

Cable joint and termination accessories for power cable

1. General

XLPE cables shall be terminated and jointed with suitable terminating kits and shall be of the blocking type designed that prevents the ingress of moisture from one cable to the next through the through joints.

The Straight through joint kit or termination shall be complete with all accessories, jointing material, insulating stress control and sealing material, lugs, nuts, bolts etc. as well as an instruction booklet Explaining the method of using the kit and it shall be complied with IEC 60502.

The straight through joints should be absolutely impervious to the entry of water. The manufacturer shall use the proven technologies and design to ensure a construction which will prevent entry of water or any other liquid inside the straight through joint and cable.

1.1 General requirements for straight joint and terminations

The joint shall be as the following requirement:

- Each kit shall be provided with all necessary insulation materials and other accessories, cable lugs must be tinned copper suitable for connection Cu, Al, Al Alloy, ACSR on copper terminals or aluminums terminals. Cable lugs inside are covered with contact grease for the best electrical contact, closed by protection cap. It shall be suitable for crimping by hexagonal compression, where all **accessories shall be dry & clean.**

• Red anti-tracking mastic

The Red anti-tracking mastic must be suitable for power cable heat shrink outdoor termination and joints for 12 and 36 kV to provide insulation and sealing. The red mastic shall not flow or exude at temperatures below 85°C.

- Each kit shall be provided with all necessary insulation materials, grounding kit and other accessories; the thickness of insulated material should comply with the min thickness of cable's insulation.
- Designs, drawings and details of all terminations, quantified materials to be used, with copies of instructions shall be submitted for approval by the Engineer before the factory orders are issued for manufacture.
- Each kit shall be provided with complete detailed installation instruction and be clearly marked to show its application.
- Three copies of the instruction for the installation of each type of cable termination supplied shall be submitted to the engineer

1.2 Condition of operation and rating:

The cables where laid in the ground shall be rated to suit the following conditions:

Condition	Specifications
Depth of laying	1.0 m

Ground Temperature	400°C at 1.0 m depth
Soil thermal resistivity	2 Cm / W
Spacing between circuits	0.6 m

2. Heat Shrinkable Cable Joints and Termination

2.1 General

The cable jointing and terminating accessories for power cables shall be according to related standards and comprise the standard predictions of an approved manufacturer. These having been previously tested according to **IEC60502-4, IEC 61442 and CENELEC HD 639.1** and approved in service.

The required type of straight joints and terminations is heat shrinkable, where other proposed type could be accepted.

The heat shrink tubing and moulded parts shall be flexible, flame retardant, polyolefin-based materials and shall reduce to the predetermined size and shape when heated above 120°C. Wherever required, the heat shrinkable components shall be provided with an internal coating of hot melt adhesive/ compound which shall not flow or exude at temperature below 85°C. Stress control tubing shall be included to provide stress relief for the higher voltage cables as required. The complete kit should also include additional components necessary for efficiently connecting the cable screen and armour to the earth and to provide adequate protection to the joint or termination.

The joints shall be suitable for operation when directly buried in the ground or installed in exposed conditions as required in service. The terminations shall have adequate sealing against the ingress of moisture/water and the core insulating tubes shall be non-tracking and weather resistant. Details of design of all Joints and terminations, materials to be used, with copies of jointing instructions shall be submitted for approval by the Engineer before the factory orders are issued for manufacturing.

2.2 Straight Joints

- a) For conductor jointing, the required number of crimping type connectors shall be supplied in the kit. The dimensions of the connectors should conform to DIN 46267.
For the ease of installation and to eliminate problems arising out of improper crimping or use of improper crimping connectors or tools, joints with sheer bolt bimetallic mechanical connectors will be preferred. However, the connector design should have been tested in accordance with **IEC-61238 Class A**.
- b) High permittivity void filler mastic shall be used over the screen end to fill the voids that may exist below the stress control tubing. The stress control function over the connectors and at the screen cut back shall be achieved by a combination of stress grading filler and thermally stable heat shrinkable stress control tubing.
The impedance of stress control tubing shall not change over the range of temperature from 0 Deg. C to 125 Deg. C. The impedance shall also remain constant irrespective of the differences in stress which will exist within the tubing due to the heating effect within the conductor and the ambient temperature.
- c) Insulation tube layer over the stress control tube and outer tube layer over armour should have a high recovery force to achieve tight electrical interfaces and perfect sealing ability. A Joint design with

mechanical sheer bolt connectors and insulation tubing, duly tested as a complete system, in accordance with IEC-60502-4 and CENELEC HD 629.1 S2 standard, will be given preference to joints with multi-layer tubing's.

- d) Electrical continuity of the copper tape screen across the joint shall be provided by means of tinned copper mesh of adequate cross section and constant force stainless steel roll springs.
In case of cables with wire shield, the required connectors should be included in the kit for connection of the shield wires across the joint.

- e) In 3 core cables, the electrical continuity of the armour shall be reinstated by use of a steel armour case with adequate short circuit withstand capability. The steel armour case shall also withstand the external mechanical forces that may otherwise damage the cable components.
On all armoured cable, armouring wires or tapes shall be bonded across each straight joint in an approved manner by means of a copper bond with a sectional area of at least 95 mm². The resistance of all copper bonds shall not be higher than that of an equal length of the armouring and the metallic screen.

The design of the steel armour case shall ensure reduced overall diameter and minimum air entrapment in the joint to improve heat dissipation and increased rating factor of the cable. The armour case shall be secured over the armour with 2 no of stainless-steel worm drive clamps on either side. An adjustable stainless steel support ring shall be placed under the armour to enable adequate electrical contact and to avoid the penetration of wire armour into the cable bedding.

To ensure a reliable connection of the cable armour in single core cables, the aluminum wires must be joined across the joint with sheer bolt mechanical or compression connectors.

- f) To prevent the joint and cable components from external environment and water ingress, the encapsulation of the joint shall be achieved by thick wall adhesive lined sealing sleeves.

Each kit shall be provided with complete detailed installation instruction and be clearly marked to show its application.

Three copies of the instruction for the installation of each type of cable joint supplied, shall be submitted to the engineer.

2.3 Repair Joints

Repairing joints will be used to repair the damaged cables without adding additional cable length.

Each Repairing joint shall be provided with all necessary insulation materials and other accessories; the mechanical connector shall be bolted type with more than 400mm length, to join the cable conductor and must be for connection Cu, Al.

Thickness of insulated material should comply with the min thickness of cable's insulation. They shall utilize the heat shrinkable system with mechanical connector according to IEC 61238-1 Class A.

Each Repairing joint shall be provided with all necessary insulation materials and other accessories. And shall be provided with complete detailed installation instruction and be clearly marked to show its application.

2.4 General requirements for heat shrinkable terminations

1. The stress control function at the screen cut back shall be provided by thermally stable heat shrinkable stress control tubing in combination with high permittivity void filler mastic over the screen end. The impedance of stress control tubing shall not change over the range of temperature from 0 Deg. C to 125 Deg. C. The impedance shall also remain constant

irrespective of the differences in stress which will exist within the tubing due to the heating effect within the conductor and the temperature of environment.

2. The kits offered shall provide for total environmental sealing of the cable crotch. A cable breakout with sealant coating should be provided for 3 core cable terminations.
3. Adequate quantity of sealant strips for application over the lug barrel and exposed strands between the lug and cable insulation shall be provided in the kit.
4. Anti-tracking breakout Insulation Tubing shall be supplied to provide complete leakage insulation between the lugs and the cable breakout to prevent the cable insulation from the effects of weathering and electrical tracking caused by the leakage current flowing over the insulation surface. The tubing shall be coated with non-tracking flexible sealant at one end.
5. Single piece, heat shrinkable weather sheds having non tracking, weather resistant properties shall be supplied with the kits for application over non tracking tubing. The quantity of sheds to be supplied shall depend upon voltage grade and Indoor / Outdoor application and shall be indicated in the kit content list.
6. Connection of the copper tape screen to ground shall be achieved by tinned copper braids of adequate cross section secured in place with constant force stainless steel roll springs.

Each kit shall be provided with complete detailed installation instruction and be clearly marked to show its application.

Three copies of the instruction for the installation of each type of cable termination supplied, shall be submitted to the engineer.

2.4.1 Indoor Terminations

Indoor termination kits shall be suitable for terminating the cables in air, transformer/switchgear cable boxes. Each termination kit shall be complete in all respects including crimping type lugs. The Lugs dimensions should be according to DIN 46235.

Aluminum cable lugs shall have corrosion inhibiting compound filled inside and ends closed with protection caps. Sheer bolt mechanical lugs suitable for both copper and aluminum conductors shall also be considered. All required materials for cable preparation shall be supplied with the kit.

For 3 Core cables Indoor terminations, the tail length shall not be less than 600 mm and 850mm for 12 kV and 36 kV respectively & (1) shed per phase for 36kv indoor terminations.

2.4.2 Outdoor Terminations

Terminating kits shall be suitable for outdoor use for terminating cables. The termination kit shall be complete in all respects including crimping type cable lugs. Aluminum cable lugs shall have corrosion inhibiting compound filled inside and ends closed with protection caps. Sheer bolt mechanical lugs suitable for both copper and aluminum conductors shall also be considered. All required materials for cable preparation shall be supplied with the kit.

For 3 Core Outdoor terminations, the tail length shall not be less than 800mm and 1200mm for 12 kV and 36 kV respectively.

The recovered thickness of insulation tubing over the connector shall be uniform and equal to insulation thickness as in IEC 60502-2. The insulation tubing shall be generally suitable for outdoor installation, ultra-violet and chemical resistant, with creepage distance not less than 40mm/kV.

3. Cold Cable Terminations

The cable jointing and terminating accessories for power cables shall be according to IEC 60502-4 and comprise the standard predicts of an approved manufacturer. These having been previously tested and approved in service.

They shall be cold silicon rubber terminations and shall meet or exceed the specifications of cables mentioned.

Terminations shall provide water proofing, mechanical and electrical protection, moisture sealed, including the crotched area of multi core cables and complete re-jacketing of individual cores (including **3 core anti tracking breakout**), to be suitable for operation in the ground or installed in exposed position or in condition of high humidity, as required in service.

The recovered thickness of insulation tubing over the connector shall be uniform and equal to insulation thickness as in IEC 60502-2. The insulation tubing shall be generally suitable for indoor / outdoor installation, ultra-violet and chemical resistant, with creepage distance of 40mm/kV.

The kit shall include all arrangements to terminate cable screening, armouring and sheathing in such a way as to provide earth continuity and adequate protection as required at all joints and terminations.

4. Packing & Identification

All components shall be supplied in a single package as a complete kit. The kit label shall indicate the complete details of the kit such as voltage grade, type of kit, i.e. indoor/ outdoor termination or joint along with number of cores and conductor size. Each kit shall have a batch not printed on the label.

5. Traceability

For traceability purpose, each component of termination & straight joint shall be made up into kits in which each part shall be correctly identify the manufacturer's name, part number, manufacturing date, minimum & maximum cable cross-sections, minimum & maximum insulation diameters, rated voltage and any other necessary marking.

6. Samples

The Contractor may be required to submit a sample for offered terminations and joints for evaluation purposes. EDCO has the right to reject the offer if the samples are not submitted or do not meet the specification requirement.

7. Inspection and Testing

All cables joints and terminations shall be subjected to inspection and testing in accordance with IEC 60502-4 or IEEE 404. The purchaser shall attend these tests.

Adequate notice shall be given when the cables joints and terminations are ready for inspection and tests, every facility shall be provided by the supplier to enable the purchaser to carry out the necessary inspections and tests.

Before the Joints and terminations are packed or dispatched, all tests including the electrical test shall have been carried out successfully.

No passing of plant or materials by the purchaser shall relieve the Contractor from this responsibility. The Contractor shall also be responsible for proper carrying out of all tests of plant or materials carried out or supplied by a sub-contractor to the same extent as if the work were carried out or supplied by the Contractor himself.

If, due to the Contract work and/or component materials not complying with this specification, further tests are necessary, the Contractor shall pay all additional costs, which may be incurred in re-testing.

The following tests shall be carried out in accordance with IEC 60502 and its amendments:

- a) Routine Tests.
- b) Type Tests, Electrical
- c) Type Tests, non-electrical.
- d) Special Tests

8. Document to be Supplied in the Offer

The following items must be attached and submitted with the offer:

- Instructions for installation for each type of offered accessories.
- Catalogues, technical leaflets, drawings...etc.
- kit content list
- Test certificates.
- Reference lists for similar products.

9. XLPE Cable (NOT REQUIRED)

All XLPE cables shall comply with the current editions of IEC 60502-2, or other equivalent and related National Standards, subject to the variations and additions stated herein.

All cables shall be suitable for operation under the respective loads and such sudden variations of load and voltage as may be met with under working conditions on the system, and in the climatic conditions prevailing on site.

- **Rated Voltage**

The rated voltages of cables in this tender are $U_0/U(U_m) = 19/33(36)$ KV and $6.35/11(12)$ kV according to BS 6622, where U_0 , U and U_m as defined in IEC 60502-2 or other approved Standards. Conductors shall be circular stranded and compacted copper or aluminium with cross sections, as mentioned in SCOPE OF WORK above.

- **Highest Rated Temperature**

XLPE insulated cables shall be designed for a maximum continuous conductor temperature of 90°C, and a maximum short-circuit temperature of 250°C.

- **Conductor Screening**

Conductor screening shall consist of a layer of thermosetting extruded semi-conducting compound of adequate thickness having a smooth even surface in intimate contact with the cable insulation and the conductor but firmly bonded to the insulation layer. The nominal thickness of this layer shall be 0.5mm.

- **Insulation and Insulation Screening**

Insulation material and thickness shall meet all the relevant requirements of IEC 60502 or other approved standards. The insulation shall be dry-cured cross-linked polyethylene (XLPE) with a nominal thickness of 8.0mm and 3.4mm (minimum average) for 19/33(36) kV and 6.35/11(12) kV respectively. The minimum thickness at any point shall not fall below 7.10mm and 2.96mm for 19/33(36) kV and 6.35/11(12) kV respectively.

Insulation screening shall consist of a layer of thermosetting extruded semi-conducting compound (easy strippable), having an intimate contact with the cable insulation and the semi conductive swellable tape. The nominal thickness of this layer is 0.7 mm.

- **Metallic Layer**

The metallic layer shall be constructed of annealed high-conductivity copper wires and tape in accordance with IEC 60228 and another related standard.

- **Semi-conducting insulation screening**

Semi-conducting insulation screening shall have a supplementary copper wire screen helically applied in intimate contact with the non-metallic semi-conducting screening. A copper tape counter-helix shall be applied over the copper wires.

The nominal cross section of the metallic screen for each cable shall not be less than 50mm² excluding copper tape. The metallic layer should have an earth fault current carrying capacity of 7 KA for one second.

The minimum size of copper tape binder shall be 0.1 x 15 mm².

- **Water Swelling Tape**

The screen area shall be watertight in the longitudinal direction by means of two layers of semi conductive swellable tapes with one layer under and the second layer over the metallic screen.

- **Identification of Cores**

The cores of all three core power cables shall be identified by colors as follows: -

<u>COLOR</u>
RED
YELLOW
BLUE

While black colored for single core cables

- **Separation Sheath (Bedding)**

The inner covering (Separation sheath) material shall be PVC compound for AL cables and single-phase Cu cables, while it should be PE for three phase Cu cables (PVC to be replaced by PE compound is acceptable) and should be applied under the armour. The nominal thickness of this sheath shall conform to IEC 60502/ other approved standards, while the minimum accepted value shall be 2mm for nonarmoured cables.

- **Fillers Requirements**

Fillers shall be of materials suitable for the operating temperature of the cable and compatible with the insulation. The fillers shall be non-hygroscopic.

- **Armour**

Armour for multicore cables shall consist of a layer of round or flat galvanized steel wires applied over an approved bedding. While for single core cables it should be of hard drawn aluminum wires.

The dimensions of the armour wires shall conform to IEC 60502/other approved Standards.

- **Over Sheath**

The outer sheath shall consist of:

- a) extruded continuous **black** PVC type ST2 for armoured, Cu, three phase cables.
- b) for armoured, Cu, single phase cables, and AL single and three phase cables:
 - 1) The outer sheath to be PE if the inner sheath is PVC
 - 2) The outer sheath PVC ST2 if the inner sheath is PE.
- c) HDPE ST7 for nonarmoured.

According to IEC 60502 or equivalent standard. As protection against termite attack, the outer covering shall contain an evenly dispersed mixture of an approved anti-termite deterrent. The Tenderer shall state in this offer the types and amounts of chemicals he intends to add. The Contractor shall state on the cable test certificate the amounts of insecticides added. The Engineer reserves the right to select samples of such outer covering for analysis to check the quantities added.

The nominal thickness of the sheath shall be in accordance with IEC 60502 or other approved Standards, while the min nominal value for nonarmoured cables should not be less than 2.5 mm.

The extruded over sheaths of cables shall be embossed with the following: -

Cable voltage designation, the conductor size, and the words "*ELECTRIC CABLE*" in English, the number of tenders, the manufacturer name, year of manufacture and *EDCO* name. The length in meters shall be also embossed on the outer sheath all along each cable length at each three meters. The letters and figures shall consist of upright block characters arranged along two or more lines approximately equally spaced around the circumference of the cable. The maximum height of the characters shall be 13 mm and the minimum size 15 per cent of the approximate overall diameter of the cable or 3 mm whichever is the greater. The space between the end of one set of engraved characters and the beginning of the next shall not be greater than 150 mm

- **Current Carrying Capacity and Design Parameters**

The maximum continuous current carrying capacity, the maximum permissible continuous conductor temperature, and the factors for determining such rating and temperature shall be based on IEC 60287 and subsequent amendments/ other approved Standards.

A sample of each type should be submitted with the offer and any offer received without drawings and samples will be rejected during evaluation without any prior notice.

<u>SCHEDULE NO.</u>	<u>DESCRIPTION</u>
A	Schedule of Requirements
B	Price Schedule
C	Guaranteed Delivery Periods and Manufacturer Schedule
D	Deviations From Specification
E	Type test certificate

SCHEDULE (A)
SCHEDULE OF REQUIREMENTS

Item No.	Description Unit	UNIT	Quantity
1.	Straight joint for 19/33 (36) kV, 300 mm ² AL., 3-Core, copper wire and tape screened, XLPE cable. Armoured (galvanized SWA)	Kit	6

SCHEDULE (B)
PRICE SCHEDULE

Item No.	Description	Quantity	UNIT PRICE & CURRENCY		TOTAL PRICE C&F AQABA-JORDAN
			FOB	C&F AQABA	
1.	Straight joint for 19/33 (36) kV, 300 mm ² AL., 3-Core, copper wire and tape screened, XLPE cable. Armoured (galvanized SWA)	6 KIT			

IMPORTANT NOTES:

1. THE REQUIRED TYPE OF STRAIGHT JOINTS AND TERMINATIONS ARE HEAT SHRINKABLE, WHERE OTHER PROPOSED TYPE COULD BE ACCEPTED.
2. EDCO HAS THE RIGHT TO ACCEPT PARTIAL OFFERS AND TO AWARD PART OF THE ITEMS QUANTITIES WITHOUT ANY LIMIT OR NOTICE.
3. FAILURE TO SUBMIT SUCH SAMPLE, EDCO HAS THE RIGHT TO REJECT THE OFFER.
4. EDCO HAS THE RIGHT TO REJECT ANY OFFER BASED ON EVALUATION THE SUBMITTED SAMPLE IN TERMS OF THE QUALITY, LIABILITY AND WELL-KNOWN AND REPUTABLE MANUFACTURERS.

SCHEDULE (C)
MANUFACTURERS & GUARANTEED DELIVERY PERIODS

The Tenderer shall state the country where manufacture and the delivery periods entered shall be binding on the Contractor.

Item No.	Description Unit	MANUFACTURER	DELIVERY PERIOD C & F AQABA PORT- JORDAN
1.	Straight joint for 19/33 (36) kV, 300 mm ² AL., 3-Core, copper wire and tape screened, XLPE cable. Armoured (galvanized SWA)		

SCHEDULE (D)

**DEVIATION FROM SPECIFICATION IF ANY
TO BE COMPLETED BY THE TENDERER**

TEM NO.	BREIF DESCRIPTION	DEVIATIONS

SCHEDULE (E)

LIST OF TYPE TEST CERTIFICATES

The following type test certificates covering the equipment offered to IEC recommendations shall be submitted with the tender.

<u>Type test</u>	<u>Certificate No.</u>	<u>Certificate Authority</u>