WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED
(A Govt. of West Bengal Enterprise)

TECHNICAL SPECIFICATION

FOR

NON HEAT SHRINKABLE TYPE LINE CONDUCTOR COVER

AS

RETROFIT ELECTRICAL INSULATION

SUITABLE FOR

OVERHEAD CONDUCTORS

TECHNICAL SPECIFICATIONFOR NON HEAT SHRINKABLE TYPE LINE CONDUCTOR COVER AS RETROFIT ELECTRICAL INSULATION SUITABLE FOR OVERHEAD CONDUCTOR

1. SCOPE:

1.1 The specification covers the design, manufacture, testing, supply and delivery in proper packed condition of 1.1kV, 11kV and 33 kV grade non heat shrinkable type line conductor cover as retrofit electrical insulation for overhead conductors.

This type of insulation is suitable for use on overhead ACSR conductor in wet and dry condition for outdoor use at conductor temperatures not exceeding 90°C for continuous operation, 130°C for emergency overload conditions, and 250°C for short-circuit conditions. It is considered suitable for all sizes and voltage classifications of overhead conductor at voltage ratings of 440V to 33 kV phase-to-phases.

2. DEVIATION:

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned in the 'Deviation Schedule' with reasons duly supported by documentary evidences and advantages of such deviation. Such deviation suggested may or may not be accepted. But deviations not mentioned in 'Deviation Schedule' will not be considered afterwards.

3. LOCATION:

The non-shrinkable type line conductor cover should be used very selectively at specific locations as retrofit electrical insulation for overhead conductors to help prevent electrical accidents & outages caused due to accidental clashing between live conductors.

4.0 SYSTEM DETAILS:

DESCRIPTION	LT SYSTEM	11kV SYSTEM	33kV SYSTEM
Voltage Grade	254/440V	6.35/11kV	19/33kV
Highest Voltage	660V	12kV	36kV
Frequency	50 C/S	50 C/S	50 C/S

5.0 SIZES OF ALUMINIUM CONDUCTOR GALVANISED STEEL REINFORCED

The conductors shall comply with the Indian Standard Specification IS: 398 (Part I & II) of 1996 with latest amendments.

Description of materials	STRANDING AND WIRE DIAMETER (mm)		TOTAL SECTIONAL AREA (mm^2)	APPROXIMATE OVER-ALL DIAMETER (mm)	APPROXIMATE CALCULATED BREAKING LOAD (KN)
	ALUMINIUM	STEEL			
ACSR:20mm2 (Squirrel)	6/2.11	1/2.11	24.48	6.33	7.61
ACSR:30mm2 (Weasel)	6/2.59	1/2.59	36.88	7.77	11.12
ACSR:50mm2 (Rabbit)	6/3.35	1/3.35	61.70	10.05	18.25
ACSR:100mm2 (DOG)	6/4.72	7/1.57	118.5	14.15	32.41
ACSR:150mm2 (WOLF)	30/2.59	7/2.59	194.9	18.13	67.34

6.0 MODULUS OF ELASTICITY & CO-EFFICIENT OF LINEAR EXPANSION OF ACSR CONDUCTOR:

The values of the final modulus of elasticity and Co-efficient of linear expansion for ACSR shall be as given hereunder.

No. of Wires	Final Modulus of Elasticity GN/m^2 (Practical)	Co-efficient of linear expansion/^{0} c.
ACSR 6/1	79	19.1×10^{-6}
ACSR 6/7	75	19.8×10^{-6}
ACSR 30/7	80	17.8×10^{-6}

7.0 WEATHER CONDITION:

Monsoon prevails generally from the month of June to October with showers sometimes heavy, acidic, smoky, industrial and foggy.

Maximum ambient temperature	::	50 degree C.
Minimum ambient temperature	::	4 degree C
Thermal resistance of soil	::	150 degree C-Cm/Watt
Maximum Daily average ambient temp	::	40 degree C
Maximum relatively humidity	::	100.00%
Average rainfall per annum	::	200 cm
Maximum height above the Sea level	::	1000 Meters

8.0 STANDARDS:

The Line conductor Cover shall conform to the following standards to the extent of WBSEDCL's requirement is fulfilled.

IEC 60243	Standard that determines the short-term electric strength of solid insulating materials at power frequencies.
IEC 60587	Electrical insulating materials used under severe ambient conditions - Test methods for evaluating resistance to tracking and erosion
IEC 61621	Dry, solid insulating materials-Resistance test to high-voltage, low- current arc discharges
IEC 62217	Polymeric HV insulators for indoor and outdoor use-General definitions, test methods and acceptance criteria
IEC 62631-3-2	Dielectric and resistive properties of solid insulating materials - Part 3-2: Determination of resistive properties (DC methods)-Surface resistance and surface resistivity
ASTM D149	Standard test method is used to measure the dielectric strength and dielectric breakdown voltage of solid electrical insulating materials. The test is used to determine the maximum voltage required to cause a dielectric breakdown through the material. This test is often used to measure the durability of insulation materials used in electronic devices.
ASTM D257	Standard Test Methods for DC Resistance or Conductance of Insulating Materials

ASTM D495	Standard Test Method for High - Voltage, Low - Current, Dry Arc Resistance of Solid Electrical Insulation
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness Shore Hardness
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM G154	The standard practice for exposing nonmetallic materials to fluorescent UV light
ASTM D570	Standard Test Method for Water Absorption of Plastics
UL 94	Plastics flammability standard released by the Underwriters Laboratories (USA)
ASTM D2303	Standard Test Methods for Liquid-Contaminant, Inclined-Plane Tracking and Erosion of Insulating Materials

9.0 MATERIAL ACSR LINE CONDUCTOR COVER:

9.1 Material used for electrical insulation of ACSR overhead conductor as retrofit covering shall be ultraviolet (UV) radiation exposure resistant. The finished product shall withstand the adverse atmospheric conditions due to weather, proximity to the coast, fumes, ozone, acids (particularly nitric acid in the coastal areas and sulfuric acid in the oil field areas), bases/alkalis, and hydrocarbon components, dust or rapid changes to air temperature (temperature extremes). There shall not be significant material degradation such as development of surface cracks and unacceptable increase in surface hardness etc.

9.2 Material used for conductor insulated retrofit covering shall be resistant to atmospheric and chemical degradation. Salt air, airborne pollutants, industrial pollutants such as cement dust, sulfur, rain and humidity shall not result in flashover on the coating.

9.3 Material used for conductor insulated retrofit covering shall exhibit long-term water repellency and Hydrophobicity.

9.4 Material used for conductor insulated retrofit covering shall be easy to retrofit. The cover shall have excellent arc resistance.

9.5 The warranty for Material used for conductor insulated retrofit covering on the ACSR Conductor shall be for a period of 5 years

9.6 Material used for conductor insulated retrofit covering must have an "anti-tracking property" on a line conductor cover refers to its ability to resist the formation of conductive paths on its surface, preventing electrical arcs or "tracking" that can occur when moisture or contaminants accumulate, essentially acting as a barrier against electrical discharge along the surface of the conductor cover.

9.7 Material used for conductor insulated retrofit covering must be tested for Heat Deflection Temperature, Exposure to Flame (Self-extinguishing) and Resistance to Heat & Fire as per specification and Ref. Standard IS/ASTM.

10.0 TECHNICAL PARAMETERS OF ACSR LINE CONDUCTOR COVER:

Non heat shrinkable type line conductor cover as retrofit insulation for overhead conductors shall have the following properties:

Description	Requirement
Material	Silicon Rubber / Cross Linked polyolefin
Appearance	Insulation Sleeve for Conductor
Locking arrangement: Conductor cover being tubular and split longitudinally is wrapped around the conductor.	First longitudinal edge and the second longitudinal edge of the conductor cover must ensure wrapping of conductor throughout the life of the cover. Locking arrangement must be with self-gripping property so that insulation cover must tightly 360^0 wrapped on the ACSR conductor without applying any tie, glue etc.
Application Area	Non heat shrinkable type line conductor cover as retrofit insulation for overhead conductors.

10.1 Mechanical Properties:

Test description	Requirement
Tensile strength in accordance with ASTM D412	Minimum tensile strength of 4 N/ sq.mm
Ultimate elongation in accordance with ASTM D412	Minimum elongation value of 100 per cent.
Tear strength in accordance with ASTM D624	The tear strength must be at least 12 N/mm.

10.2 Physical Property

Test description	Requirement
Hardness (Shore A) in accordance with ASTM D2240	Hardness range of 61 to 75 of Shore A
Exposer to UV radiation in accordance with ASTM G154	No Colour Change, deformation or cracks
Water absorption in accordance with ASTM D 570	Max. 0.5% after 7days immersion in water at 23^0C
Flammability in accordance withUL94 /IEC 62217	According to standard.

10.3 **Electrical Properties:**

Test description	Requirement
Dielectric Strength according to ASTM D 149/IEC 60243	>13 kV/mm
Volume Resistivity @ 27^0C according to ASTM D 257 /IEC 62631-3-1	>1.0 X 10^12 Ω-CM
Resistance to tracking and erosion test in AC voltage following the constant voltage application method (Method-I IEC-60587 and ASTM D2303) continuously for six hours duration.	No tracking or erosion and all samples sustained the 4.5kV test voltage
Dry Arc resistance The spacing between both electrodes is to be kept at 6 mm in accordance with ASTM D495. Arc resistance is to be defined as the time it took to generate conductive channels on the specimen by arcing. Arc resistance , Seconds according to IEC 61621 is also acceptable	Less than 200 seconds, sample must take to fail under the test conditions

10.4 **TYPE TEST**:

All the tests mentioned below are to be made as per details given in list. The party shall submit Type Test report from CPRI or ERDA or Any NABL accredited third party LAB as per relevant IS/ IEC for each offered item of identical type, voltage grade, size, material and design, carried out within 5 years from the due date of opening of tender. Type Test Certificate should bear NABL Logo. Accreditation of NABL LAB should be displayed in the official website of NABL

1) Tensile strength
2) Ultimate elongation
3) Tear strength
4) Hardness
5) Exposer to UV radiation
6) Water absorption
7) Dielectric Strength
8) Volume Resistivity
9) Tracking and erosion test
10) Dry Arc resistance
11) Flammability

10.5 **Sampling for testing**:

The factory manufacturing insulation covers must have the necessary own-in-house testing facilities and equipment to perform physical inspections as well as tests for tensile strength, elongation at break, and electrical dielectric strength specified in Section 10.6 under the compulsory routine tests.

The manufacturer will have to provide routine test reports based on their own in-house testing facilities and methods. These reports shall refer any of relevant National, International, or ASTM standards listed in section 8.0 or equivalent.

Sampling procedures for inspection: Below are the sampling schemes used for lot-by-lot inspection.

(This is applicable for factory test and acceptance test)

LOT OF EACH CATEGORY OF CONDUCTOR COVER	SAMPLE SIZE
2-50 PACKET	One test sample, 1000 mm long, from one packet for testing as per 10.7.1. One test sample, 1000 mm long, from another packet for testing as per 10.7.2. One test sample, 500 mm long, from any one of the above packets for testing as per 10.7.3. One test sample, 500 mm long, from any one of the above packets for testing as per all other tests.
51 TO 500 PACKET	One test sample, 1000mm long, from one packet for testing as per 10.7.1 One test sample, 1000 mm long, from another packet for testing as per 10.7.2. One test sample, 500mm long, from any one packet other than above two for testing of 10.7.3 One test sample, 500mm long, from any of above packets for testing of all other tests
501 AND OVER PACKET	Two test samples, each 1000 mm long, from two different packets for testing as per 10.7.1. Two test samples, each 1000 mm long, from another two different packets for testing as per 10.7.2. Two test samples, each 500 mm long, from any of the above packets for testing as per 10.7.3. Two test samples, each 500 mm long, from any of the above packets for testing all other tests.

10.5.1 **ACCEPTANCE TEST**: Acceptance tests must be carried out by a third-party laboratory accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories). The entire cost of acceptance tests as conducted as per relevant ASTM / IS / user-defined standards, shall be deemed included in the quoted price of the insulation covers.

For acceptance testing, sampling must be conducted in the presence of the manufacturer's representative after the issuance of the Material Acceptance Note at the consignee's store. Both parties should sign and seal the sample, which will then be sent by the manufacturer to the testing laboratory through their own arrangements. WBSEDCL's role is limited to witnessing the acceptance process.

The manufacturer must provide advance notice specifying the actual date of the acceptance tests. All acceptance tests must be conducted in the presence of a WBSEDCL representative.

10.5.2. **TEST REPORT**:

Full description of the samples and its origin;

Method of preparation of test pieces, for example, whether testing is done as per WBSEDCL specification or followed any other better testing environment to meet the testing purpose. But for that it has to be mentioned in advance with tender document.

Test Method

- The reference of this Indian Standard / ASTM/ International Standard;
- The procedure use, if any other;
- The test piece dimensions.

Test Details: As per Clause 10.6

Test Results: As per standard / Specification

Date of Test.

10.6 ROUTINE TEST & ACCEPTANCE TESTS:

The acceptance test shall be carried out on Non heat shrinkable type line conductor cover as retrofit insulation for overhead conductors in accordance with this specification.

The following acceptance tests shall be made on offered /supplied sample.

DESCRIPTION OF TEST	ACCEPTANCE TEST	ROUTINE TEST	REMARKS
PHYSICAL			
SHAPE	√	√	
DIEMENSIONS	√	√	
THICKNESS	√	√	Optional: If test setup is available in the manufacturer's laboratory for testing they should furnished all electrical tests also as routine test. If the factory does not have the test setup, the manufacturer may submit routine test reports as per their own testing methods. On that ground only, routine test of "Optional" mentioned tests are kept as optional.
MARKING	√	√	
PACKAGING	√	√	
MECHANICAL			
TENSILE STRENGTH	√	√	
ELONGATION AT BREAK	√	√	
ELECTRICAL			
DIELECTRIC STRENGTH	√	√	
AC 1 MINUTE DRY WITHSTAND TO FAILURE	√	Optional	
AC 1 MINUTE WET WITHSTAND TO FAILURE	√	Optional	
AC 4HOURS DRY WITHSTAND TEST	√	Optional	

10.7 Electrical Test to be conducted on wrapping type line conductor cover

10.7.1 AC 1 minute dry withstand to failure

A 1000mm long sample of wrapping type line conductor cover is to be installed on the specified size of ACSR conductor. A solidly grounded 200mm wide copper mesh is to be wrapped around the sample in the middle of its span. The AC voltage is to be applied to the ACSR conductor at various voltage levels. The sample should withstand the applied voltage for 60 seconds before raising the voltage level in 1 kV steps.

10.7.2 AC 1 minute wet withstand to failure

10.7.2.1 Horizontal orientation –

Using the same test arrangement as mentioned in section 10.7.1 only taking care that the lip of the sample is to be kept pointed upwards. According to the standard IEEE-4 2000, the rain rate will be 1-1.5 mm/min at the sample level and the water conductivity 100µS/cm. The AC voltage is to be applied to the ACSR conductor as mentioned below. The sample should withstand the applied voltage for 60 seconds before incrementing the voltage in 1 kV steps.

10.7.2.2 Vertical orientation –

In addition, to simulate field applications, a wet withstand test is to be set up in a vertical orientation. A 500MM long sample of wrapping type line conductor cover is to be installed on the respective size of ACSR conductor is

to be attached to an insulated structure to maintain slight radius of ACSR conductor and installed in a vertical orientation. A solidly grounded 200MM wide copper mesh is to be wrapped around the sample in the middle of its span. Rain fall was directed to flow on the exposed conductor and on the sample. Voltage is to be incremented in 1 kV steps each minute.

10.7.3 AC 4 hours dry withstand

Using the same test arrangement as mentioned above in AC 1 minute dry withstand to failure, the AC voltage is to be applied to the ACSR conductor according to voltage level as noted below. The sample should withstand the applied voltage for 4 hours.

TEST DESCRIPTION	MINIMUM WITHSTAND VOLTAGE		
	FOR LT OH APPLICATION	FOR 11kV OH APPLICATION	FOR 33kV OH APPLICATION
AC 1 minute dry withstand to failure	1kV	12kV	36kV
AC 1 minute wet withstand to failure			
Horizontal orientation	1kV	12kV	36kV
Vertical orientation	1kV	12kV	36kV
AC 4 hours dry withstand	1kV	7kV	20kV

Tests are to be performed as per relevant standards and its amendments.

11.0 TEST WITNESS:

All Tests shall be performed in presence of Purchaser's representative if so desired by the Purchaser.

The supplier shall give at least fifteen (15) days advance notice for witnessing such tests.

TEST CERTIFICATE:

Certified copies of all routine tests carried out at Works shall be furnished in Six (6) copies for approval of the purchaser.

The Non heat shrinkable type line conductor cover as retrofit insulation for overhead conductors shall be dispatched from Works only after receipt of Purchaser's written instruction of dispatch.

Type Test Certificates of the Non heat shrinkable type line conductor cover as retrofit insulation for overhead conductors offered shall be furnished. Otherwise the line conductor cover shall have to be type tested on similar rating as per Clause – 10.4 without any charges to prove the design.

12.0 Identification of product by Package Labeling and legible marking on product:

The line conductor cover as retrofit insulation of overhead conductors required for 440V, 11kV and 33kV overhead line **to be used for Electrical insulation** covering of different sizes of ACSR Conductor like ACSR:20mm^2 (Squirrel), ACSR:30mm^2 (Weasel), ACSR:50mm^2 (Rabbit), ACSR:100mm^2 (DOG), ACSR:150mm^2 (WOLF).

APPLICATION VOLTAGE LEVEL	MAXIMUM THICKNESS OF OH ACSR CONDUCTOR COVER	STANDARD PACKING LENGTH WITH TOLLERANCE
LV OH LINE	1.2MM	100M±5%
11kV OH LINE	1.9MM	50M±5%
33kV OH LINE	2.9MM	25M±5%

For identification purpose, a suitable packing specification shall be provided with all sealed packing. **Packing specification** shall be suitably displayed for all sealed packing. Product Identification specification shall also be provided online conductor cover and following information shall be printed in a **distance of 1m throughout** the length.

Make --------, Product Details-------- (Voltage level, Thickness of cover, Size of Conductor to be used) Manufacturing month/year ---------, Property of WBSEDCL.

Packaging must be strong enough to withstand damage during transportation, storage and handling.

The package labeling and marking on product must be remaining legible throughout the life of its storing before application and for that all the markings on it in indelible ink. The marking shall be verified by visual inspection and durability test for type tests. No -durability test is required for routine and acceptance tests.

Marking with sticker/written by Ink is not acceptable.

13.0 Qualifying requirements

The Bidder should have proven experience of not less than 3 years in design, manufacture, supply, and testing at works / NABL Lab for the non-shrinkable type line conductor cover as retrofit insulation for overhead conductors offered of equal or higher voltage class. The non-shrinkable type line conductor cover as retrofit insulation for overhead conductors offered by the Bidder should be in successful operation at least for 2 years as on the date of submission of the tender.

14.0 Performance Guarantee

The non-shrinkable type line conductor cover as retrofit insulation shall be suitable for storage without deteriorating at a temperature up to 50^0 Celsius under normal conditions of storage and shall have unlimited indoor storage life. The stored conductor covers found defective, it shall be replaced by the supplier free of cost within one month of receipt of intimation. The conductor cover offered shall be guaranteed for satisfactory performance for a period of 60 months from the date of SRV. In case of failure within this period, the supplier shall make necessary replacement of the faulty conductor cover at no extra cost to the purchaser. If the faulty, defective stored conductor covers are not replaced as per the above guarantee clause, the Company shall recover an equivalent amount plus 15% supervision charges from any of the supplier's bills.

15.0 Documentation

Documents to be submitted at the time of physical delivery at consignee stores:

The following documents are to be submitted by the supplier to the consignee stores at the time of dispatch to stores by the supplier:

a) Copy of Purchase Order
b) Inspection Test certificate
c) Guarantee certificate

d) Pro-forma Invoice
e) Packing list
f) Challan in triplicate
g) Way bill, if applicable

16.0 Guaranteed Technical Particulars for non-shrinkable type line conductor cover

Sr. No	Particulars of GTP Parameter	WBSEDCL Requirement	Offer
1	Manufacturer's Name and Address		
2	Manufacturer's conductor cover Type	Wrapping	
3	Rated Voltage in kV	440V, 11kV, 33kV	
4	Suitable for ACSR type	ACSR:20mm^2 (Squirrel), ACSR:30mm^2 (Weasel), ACSR:50mm^2 (Rabbit), ACSR:100mm^2 (DOG), ACSR:150mm^2 (WOLF)	
5	Storage Temperature	50^0 C max	
6	Material to be used	Silicon Rubber / Cross Linked polyolefin	
7	Shelf life of components in the kit	Unlimited	
8	Time Required for energization after completion of retrofitting	Immediate	
9	Conductor resistance test(as per ACSR cross section area)	Not vary more than 10% of initial value	
10	Appearance	Insulation Sleeve for Conductor	
11	Locking arrangement	Conductor cover being tubular and split longitudinally is wrapped around the conductor.	
12	Application Area	Non heat shrinkable type line conductor cover as retrofit insulation for overhead conductors	
13	Tensile strength	Min. 4 N/ sq.mm	
14	Ultimate elongation	Min. 100 per cent	
15	Tear strength	At least 12 N/mm	
16	Hardness	61 to 75 of Shore A	
17	Exposer to UV radiation	No Colour Change, deformation or cracks	
18	Water absorption	Max. 0.5%	
19	Flammability	According to standard.	
20	Dielectric Strength	>13 kV/mm	
21	Volume Resistivity	>1.0 X 10^12 Ω-CM	
22	Resistance to tracking and erosion test	No tracking or erosion	
23	Dry Arc resistance	Min. 200 seconds.	
24	AC 1Minute Dry withstand to Failure	As specified	
25	AC 1Minute wet withstand to Failure	As specified	
26	AC 4hours Dry withstand to Failure	As specified	