
185	A2	A3	A4	A5	A6	A7	A8	A9	A10
240	-	A4	A11	A12	A13	A14	A15	A16	A17
300	-	A5	A12	A18	A19	A20	A21	A22	A23
400	-	A6	A13	A19	A24	A25	A26	A27	A28
500	-	A7	A14	A20	A25	A29	A30	A31	A32
630	-	A8	A15	A21	A26	A30	A34	A35	A36
800	-	A9	A16	A22	A27	A31	A35	A36	A37
1000*	-	A10	A17	A23	A28	A32	A36	A37	A38

*Round stranded or Milliken Conductors

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Appendix B – Single Core XLPE Bottle End Joint

Table B lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

	CABLE SIZE (mm^2)	VARIATION
SINGLE CORE XLPE/CWS CABLE	**95**	B1
	185	B2
	240	B3
	300	B4
	400	B5
	500	B6
	630	B7

Appendix C – Single Core XLPE/CWS to Single Core XLPE/CWS Branch Joint

Table C (lists the variation in cables sizes for which branch cable joints will be needed.

It is recognised that a particular joint kit may cover a number of different cable sizes. Normally branched cables would be of same cross section as the through connecting cable, however it may be possible that various combinations of three interconnecting cables may be necessary ,so a flexible system allowing multiple configurations is preferred.

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CABLE SIZE (mm^2)	95	185	240	300	400	500	630
95	C1	C2	C3	C4	C5	C6	C7
185	C2	C8	C9	C10	C11	C12	C13
240	C3	C9	C14	C15	C16	C17	C18
300	C4	C10	C15	C19	C20	C21	C22
400	C5	C11	C16	C20	C23	C24	C25
500	C6	C12	C17	C21	C24	C26	C27
630	C7	C13	C18	C22	C25	C27	C28

Appendix D – Single Core XLPE/CWS to Single Core Paper Straight Joint

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Table D lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		SINGLE CORE XLPE/CWS SIZE (mm^2)							
		95	**185**	**240**	**300**	**400**	**500**	**630**	**1000***
SINGLE CORE UNARMOURED PILC CABLE SIZE (mm^2/in^2)	**95 / 0.15”**	D1	D2	-	-	-	-	-	-
	120 -185 / 0.2”– 0.3”	D3	D4	D5	D6	D7	D8	D9	-
	240 / 0.4”	-	D10	D11	D12	D13	D14	D15	-
	300 / 0.5”	-	D16	D17	D18	D19	D20	D21	-
	400 / 0.6”	-	D22	D23	D24	D25	D26	D27	-
	500 / 0.75”	-	D28	D29	D30	D31	D32	D33	D34
	630 / 1” *	-	D35	D36	D37	D38	D39	D40	D41
	1000 / 1.5” *	-	D42	D43	D44	D45	D46	D47	D48

*Round stranded or Milliken Conductors

Appendix E – Single Core XLPE to Three Core Paper H Type Straight Joint

Table E lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		XLPE/CWS SIZE – (mm^2)						
		95	**185**	**240**	**300**	**400**	**500**	**630**
THREE CORE H TYPE PAPER CABLE SIZE (mm^2 / in^2)	**95 / 0.15”**	E1	E2	E3	E4	-	-	-
	120 -185 / 0.2”– 0.3”	E5	E6	E7	E8	-	-	-
	240 / 0.4”	E9	E10	E11	E12	-	-	-
	300 / 0.5”	E13	E14	E15	E16	E17	E18	E19
	400 / 0.6”	-	E20	E21	E22	E23	E24	E25
	500 / 0.75”	-	E26	E27	E28	E29	E30	E31
	630 / 1”	-	E32	E33	E34	E35	E36	E37

Appendix F – Single Core XLPE to Three Core Paper HSL Straight Joint

Table F lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		THREE CORE HSL TYPE PILC CABLE SIZE mm² / in²				
		95 0.15”	**185 0.3”**	**240 0.4”**	**300 0.5”**	**400 0.6”**
XLPE/CWS CABLE SIZE mm²	**95**	F1	F2	-	-	-
	185	F3	F4	F5	F6	F7
	240	-	F8	F9	F10	F11
	300	-	F12	F13	F14	F15
	400	-	F16	F17	F18	F19
	500	-	F20	F21	F22	F23
	630	-	F24	F25	F26	F27

Appendix G – Single Core Paper Straight Joint

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Table G lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		SINGLE CORE UNARMOURED PILC CABLE SIZE – (mm^2 / in^2)						
		95 / 0.15”	**120 -185 / 0.2”– 0.3”**	**240 / 0.4”**	**300 / 0.5”**	**400 / 0.6”**	**500 / 0.75”**	**630 / 1”**
SINGLE CORE UNARMOURED PILC CABLE SIZE	**95 / 0.15”**	-	-	G1	G2	G3	G4	G5
	120 -185 / 0.2”– 0.3”	-	G6	G7	G8	G9	G10	G11
	240 / 0.4”	G12	G13	G14	G15	G16	G17	G18
	300 / 0.5”	G19	G20	G21	G22	G23	G24	G25
	400 / 0.6”	G26	G27	G28	G29	G30	G31	G32
	500 / 0.75”	G33	G34	G35	G36	G37	G38	G39
	630 / 1”	G40	G41	G42	G43	G44	G45	G46

Appendix H – Single Core Unarmoured PILC Bottle End Joint

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Table H lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		VARIATION
SINGLE CORE UNARMORED PILC CABLE SIZE (mm^2 / in^2)	95 / 0.15”	H1
	120 -185 / 0.2” – 0.3”	H2
	240 / 0.4”	H3
	300 / 0.5”	H4
	400 / 0.6”	H5
	500 / 0.75”	H6
	630 / 1”	H7

Appendix J – Three Core H Type PILC Bottle End Joint

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Table J lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		VARIATION
THREE CORE H TYPE PILC CABLE SIZE (mm^2 / in^2)	95 / 0.15”	J1
	120 -185 / 0.2” – 0.3”	J2
	240 / 0.4”	J3
	300 / 0.5”	J4
	400 / 0.6”	J5
	500 / 0.75”	J6
	630 / 1”	J7

Appendix K – Three Core HSL Type PILC Bottle End Joint

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Table K lists the variation in cables sizes for which cable joints will be needed. It is recognised that a particular joint kit may cover a number of different cable sizes.

		VARIATION
THREE CORE HSL TYPE PILC CABLE SIZE (mm^2 / in^2)	95 / 0.15”	K1
	120 -185 / 0.2” – 0.3”	K2
	240 / 0.4”	K3
	300 / 0.5”	K4
	400 / 0.6”	K5
	500 / 0.75”	K6
	630 / 1”	K7

Appendix L – Single Core XLPE Indoor Termination (Cold Shrink)

Table L lists the variation in cables sizes for which Cold Applied Indoor Terminations will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm²	**95**	L1
	185	L2
	240	L3
	300	L4
	400	L5
	500	L6
	630	L7

Appendix M – Single Core XLPE Outdoor Termination (Cold Shrink)

Table M lists the variation in cables sizes for which Outdoor Terminations will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm^2		
	95	M1
	185	M2
	240	M3
	300	M4
	400	M5
	500	M6
	630	M7
	800	M8
	1000*	M9

*Round Stranded or Milliken Conductors

Appendix N – Single Core XLPE Outdoor Termination (Heat Shrink)

Table N lists the variation in cables sizes for which Heat Shrink Outdoor Terminations will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm²	**95**	N1
	185	N2
	240	N3
	300	N4
	400	N5
	500	N6
	630	N7

Appendix P – Oil Barrier Termination

Table P lists the variation in cables sizes for which Heat Shrink Outdoor Terminations will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm²	**95**	P1
	185	P2
	240	P3
	300	P4
	400	P5
	500	P6
	630	P7

Appendix Q – Single Core XLPE 630A/1250A Screened Elbow Termination

Table P lists the variation in cables sizes for which Screened Elbow Terminations will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm^2		
	95	Q1
	185	Q2
	240	Q3
	300	Q4
	400	Q5
	500	Q6
	630	Q7
	800	Q8
	1000	Q9

Appendix R – Single Core XLPE 630A/1250A Screened Elbow Branch Termination

Table R lists the variation in cables sizes for which Screened Elbow Branch Terminations (Piggy Back connectors) will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm^2	**95**	R1
	185	R2
	240	R3
	300	R4
	400	R5
	500	R6
	630	R7
	800	R8
	1000	R9

Appendix S – Single Core XLPE Inner Cone Termination

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Table S lists the variation in cables sizes for which Inner Cone Terminations will be needed. It is recognised that a particular termination kit may cover a number of different cable sizes.

XLPE/CWS CABLE SIZE mm²		
	95	S1
	185	S2
	240	S3
	300	S4
	400	S5
	500	S6
	630	S7
	1000	S8

Appendix T – 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)**
4.1	Product not to be Changed		
4.2	Electricity North West Technical Approval		
4.3	Quality Assurance		
4.4	Formulation		
4.5	Identification Markings		
4.6	Minimum Life Expectancy		
4.7	Product Conformity		
4.8	Confirmation of Conformance		
5.1	Requirements for Type Tests at the Supplier's Premises		
5.2	Requirement for Routine Tests at the Supplier's Premises		
6.1.1	General		
6.1.2	Paper-Insulated Cables		
6.1.3	XLPE-Insulated Cables		
6.1.4	Resins, Mastics and Other Sundry Materials		
6.2	Type Test Requirements		

6.3.1	Identification		
6.3.2	Packaging		
6.3.3	Labelling		
6.4.1	Joints - General		
6.4.2	Mechanical Connectors		
6.4.3	Screen/Earth Connections		
6.4.4	Mesh Screen layer		
6.4.5	Paper Cable Preparation		
6.4.6	Resin Encapsulation		
6.5	Heat Shrink Wraparound Sleeve Option		
6.6.1	Terminations - General		
6.6.2	Mechanical Lugs		
6.6.3	Screen/Earth Connections		
6.6.4	Types of Terminations		
6.6.5	Outdoor Cable Termination		
6.6.6	Oil Barrier Terminations		
6.6.7	630A and 1250A Separable Elbow Connectors		
6.6.8	Inner Cone Terminations		

6.7	Cable Joints/Terminations Instructions		
6.8	Material Safety Data Sheets		
6.9	Joint and Termination Failures		
6.10	Storage Requirements		
6.11	Technical Support		

* 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: