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Electricity Specification 400J11

Issue 7 December 2021

Joints, Terminations, Associated Sealants and Components for use on 11kV Networks (U_m = 12kV)

Amendment Summary

ISSUE NO. DATE	DESCRIPTION
Issue 6 **4th May 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. Information for packaging and labelling has been updated in Section 6.3 Clarification on PICAS/PIAS cable sizes added Requirement for colour instructions and option to include/not include in kits added Requirement for providing MSDS added in Section 6.5.9 Options for 400mm^2 to 300mm^2 jointing added to Appendices A & C Various minor amendments made to other sections Prepared by: David M Talbot Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering and Technical Director
Issue 7 **December 2021**	Matrix charts in Appendices A through to R updated to show the legacy cables cross sections in imperial measurements. Prepared by: David M Talbot Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering and Technical Director

Contents

1 Introduction

This specification details 11kV Cable Joints, Cable Terminations, Associated Sealants and Components employed on the electricity distribution network owned by Electricity North West Limited (Electricity North West).

Jointing of 11kV cables is a key activity undertaken by Electricity North West and is carried out for a variety of reasons including new construction and extension of the Primary and Distribution network, Primary network interconnection, connection to local network substations, diversions, 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, the cost to reinstate the hole following completion of the jointing works and the costs associated with the reliability of the joint during its service life.

A full suite of joints and terminations will be necessary to minimise repair time and reduce excavation costs.

Only the 11kV Joints and Terminations listed in Appendix A to W of this specification shall be used on the Underground Distribution System, within the scope of this specification.

2 Scope

This specification covers all 11kV Cable Joints, Cable Terminations, Associated Sealants and Components to be used on the Underground Cable Distribution System.

3 Definitions

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.
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.

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 documents EPD311 and 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. Manufacturers shall supply a full 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 X. 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.

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 Particulars

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 6.35/11kV (U_m = 12 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 25kA Symmetrical, 63kA Asymmetrical.

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 listed in this Section (Section 6.1).

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.

Mechanical shear-bolt connectors/lugs shall be supplied in all joint and termination kits.

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.

All components shall be compatible with Electricity North West's approved cleaning wipes.

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.

The ease of construction (labour costs) shall be taken into consideration with the joint kit 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 below.

The kits shall include all items and components required to construct the joint with the exception of resin encapsulation material. These items shall include, but not limited to, the joint bodies, tubes, mastics, tapes, braids, connectors, shell sets, clips and shell sealing putty.

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 (PICAS or PIAS cables of cross sections 95/185 and 300mm^2 only)

(d) HD 621

Cables may be of belted or screened constructions, and the supplied kits and instructions should cover both eventualities

The main cross-sectional areas to be jointed will cover the following sizes, there may be on occasion sizes not listed here that the supplier is expected to offer kits or modules to cover these as required.

PAPER INSULATED CABLE SIZES (STRANDED ALUMINIUM OR COPPER)			
Minimum CSA		**Maximum CSA**	
In²	**Equivalent mm²**	**In²**	**Equivalent mm²**
0.0145	10	0.5	300

Cable joints to connect new XLPE insulated cables to legacy 33kV paper insulated 3 core cables which are de-rated to operate at 11kV will also be required – details of the joint options are shown in Appendix F and G.

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 ES400C9)

(c) ENA TS 09-17

(d) ENA TS 09-20

(e) ENA TS 09-21

(f) HD 620

(g) IEC 60502-2

The main cross-sectional areas of polymeric cables to be jointed will cover the following sizes, there may be on occasion sizes not listed here that the supplier is expected to offer kits or modules to cover these as required:

POLYMERIC INSULATED CABLES		
SAC	**Stranded Aluminium**	**Stranded Copper**
95 - 300	400	400 - 630

The cables will have a copper wire screen of 35mm^2 cross section and an equalising tape or wire. ES400C9 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. JEM 9X)

(b) Polyurethane resins

(c) Mastics and Tapes

(d) Pre-soaked PF Solvent Bucket Wipes

6.2 Type Test Requirements

All joints, terminations and 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 HD 629 / IEC 60502-4 or equivalent.

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 tubes and breakouts 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 conversation 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 6.35/11kV 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 mechanical 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 offer a high radial pressure around the prepared cable and connector to maintain electrical stress control and resistance to moisture penetration. To prove this, the minimum applied radial pressure withstand test to which ENWL will accept is 1 bar for 100 hours duration at ambient temperature, when the joint body is recovered down to a diameter in the middle of its stated operating range. 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.

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

Heat shrink modules shall be used for paper cables 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 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

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

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.

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 or aluminium or solid aluminium conductors. The connectors shall be designed to offer cable range taking facility. The shear off bolts shall have a 1.5mm pitch thread.

Each side of the connector shall have a minimum of two brass shear-off connection bolts. The bolts should be able to be tightened using standard tools as listed below:

13mm, 17mm or 19mm AF sockets – any additional tool that may be required to achieve this should be included in the kit.

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. A recommended procedure for dealing with any protruding / sharp edge on bolts shall be provided to emphasise the importance of this step in any instructions.

The centre bolt connecting the two parts of the connector together shall be removable after shear-off.

The bores of the connector shall be serrated and shall have a tapered lead-in. For connecting smaller cables to larger cross section cables, centralising build-up sleeves shall be provided in a separate packet / build up kit. The ends of the connector shall have a minimum radius of 3mm.

Mechanical connectors shall comply with the requirements of BS EN 61238-1. Connectors shall pass the tensile, load cycling and short circuit test as specified in these standards. Connectors which have passed older type specifications such as ENA ERC 79 or BS 4579 Parts 1 and 3 shall be deemed to be acceptable so long as full Type Approval documentation can be provided along with satisfactory service performance.

Connectors shall be manufactured from one of the following aluminium grades: 6082; 6063; 6056, 6005 or 6060 and or from copper using CW118C. Aluminium connectors shall be heat treated to T6. Connectors, where required shall be tin plated to allow for both copper and aluminium conductors to be jointed. Bolts shall be manufactured from brass grade CZ121.

Additional build up/or centralising sleeves shall have relevant information size markings marked on the sleeve and any special fitting instructions shall be included with them.

6.4.3 Screen/Earth Connections

Tinned copper interwoven braids shall be used to either reinstate a circumferential screen around the applied joint or to carry the screen/earth connection across cable joints, except where the screen wires are utilised. The minimum size of braid for single core joints is 35mm^2 and for trifurcating joints/ branch joints the minimum size is 95mm^2. The copper braid shall be used in conjunction with mechanical connectors, roll springs or worm-drives to make connection to the screen/earth or sheath of the cables being jointed. The braids where necessary, shall be water-blocked. Braids when jointed into mechanical connectors shall have soldered ends to suit.

On PICAS and PIAS cables the use of a worm-drive clip and “cheese grater” contact strip is preferred. Worm-drives shall have a minimum break torque of not less than 10Nm and shall meet the full requirements of the current edition of BS 5315. Joints shall be compatible with either the ENWL approved PICAS and PIAS earthing kits or be supplied as a module for use with the appropriate main kit.

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

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

6.4.4 Paper Cable Preparation

Paper cables shall be fully screened by using a conductive 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.

6.4.5 Types of cable Joints

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

6.4.5.1 Single Core 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).*
- Single Core XLPE Loop Joint (see Appendix D).*

*These joints can be configured as Triplex (all three single cores in one shell) or single core (one core per shell) – both options are required.

Single core polymeric straight joints, stop ends, branch joints and loop joints shall be supplied as a set of three phases and be referred to as a complete kit.

6.4.5.2 Transition Joints (Straight Joints):

- Single Core XLPE to Three Core Paper Straight Joint (see Appendix E).
- Single Core XLPE (11kV) to Three Core "H" Type Paper (33kV) De-rated Straight Joint (see Appendix F).
- Single Core XLPE (11kV) to Three Core "HSL" Type Paper (33kV) De-rated Straight Joint (see Appendix G).

6.4.5.3 Transition Joints (Branch Joints):

- Single Core XLPE to Three Core Paper Branch Joint (XLPE to be branch cables) (see Appendix H).
- Single Core XLPE to Three Core Paper Branch Joint (Double side both paper) (see Appendix J).
- Single Core XLPE to Three Core Paper Branch Joint (Double side both XLPE) (see Appendix K).
- Single Core XLPE to Three Core Paper Branch Joint (Paper to be branch cable) (see Appendix L).
- Three Core Transitional Loop Joint "Paper and XLPE" (see Appendix M)

6.4.5.4 Three Core Joints:

- Three Core Paper Straight Joint (see Appendix N).
- Three Core Paper Bottle End Joint (see Appendix O).
- Three Core "All" Paper Branch Joint (see Appendix P)
- Three Core Paper Loop Joint (see Appendix Q)

6.4.6 Resin Encapsulation

All joints shall be encapsulated in resin. The joint shell shall provide a minimum covering of 10mm over the completed joint. The cable joint shells when filled with resin are for use on the 6.35/11kV three phase, 50Hz alternating current, standard and non-standard phase sequence distribution systems.

The joint shells shall be manufactured from a plastic material such as Virgin Acrylonitrile Butadiene Styrene (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. Shells which are injection moulded shall be 1.2mm (minimum) thick for shells which have an empty resin volume of less than 1.5 litres and 1.5mm (minimum) thick for shells equal to or greater than 1.5 litres. Vacuum formed shells which have an empty resin volume of less than 8 litres shall be made from sheets of Virgin HIPS, Virgin ABS or PETG which are 2mm (minimum) 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 3mm (minimum) thick.

The joint shells shall be proven to pass the Cold Weather Test 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 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 overnight to chill to -20ºC. Once the materials have reached -20ºC the resin shall be mixed, and the shells filled while still inside the environmental chamber and left for 2 hours. During the mixing, pouring and waiting stage the temperature shall be kept between -5º and -10ºC. The Tenderer shall provide a test report detailing the result for each shell offered, including details of independent witnesses, at the time of Tender.

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 openings shall be covered by suitable lids to provide strength at these positions.

The joint shells shall have a suitable sealing material between flanges and suitably secured by metal clips prior to resin fill, and 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.

The joint shells supplied shall be manufactured using material of sufficient wall thickness and formed using adequate reinforcing (ribbing) to withstand the encapsulating weight of the 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.

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

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

6.5 6.35/11kV Cable Terminations

6.5.1 General

Cable terminations shall be cold applied.

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

6.5.2 Mechanical Lugs

Mechanical lugs shall be water blocked. 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 suitable for round solid aluminium conductors or stranded aluminium or copper conductors. They shall be range taking in their material and construction. The shear off bolts shall have a 1.5mm pitch thread.

Indoor lugs shall be made from tinned aluminium or brass. Outdoor lugs shall be made from brass or tinned copper.

The lug shall have a minimum of two shear-off connection bolts.

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

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

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 applied termination.

The bore of the lug shall be serrated and shall have a tapered lead-in. The outer diameter of the entry end of the lug barrel shall have a minimum radius of 3mm. Mechanical lugs shall comply with the requirements of BS EN 61238-1. Lugs shall pass the tensile, load cycling and short circuit test as specified in these standards. Lugs which have passed older type specifications such as ENA ERC 79 or BS 4579 Parts 1 and 3 shall be deemed to be acceptable as long so full Type Approval documentation can be provided along with satisfactory service performance.

Lugs shall be manufactured from one of the following material:

Indoor terminations:

Aluminium grades: 6082; 6063; 6056 6005 or 6060 and shall be heat treated to T6.

Bolts shall be manufactured from brass grade CZ121 or aluminium with a brass contact nose of grade CZ121. Any aluminium bolt must be coated with a suitable oil to prevent oxidisation.

Outdoor terminations:

Brass grades CZ121 and Copper grades CW118C.

Bolts shall be manufactured from brass grade CZ121.

The indoor termination shall be provided with centre palm lugs which are suitable for both M12 and M16 threaded connection studs. This shall be achieved by using a suitable insertion spacer or washer. This washer shall be thinner than the depth of palm of the lug. Indoor lugs can be aluminium for conductor size up to 300 mm but shall be manufactured from brass for 400 mm conductor sizes. Spare kits containing off set palm lugs shall be available.

Offset palm lugs shall be provided as a separate option to replace the centre palm lug version in the termination kit. These should follow same requirements for material and construction of palm hole and conductor connection.

The outdoor termination shall be provided with a 3-hole brass lug suitable for 12mm connection studs. The bottom hole should be slotted.

6.5.3 Screen/Earth Connections

For outdoor and indoor terminations, the three 35mm^2 copper screen wires of the XLPE single core cables shall be terminated into one brass lug suitable for either M12 or M16 threaded connection studs. The screen/earth or sheath connection shall be capable of carrying without any increase in contact resistance an earth fault current of 3kA for 3s. Evidence shall be provided that all connections are capable of carrying this amount of current for the duration stated.

6.5.4 Types of Terminations

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

- Single Core XLPE Indoor Termination (See Appendix R)
- Single Core XLPE Outdoor Termination (See Appendix S)
- Single Core XLPE 200A Load Break Elbow Termination (See Appendix T)
- Single Core XLPE 250A Non-Load Break Elbow Termination (See Appendix U)
- Single Core XLPE 630A Elbow Termination (See Appendix V)
- Single Core XLPE 630A Piggy Back Termination (See Appendix W)

Single core polymeric terminations and separable connectors shall be supplied as a set of three phases and be referred to as a complete kit.

6.5.5 Outdoor Cable Termination Crucifix

The outdoor termination shall be used with a cable termination crucifix (refer to the example shown in Fig. 1). The crucifix shall be manufactured from galvanized steel section and shall conform to all requirements of this specification and ENA TS 43-95 (Steelwork for Overhead Lines). Manufacturing tolerances shall be those given in ENA TS 43-95. Galvanizing shall be to BS EN ISO 1461. Galvanized steelwork shall be free from sharp edges or points left by the galvanization process.

The crucifix shall be provided with one key-hole attachment point at the top as shown in the drawings. Two galvanized coach screws shall be provided in the kit to attach the crucifix to the pole. The crucifix shall also be provided with a "triplex" cable clamp which shall be capable of clamping securely single core XLPE cables in triplex formation as specified in 6.1.3 (b).

The crucifix shall be designed for attachment of three surge diverters (one per phase). The single core XLPE cables shall terminate on the surge diverters using the three-hole brass lug (slot and 2 hole) provided with the terminations. The design of the crucifix shall ensure that no undue sideways pressure is applied to the outdoor termination body, i.e. the connection made to the surge diverter with the lug/termination body shall be true and straight.

The crucifix shall be provided with two separate earth/screen connections: one for an external single core 70mm^2 connection and one for the 120mm^2 connection (all three 35mm^2 Copper Screens of a three-phase circuit).

6.5.6 200A Load Break and 250 A Non-Load Break Elbow Connectors

These shall be manufactured from high quality silicone or EPDM rubber. They shall meet the requirements of HD629 and IEC 60502-4.

6.5.7 630A Separable Elbow Connectors

These shall be manufactured from high quality silicone or EPDM rubber and shall be suitable for Type C interface according to BS EN50180/BS EN 50181. They shall be of the bolted type and designed to connect XLPE insulated cable to transformers, switch gear, etc, and shall meet the requirements of HD629, IEC 60502-4 and BS EN 50180 or BS EN 50181 Table 1 Type C.

They shall be available for conductor sizes ranging from 95mm – 300mm solid aluminium and 400 - 630mm stranded copper.

The lugs provided in the kits shall be 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 solid aluminium conductors. They shall be range taking in their material and construction. The shear off bolts shall preferably have a 1.5mm pitch thread.

The lug 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 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.

The bore of the lug shall be serrated and shall have a tapered lead-in. The outer diameter of the entry end of the lug barrel shall have a minimum radius of 3mm.

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

Lugs shall pass the tensile, load cycling and short circuit test as specified in this standard.

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.

Double connection (Piggy Back) versions shall be available.

Single core polymeric terminations and separable connectors shall be supplied as a set of three phases and be referred to as a complete kit.

6.5.8 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 jointing instructions shall be provided in an editable word document in Electricity North West approved format. Instructions and 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 CP411 Pt2.

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.

6.5.9 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

6.5.10 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.

6.6 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.

6.7 Technical Support and Development

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. submerged cable application) 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

All references to documents listed below are to the latest versions, unless stated otherwise.

DOCUMENTS REFERENCED	
Health and Safety at Work Act 974	
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 480	Impregnated paper-insulated cables for electricity supply for working voltages up to and including 33 kV.

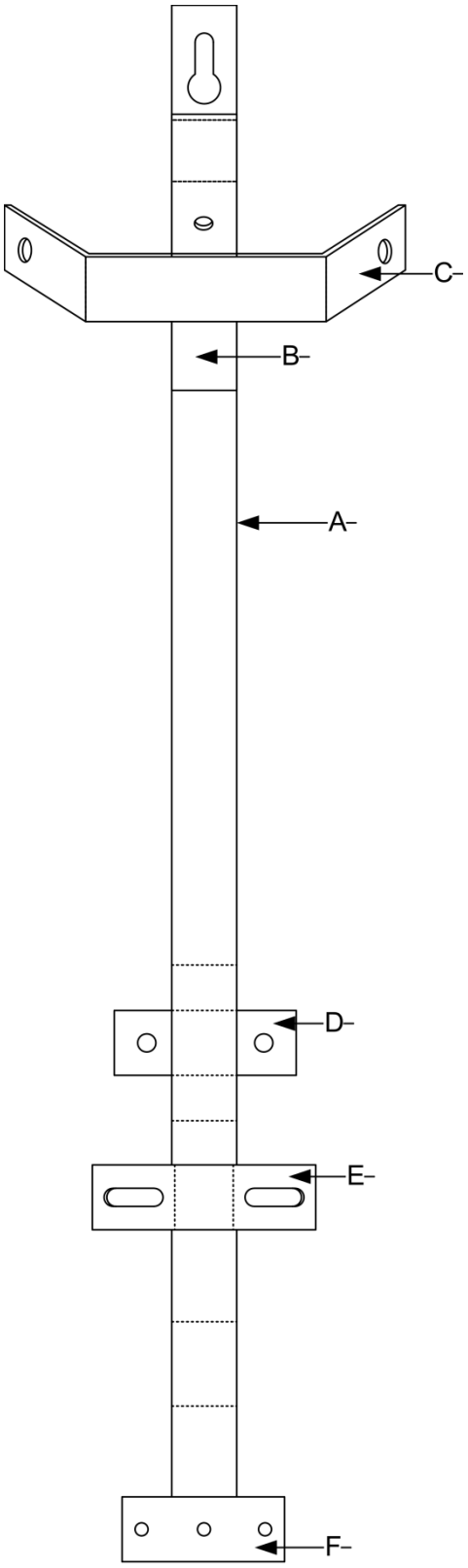
BS EN 61238-1-3	Compression and mechanical connectors for power cables. Part 1-3: Test methods and requirements for compression and mechanical connectors for power cables for rated voltages above 1 kV (U_m = 1,2 kV) up to 36 kV (U_m = 42 kV) tested on non-insulated conductors
BS 4579-1: 1970	Specification 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 5315	Hose clamps (worm drive type) for general purpose use (metric series)
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 628	Test Methods for Accessories for Power Cables with Rated Voltage from 3,6/6 kV (U_m = 7,2kV) up to and Including 20,8/36kV (U_m = 42kV).
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)
IEC 61442	Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 36 kV (Um = 42 kV)
ENA TS 09-12	Impregnated paper insulated corrugated aluminium sheathed 6350/11000 volt cable.
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 09-21	Cross-linked polymeric insulated triplex cables for rated voltage of 6 350/11 000 volts (U_m = 12 000V).
ENA TS 43-95	Steelwork for overhead lines.
ENA ERC 79	Type Approval Tests for Connection and Terminations for Aluminium Conductors of Insulated Power Cables.
EPD311	Approval of Equipment.
CP311	Equipment Approval Process.
ES400C9	11kV Distribution Cables.

8 Keywords

11kV; joint; jointing; termination.

Fig. 1 – 11kV Pole Top Crucifix (1 of 7)



Material: 5x50 mild steel dip galvanized.

See Sheets 2 to 7 for Details A to F.

Fig. 1 – 11kV Pole Top Crucifix (2 of 7) – Detail A

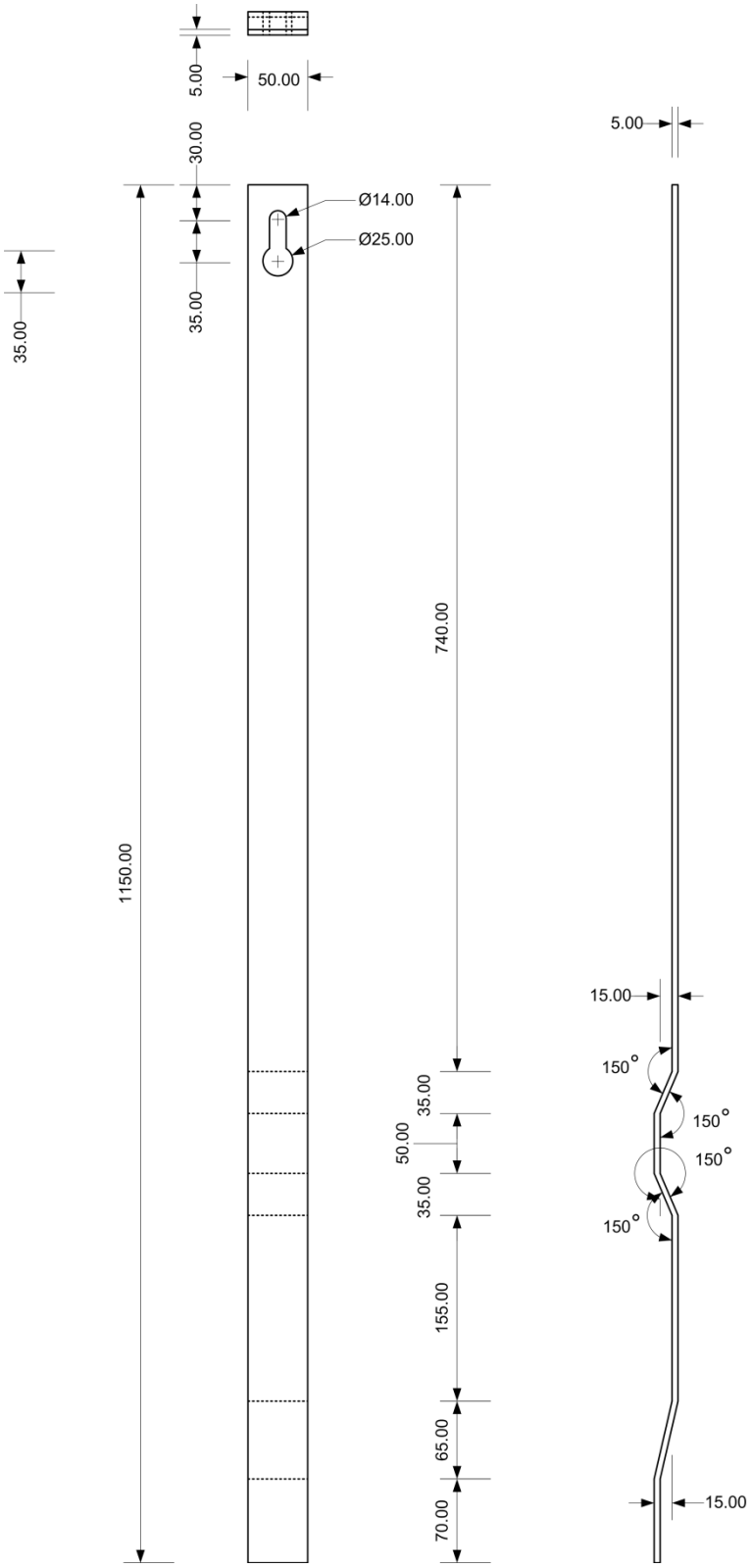
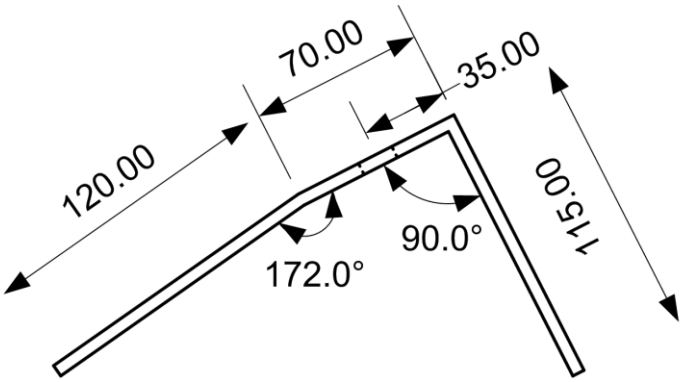


Fig. 1 – 11kV Pole Top Crucifix (3 of 7) – Detail B



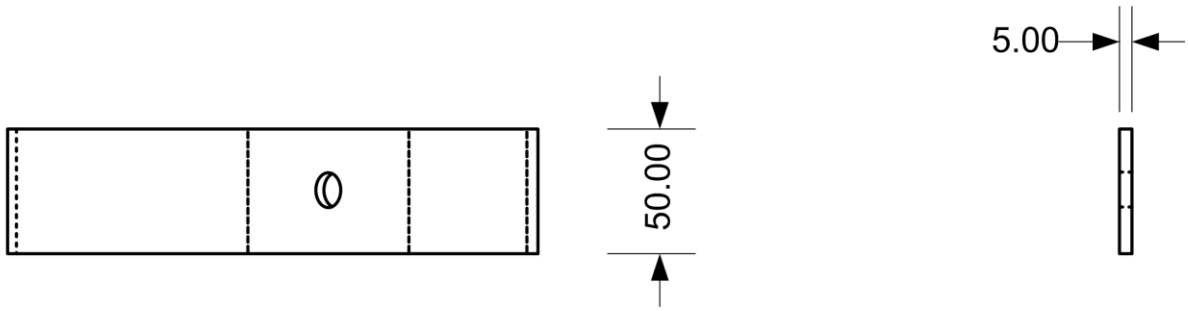


Fig. 1 – 11kV Pole Top Crucifix (4 of 7) – Detail C

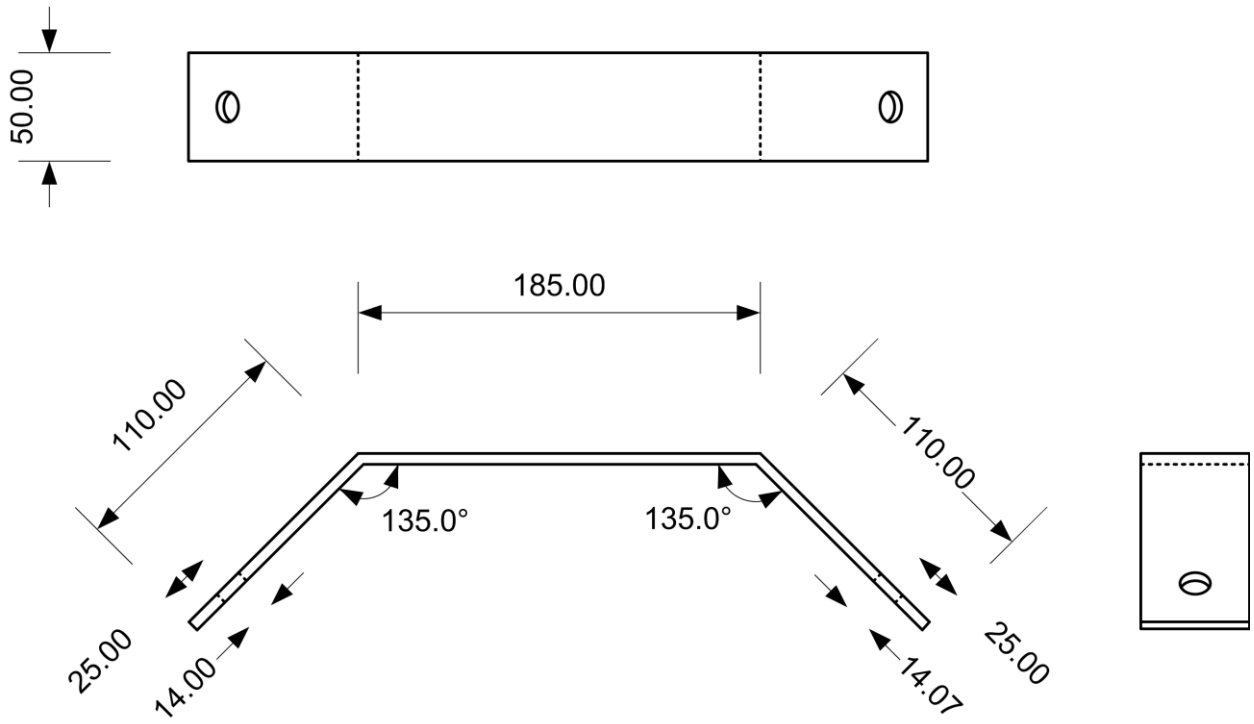


Fig. 1 – 11kV Pole Top Crucifix (5 of 7) – Detail D

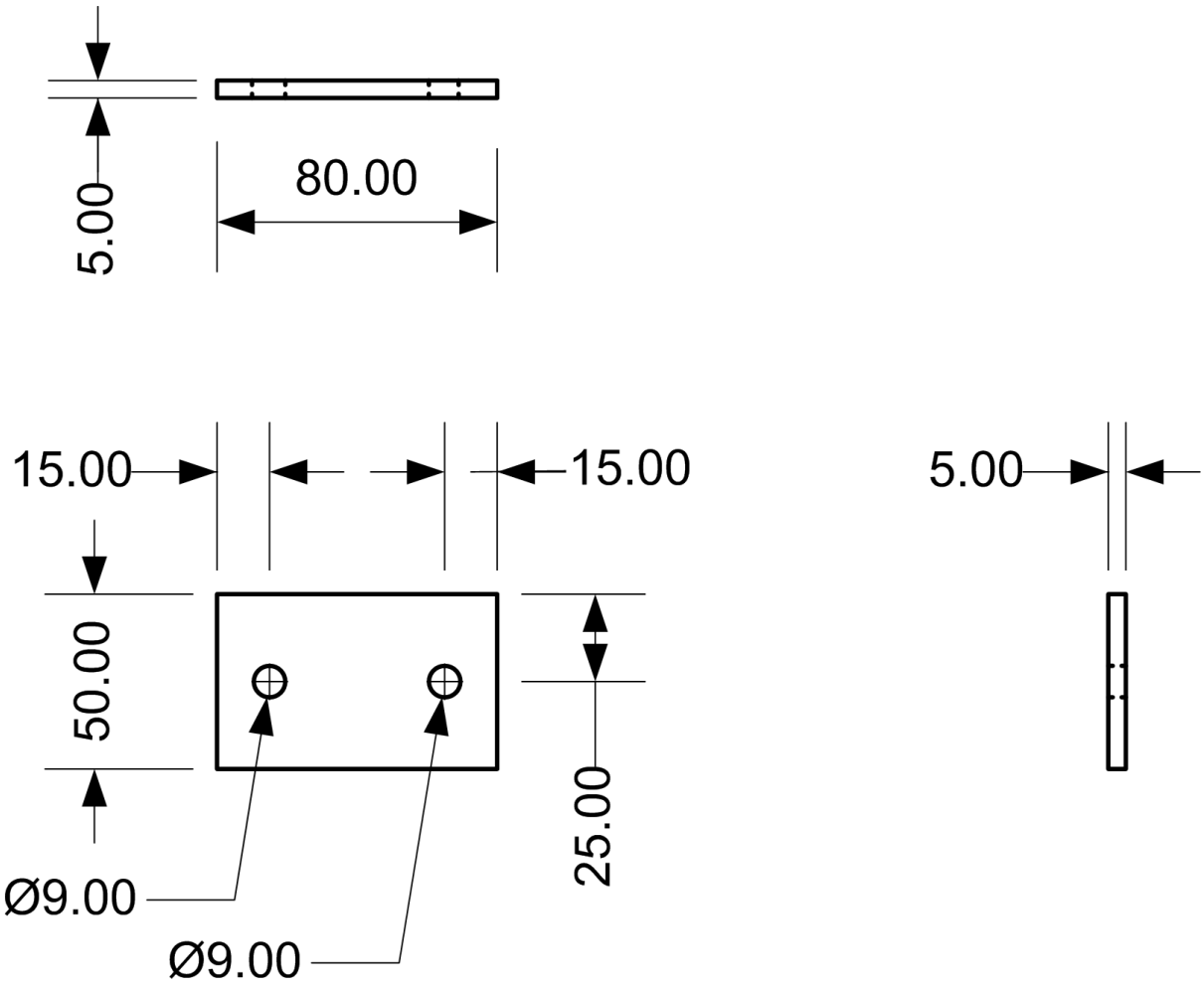


Fig. 1 – 11kV Pole Top Crucifix (6 of 7) – Detail E

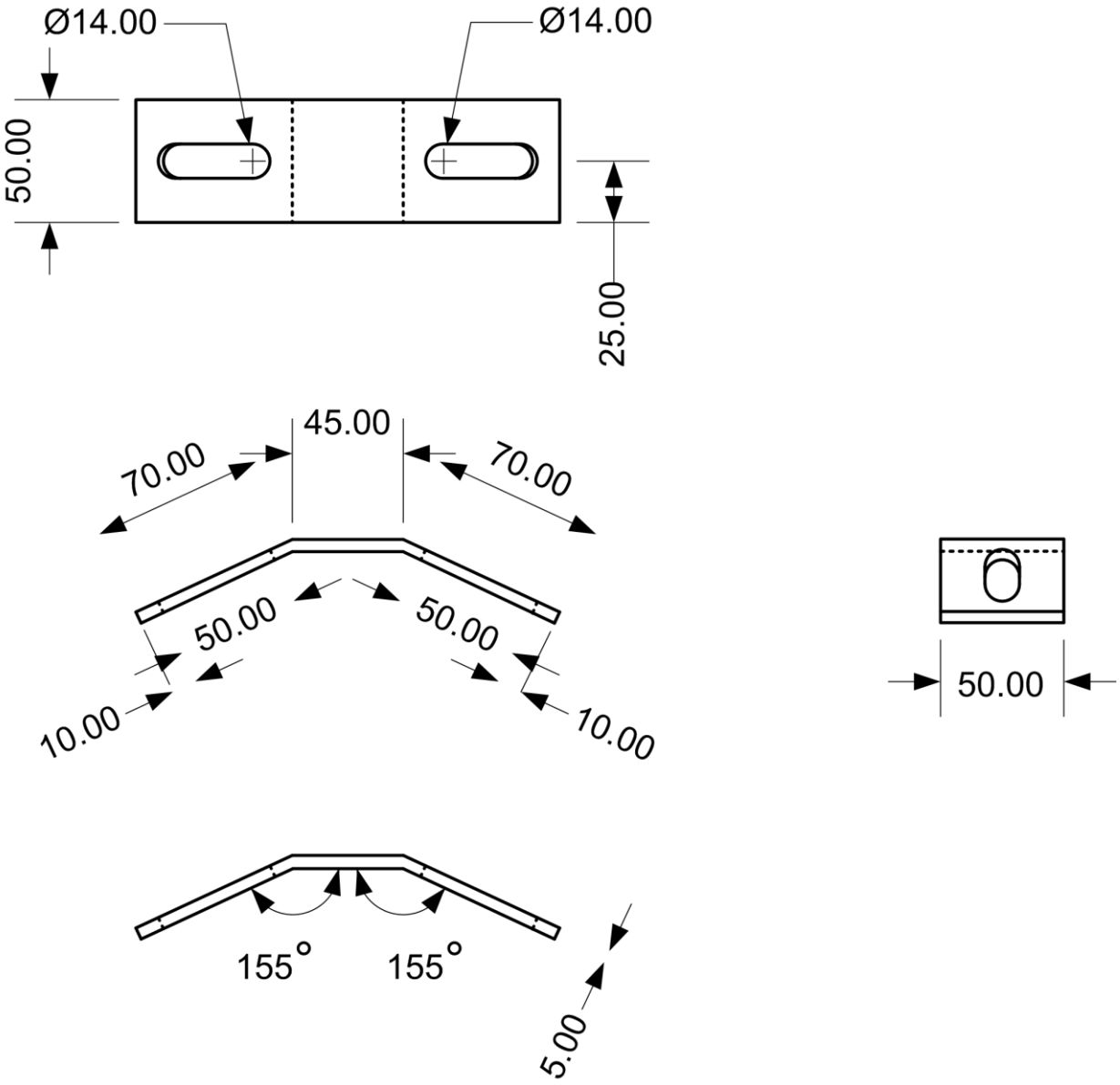
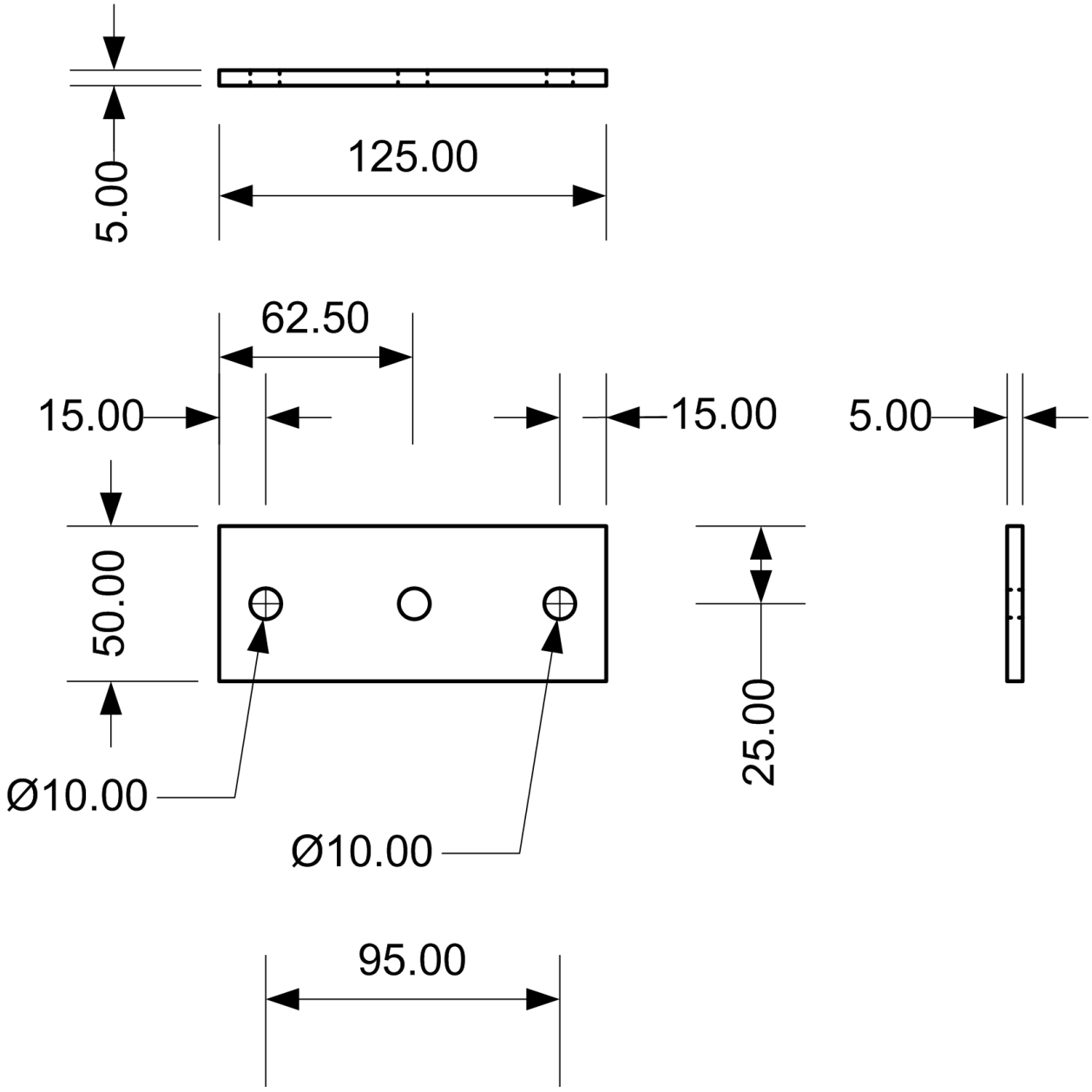


Fig. 1 – 11kV Pole Top Crucifix (7 of 7) – Detail F



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

Table A (a) lists the variation in cables sizes for which cable joints will be needed. Table A (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table A (a)

Dec 21

	CABLE 2 maximum polymeric CSA (mm²)				
CABLE 1 maximum polymeric CSA (mm²)	95* solid	185* solid	300* solid	400** stranded Cu or AL	630** stranded AL
95* solid	A1	A2	A3	N/A	N/A
185* solid	N/A	A4	A5	N/A	N/A
300* solid	N/A	N/A	A6	N/A	N/A
400** stranded Cu or AL	N/A	N/A	A7	A8	A9
630** stranded	N/A	N/A	N/A	N/A	A10

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.
** See 6.1.3 (b) for general description of cable – stranded conductors.

Table A (b)

Dec 21

JOINT REFERENCE FROM TABLE A (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
A1					
A2					
A3					
A4					
A5					

A6					
A7					
A8					
A9					
A10					

Dec 21

Appendix B – Single Core XLPE Bottle End Joint

Table B (a) lists the variation in cables sizes for which cable joints will be needed. Table B (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table B (a)

CABLE 1 maximum polymeric CSA (mm^2)	
95* solid	B1
185* solid	B2
300* solid	B3

Dec 21

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

Table B (b)

JOINT REFERENCE FROM TABLE B (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME
B1			N/A	
B2			N/A	
B3			N/A	

Dec 21

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

Table C (a) lists the variation in cables sizes for which cable joints will be needed. Table C (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table C (a)

Dec 21

	CABLE 2 (Main through cable) (maximum polymeric CSA (mm^2)			
CABLE 1 maximum polymeric CSA (mm^2)	95* solid AL	185* solid AL	300* solid AL	400** stranded AL
95* solid AL	C1	C2	C3	N/A
185* solid AL	C4	C5	C6	N/A
300* solid AL	C7	C8	C9	C10
400** stranded AL	N/A	N/A	C10	C11

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.
** See 6.1.3 (b) for general description of cable – stranded conductors.

Table C (b)

Dec 21

JOINT REFERENCE FROM TABLE C (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
C1					
C2					
C3					
C4					

C5					
C6					
C7					
C8					
C9					
C10					
C11					
C1/3					
C2/3					
C3/3					
C4/3					
C5/3					
C6/3					
C7/3					
C8/3					
C9/3					
C10/3					
C11/3					

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NOTE:

Items C1 to C11 cover a single phase version of this joint (i.e. one phase per shell)
Items C1/3 to C11/£ cover a triplex version of this joint (i.e three phases in one shell)

Appendix D – Single Core XLPE to Single Core XLPE Loopjoint

Table D (a) lists the variation in cables sizes for which cable joints will be needed. Table D (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table D (a)

	CABLE 2 (maximum polymeric CSA (mm^2))		
CABLE 1 maximum polymeric CSA (mm^2)	95* solid	185* solid	300* solid
95* solid	D1	D2	D3
185* solid	N/A	D4	D5
300* solid	N/A	N/A	D6

Dec 21

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

Table D (b)

JOINT REFERENCE FROM TABLE E (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
D1					
D2					
D3					
D4					
D5					
D6					

Dec 21

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

Table E (a) lists the variation in cables sizes for which cable joints will be needed. Table E (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table E (a)

	CABLE 2** PAPER PILC or PICAS/PIAS(95-300mm² only)						
CABLE 1 XLPE maximum polymeric CSA (mm^2/ in^2)	35 / 0.06 in^2 25 / 0.04 in^2 16 / 0.0225 in^2 10 / 0.015 in^2	70 / 0.1 in^2 50 / 0.075 in^2	95 0.15 in^2	150 120 / 0.2 in^2	185 0.25 in^2	300 0.4 in^2 0.3 in^2	0.5 in^2
95* solid	E1	E2	E3	E4	E5	E6	E7
185* solid	E8	E9	E10	E11	E12	E13	E14
300* solid	E15	E16	E17	E18	E19	E20	E21

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NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table E (b)

JOINT REFERENCE FROM TABLE E (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
E1					
E2					
E3					
E4					
E5					
E6					
E7					

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E8					
E9					
E10					
E11					
E12					
E13					
E14					
E15					
E16					
E17					
E18					
E19					
E20					
E21					

Dec 21

Appendix F – 33kV DERATED "H" TYPE CABLE-SINGLE CORE XLPE TO THREE CORE PAPER STRAIGHT JOINT

Table F (a) lists the variation in cables sizes for which cable joints will be needed. Table F (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table F (a)

Dec 21

	CABLE 2 XLPE CABLE (maximum polymeric CSA (mm^2)		
CABLE 1 ** THREE CORE PAPER H TYPE 33kV CSA (mm^2 / in^2)	95* solid	185* solid	300* solid
95 / 0.15 in^2	F1	F2	N/A
120/150mm^2 / 0.2 in^2	F3	F4	F5
0.25 in^2	F6	F7	F8
185/0.3 in^2	F9	F10	F11
0.4 in^2	F12	F13	F14
300mm^2	F15	F16	F17
0.5 in^2	F18	F19	F20

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table F (b)

Dec 21

JOINT REFERENCE FROM TABLE F (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
F1					
F2					
F3					
F4					
F5					
F6					
F7					
F8					
F9					
F10					
F11					
F12					
F13					
F14					
F15					
F16					
F17					
F18					
F19					
F20					

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix G – 33kV Derated "HSL" Type Cable -Single Core XLPE to Three Core Paper Straight Joint

Table G (a) lists the variation in cables sizes for which cable joints will be needed. Table G (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table G (a)

	CABLE 2 XLPE CABLE (maximum polymeric CSA (mm^2)	
CABLE 1 ** THREE CORE PAPER HSL TYPE 33kV CSA (mm^2 / in^2)	300* solid	400** stranded
0.15 in^2 / 95mm^2	G1	G2
0.25 in^2 / 150mm^2	G3	G4
0.3 in^2 /185mm^2	G5	G6
0.4 in^2 / 240mm^2	G7	G8
0.5 in^2 / 300mm^2	G9	G10

Dec 21

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table G (b)

JOINT REFERENCE FROM TABLE G (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
G1					
G2					

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G3					
G4					
G5					
G6					
G7					
G8					
G9					
G10					

Dec 21

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix H – Single Core XLPE to Three Core Paper Branch Joint

Table H (a) lists the variation in cables sizes for which cable joints will be needed. Table H (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table H (a)

Dec 21

	CABLE 2 BRANCH CABLE (maximum polymeric CSA (mm^2)		
CABLE 1** PAPER PILC or PICAS/PIAS (95-300mm^2 only) THROUGH CABLE CSA (mm^2 / in^2)	95* solid	185* solid	300* solid
35 / 0.06 in^2 25 / 0.04 in^2 16 / 0.0225 in^2 10 / 0.015 in^2	H1	H2	N/A
70 / 0.1 in^2 50 / 0.075 in^2	H3	H4	H5
95 /0.15 in^2	H6	H7	H8
150 /120 / 0.2 in^2	H9	H10	H11
185 /0.25 in^2	H12	H13	H14
300 /0.4 in^2/0.3 in^2	H15	H16	H17
0.5 in^2	H18	H19	H20

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table H (b)

JOINT REFERENCE FROM TABLE H(I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE	MANUFACTURER'S KIT REFERENCE
H1						
H2						
H3						
H4						
H5						
H6						
H7						
H8						
H9						
H10						
H11						
H12						
H13						
H14						
H15						
H16						
H17						
H18						
H19						
H20						

Dec 21

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix J – Single Core XLPE to Three Core Paper Branch Joint (Double Side Both Paper)

Table J (a) lists the variation in cables sizes for which cable joints will be needed. Table J (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table J (a)

Dec 21

	CABLE 2 XLPE CABLE (maximum polymeric CSA (mm^2)		
CABLE 1** DOUBLE PAPER PILC or PICAS/PIAS (95-300mm^2 only) CSA (mm^2 / in^2)	95* solid	185* solid	300* solid
35 / 0.06 in^2 25 / 0.04 in^2 16 / 0.0225 in^2 10 / 0.015 in^2	J1	J2	N/A
70 / 0.1 in^2 50 / 0.075 in^2	J3	J4	J5
95 /0.15 in^2	J6	J7	J8
150 /120 / 0.2 in^2	J9	J10	J11
185 /0.25 in^2	J12	J13	J14
300 /0.4 in^2/0.3 in^2	J15	J16	J17
0.5 in^2	J18	J19	J20

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table J (b)

Dec 21

JOINT REFERENCE FROM TABLE J(I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
J1					
J2					
J3					
J4					
J5					
J6					
J7					
J8					
J9					
J10					
J11					
J12					
J13					
J14					
J15					
J16					
J18					
J19					
J20					

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix K – Single Core XLPE to Three Core Paper Branch Joint (Double Side Both XLPE)

Table K (a) lists the variation in cables sizes for which cable joints will be needed. Table K (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table K (a)

Dec 21

	CABLE 2 DOUBLE XLPE CABLE (maximum polymeric CSA (mm^2)		
CABLE 1** 3 CORE PAPER PILC or PICAS/PIAS (95-300mm^2 only) CSA (mm^2 / in^2)	95* solid	185* solid	300* solid
35 / 0.06 in^2 25 / 0.04 in^2 16 / 0.0225 in^2 10 / 0.015 in^2	K1	K2	N/A
70 / 0.1 in^2 50 / 0.075 in^2	K3	K3	K3
95/0.15 in^2	K6	K7	K8
150/120 / 0.2 in^2	K9	K10	K11
185/0.25 in^2	K12	K13	K14
300/0.4 in^2/0.3 in^2	K15	K16	K17
0.5 in^2	K18	K19	K20

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table K (b)

Dec 21

JOINT REFERENCE FROM TABLE K (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
K1					
K2					
K3					
K4					
K5					
K6					
K7					
K8					
K9					
K10					
K11					
K12					
K13					
K14					
K15					
K16					
K17					
K18					
K19					
K20					

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix L – Single Core XLPE to Three Core Paper Branch Joint (Paper Branch onto XLPE)

Table L (a) lists the variation in cables sizes for which cable joints will be needed. Table L (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table L (a)

Dec 21

	CABLE 2** BRANCH CABLE PAPER PILC or PICAS/PIAS (95-300mm² only) CSA (mm² / in²)				
CABLE 1 THROUGH CABLE (maximum polymeric CSA (mm²)		Up to 0.15in²	Up to 02.5in²	Up to 300mm²	Up to 0.5in²
	95*	L1	L2	L3	L4
	185*	L5	L6	L7	L8
	300*	L9	L10	L11	L12

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table L (b)

Dec 21

JOINT REFERENCE FROM TABLE L (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
L1					
L2					
L3					
L4					

L5					
L6					
L7					
L8					
L9					
L10					
L11					
L12					

Dec 21

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix M – Single Core XLPE to Three Core Paper Loop Joint

Table M (a) lists the variation in cables sizes for which cable joints will be needed. Table M (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table M (a)

Dec 21

	CABLE 2 XLPE CABLE (maximum polymeric CSA (mm^2)		
CABLE 1** PAPER PILC or PICAS/PIAS (95-300mm^2 only) CSA (mm^2 / in^2)	95* solid	185* solid	300* solid
35 / 0.06 in^2 25 / 0.04 in^2 16 / 0.0225 in^2 10 / 0.015 in^2	M1	M2	N/A
70 / 0.1 in^2 50 / 0.075 in^2	M3	M4	M5
95/0.15 in^2	M6	M7	M8
150/120 / 0.2 in^2	M9	M10	M11
185/0.25 in^2	M12	M13	M14
300/0.4 in^2/0.3 in^2	M15	M16	M17
0.5 in^2	M18	M19	M20

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table M (b)

JOINT REFERENCE FROM TABLE M (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
M1					
M2					
M3					
M4					
M5					
M6					
M7					
M8					
M9					
M10					
M11					
M12					
M13					
M14					
M15					
M16					
M17					
M18					
M19					
M20					

Dec 21

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix N – Three Core Paper Straight Joint

Table N (a) lists the variation in cables sizes for which cable joints will be needed. Table N (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table N (a)

Dec 21

	CABLE 2** PILC or PICAS/PIAS (95-300mm² only)						
CABLE 1** PILC or PICAS/PIAS (95-300mm² only) CSA (mm² / in²)	35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	70 / 0.1 in² 50 / 0.075 in²	95 0.15 in²	150 / 120 / 0.2 in²	185 0.25 in²	300 0.4 in²/0.3 in²	0.5 in²
35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	N1	N2	N3	N4	N5	N6	N/A
70 / 0.1 in² 50 / 0.075 in²	N2	N7	N8	N9	N10	N11	N/A
95 /0.15 in²	N3	N8	N12	N13	N14	N15	N/A
150 /120 / 0.2 in²	N/A	N9	N13	N16	N17	N18	N/A
185 /0.25 in²	N/A	N10	N14	N17	N19	N20	N21
300 /0.4 in²/0.3 in²	N/A	N11	N15	N18	N20	N22	N23
0.5 in²	N/A	N/A	N/A	N/A	N21	N23	N24

NOTE:

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table N (b)

Dec 21

JOINT REFERENCE FROM TABLE N (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					
N14					
N15					
N16					
N17					
N18					
N19					
N20					
N21					
N22					
N23					
N24					

NOTE: It is noted that more than one build-up kit may be required. The number of build-up kits shall be indicated.

Appendix O – Three Core Paper Bottle End Joint

Table O (a) lists the variation in cables sizes for which cable joints will be needed. Table O (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table O (a)

CABLE 1 ** PILC or PICAS/PIAS (95-300mm² only) CSA (mm² / in²)	
35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	O1
70 / 0.1 in² 50 / 0.075 in²	O2
95 /0.15 in²	O3
150 /120 / 0.2 in²	O4
185 /0.25 in²	O5
300 /0.4 in²/0.3 in²	O6
0.5 in²	O7

Dec 21

NOTE:
** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table O (b)

JOINT REFERENCE FROM TABLE O (I)	MANUFACTURER'S JOINT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
O1				
O2				
O3				
O4				
05				
06				
07				

Dec 21

Appendix P – Three Core "All" Paper Branch Joint

Table P (a) lists the variation in cables sizes for which cable joints will be needed. Table P (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table P (a)

Dec 21

	CABLE 2 ** PILC or PICAS/PIAS(95-300mm² only) CSA (mm² / in²)						
CABLE 1** PILC or PICAS/PIAS (95-300mm² only) CSA (mm² / in²)	35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	70 / 0.1 in² 50 / 0.075 in²	95 0.15 in²	150 120 / 0.2 in²	185 0.25 in²	300 0.4 in²/0.3 in²	0.5 in²
35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	P1	P2	P3	P4	P5	P6	N/A
70 / 0.1 in² 50 / 0.075 in²	P2	P7	P8	P9	P10	P11	N/A
95 /0.15 in²	P3	P8	P12	P13	P14	P15	N/A
150 /120 / 0.2 in²	N/A	P9	P13	P16	P17	P18	N/A
185 /0.25 in²	N/A	P10	P14	P17	P19	P20	P21
300 /0.4 in²/0.3 in²	N/A	P11	P15	P18	P20	P22	P23
0.5 in²	N/A	N/A	N/A	N/A	P21	P23	P24

NOTE:

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table P (b)

Dec 21

JOINT REFERENCE FROM TABLE P (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
P1					
P2					
P3					
P4					
P5					
P6					
P7					
P8					
P9					
P10					
P11					
P12					
P13					
P14					
P15					
P16					
P17					
P18					
P19					
P20					
P21					
P22					
P23					
P24					

Appendix Q – Three Core Paper Loop Joint

Table Q (a) lists the variation in cables sizes for which cable joints will be needed. Table Q (b) further breaks down the specific joint requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular joint may cover a number of different cable sizes.

Table Q (a)

Dec 21

	CABLE 2** PILC or PICAS/PIAS (95-300mm² only) CSA (mm² / in²)						
CABLE 1** PILC or PICAS/PIAS (95-300mm² only) CSA (mm² / in²)	35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	70 / 0.1 in² 50 / 0.075 in²	95 0.15 in²	150 120 / 0.2 in²	185 0.25 in²	300 0.4 in²/0.3 in²	0.5 in²
35 / 0.06 in² 25 / 0.04 in² 16 / 0.0225 in² 10 / 0.015 in²	Q1	Q2	Q3	Q4	Q5	Q6	N/A
70 / 0.1 in² 50 / 0.075 in²	Q2	Q7	Q8	Q9	Q10	Q11	N/A
95/0.15 in²	Q3	Q8	Q12	Q13	Q14	Q15	N/A
150/120 / 0.2 in²	N/A	Q9	Q13	Q16	Q17	Q18	N/A
185/0.25 in²	N/A	Q10	Q14	Q17	Q19	Q20	Q21
300/0.4 in²/0.3 in²	N/A	Q11	Q15	Q18	Q20	Q22	Q23
0.5 in²	N/A	N/A	N/A	N/A	Q21	Q23	Q24

NOTE:

** See 6.1.2 (a), (b) or (c) for general description of cable – copper stranded conductors for 6.1.2 (a) and 6.1.2 (b) and stranded aluminium conductor for 6.1.2 (c).

Table Q (b)

Dec 21

JOINT REFERENCE FROM TABLE Q (I)	MANUFACTURER'S KIT REFERENCE	CABLE SIZE (IN) BUILD-UP KIT REFERENCE (If ANY)	CABLE SIZE (OUT) BUILD-UP KIT REFERENCE (If ANY)	SHELL SIZE (EMPTY) VOLUME	CONNECTOR REFERENCE
Q1					
Q2					
Q3					
Q4					
Q5					
Q6					
Q7					
Q8					
Q9					
Q10					
Q11					
Q12					
Q13					
Q14					
Q15					
Q16					
Q17					
Q18					
Q19					
Q20					
Q21					
Q22					
Q23					
Q24					

Appendix R – Single Core XLPE Indoor Termination

Table R (a) lists the variation in cables sizes for which Indoor Terminations will be needed. Table R (b) further breaks down the specific termination requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular termination may cover a number of different cable sizes.

Table R (a)

Cable Size	95*	R1
	185*	R2
	300*	R3
	400**	R4
	630**	R5

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.3 (b) for general description of cable – copper stranded conductors.

Table R (b)

JOINT REFERENCE FROM TABLE R (I)	MANUFACTURER'S TERMINATION REFERENCE	BUSHING BOOT REFERENCE	LUG REFERENCE
R1			
R2			
R3			
R4			
R5			

Appendix S – Single Core Outdoor Termination

Table S (a) lists the variation in cables sizes for which Outdoor Terminations will be needed. Table S (b) further breaks down the specific termination requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular termination may cover a number of different cable sizes.

Table S (a)

Cable Size	95*	S1
	185*	S2
	300*	S3
	400**	S4
	630**	S5

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.3 (b) for general description of cable – copper stranded conductors.

Table S (b)

JOINT REFERENCE FROM TABLE S (I)	MANUFACTURER'S TERMINATION REFERENCE	LUG REFERENCE
S1		
S2		
S3		
S4		
S5		

Appendix T – Single Core XLPE 200A Load Break Elbow Termination

Table T (a) lists the variation in cables sizes for which 200A Load Break Elbows will be needed. Table T (b) further breaks down the specific termination requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular termination may cover a number of different cable sizes.

Table T (a)

Cable Size	95*	T1

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

Table T (b)

JOINT REFERENCE FROM TABLE T (I)	MANUFACTURER'S TERMINATION REFERENCE	LUG REFERENCE
T1		

Appendix U – Single Core XLPE 250A Non-Load Break Elbow Termination

Table U (a) lists the variation in cables sizes for which 250A Non-Load Break Elbows will be needed. Table U (b) further breaks down the specific termination requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular termination may cover a number of different cable sizes.

Table U (a)

Cable Size	95*	U1

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

Table U (b)

JOINT REFERENCE FROM TABLE U (I)	MANUFACTURER'S TERMINATION REFERENCE	LUG REFERENCE
U1		

Appendix V – Single Core XLPE 630A Elbow Termination

Table V (a) lists the variation in cables sizes for which 630A Elbow Terminations will be needed. Table V (b) further breaks down the specific termination requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular termination may cover a number of different cable sizes.

Table V (a)

Cable Size	95*	V1
	185*	V2
	300*	V3
	400**	V4
	630**	V5

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.3 (b) for general description of cable – copper stranded conductors.

Table V (b)

JOINT REFERENCE FROM TABLE V (I)	MANUFACTURER'S TERMINATION REFERENCE	LUG REFERENCE
V1		
V2		
V3		
V4		
V5		

Appendix W – Single Core XLPE 630A Piggy Back Termination

Table W (a) lists the variation in cables sizes for which 630A Piggy Back Terminations will be needed. Table W (b) further breaks down the specific termination requirement so that a cost comparison can be made between different Suppliers. It is recognised that a particular termination may cover a number of different cable sizes.

Table W (a)

Cable Size	95*	W1
	185*	W2
	300*	W3
	400**	W4
	630**	W5

NOTE:

* See 6.1.3 (b) for the general description of cable – aluminium solid conductors.

** See 6.1.3 (b) for general description of cable – copper stranded conductors.

Table W (b)

JOINT REFERENCE FROM TABLE W (I)	MANUFACTURER'S TERMINATION REFERENCE	LUG REFERENCE
W1		
W2		
W3		
W4		
W5		

Appendix X – 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**		
6.2	**Type Test Requirements**		
6.3.1	**Identification**		

6.3.2	**Packaging**		
6.3.3	**Labelling**		
6.4.1	**General**		
6.4.2 **	**Mechanical Connectors**		
6.4.3	**Screen/Earth Connections**		
6.4.4	**Paper Cable Preparation**		
6.4.5.1	**Single Core Joints**		
6.4.5.2	**Transition Joints (Straight Joints)**		
6.4.5.3	**Transition Joints (Branch Joints)**		
6.4.5.4	**Three Core Joints**		
6.4.6	**Resin Encapsulation**		
6.5.1	**General**		
6.5.2	**Mechanical Lugs**		
6.5.3	**Screen/Earth Connections**		
6.5.4	**Types of Terminations**		
6.5.5	**Outdoor Cable Termination Crucifix**		
6.5.6	**200A Load Break and 250A Non-Load Break Elbow Connectors**		
6.5.7	**630A Separable Elbow Connectors**		

6.5.8	**Cable Joints/Terminations Instructions**		
6.5.9	**MSDS**		
6.5.10	**Joint and Termination Failures**		
6.6	**Storage Requirements**		
6.7	**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: