

**TECHNICAL SPECIFICATION FOR JOINTING/TERMINATION KITS FOR
11 KV XLPE CABLE**

- 1.0 The instructions given hereunder are in addition to supersession of the instructions given elsewhere in the tender documents and these are to be treated as final requirement in this regard wherever any ambiguity arises.
- 1.1 **SCOPE:** The specification covers design, manufacturer, testing, packing, inspection and delivery anywhere in U.P. of cable terminations and joints employing Heat Shrinkable technology suitable for 11 KV (E) , 3 core XLPE insulated screened and armoured cables as per IS 7098 (with latest amendment), having compacted circular stranded conductor of sizes 35 mm² to 400 mm² or as per requirement.
- 1.1.2 It is not the intent to specify completely herein all details of design and construction of equipment/system. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to vendor's guarantee in a manner acceptable to the purchase who will interpret the meaning of the drawings and specification and shall have the power to reject any work or materials, which in his judgment are not in full accordance therewith.
- 1.1.3 Tenderer has to submit all relevant papers & copies of all the relevant documents. Failing to do so may amount to the bids being considered non-responsive and outright rejection. The information as asked for is to be mentioned specifically and not be narrated as 11 KV as per ISS, relevant standard, reference to other pages of tender bid etc.
- 1.2 Technical data sheet annexed has to be filled in completely and separately for indoor/outdoor terminations and straight through joints where ever asked for. Copies of the documents where asked for are to be enclosed for each requirement.
- 1.3 The tender documents have to be completely filled in and submitted even if there is repetition of the information. The offer must have a clause wise affirmation of the technical requirements. Deviations/non conformance / alternatives /equivalents must be all separately listed as deviations.
- 2.0 **APPLICABLE STANDARDS:**
- 2.1 Applicable standards for testing of heat shrink joints
- a) VDE-0278 Power Cable Accessories with rated voltage up to 36KV.
 - b) IS-13573/1992- Including Amendment No. 1 March 1996-Joints & Terminations, for polymeric cables for working voltage 6.6 KV up to and including 33KV –Type test requirements.
 - c) ESI-09 –13-Electricity Supply industry specification-performance requirements of heat shrinkable components.
 - d) IEEE-48-Standards Test procedures and requirements for high voltage alternating current cable termination.
 - e) ASTM-D-2303-Liquid contaminant inclined plane Tracking and erosion test.
 - f) IEC-243- Recommended methods of test for electric strength of solid insulating material at power frequencies.

- g) ISO-37 Determination of testing stress strain properties of vulcanised rubbers.
- h) IS: 7098 (Part-II) for XLPE Cable, Bidders shall enclose copies of type/sequence test reports as per IS: 13573-1992 conducted and test reports for materials properties wherever asked for with fail

3.0 **DESIGN REQUIREMENTS:**

3.1 **Class of Termination (No Straight through Joints)**

- 3.1.1 The heat shrinkable cable terminations (Indoor and Outdoor type) offered shall be class-I terminations as defined in IEEE standards 48, and the straight through joints must be suitable for direct burial, uncontrolled backfill, water logging, and open trays / trenches.

3.2 **Stress Control**

- 3.2.1 The control function at the screen cut back shall be provided by heat shrinkable tubing having volume resistivity of minimum 10^7 ohms-meter for both termination and joint. Also, the relative permittivity shall be minimum 15. Bidder shall furnish documentary evidence confirming adherence to these, along with his bid.
- 3.2.2 The impedance of stress control tubing shall not change over a range of temperature from 0 deg.C to 125 deg.C. The impedance shall also remain constant in spite of the difference in stress which will exist within the sleeve due to heating effect within the conductor and the temperature of environment. Bidder must submit documentary evidence including graphs showing the effects of stress, temperature and aging on the impedance of the stress tubing along with the bid.
- 3.2.3 For straight through joints prior to the installation of the stress control tubing, a high permittivity mastic must be applied over the ferrule, overlapping the insulation by 3mm. The minimum permittivity of this mastic shall be 15.
- 3.2.4 As the steps caused by semi-conductive screen cut back, high permittivity hot melt mastic or conductive paint is to be provided to prevent discharge activity at the step. The minimum permittivity of the mastic should be 15 and resistivity of paint shall be same as the resistivity of semi conductive screen.
- 3.2.5 Fluorinated silicone grease shall be provided for filling up the nicks and scratches on the surface of XLPE insulation.
- 3.3 Non-tracking erosion and weather resistant protection.
 - 3.3.1 The entire surface, from the high voltage point (lug) to the armour earthing arrangement of the XLPE core/ cable (including cable crotch sealing breakout) shall be non tracking, weather and erosion resistant, and hydrophobic in nature.
 - 3.3.2 A heat shrinkable flexible polymeric tubing, preferably coloured red, and possessing non-tracking erosion and weather resistant properties shall be used as an external covering for the cable cores for both indoor and outdoor terminations. Rain sheds (skirts) where ever required for providing additional creepage shall also be of the same material as the non tracking tube.
 - 3.3.3 The tube material shall conform to the requirements of ASTM-D-2303, ESI-09-13 copies of test report shall be furnished.
 - 3.3.4 The material of the non-tracking, erosion and weather resistant cable breakout for the cable crotch, and rain sheds shall be silicon based and shall meet the requirement of ASTM-D-2303, ESI-09-13. Copies of test report thereof to be submitted with offer.
 - 3.3.5 The material used for manufacturing the non tracking tubings, breakout and rain sheds (skirts) material shall have an assessed life exceeding 40 years. Test reports pertaining to accelerated

weathering tests of at least 1600.00 Hours shall be submitted in support of this assessment. Longer duration accelerated testing wherever conducted shall be given preference. Load cycling tests alone, shall not be considered sufficient is for such life assessment.

3.4 **Environment sealing:**

3.4.1 Adhesives and sealants shall be provided in the termination and jointing kits for environmental sealing against ingress of moisture and aggressive gases. The adhesives and sealants will flow due to heating of heat shrinkable components or otherwise during installation and will fill voids and adhere to metal components and cable sheaths.

3.4.2 For terminations: The sealing of the strands between the lug barrel and cable termination shall be provided by:

- a) Non-tracking, erosion and weather resistant heat shrinkable tubing pre-coated with non-tracking sealant.
- b) Non-tracking sealant strips
- c) The sealants must have an indefinite shelf life.

3.4.3. **For Joints:** Heat Shrinkable flexible polymeric tubing, preferably black coloured, pre-coated with adhesives shall be provided for sealing the exposed metallic sheaths and sheath/earth connections.

3.4.4. Bidders shall indicate in his bid, peel strength data (minimum and typical values) between the following components:

- a. Non-tracking tubing & aluminium lug.
- b. Non-tracking tubing & PVC
- c. Non-tracking tubing & Polyethylene.
- d. Non-tracking tubing & copper.

3.5 **Provision of additional creepage for Indoor & Outdoor terminations:**

3.5.1 Single piece, heat shrinkable weather sheds having non-tracking, erosion and weather resistant properties shall be supplied with the kits for application over non-tracking tubing. The quantity of sheds to be supplied shall depend on voltage grade and indoor/ outdoor application and shall be indicated alongwith the bid. Each shed shall give additional creepage length of at least 100mm.

3.6 **Insulation and screen reinstatement for joints.**

3.6.1 To ensure a void-free bond between the rebuilt insulation and non metallic screen the bidder shall apply single co-extruded dual-wall tubing which enables the final insulating layer to be installed complete with a conductive polymeric screen in one step. This dual walled tubing must be co-extruded and shall be offered with joints. Bidder must confirm they are offering co-extruded dual wall tubing for straight through joints as indicated above.

3.6.2 The total installed thickness (excluding the stress control layer) of the insulation, over the ferrule, shall be at least 50% more than the cable insulation thickness.

3.7 **Earth/Screen Continuity/Termination System.**

3.7.1. Screen continuity by being tinned copper mesh and earth continuity by using tinned copper braids of appropriate sizes, shall be provided for transfer screen/earth in straight through joints.

3.7.2. In terminations, tinned copper braids of appropriate sizes along with copper lugs at appropriate sizes shall be provided for the continuity of screen/armour along with adequate clamping arrangements.

3.8 Lugs / ferrules

- 3.8.1 The requisite number and type (Aluminium) of Lugs/Ferrules for compact circular stranded conductors shall be provided for termination/joints.
- 3.8.2 Lugs and ferrules shall be of crimping type heavy duty and shall be rated for the current carrying capacity of the XLPE cable conductors and shall conform to the relevant standards.

3.9 Testing of the Kit

- 3.9.1. All the components shall be sealed separately and marked clearly for the purpose of identification of each component.
- 3.9.2. Components shall be supplied in a single package as a complete kit for one termination/joint and shall bear the manufacturer's name and the cable sizes or kit sizes for which it can be used voltage grade.
- 3.9.3. Besides above identification marking on packing, following identification marking shall be made on stress control tubes, dual wall tubes, outer jacketing tubes (in straight through joints), breakouts, rain sheds, non tracking tubes,
- a) Batch No, to co-relate with the raw materials used to manufacture the components.
 - b) Shrink ratio.
 - c) Manufacturer's name.
- 4.0 Detailed Bill of materials and installation instructions shall be provided with each kit.

5.0 Performance Tests:

- 5.1 The XLPE terminations and joints of the identical type brand and type design as offered in the bids shall have been tested for all the tests covered under ISI 3573/VDE-0278 strength (with amendments to date). Type test certificate showing satisfactory results shall be furnished along with the bid from any of the following:
- a) CPRI, Bangalore/Bhopal
 - b) Indian Institute of Technology, Kanpur/Delhi/Bombay/Kharagpur.
 - c) ERDA, Vadodra.

6.0 Special Requirements.

- 6.1 The kits shall be suitable for storage without deterioration at a temperature upto 50⁰C and shall have unlimited shelf life.
- 6.2 The heat shrink system of the identical type brand and design as offered in the bids shall have proven performance of at least 5 years in Indian Conditions.
- 6.2.1 Documentary evidence shall be submitted with the bid against clause 6.2
- 6.3 Prices are to be quoted firm only.

6.4 Inspection & Testing:

- 6.5 All acceptance tests and inspection of material shall be carried out at the place of manufacturer unless otherwise specially agreed upon by the bidder and purchaser at the time of purchase. Relevant documents including certificate of compliance regarding import/inflow of materials/tubing, test reports under type approval and quality assurance shall be made available to the inspection team for its checking and verification.
- Further tests mentioned below shall be conducted as acceptance tests at supplier's works or any approved test laboratory preferably at place where suppliers work is situated/ which will be arranged by the supplier at his own cost:
- a) Visual Inspection: The offered kits should be free from any visible defects.

- b) Physical verification of contents – all the contents shall be checked as per kit contents list enclosed by the supplier.
- c) Electric Strength test for insulation tubing.
- d) Elongation tests for all types of tubing.
- e) Wall thickness ratio in expended condition.
- f) Longitudinal change after full recovery.
- g) Tracking and erosion resistance test.

Test at SI No. (c), (d), (e), (f) & (g) shall be done on sample randomly selected from the offered lot.

- 6.4.2 Nigam has the right to send any kit, out of the supply made to any recognized laboratory for testing a complete make over joint or termination or both on XLPE cable in accordance with IS 13573 /VDE-0278. The cost of cable, kits transportation and testing etc, shall be borne initially by the Nigam but in case the materials are not found as per desired specification, the complete charges along with any other penalty which may be levied, will be supplier's liability. In case it is required to send the complete made joint or termination or back for the said testing. Supplier shall be intimated accordingly and he shall send his representative along with cable jointer to do the jointing work free of cost and sealing sample for sending to test lab. The firm shall also render necessary assistance to the officers of Pashchimanchal Vidyut Vitran Nigam Limited, Meerut. They shall be responsible to ensure correct supply of material at the destination both in terms of quantity as well as quality as per order.
- 6.4.3 Bidder shall submit adequate evidence of their materials being able to have minimum life of 40 years confirmed through accelerated aging test which will include (a) heat aging, (b) Atlas Weather-O-Meter testing and (c) EMMAQUA testing.

6.5 Guarantee:

- 6.5.1 The materials supplied against this specification shall be backed up by manufacturer's guarantee for a period of 60 months from the date of commissioning or 66 months from the date of completion of supply, whichever is earlier, against defective design, material and manufacturing of termination and joints. In case of failure of any component of termination and joints, the tenderer shall replace such defective termination and kits free of cost within 1 month of such declaration and shall furnish an undertaking on non-judicial stamp paper of Rupees Ten along with his offer to bear the entire expense which will be incurred by Nigam towards material and labour in total for rectification/repair.

6 Bill of material for each kit sample.

- 6.1 Bidder shall indicate in his bid the kit contents of the kits offered for purchaser's approval and shall submit sample (s).

7 Training & Free Jointing Work:

- 7.1 Tenderer will have to give training to staff of PVVNL for installation of joints and termination supplied by them (in the event of an order being placed) free of cost in consultation with CE of Distribution zone's of PVVNL and such joints/terminations (as the case may be) shall be installed by them free of charge. However, kits and other sundry items shall be provided by Nigam.

8.0 Packing & Forwarding:

- 8.1 For the purpose of identification, gloves shall be marked clearly and permanently in a prominent position with the suppliers name and reference number.

Electrically conducting components shall be marked 'conducting' clearly and permanently.

- 8.2 Component shall normally be supplied in a package as a complete joint which shall be clearly with the following:-
1. PROPERTY OF PVVNL.
 2. DESTINATION OF CONSIGNEE AND DESTINATION RAILWAY STATION.
 3. KIT NUMBER.
 4. CONTRACT/SPECIFICATION NO.
 5. VOLTAGE APPLICATION AND SIZE AND TYPE OF KIT.
 6. STANDARDS USED FOR MANUFACTURING THE KIT.
- 8.3 The components shall normally be supplied in a package which shall be designed to protect the contents against ingress of moisture and mechanical damage.
- 8.4 Components supplied with adhesive coatings shall have means to prevent coated surfaces from adhering to each other.
- 8.5 Details bill of material alongwith installation instruction shall be provided with each kit.
- 8.6 Whenever the material is supplied to consignee, the supplier shall prepare the following information in the form of packing slip in quadruplicate, and send the same to the consignee and obtain its acknowledgment on the same. The consignee will return to the supplier one copy of the packing slip with the remarks.
1. Purchase order No. and date.
 2. Quantity allotted to the stores and rate applicable.
 3. Quantity so far supplied and the rate applied.
 4. Quantity now supplied and the rate applied.
 5. Total quantity supplied under the P.O. with rates applied.
 6. Program for supply of balance quantity to the Store.

GUARANTEED TECHNICAL PARTICULARS

(As applicable for Termination/ Jointing Kits Suitable for 11KV XLPE Cable)

Type of Jointing Kits: Heat Shrinkable

| Sl. No. | Property | Assured Value |
|---------|--------------------------------------|--|
| 1. | Impulse Voltage Withstand | No Break-Down at 75 KV |
| 2 | High Voltage Withstand | No Break-Down at 19 KV |
| 3 | Partial Discharge at 12.7 KV | PD- 20 pC. |
| 4 | Thickness of Insulation over Ferrule | 4.79 mm-Minimum |
| 5 | Corrosion Resistance | 500 hrs. Min. at 120+ 3 ⁰ C |
| 6 | Dimensions | |
| a) | Wall Thickness Ratio | 0.6Min. |
| b) | Longitudinal change | 10% Max. |
| 7 | Electric Strength | For Anti- Tracking Tube: 10MV/Meter Min. For Stress Control Tube: Not Applicable. |
| 8 | Heat Shock | No splitting cracking, dripping or flowing after 30min. at 250 ⁰ C |
| 9 | Low temperature Flexibility | No cracking after 4 hours at minus 40 ⁰ C max. |
| 10 | Relative Permeability | For Anti- Tracking Tube: 3 Min. to 5 max. For Stress Control Tube: 15 Minimum. |
| 11 | Thermal Ageing | 500 hrs. Min. at 120+ 3 ⁰ C |
| 12 | Tensile Strength | 8 N/mm ² Min. |
| 13 | Ultimate Strength | 100% Min. |
| 14 | Tracking Resistance | For Anti- Tracking Tube: No tracking, erosion to top surface or flame failure after. 1hr. @ 2.5KV 1hr. @ 2.75KV 20mins. @ 3.0KV For Stress Control Tube: Not Applicable. |
| 15 | Volume Resistivity | 10+E10 Ohm meters Min. |
| 16 | Water Absorption | 0.5 max. 24 hrs. @ 25 ⁰ C Imax. 24 hrs. @ 50 ⁰ C |
| 17 | Water Vapour Permeability | 25 ⁰ C 75 RH -5g/m ² /d 38 ⁰ C 90RH -10g/m ² /d |