

TECHNICAL SPECIFICATION FOR 33 KV HEAT SHRINKABLE TERMINATION/JOINTING KITS

1.0 SCOPE : This specification covers designing, manufacturing, testing, packing, inspection & delivery anywhere in PVVNL of cable straight through Jointing kits, suitable for 33KV(E), 3core XLPE insulated screened and armored cable as per IS 7098 (with latest amendment), having compacted circular stranded conductor of size 70 to 300 mm² or as per requirement.

1.1 It is not the intent to specify completely herein all the details of the design and construction of material. However the material would be inert and capable of resisting degradation during t

1.2 the service life of the cable system and shall conform in all respects to high standards of engineering design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered material shall be complete with all components necessary for their effective and trouble free operation. Such, components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

The bidder will have to submit all relevant papers, copies of test reports as required to substantiate its claim or as required.

2.0 STANDARDS:

2.1 The materials shall conform in all the respects to relevant 'Indian Standard Specification' with latest amendments indicated below:-

| Sl. No. | Indian Standard specification with latest amendments-Title | International or internationally recognized standard with latest amendments-Title |
|---------|---|---|
| 1.(a) | IS: 13573: 1992-Joints of polymeric cable for working voltages 6.6 KV up to and including 33KV | 1. VDE-0278-Power Cable Accessories with rated Voltage upto 36KV. 2. ESI-09-13- Performance Specification for High Voltage Heat-Shrinkable Components for Use With High Voltage Solid Type Cable Upto And Including 33 KV. |
| (b) | IS:2584-1963-Methods for test for electric strength of solid insulating materials at power frequencies. | 3. IEEE-48 Standard Test Procedures And Requirement for High-Voltage Alternating Current Cable Termination. |
| | | 4. ASTM-D-2303-Lequid -Contaminant, Inclined-Plane Tracking Materials. |
| | | 5. IEC-332/BS-4066-Testing on electric cables under fire conditions. |
| | | 6. ASTM-D- 150 -Standard test methods for AC losses characteristics and Permeability of solid electrical materials. |
| | | 7. DIN-445 astmd-412- Standard test methods for rubber properties in tension. DIN-53476-Testing Plastic: Determination of water absorption. |
| 2. | IS: 7098(Part-II) for XLPE Cable. | IEC:502(1983). |

Jointing kits confirming to other internationally accepted standards, which ensure equal or higher quality than the standard mentioned above, would also be acceptable. In case the Bidder who wishes to offer material conforming to the other standards, salient points of difference between the standards adopted and specific standards with authentic English Translation shall be furnished alongwith the offer. In case of conflicts the order of proceeds shall be (I) IS (II) IEC (III) other standards. In case of any difference between this IS and this specification provision contained in this specification shall pervade over IS.

3.0 SERVICE CONDITIONS:

The jointing kits type supplied against this specification shall be suitable for satisfactory and continuous operation under the following climate conditions:

| | | |
|--------|---|---|
| (i) | Location | At various locations in the State of Uttar Pradesh. |
| (ii) | Max. ambient air degree Temperature (dig C) | 50 |
| (iii) | Min. ambient air temperature (dig C) | (-) 5 |
| (iv) | Average daily ambient air tem. (dig C) | 47.2 |
| (v) | Max. Relative Humidity(%) | 100 |
| (vi) | Max. Altitude above mean sea level (m) | 1450 |
| (vii) | Average annual rainfall (mm) | 1200 |
| (viii) | Isocrauntic level (days per year) | 50 |
| (ix) | Seismic level (Horizontal accn. | 0.33g. |

4.0 PRINCIPAL PARAMETERS:

| | |
|----------------------|-----------------------------|
| Type of installation | Outdoor/indoor/underground. |
| System Voltage | 33KV + 10% -15% |
| System Frequency | 50 Hz +_ 5% |
| No. of phase | Three |
| System earthing | Solidly grounded |

5.0 TECHNICAL REQUIREMENT:

- 5.1 The cable jointing kits offered shall be class-I terminations as defined in IEEE standard 48.
- 5.2 The straight through joints must be suitable for direct burial, uncontrolled backfill, water logging and open trays and trenches.
- 5.3 The joints shall be used in moderately hot and humid climate conducive to rust and fungus growth.
- 5.4 The component used in joints shall be suitable for use in high voltage cable joints and shall be suitable for indoor and outdoor applications as required.
- 5.5 joints shall be suitable for use with the XLPE cables manufactured in accordance with the IS: 7098 (Part-II).
- 5.6 Component used in joints shall not be adversely affected in any manner by contact with other materials normally used in the construction of cable joints and shall not increase the rate of corrosion of any metal with which they may come in contact.
- 5.7 The joint should have all the components to provide complete insulation of joint, providing stress grading of joint at the screen/shield end and in connector area, and should be able to withstand all thermal and dynamic stresses related to urban power distribution.

- 5.8 External leakage between conductor and ground and earthing should be completely prevented.
- 5.9 The joints should be capable of withstanding impulse voltage of 170 KV minimum for 33KV joints respectively.
- 5.10 The joints should be capable of withstanding DC voltage of 170KV minimum for 33KV joints
- 5.11 Partial discharge shall not exceed to 20 pC for test voltage of 38KV for 33KV joints.
- 5.12 Minimum thickness of insulation over ferrule should be 11.73mm for 33KV straight through joints.
- 5.13 The joints will have a device for electrical stress control at the end of insulation screen/shield.
- 5.14 Technical data sheet annexed as annexure –I has to be filled in completely and separately for straight through joints. Copies of the documents are to be enclosed for each requirement.

6.0 **DESIGN REQUIREMENTS:**

6.1 **Stress Control**

- 6.1.1 The control function at the screen cut back shall be provided by heat shrinkable tubing having volume resistivity of minimum 10^7 ohms-meters for joint. Also, the relative permittivity shall be minimum 15.
- 6.1.1 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 inspite of the difference in stress which will exist with in 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.
- 6.1.2 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.
- 6.1.3 Fluorinated silicone grease shall be provided for filling up the nicks and scratches on the surface of XLPE insulation.
- 6.1.4 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.
- 6.1.5 A heat shrinkable flexible polymeric tubing, preferably coloured red, and possessing non-tracking erosion and weather resistant properties shall be used at 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.
- 6.1.6 The tube material shall conform to the requirements of ASTM-D-2303, ESI-09-13 copies of test report shall be furnished.
- 6.1.7 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.
- 6.1.8 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.

6.2 **Environment sealing:**

6.2.1 Adhesives and sealants shall be provided in the 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.

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

6.3 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.

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

6.4.1 To ensure a void-free bond between the rebuilt insulation and non metallic screen the bidder shall apply a 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 a co-extruded and shall be offered with joints. Bidder must confirm they are offering co-extruded dual wall tubing for straight enough joints as indicated above.

6.4.2 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.

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

6.5.1 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.

7.0 The components of the heat shrinkable joint such as internal insulation tube, stress control tube, anti track tube, external protective tube and other molded components shall confirm to the requirement of ESI-09-13.

8.0 **Lugs/Ferrule**

8.1 The requisite number and type of aluminum Lugs/ferrules for compact circular stranded conductor shall be provided for joints.

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 confirm to the relevant standards.

9.0 **GUARANTEED TECHNICAL PARTICULARS:**

The guaranteed technical particulars of the conductors shall be per details given in enclosed Annexure-A

10.0 **TESTS:**

10.1 Type Test : The bidder should submit type test report alongwith the bid and it shall be strictly in accordance with IS: 13573:1992 (With latest amendments), for joints of various cable sizes and voltages specified. The test should be conducted at laboratory national/international repute where all the test facilities for conducting tests as per the specification are available.

10.2 **Routine Tests:**

The bidder should clearly indicate the routine tests carried out during manufacturing of joints. The bidder shall also mention the relevant standard used for testing.

10.3 Acceptance Tests:

- 10.3.1 Visual Inspection: the specimen shall be complete tubing or moulded components and shall be in the expanded condition.
- 10.3.2 The specimen shall be checked for freedom pin holes, cracks, inclusion and other defects. In colour, where applicable, shall be easily recognized as a basic colour as specified.
- 10.3.3. Suppliers identification and size makings, where applicable, shall be checked for legibility.
- 10.3.4 Products having sealant coating shall be examined for continuity, evenness and extent of coating.
- 10.3.5 Physical Verification of the kit content: All the kit contents shall be verified and checked as per the kit content list enclosed by the supplier.
- 10.3.6 Corrosion resistance test of tubing or moulded components.
- 10.3.7 Wall thickness ratio in the expanded condition and longitudinal change after full recovery for the moulded component.
- 10.3.8 Heat Shock.
- 10.3.9 Tracking resistance.

11.0 Inspection:

- 11.1 All acceptance tests and inspection shall be carried out at the place of manufacturer unless otherwise specially agreed upon by the Bidder and purchaser at the time of purchase. The Bidder shall offer to inspecting official representing the purchaser, all reasonable facilities without charge, to satisfy him that the material is being furnished in accordance with this specification. The purchaser has the right to have the tests carried out at his own cost by an independent agency, wherever there is a dispute regarding the quality of supply.

12.0 Quality Assurance Plan:

- 12.1 The bidder shall invariably furnish following information alongwith his bid, failing which his bid shall be treated as Non-responsive. These information shall be separately given for individual type of material offered.
 - i) Statement giving list of important raw materials, names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of test normally carried out on raw materials in presence of Bidder's representative, copies of test certificate.
 - ii) Information and copies of test certificate as in (1) above in respect of bought out accessories.
 - iii) List of manufacturing facilities available.
 - iv) Level of automation achieved and list of areas where manual processing exists.
 - v) List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections.
 - vi) List of testing equipment available with the bidder for final testing of equipment and specify test limitation, if any, vis-a-vis the type, special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

12.2 The successful Bidder shall, within 30 days of placement of order, submit following information to the purchaser.

- (i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from, furnished alongwith offer.
- (ii) All type test certificate of raw materials, bought accessories and components as per relevant standards.

13.0 Documentation:

The bidder should append with the offer detailed cross section lay out drawing of the joints and should also clearly indicate, the co-relation between the dimensions in the drawing to the quantities of material supplied as per the Bill of Material for the joints, to be submitted with the offer.

14 Guarantee:

- 14.1 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 installation, whichever is earlier, against defective design, material and manufacturing of joints. In case of failure of any component of joints, the tenderer shall replace such defective 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.

15.0 Packing & Forwarding:

- 15.1 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.

- 15.2 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.

- 15.3 The components shall normally be supplied in a package which shall be designed to protect the contents against ingress of moisture and mechanical damage.

- 15.4 Components supplied with adhesive coatings shall have means to prevent coated surfaces from adhering to each other.

- 15.5 Details bill of material alongwith installation instruction shall be provided with each kit.

- 15.6 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 Jointing Kits Suitable for 33KV XLPE Cable)

Type of Jointing Kits: Heat Shrinkable

| Sl. No. | Property | Assured Value |
|----------------|--------------------------------------|--|
| 1. | Impulse Voltage Withstand | No Break-Down at 170 KV |
| 2 | High Voltage Withstand | No Break-Down at 57 KV |
| 3 | Partial Discharge at 38.0 KV | PD- 20 pC. |
| 4 | Thickness of Insulation over Ferrule | 11.73 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 |