

BIDDING DOCUMENT

FOR

**Supply of Galvanized Steel Tubular Poles,
11KV Polymer Insulators and ACSR
Conductors under Saubhagya Scheme**



**TENDER IDENTIFICATION NOS:
No.ACE(MM)Saubhagya/2018-19/01.**

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Section – 1

Terms & Conditions:

(I) Specific Terms and Conditions

(a) Package-A:

1. The technical specifications of the materials should comply the standard technical specifications Section-2. No deviation will be allowed. Necessary GTPs are to be submitted along with the offer.
2. Copy of the certificate for enlistment as approved vendors of the concerned utilities should be submitted.

(b) Package-B:

1. The technical specifications of the materials should comply the standard technical specifications Section – 3 & 4. No deviation will be allowed. Necessary GTPs are to be submitted along with the offer.
2. Copy of the certificate for enlistment as approved vendors of the concerned utilities should be submitted.

(c) Package-C:

1. The technical specifications of the materials should comply the standard technical specifications Section - 5. No deviation will be allowed. Necessary GTPs are to be submitted along with the offer.
2. Copy of the certificate for enlistment as approved vendors of the concerned utilities should be submitted.

(II) General Terms and Conditions:

1. Bidder can quote for any one or all the Packages.
2. Bidder should submit their offer(s) in separate envelop(s) in case of more than one Package(s).
3. Envelop should be clearly marked to indicate the name of the Package and the name of the Bidder.
4. No price variation shall be allowed during validity period of the tender.
5. Purchase orders shall be awarded to more than one responsive bidders at the rate(s) offered by the L-I bidder(s).
6. Delivery period should start 15 days from the date of purchase order and to be completed by 15/11/2018.
7. The materials are to be delivered at any location specified by MePDCL.
8. The undersigned reserves the right to accept or reject any or all the tenders without assigning any reason thereof.

Additional Chief Engineer(MM)
MeECL.,Shillong

Section –2

TECHNICAL SPECIFICATION FOR HOT DIP GALVANIZED STEEL TUBULAR POLES FOR OVERHEAD POWER LINES

1.0 SCOPE :

1.1.1 This specification covers the general requirements towards design, manufacture, testing at manufacturers works, supply and delivery for galvanized tubular steel poles of circular cross section (swaged type) for overhead power lines.

2.0 STANDARD :

2.1 The tubular steel poles shall conform to the latest edition of Indian Standard specification

- IS: 2713 (Part – I, II & III): 1980 Specification for Steel Tubular poles.
- The Steel Tubular Poles conforming to other internationally accepted standards which ensure equal or higher quality than the standards mentioned above shall also be acceptable. In case the bidder wishes to offer material conforming to the other standards, salient points of difference between adopted and specified standards with authentic English Translation shall be furnished.

3.0 Topography and Climatic Condition :

3.1 The materials offered, shall be suitable for operation in tropical climate and will be subjected to the sun and inclement weather and shall be able to withstand wide range of temperature variation. For the purpose of design, average atmospheric temperature may be considered to be 50 °C with humidity nearing saturation.

4.0 Materials :

4.1 The materials used in construction of tubular steel poles shall be of the tested quality of steels of minimum tensile strength of 410 MPa .

4.2 The materials, when analyzed in accordance with IS: 228 (Part-III : 1972) and IS: 228 (Part-IX)-1975 shall not show sulphur and phosphorous contents of more than 0.060 percent each.

5.0 FREEDOM FROM DEFECTS

5.1 Poles shall be well finished, clean and free from harmful surface defects. Ends of the pole shall be cut square. Poles shall be straight, smooth and cylindrical.

6.0 TOLERANCES

6.1 **Outside diameter** – The poles shall be as nearly circular as possible and their outside diameter shall not vary from the appropriate value, except at the joint or step, by more than ± 1.0 percent.

6.2 Thickness

6.2.1 In the case of welded tubes, its thickness shall not fall below the thickness specified by more than 10 percent.

6.2.2 In the case of seamless tubes, the following tolerances on thickness shall apply

- a). Where the ratio of the thickness to the outside diameter is more than 3 percent, - 12.5 percent of the specified thickness; and

- b). Where the ratio of the thickness to the outside diameter is equal to or less than 3 percent; - 15 percent of the specified thickness.

6.3 **Length** – the tolerance on the length shall be as follow :

On the length of any section : $\pm 40\text{mm}$

On the overall length of poles : $\pm 25\text{mm}$

6.4 **Weight** – The mean weight for bulk supplies shall be not more than 5 percent below the calculated value. The weight of any single pole shall not fall below the calculated weight by more than 10 percent.

6.5 **Straightness** - The finished pole shall not be out of straightness by more than 1/600 of its length.

7.0 **PROTECTION AGAINST CORROSION:** The pole shall be **Hot Dip Galvanized (inside & outside)** having minimum mass of zinc coating 400 gms per sq, mtr as per IS: 2633/1972.

8.0 **Earthing Arrangements :** For earthing arrangement a through hole of 14mm diameter shall be provided in each pole at a height of 300mm above the planting depth. An MS nut suitable for a bolt of 5/8” is to be welded in the hole.

9.0 Convex type caps to be provided and welded to each pole.

10.0 MS base plates to be provided with each pole.

11.0 PRINCIPAL PARAMETERS

Sl. No	ITEM DESCRIPTION	PARAMETER	PARAMETER
1	Type of Pole	SP-39	SP-14
2	Overall Length	9.5 M	8.0 M
3	Planting Depth	1.8 M	1.5 M
4	Load Applied from top at a distance of	0.60 M	0.30 M
5	Height above ground	7.7 M	6.5 M
6	Length of sections		
a.	Bottom	5.0 M	4.5 M
b.	Middle	2.25 M	1.75 M
c.	Top	2.25 M	1.75
7	Outside Diameter & thickness of section		
A	Bottom, mm	165.1 x5.4	139.7 x4.85
B	Middle, mm	139.7 x4.5	114.3 x3.65
C	Top, mm	114.3 x 3.65	88.9 x 3.25
8	Approx. Wt of	170 KG	111 KG

	pole		
9	cripling load	441 kgf	322 kgf
10	breaking load	621 kgf	453 kgf
11	Ultimate tensile strength	410 MPa (42 KGf / mm ²)	410 MPa (42 KGf / mm ²)
12	Load for Permanent Set Test	302 kgf	220 kgf
13	Load for Temporary Deflection Test	151 kgf	131 kgf
12	Base Plate	An MS base plate shall be provided.	An MS base plate shall be provided.
13	Galvanising and marking	The complete pole shall be galvanized as per IS: 6745/1972. To indicate the planting depth, the outer diameter of the pole at a height of 1.80m from the bottom of pole shall be marked with black paint.	The complete pole shall be galvanized as per IS: 6745/1972. To indicate the planting depth, the outer diameter of the pole at a height of 1.50m from the bottom of pole shall be marked with black paint.

12.0 Tests and Test Certificates

- 12.1 The following tests shall be conducted on finished poles :
- Tensile test and chemical analysis for sulphur and phosphorous ,
 - Temporary Deflection test,
 - Permanent set test, and
 - Drop test.
- 12.2 In addition to above, verification of pole's dimensions as per IS: 2713 (Part-III): 1980 shall be carried out during acceptance of lots.
- 12.3 Number of poles selected for conducting different tests shall be in accordance to clause No.10.1.1 and No. 10.1.12: of IS: 2713 (Part-I) 1980.
- 12.4 Tests shall be carried out before supply of each consignment at the Manufacturers works and test certificates should be submitted to the purchaser for approval prior to delivery.
- 12.5 Re-tests, if any, shall be made in accordance with IS: 2713 (Part-I) 1980.
- 12.6 Purchaser reserves the right to inspect during manufacturing and depute his representative to inspect/test at the works.
- 12.7 If any extra cost is required for carrying out the above specified tests, the same shall be borne by the tenderer.
- 12.8 Hot dip Galvanized test for zinc coating in accordance with IS: 2633/1972

13.0 Marking :

- 13.1 The poles shall be marked with designation, manufacturer's identification The poles shall be marked with the ISI certification mark.

Section - 3

TECHNICAL SPECIFICATION FOR POLYMER DISC INSULATOR

Scope : This specification cover the design, manufacturing, testing at manufacturers works, transport to site, insurance, unloading & storage of 11 KV Polymer Disc Insulator (B & S type) suitable for use in 11 KV Overhead Lines situated in any part of Meghalaya under the jurisdiction of MePDCL.

General Requirements:

1 The Composite insulators will be used on lines on which the conductor will be ACSR of size up to 200 Sq.mm. The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.

2 Insulator shall be suitable for 3 Phase, 50 Hz effectively earthed 11KV Overhead Lines in a moderately/heavily polluted atmosphere.

3 Bidder, if manufacturer, must be an indigenous manufacturer and supplier of composite insulators of rating 11KV or above or must have developed proven in house technology and manufacturing process for composite insulators of above rating. The Bidder shall furnish necessary evidence in support of the above along with the bid, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the owner.

4 Insulators shall be suitable for both Suspension & Strain type of load and shall be of B&S type.

5 Insulator shall be suitable for the long Rod Type. The diameter of Composite Insulator shall be as per technical specification.

6 Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the commendation of IEC- 60815/ IS: 13134.

7 The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

$$\pm (0.04d + 1.5) \text{ mm when } d \leq 300 \text{ mm}$$

$$\pm (0.025d+6) \text{ mm when } d > 300 \text{ mm}$$

Where, d being the dimensions in millimetres for diameter, length or creepage distance as the case may be. However, no negative tolerance shall be applicable to creepage distance.

8 The composite insulators including the end fitting connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

9 All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

10 Inter- changeability: The composite insulator together with the B&S fittings shall be of standard design suitable for use with the hardware of any other indigenous make confirming to relevant standards referred herewith.

Service condition : The insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following topical condition :

- | | |
|----------------------------------|-------------------------------------|
| a) Max. ambient temperature | : 40 ° C |
| b) Min. ambient temperature | : -5 ° C |
| c) Relative humidity | : 10 % to 100 % |
| d) Avarage number of rainy days | : 150 / annum. |
| e) Max. Anual Rainfall | : 12000 mm |
| f) Max. Wind Pressure | : 150 Kg/ sq. Meter |
| g) Max. Wind Velocity | : 50 Km/ hour |
| h) Max. Altitude above MSL | : 1300 Meter. |
| i) Seismic level | : 0.3 g (Horizontal acceleration) |
| j) Avarage Thunder storm | : 45 Days per annum |

: Moderately cool to hot and humid tropical climate, conductive to rust and fungus growth.

System Parameters :

- a) Nominal system voltage : 11 KV
b) Highest system voltage : 12 KV
c) Power frequency : 50 Hz.
d) Number of Phases : Three.
e) System earthing : 11 KV Solidly earthed,

Standard: The following Indian / International Standards with latest revisions and amendments shall be referred while accessing conformity of insulators with this specification.

Sl. No.	Indian Standard	Title	International Standard
1.		Definition, test methods and acceptance criteria for composite insulators for a.c. overhead lines above 1000V	IEC : 61109
2.	IS : 731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC : 60383
3.	IS : 2071	Methods of High Voltage Testing	IEC : 60060-1
4.	IS : 2486	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	IEC : 60120 IEC : 60372
5.		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC : 60575
6.	IS : 13134	Guide for the selection of insulators in respect of polluted conditions	IEC : 60815
7.		Characteristics of string insulator units of the long rod type	IEC : 60433
8.		Hydrophobicity classification guide	STRI guide 1.92/1
9.		Radio interference characteristics of overhead power lines and high-voltage equipment	CISPR:18-2 part 2
10.	IS : 8263	Methods of RI Test of HV Insulators	IEC : 60437
11.		Standard for insulators – Composite- Distribution Dead-end type	ANSI C29 13-2000
12.	IS : 4759	Hot dip zinc coatings on structural steel & other allied products	ISO : 1459 ISO : 1461
13.	IS : 2629	Recommended Practice for Hot, Dip Galvanisation for iron and steel	ISO-1461 (E)
14.	IS : 6745	Determination of weight of zinc coating on zinc coated iron and steel articles	ISO : 1460
15.	IS : 3203	Methods of testing of local thickness of electroplated coatings	ISO : 2178
16.	IS : 2633	Testing of Uniformity of coating of zinc coated articles	
17.		Standard specification for glass fiber strands	ASTMD 578-05
18.		Standard test method for compositional analysis by Thermo-gravimetric	ASTM E 1131-03
19.	IS : 4699	Specification for refined secondary zinc	

Technical Requirement:

1. Composite Insulators shall be designed to meet the light quality, safety and reliability and are capable of withstanding a wide range of environmental conditions.

- (a) Core : The internal insulating part
- (b) Housing : The external insulating part.
- (c) Metal and fittings : For attaching to hardware to support conductor.

Core: It shall be a glass-fibber reinforced epoxy resin rod of high strength (FRP rod).

Glass fibbers and resin shall be optimized in the FRP rod. Glass fibbers shall be Boron free electrically corrosion resistant (ECR) glass fibber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP shall be manufactured through Pultrusion process. The FRP rod shall be void free.

Housing (Sheath):

The FRP rod shall be covered by a seamless sheath of a silicone elastometric compound or silicone alloy compound of a thickness of 3 mm minimum. It shall be one-piece housing using injection Moulding Principle to cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences, external pollution and humidity. Housing shall conform to the requirement of IEC 61109/92-93 with latest amendments.

It shall be extruded or directly moulded on core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing / bonding area shall be free from voids.

Manufacturer should furnish a description of its quality assurance programme including fabrication; testing and inspection for any material (i.e rubber) Components (i.e. rod) or hardware (i.e. end filings). The manufacturer has had fabricated by others should also be included. Manufacturing methods and material composition documentation will be a part of Technical Bid to be submitted along with offer.

WEATHERSHEDS:

The composite polymer Weathersheds made of silicone elastometric compound or silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or moulded as part of the sheath and shall be free from imperfections. The Weathersheds should have silicon content of minimum 30% by weight. The strength of the Weathersheds to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

METAL END FITTINGS:

End fittings transmit the mechanical load to the core. They shall be made of Malleable Cast Iron or Spherical Graphite Cast Iron. Hardware of respective specified mechanical load and shall be hot dip galvanized with Zinc coated with minimum 99.95% purity of electrolytic high grade Zinc in accordance with IS 2629. The material used in fittings shall be corrosion resistant.

Metal end fittings shall be uniform and without sharp edges or corners and shall be free of cracks, flakes, silvers, slag, blow-holes shrinkages defects and localized porosity.

They shall be connected to the rod by means of a controlled compression technique. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be property attached to the core by a coaxial or hexagonal compression process and should not damage the individual fibbers or crack the core.

The gap between fittings and sheath shall be sealed by flexible silicone elastometric compound or silicone alloy compound sealant, system of attached of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and etal connection. The sealing must be moisture proof.

The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IEC: 60120/IS:2486 Part-II/1989.

The finished surface shall be smooth and shall have a good performance. The surface shall not crack or get chipped due to ageing effect under normal and abnormal service conditions or while handling during transit or erection.

The design of the fittings and the insulators shall be such that there is no local corona formation or discharges likely to cause the interference to either should or vision transmission.

Workmanship:

a) All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage field. Bidders shall offer only such insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission lines.

b) The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.

c) The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

d) The core shall be sound and free of cracks and voids that may adversely affect the insulators.

e) Weather sheds shall be uniform in quality. They shall be clean, sound and smooth and shall be free from defects and excessive flashing at parting lines.

f) End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress. Effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

g) All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. or 87µm thickness and shall be in accordance with the requirement of IS:4579. The zinc used for galvanizing shall be of purity 99.5% as per IS : 4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one (1) minute duration under the standard prece test. The galvanizing shall be carried out only after any machining.

Marking: Each insulator shall be legibly and indelibly marked (embossing/engraved) to show the following :

- a) Name & Trade mark of the manufacturer
- b) Month & Year of manufacturing
- c) Voltage & Type
- d) Minimum Failling Load (in KN)

N.B. Marking with sticker/written by Ink is not acceptable.

Type Test: The following Type Test shall have to be conducted as per reference IEC mentioned above on insulator unit, components, materials or complete strings:

- a) Sudden Load Release Test
- b) Thermal Mechanical Pre-stress Test
- c) Dry Positive & Negative Lightning Impulse voltage withstand test
- d) Dry Positive & Negative Lightning Impulse Flashover voltage test
- e) Dry & Wet Power Frequency Voltage withstand test
- f) Dry & Wet Power Frequency Voltage Flashover test
- g) Radio Interference test
- h) Recovery of Hydrophobicity test.
- i) Dye Penetration Test.
- j) Water Diffusion Test
- k) Chemical composition test for Silicon content

- l) **Brittle fracture resistance test.**
- m) **Damage Limit proof & Mechanical Withstand Test.**

Routine Test :

- a) **Identification of marking**
- b) **Visual inspection**
- c) **Mechanical routine test**

Acceptance Test : The following test will be carried out at manufacturers works during inspection of the offered insulators before delivery :

- a) **Visual examination**
- b) **Verification of dimension**
- c) **Galvanizing test**
- d) **Mechanical performance test**
- e) **Mechanical Failing Load test**

Inspection:

All Acceptance tests shall be carried out at manufacturer's works in presence of the MePDCL's and manufacturers representatives. In addition to above, all routine tests are also to be carried on the insulator as per relevant IS / IEC. The entire cost of acceptance and routine test that to be carried out as per relevant IS / IEC shall be treated as included in the quoted price of Insulator.

The manufacturer shall give at least 21(twenty one) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out from the date when the tests will be carried out.

Routine tests on all insulators shall be carried out as per IEC / IS and test reports shall be submitted along with respective inspection offer.

Sampling & Rejection during inspection:

The sampling and rejection procedure for Acceptance Test shall be as per IEC 61109.

Packing:

a) **All insulators shall be packed in strong corrugated box of min. 7 ply duly palette or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.**

b) **The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.**

c) **Suitable cushioning, protective padding or dunn age or spacers shall be provided to prevent damage or deformation during transit and handling.**

d) **Each wooden case / crate / corrugated box shall have all the markings stenciled on it in indelible ink.**

e) **The bidder shall provide instructions regarding handling and storage precautions to be taken at site.**

Guarantee:

In the event of any defect in the equipment / materials arising out of faulty design, materials, workmanship within a period of 12 (twelve) months of commissioning or 18 (eighteen) months from the date of last despatch of any integral part of the equipment / materials whichever is earlier the supplier shall guarantee to replace or repair the same to the satisfaction of the purchaser.

If the supplier fail to do so within a reasonable time, MePDCL reserves the right to effect repair or replacement by any other agency and recover charges for repair or replacement from the supplier.

Quality Assurance Plan:

1. **The successful bidder shall submit following information along with the bid.**
2. **Test certificates of the raw materials and bought out accessories.**

3. Statement giving list of important raw material, their grades along with names of sub- suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.
4. List of manufacturing facilities available.
5. Level of automation achieved and lists of areas where manual processing exists.
6. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
7. List of testing equipments available with the bidder for final testing equipment along with valid calibration reports.
8. The manufacturer shall submit Manufacturing Quality Assurance Plan (QAP) for approval & the same shall be followed during manufacture and testing.
9. The successful bidder shall submit the routine test certificates of bought out raw materials/accessories and central excise passes for raw material at the time of inspection.
10. The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the **representatives shall have full facilities for unrestricted inspection of the Supplier's and sub-Supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.**
11. The material for final inspection shall be offered by the Supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogeneous and shall contain insulators manufactured in 3-4 consecutive weeks.
12. The Supplier shall keep the Owner informed in advance of the time of starting and the progress of manufacture of material i/n their various stages so that arrangements could be made for inspection.
13. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the owner in writing waives off the inspection. In the later case also the material shall be dispatched only after satisfactory testing specified herein has been completed.
14. The acceptance of any quantity of material shall in no way relieve the Supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such material are later found to be defective.

ANNEXURE: A

Test on Insulator units :

1. RIV Test (Dry): The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz voltage of 10 kV & 30 kV for 11 kV & 33 kV class insulators respectively under dry condition. The test procedure shall be in accordance with IS: 8263/IEC: 437/CISPR 18- 2.

2. Brittle Fracture Resistance Test : Brittle fracture test shall be carried out on naked rod along with end fittings by applying “1n HNO₃ acid” (63 g conc. HNO₃ added to 937 g water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96 Hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3. Recovery of Hydrophobicity & Corona Test:

i) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification (Extract enclosed at Annexure-D) Dry the sample surface.

(ii) The sample shall be subjected to mechanical stress by bending the Sample over a ground electrode. Corona is continuously generated by applying 12 kV to a needle like electrode placed 1 mm above the sample surface. Tentative arrangement shall be as shown in Annexure-E. The test shall be done for 100 hrs.

(iii) Immediately after the corona treatment, spray the surface with Water and record the HC classification. Dry the surface and repeat The corona treatment as at Clause-2 above. Note HC classification. Repeat the cycle for 1000 Hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.

(iv) Allow the sample to recover and repeat Hydrophobicity Measurement at several time intervals. Silicone rubber should recover to HC 1 – HC 2 within 24 to 48 hours, depending on the Material and the intensity of the corona treatment.

4. Chemical composition test for Silicon content:

The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X-ray) Analysis or Thermo-gravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

SPECIFIC TECHNICAL PARTICULARS FOR 11 KV DISC INSULATOR

	11 KV Disc
Type of insulator	Polymeric composite Disc Insulator
Reference Standard	IEC 61109
Material of FRP Rod	Boron free ECR
Material of sheds	Silicon Rubber
Type of metal end fittings	Ball & Socket
Nominal Ball Pin Diameter	16 mm
Material of end fittings	SGCI / MCI
Material of sealing compound	RTV Silicon
Colour of sheds	Grey
Rated voltage	11 KV
Highest voltage	12 KV
Dry Power Frequency Withstand voltage	60 KV
Wet Power Frequency Withstand voltage	35 KV
Dry Power Frequency Flashover Voltage	75 KV
Visible Discharge Voltage (PF)	9 KV
Wet Power Frequency Flashover Voltage	45 KV
Dry Lightning Impulse withstand voltage	Positive : 75 KV Negative :80 KV
Dry Lightning Impulse Flashover voltage	Positive : 95 KV Negative : 100 KV
RIV at 1 MHz when energised at 10 KV / 30 KV (rms) under dry condition	< 50 microvolt
Creepage distance (min)	320 mm
Min Failing load	45 KN
Dia of FRP Rod	16 mm
Length of FRP Rod (min)	200 mm
Dia of weather sheds	100 mm
Thickness of housing	3 mm
Dry arc distance	170 mm
Method of fixing sheds to housing	Injection moulding
No of weather sheds (min)	Three
Type of sheds	Aerodynamic
Type of packing	Wooden/Corrugated box
No of insulator in each pack	Thirty
Guarantee	12 months from commissioning or 18 months from the date of last despatch.

Section – 4

TECHNICAL SPECIFICATION FOR 11 KV -5 KN Composite Silicon Rubber Polymer Pin Insulators For use in 11KV System

1.0. Scope

This specification covers design, manufacture, testing and supply of composite insulators for use in the 11KV overhead transmission lines and substations.

The composite insulator will be used on lines on which the conductor will be ACSR of size.

2.0. APPLICABLE STANDARDS

2.1. Standards

Following Indian/International Standards, which shall mean latest revision, with amendments/changes adopted and published, unless specifically stated otherwise in the specification, shall be referred while accessing conformity of insulators with these specifications.

- 2.1.1 In the event of supply of insulators conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent or better to those specified. In case of award, salient features of comparison between the standards proposed by the bidder and those specified in this document will be provided by the Supplier to establish equivalence.

Sl. No.	Indian Standard	Title	International Standard
1.		Definition, test methods and acceptance criteria for composite insulators for a.c. overhead lines above 1000V	IEC : 61109
2.	IS : 731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC : 60383
3.	IS : 2071	Methods of High Voltage Testing	IEC : 60060-1
4.	IS : 2486	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	IEC : 60120 IEC : 60372
5.		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC : 60575
6.	IS : 13134	Guide for the selection of insulators in respect of polluted conditions	IEC : 60815
7.		Characteristics of string insulator units of the long rod type	IEC : 60433
8.		Hydrophobicity classification guide	STRI guide 1.92/1
9.		Radio interference characteristics of overhead power lines and high-voltage equipment	CISPR:18-2 part 2
10.	IS : 8263	Methods of RI Test of HV Insulators	IEC : 60437
11.		Standard for insulators – Composite-Distribution Dead-end type	ANSI C29 13-2000

12.	IS : 4759	Hot dip zinc coatings on structural steel & other allied products	ISO : 1459 ISO : 1461
13.	IS : 2629	Recommended Practice for Hot, Dip Galvanisation for iron and steel	ISO-1461 (E)
14.	IS : 6745	Determination of weight of zinc coating on zinc coated iron and steel articles	ISO : 1460
15.	IS : 3203	Methods of testing of local thickness of electroplated coatings	ISO : 2178
16.	IS : 2633	Testing of Uniformity of coating of zinc coated articles	
17		Standard specification for glass fiber strands	ASTMD 578-05
18		Standard test method for compositional analysis by Thermogravimetry	ASTM E 1131-03
19	IS : 4699	Specification for refined secondary zinc	

The addresses of organizations who offer the above standards are given at Annexure-A

3.0. Technical Description of Composite Insulators :

3.1. Service condition

The polymer insulators to be supplied shall be suitable for satisfactory continuous operation under conditions as specified below:

Maximum ambient temperature : 50⁰C
Minimum ambient temperature : -5⁰C
Relative humidity : 0 to 100%

3.2. Composite Insulators long rod type for tension locations and pin/ post type for suspension locations

- 3.2.1. The insulators shall be suitable for 3Ph. 50Hz, effectively earthed 11KV O/H distribution system in a moderately/heavily polluted atmosphere.
- 3.2.2. Bidder must be an indigenous manufacturer and supplier of composite insulators of rating 33KV or above or must have developed proven in house technology and manufacturing process for composite insulators of above rating OR posses technical collaboration/association with a manufacturer of composite insulators of rating 33KV or above. The Bidder shall furnish necessary evidence in support of the above along with the bid, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the owner.
- 3.2.3. Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc., and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC-60815/IS : 13134.

3.2.4. The size of composite insulator, minimum creepage distance and mechanical strength along with hardware fittings shall be as follows.

Sl. No.	Type of composite insulators	Nominal system voltage KV (rms)	Highest system voltage KV (rms)	Visible discharge test voltage KV (rms)	Wet power frequency withstand voltage KV (rms)	Dry lighting Impulse withstand voltage KV (rms)	Minimum creepage distance (mm)	Min. failing load KN	Pin rod shank diameter mm
1	Pin Insulator	11	12	9	45	110	320	5	20

3.3. Dimensional Tolerance of Composite Insulators

The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109 :

$\pm (0.04d + 1.5)\text{mm}$ when $d \leq 300\text{mm}$

$\pm (0.025d+6)\text{mm}$ when $d > 300\text{mm}$

Where, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be.

However, no negative tolerance shall be applicable to creepage distance.

3.4. Interchangeability

The composite insulators including the end fitting connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

3.5. Corona and RI performance

All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

3.6. Maintenance

3.6.1. The composite insulators offered shall be suitable for use of hot line maintenance technique so that usual hot line operation can be carried out with ease, speed and safety.

4.0. Technical description of composite Insulators.

4.1 Design and construction

The composite insulator shall have a core, housing & weathershed of insulating material and steel/aluminum hardware components for attaching it to the support/conductor.

4.1.1. Core

It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be boron free electrically corrosion resistant (ECR) glass fiber or boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through Pultrusion process. The FRP rod shall be void free. The diameter of FRP rod should be 20 mm only.

4.1.2 Housing (Sheath)

The FRP rod shall be covered by a seamless sheath of a silicone elastometric compound or silicone alloy compound of a thickness of 3mm minimum.

It should protect the FRP rod against environmental influences, external pollution and humidity. It shall be extruded or directly molded on the core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing/bonding area shall be free from voids.

4.1.3. Weathersheds

The composite polymer weathersheds made of silicone elastometric compound or silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. The weathersheds should have silicon content of minimum 30% by weight. The strength of the weathershed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

4.1.4. End Fittings

End fittings transmit the mechanical load to the core. They shall be made of spheroidal graphite cast iron, malleable cast iron or forged steel or aluminium alloy. They shall be connected to the rod by means of a controlled compression technique. The gap between fittings and sheath shall be sealed by a flexible silicone elastomeric compound or silicone alloy compound sealant. System of attachment of end fitting to the rod shall provide superior sealing performance between housing, i.e., seamless sheath and metal connection. The sealing must be moisture proof.

The dimensions of end fittings of Insulators shall be in accordance with the standard dimensions stated in IS: 2486/IEC60120.

5.0. Workmanship

- 5.1.** All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage field. Bidders shall offer only such insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission lines.
- 5.2.** The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.
- 5.3.** The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.
- 5.4.** The core shall be sound and free of cracks and voids that may adversely affect the insulators.

- 5.5. Weathersheds shall be uniform in quality. They shall be clean, sound, smooth and shall be free from defects and excessive flashing at parting lines.
- 5.6. End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress; effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.
- 5.7. All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. or 87µm thickness and shall be in accordance with the requirement of IS:4579. The zinc used for galvanizing shall be of purity 99.5% as per IS : 4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

6.0. Equipment Marking :

- 6.1 Each insulator unit shall be legibly and indelibly marked with the following details as per IEC-61109 :
- (a) Month & Year of manufacture
 - (b) Min. failing load/guaranteed mechanical strength in kilo Newton followed by the word 'kN' to facilitate easy identification.
 - (c) Manufacturer's name/Trade mark.
- 6.2 One 10 mm thick ring or 20mm thick spot of suitable quality of paint shall be marked on the end fitting of each composite long rod of particular strength in case of 11KV insulators for easy identification in case both types of insulators are procured by the utility. The paint shall not have any deteriorating effect on the insulator performance. Following codes shall be used as identification mark : For 45KN long rod unit : Blue

7.0 Bid Drawings :

- 7.1 The Bidder shall furnish full description and illustration of the material offered.
- 7.2 The bidder shall furnish along with the bid the outline drawing (3 copies) of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information :
- (a) Long rod diameter with manufacturing tolerances
 - (b) Minimum Creepage distance with positive tolerance
 - (c) Protected creepage distance
 - (d) Eccentricity of the long rod unit
 - (i) Axial run out
 - (ii) Radial run out
 - (e) Unit mechanical and electrical characteristics
 - (f) Size and weight of ball and socket/tongue & clevis
 - (g) Weight of composite long rod units
 - (h) Material
 - (i) Identification mark
 - (ii) Manufacturer's catalogue number

7.3 After placement of award, the supplier shall submit full dimensioned manufacturing insulator drawing containing all the details in four (4) copies to Owner for approval. After getting approval from Owner and successful completion of all the types tests, the supplier shall submit 10 more copies of the drawing to the Owner for further distribution and field use.

7.4 After placement of award the supplier shall also submit fully dimensioned insulator crate drawing for different type of insulators for approval of the owner.

8.0 Tests and Standards

Insulators offered shall be manufactured with the same configuration & raw materials as used in the insulators for which design & type test reports are submitted. The manufacturer shall submit a certificate for the same. The design & type test reports submitted shall not be more than 05 years old.

8.1. Design tests

Manufacturer should submit test reports for Design Tests as per IEC- 61109 along with the bid. Additionally following tests shall be carried out or reports for the tests shall be submitted after award of contract.

UV Test : The test shall be carried out in line with clause 7.2 of ANSI C29.13

8.2. Type Tests

8.2.1 The following type tests shall be conducted on a suitable number of individual insulator units, components, materials or complete strings and submitted along with the bid. The type test will not be later **10 years**.

Sl. No.	Description of type test	Test procedure/standard
1.	Dry lightning impulse withstand voltage test	As per IEC 61109
2.	Wet power frequency test	As per IEC 61109
3.	Mechanical load-time test	As per IEC 61109
4.	Radio interference test	As per IEC 61109 revised
5.	Recovery of Hydrophobicity test	Annexure-B (This test may be repeated every 3 years by the manufacturer)
6.	Chemical composition test for silicon content	Annexure-B (or any other test method acceptable to the owner)
7.	Brittle fracture resistance test	Annexure-B

8.2.1. It shall be the option of the purchaser to accept the insulators based on type test reports submitted by the manufacturer. The purchaser shall be free to repeat the type test & may witness the same.

Note : The purchaser, for the purpose of facilitating the type tests, may ask the bidders to quote test charges separately.

8.2.2. All the type test given in clause No. 8.2 in addition to routine & acceptance test shall be carried out on insulator along with hardware fittings wherever required.

8.3. Acceptance (sample) tests

The test samples after having with stood the routine test shall be subjected to the following acceptance test.

a)	Verification of dimensions	:	IEC : 61109
b)	Verification of the locking system (if applicable)	:	IEC : 61109
c)	Galvanizing test	:	IS : 2633/IS : 6745
d)	Verification of the specified Mechanical load	:	IEC : 61109

8.4. Routine Tests

Sl.No.	Description	Standard
1.	Identification of marking	As per IEC : 61109
2.	Visual inspection	As per IEC : 61109
3.	Mechanical routine test	As per IEC : 61109

8.5. Test during manufacture

Following test shall also be carried out on all components as applicable

a)	Chemical analysis of zinc used for galvanizing
b)	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
c)	Chemical analysis, hardness tests and magnetic particle inspection for forgings.

8.6. Sample Batch for Type Testing

8.6.1. The bidder shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the owner. The bidder shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the owner.

8.7. Additional Tests :

8.7.1 The purchaser reserves the right at his own expenses, for carrying out any other tests (s) of reasonable nature carried out at supplier's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications.

8.7.2 The purchaser also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Supplier's premises or at any other test center. In case of evidence of non compliance, it shall be binding on the part of the Supplier to prove the compliance of the items to the technical specifications by repeat tests or corrections of deficiencies or replacement of defective items, all without any extra cost to the purchaser.

881. **Co-ordination for Testing:**The supplier shall have to co-ordinate testing of insulators with hardware fittings to be supplied by other supplier and shall have to guarantee overall satisfactory performance of the insulators with the hardware fittings.

882. The bidder shall intimate the purchaser about carrying out of the type tests along with detailed testing programme at least 3 weeks advance of the scheduled date of testing during which the owner will arrange to depute his representative to be present at the time of carrying out the tests.

8.9. Quality assurance plan

8.9.1. The successful bidder shall submit following information to the owner :

8.9.1.1 Test certificates of the raw materials and bought out accessories.

8.9.1.2 Statement giving list of important raw materials, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

8.9.1.3 List of manufacturing facilities available.

8.9.1.4 Level of automaton achieved and lists of areas where manual processing exists.

8.9.1.5 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

8.9.1.6 List of testing equipments available with the bidder for final testing of equipment along with valid calibration reports.

8.9.1.7 The manufacturer shall submit manufacturing Quality Plan (MQP) for approval & the same shall be followed during manufacture and testing.

8.9.1.8 The successful bidder shall submit the routine test certificates of bought out raw materials/accessories and central excise passes for raw material at the time of inspection.

8.10. Guarantee

The supplier of insulators shall guarantee satisfactory performance of the insulators for a period of 18 months from the date of receipt of material at stores by the consignee in good condition.

8.11. Test reports

At least three copies of type test reports shall be furnished. One copy shall be returned duly certified by the owner, only after which the commercial production of the concerned material shall start.

8.11.2 Copies of acceptance test reports shall be furnished in at least three (3) copies. One copy shall be returned duly certified by the owner, only after which the material shall be dispatched.

8.11.3 Record of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

8.11.4 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by purchaser.

9.0 Inspection

- 9.1** The purchaser representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Supplier's and sub-Supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.
- 9.2** The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot of carrying out acceptance tests. The lot offered for inspection shall be homogeneous and shall contain insulators manufactured in 3-4 consecutive weeks.
- 9.3** The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.
- 9.4** No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the owner in writing. In the later case also the material shall be dispatched only after satisfactory testing specified herein has been completed.
- 9.5** The acceptance of any quantity of material shall in no way relieve the Supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such material are later found to be defective.

10.0 Packing :

- 10.0** All insulators shall be packed in strong corrugated box of min. 7 ply duly palletted or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.
- 10.2** The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- 10.3** Suitable cushioning, protective padding or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- 10.4** All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate/corrugated box shall have all the markings stenciled on it in indelible ink.
- 10.5** The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

Annexure – A

The standards mentioned in this specification are available from:

Reference abbreviation	Name and address
IEC/CISPR	International Electro technical commission, Bureau Central de la commission, electro technique international, 1 rule de verembe, Geneva, SWITZERLAND
BIS/IS	Bureau of Indian Standards, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi – 110 001, INDIA
ISO	International organization for standardization, Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heeleprup, DENMARK
NEMA/ANSI	National Electric Manufacture Association, 155, East 44 th Street, New York, NY: 10017 U.S.A
ASTM	American Society for Testing and Materials, 1916 Race St. Phelledelphia, PA19103 U.S.A.
STRI guide	STRI, Sweden, Website : www.stri.se

Tests on Insulator units :

1. RIV Test (Dry) :

The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz A.C. voltage of 10KV for 11KV class insulators respectively under dry condition. The test procedure shall be in accordance with IS:8263/IEC : 437/CISPR 18-2.

2. Brittle Fracture Resistance Test

Brittle fracture test shall be carried out on naked rod along with end fittings by applying “In HNO₃ acid” (63 g. conc.HNO₃ added to 937 g water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96-hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3. Recovery of Hydrophobicity & Corona test

The test shall be carried out on 4mm thick samples of 5cm X 7 cm.

- i) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification (Extract enclosed at Annexure-D). Dry the samples surface.
- ii) The sample shall subjected to mechanical stress by bending the sample over a ground electrode. Corona is continuously generated by applying 12KV to a needle like electrode placed 1mm above the sample surface. Tentative arrangement shall be as shown in Annexure-E. The test shall be done for 100 hrs.
- iii) Immediately after the corona treatment, spray the surface with water and record the HC classification. Dry the surface and repeat the corona treatment as at clause 2 above. Note HC classification. Repeat the cycle for 1000 hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.
- iv) Allow the sample to recover and repeat hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC1-HC2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment.

4. Chemical composition test for silicon content

The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X-ray) Analysis or Thermo-gravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

Section - 5

TECHNICAL SPECIFICATION FOR ACSR CONDUCTORS

1. SCOPE

This section covers design, manufacture, testing before dispatch, packing, supply and delivery for destination of Kms of "WEASEL" and "SQUIRREL" ACSR Conductor of size 6/1/2.59mm and 6/1/2.11mm

2. STANDARDS

The Conductor shall also comply in all respects with the IS: 398(Part-II)-1996 with latest amendments unless otherwise stipulated in this specification or any other International Standards which ensure equal or higher quality material.

The ACSR Conductor shall also conform to the following standards.

SINo	Indian Standard	Title	International
1	IS:209-9197	Specification for Zinc	BS-3436-1961
2	IS:398-1996	1996Specification for aluminum conductors for overhead transmission purposes.	
	Part-II	Aluminum conductors	IEC-209-1966
		Galvanized steel reinforced	BS-215(Part-II)
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
5	IS:1841-1978	E.C. Grade Aluminum rod produced by rolling	
6	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	BS-443-1969
8	IS:4826-1968	Galvanized coatings on round steel wires.	ASTM A472-729
9	IS:5484-1978	E.C. Grade Aluminium rod produced by continuous casting and rolling.	
10	IS:6745-1972	Methods of determination of weight of zinc-coating of zinc coated iron and steel articles	BS-443-1969

Offers conforming to standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per format enclosed.

3. GENERAL TECHNICAL REQUIREMENTS

3.1. MATERIALS/WORKMANSHIP

3.1.1. The material offered shall be of best quality and workmanship. The steel cored aluminum conductor strands shall consist of hard drawn aluminum wire manufactured from not less than 99.5% pure electrolytic aluminum rods of E.C. grade and copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC: 889-1987. The steel wire shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygen process. Steel wire drawn from Bessemer process shall not be used.

- 3.1.2. The steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with Section-II and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.
- 3.1.3. The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 250 gm/sq.m after stranding. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard prece test. The steel strands shall be preformed and postformed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC: 888-1987.

4. CONDUCTOR PARAMETERS

The Parameters of individual strands and composite steel cored aluminum conductor, shall be in accordance with the values given in Section-II.

Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations should be based on everyday temperature of 32 °C and everyday tension of 25% of UTS of conductor of 11/33 KV Lines.

5. TOLERANCES

The tolerances on standard diameter of Aluminum and Steel wires shall be as detailed in specific technical requirements.

The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.

The details of diameters, lay ratios of Aluminum and steel wires shall be in accordance with the Section-II "Technical Requirements".

6. SURFACE CONDITIONS

All aluminum and steel strands shall be smooth, and free from all imperfections, spills/and splits. The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, pressmarks, cut marks, wire cross-over, over-riding looseness, pressure and/or unusual bangle noise on tapping, material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.), dirt, grit, etc. The surface of conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension upto 50% of the ultimate strength of the conductor, the surface shall not depart from the cylindrical form nor any part of the component parts or strands move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

7. JOINTS IN WIRES

7.1. Aluminum wires

During stranding, no aluminum wire welds shall be made for the purpose of achieving the required conductor length.

No joint shall be permitted in the individual aluminum wires in the outer most layer of the finished Conductor. However, joints in the 12 wire & 18 wire inner layer of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that no two such joints shall be within 15 meters of each other in the complete stranded conductor.

7.2. **Steel wires**

There shall be no joints in finished steel wires forming the core of the steel reinforced aluminum conductor.

8. **STRANDING**

The wires used in construction of the stranded conductor, shall, before stranding, satisfy all requirements of IS-398 (Part-II) 1996.

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given under Section-II.

9. **PACKING**

- 9.1. The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of 2500 meters of **WEASEL /SQUIRREL ACSR conductor**.
- 9.2. The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN. The conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.
- 9.3. The bidders should submit their drawings of the conductor drums along with the bid. After placement of letter of intent the Manufacturer shall submit four copies of fully dimensioned drawing of the drum for Employer's approval. After getting approval from the Employer, Manufacturer shall submit 30 more copies of the approved drawings for further distribution and field use.
- 9.4. All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment for anti-termite/anti fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.
- 9.5. All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.
- 9.6. The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

- 9.7. Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.
- 9.8. Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.
- 9.9. The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.
- 9.10. Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layers of the conductor. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.
- 9.11. A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 9.12. Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.
- 9.13. The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.
- 9.14. Only one standard length of conductor shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.
- 9.15. As an alternative to wooden drum Bidder may also supply the conductors in non-returnable painted steel drums. The painting shall conform to IS:9954-1981, reaffirmed in 1992. Wooden/ steel drum will be treated at par for evaluation purpose and accordingly the Bidder should quote the package.

10. LABELLING AND MARKING

The drum number shall be branded or gauged or stencilled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum shall have the following information provided on the outside of the flange stencilled with indelible ink.

- i) Manufacturer's name and address.
- ii) Contract/Specification number.
- iii) Size and type of conductor.
- iv) Net weight of the conductor.
- v) Gross weight of the conductor and drum.
- vi) Length of the conductor.
- vii) Position of the conductor end.

- viii) Drum and lot number.
- ix) Name and address of the consignee.
- x) Month and year of manufacture.
- xi) The drum may also be marked with standard specification as per which the conductor is manufactured.

11. STANDARD LENGTHS

- 11.1. The standard length of the conductor shall be 2500 metres. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of plus or minus 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.
- 11.2. Random lengths will be accepted provided no length is less than 70% of the standard length and total quantity of such random length shall not be more than 10% of the total quantity order. When one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/-5% shall also be manufactured and all above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard length as specified.
- 11.3. Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. This is required for special stretches like river crossing etc. The Employer reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the pendency of the Contract.

12. QUALITY ASSURANCE PLAN

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the Employer along with the tender. The Quality Assurance Plan after the same is found acceptable, will be approved by the Employer.

The contractor shall follow the approved Quality Assurance Plan in true spirit. If desired by the Employer, he shall give access to all the documents and materials to satisfy the Employer that the Quality Assurance Plan is being properly followed.

13. TESTING

13.1. SELECTION OF TEST SAMPLES FOR TYPE TESTS

- 13.1.1. The samples shall be taken from a continuous length of conductor and subjected to all the tests specified in clause 14.

13.2. SELECTION OF TEST SAMPLES FOR ACCEPTANCE TESTS

- 13.2.1. Before dispatch from the works individual wire and finished steel cored aluminum conductor shall be subjected to the tests as specified in IS:398 or any other authoritative standard.
- 13.2.2. Sample for individual wires for test shall be taken before stranding from outer ends of not less than ten per cent of the spools in the case of aluminum wire and ten per cent of the wire coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 1.2 meters from the outer ends of the finished conductor from not more than 10 per cent of the finished reels.

13.2.3. The routine tests shall be same as acceptance test and shall be carried out on each coil.

14. TESTS

The following tests shall be carried out on sample/samples of conductor.

14.1 Type Tests

- (i) Visual examination
- (ii) Measurement of diameters of individual aluminum and steel wires.
- (iii) Measurement of lay ratio of each layer
- (iv) Breaking load test
- (v) Ductility test
- (vi) Wrapping test
- (vii) Resistance test on aluminum wires.
- (viii) DC resistance Test on Composite Conductor.
- (ix) Galvanizing test
- (x) Surface condition test
- (xi) Stress Strain test
- (xii) Procedure qualification test on welded joint of Aluminum Strands.

NOTE:-The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer.

The above additional lists if not conducted earlier, shall be done under the subject project package at no extra cost.

14.2 Acceptance tests and Routine tests

- (i) Visual and dimensional check on drum.
- (ii) Visual examination
- (iii) Measurement of diameters of individual aluminum and steel wires.
- (iv) Measurement of lay ratio of each layer
- (v) Breaking load test
- (vi) Ductility test
- (vii) Wrapping test

- (viii) Resistance test on aluminum wires.
- (ix) DC resistance Test on Composite Conductor.
- (x) Galvanizing test

14.3 Tests During Manufacture

The following tests during manufacture shall be carried out.

- (i) Chemical analysis of zinc used for galvanising,
- (ii) Chemical analysis of aluminum used for making aluminum strands,
- (iii) Chemical analysis of steel used for making steel strands,

14.4 Visual examination

The conductor shall be examined visually for good workmanship and general surface finish of the conductor. The conductor drums shall be rewound in the presence of Inspecting Officer. The Inspector will initially check for Scratches, Joints etc., and that the conductor shall generally conform to the requirements of the specifications/IS 398(Part-II)-1996.

14.5 Measurement of diameters of individual Aluminum and Steel Wires.

The diameters of individual Aluminum and Steel Wires shall be checked to ensure that they conform to the requirements of this specification.

14.6 Measurement of lay-ratios

The lay-ratios of each layer of the conductor shall be measured and checked to ensure that they conform to the requirements of this specification and IS:398 (Part-II)-1996.

14.7 Breaking load test

a) Breaking load test on complete conductor.

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5m length between fixing arrangement suitably fixed on a tensile testing machine. The load shall be increased at a steady rate upto 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to 100% of UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

b) Breaking load test on individual Aluminum and Galvanized steel wires.

This test shall be conducted on both Aluminum and Galvanized steel wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min. and not greater than 100 mm. / min. The ultimate breaking load of the specimens shall be not less than the values specified in the Section-II.

14.8 Ductility Test

For the purpose of this test both torsion and elongation tests shall be carried out on galvanized steel wires only.

14.9 Torsion Test

One specimen cut from each of the samples taken shall be gripped in two vices exactly 15 cms. apart. One of the vices shall be made to revolve at a speed not exceeding one revolution per second and the other shall be capable of moving longitudinally to allow for contraction or expansion during testing. A small tensile load not exceeding 2 (two) percent of the breaking load of the wire shall be applied to the samples during testing. The test shall be continued until fracture occurs and the fracture shall show a smooth surface at right angles to the axis of the wire. After fracture, the specimen shall be free from helical splits. The sample shall withstand a number of twists equivalent to not less than 18 on length equal to 100 times the diameter. When twisted after stranding the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to the next higher whole number. The fracture shall show a smooth surface at right angles to the axis of the wire.

14.10 Elongation Test

The elongation of one specimen cut from each of the samples taken shall be determined. The specimen shall be straightened by hand and an original gauge length of 200 mm. shall be marked on the wire. A tensile load shall be applied as described in 1.1.4.6.2.1 and the elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, or within 25 mm. of either mark and the required elongation is not obtained, the test shall be disregarded and another test conducted. When tested before stranding, the elongation shall be not less than 4 percent and when tested after stranding, the elongation shall be not less than 3.5 percent.

14.11 Wrapping Test

This test shall be conducted on both Aluminum and Galvanized steel wires.

14.11.1 Aluminum wires

One specimen cut from each of the samples of aluminum wires shall be wrapped round a wire of its own diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and closely wrapped in the same direction as before. The wire shall not break or show any crack.

14.11.2 Galvanized steel wires

One specimen cut from each of the samples of galvanized steel wire taken shall be wrapped round a mandrel of diameter equal to 4 times the wire diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

14.12 Resistance Test

This test shall be conducted on aluminum wires only, conforming to procedure as per IEC:889. The electrical resistance of one specimen of aluminum wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value

corresponding to 20 degrees C. by means of following formula.

$$R_{20} = R_T \frac{1}{1 + \alpha (T - 20)}$$

Where

R_{20} = Resistance corrected at 20 degrees C.

R_T = Resistance measured at T degrees C.

α = Constant mass temperature coefficient of resistance 0.004.

T = Ambient temperature during measurement

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in section-II.

14.13 Galvanizing Test

This test shall be conducted on galvanized steel wires only. The uniformity of Zinc coating and the weight of coating shall be in accordance with IS 4826-1979.

14.14 Surface Condition Test

A sample of the finished conductor for use in 11/33 KV system having a minimum length of 5 meters with compression type dead end clamps compressed on both ends in such manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminum and steel strands as indicated in Section-II.

14.15 Stress-Strain Test

The test is contemplated only to collect the creep data of the conductor from the manufacturer. A sample of conductor of minimum 10 meters length shall be suitably compressed with dead end clamps.

15. TEST SET-UP

- 15.1. The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10mm under tension. This shall be ascertained by actual measurement.
- 15.2. The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1mm + 0.1mm from the value before the test.
- 15.3. The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which

lock the steel and aluminum wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

16. TEST LOADS FOR COMPLETE CONDUCTOR

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

- 16.1. 1KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set At zero tension.
- 16.2. For non-continuous stress-strain data, the strain readings at 1KN intervals at lower tensions and 5 KN intervals above 30% of UTS shall be recorded.
- 16.3. The sample shall be reloaded to 30% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.
- 16.4. The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.
- 16.5. Reloading upto 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes. The load shall be released.
- 16.6. Reloading upto 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10,15, 30, 45 and 60 minutes and the load shall be released then.
- 16.7. Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded upto 90% of UTS at the intervals described under Clause 16.6.

17. TEST LOADS FOR STEEL CORE ONLY

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows:

- 17.1. The test shall consist of successive applications of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.
- 17.2. The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

18. STRESS-STRAIN CURVES

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at 30%,50% and 70% of UTS loadings. The presence of any aluminum slack that can be related to any observed extrusion entering the span from the compression dead ends shall be

removed from the lower ends of the design curves. Both the laboratory and standard stress-strain curves shall be submitted to the Employer along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 deg.C.

19. DC RESISTANCE TEST ON COMPOSITE CONDUCTOR

On a conductor sample of minimum 5m length, two contact clamps shall be fixed with a pre-determined bolt torque. The resistance of the sample shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 deg C as per clause no. 12.8 of IS:398 (Part-II)-1982/1996. The corrected resistance value at 20 deg.C shall conform to the requirements of this specification.

20. PROCEDURE QUALIFICATION TEST ON WELDED ALUMINUM STRANDS.

Two Aluminum wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The breaking strength of the welded joint of the wire shall not be less than the guaranteed breaking strength of individual strands.

21. CHEMICAL ANALYSIS OF ALUMINUM AND STEEL

Samples taken from the Aluminum and Steel ingots / coils/ strands shall be chemically/ spectrographically analyzed. The same shall be in conformity with the requirements stated in this specification.

22. CHEMICAL ANALYSIS OF ZINC

Samples taken from the zinc ingots shall be chemically / spectrographically analysed. The same shall be in conformity with the requirements stated in this specification.

23. VISUAL AND DIMENSIONAL CHECK ON DRUMS

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification.

24. REJECTION AND RETEST

24.1. In case of failure in any type test, the Manufacturer is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

24.2. If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All rejected material shall be suitably marked and segregated.

25. CHECKING AND VERIFICATION OF LENGTH OF CONDUCTOR

The contractor should arrange for inspection by the representative of the Employer specially authorised for this purpose. At least 50% of the total number of drums of conductor subject to minimum of two taken at random should be checked to ascertain the length of conductor. Arrangements should be made available in the works of the manufacturer for transferring the conductor from one reel to another at the same time measuring the length of the conductor so transferred by means of a meter.

26. ADDITIONAL TESTS

The Employer reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Bidder's premises, at site, or in any other standard Laboratory in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the specifications.

27. TESTING EXPENSES

- 27.1. The breakup of the testing charges for the type tests specified shall be indicated separately.
- 27.2. Bidder shall indicate the laboratories in which they propose to conduct the type test. They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.
- 27.3. The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of the conductor, except for the expenses of the inspector/Employer's representative.
- 27.4. In case of failure in any type test, if repeat type tests are required to be conducted then all the expenses for deputation of Inspector/Employer's representative shall be deducted from the contract price. Also if on receipt of the Manufacturer's notice of testing, the Employer's representative does not find 'plant' to be ready for testing, the expenses incurred by the Employer for redeputation shall be deducted from contract price.

28. TEST REPORTS

- 28.1. Copies of type test reports shall be furnished in at least six copies alongwith one original. One copy will be returned duly certified by the Employer only after which the commercial production of the material shall start.
- 28.2. Record of Routine test reports shall be maintained by the Manufacturer at his works for periodic inspectionby the Employer's representative.
- 28.3. Test certificates of Tests during manufacture shall be maintained by the Manufacturer. These shall be produced for verification as and when desired by the Employer.

29. TEST FACILITIES

The following additional test facilites shall be available at the Manufacturer's works:

- (i) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer,etc.
- (ii) Standard resistance for calibration of resistance bridges.
- (iii) Finished Conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed(variable from 8 to 16 meters per minute).The rewinding facilities shall have appropriate clutch system and be free of vibrations, jerks etc with traverse laying facilities.

30. INSPECTION

- 30.1. The Employer's representative shall, at all times, be entitled to have access to the works and all places of manufacture where conductor shall be manufactured and the representative shall have full facilities for unrestricted inspection of the Bidder's works, raw materials and process of manufacture and conducting necessary tests as detailed herein.
- 30.2. The Bidder shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.
- 30.3. The contractor will intimate the Employer about carrying out of the tests at least 45 days in advance of the scheduled date of tests during which the Employer will arrange to depute his representative/s to be present at the time of carrying out of the tests. Six (6) copies of the test reports shall be submitted.
- 30.4. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, Unless the inspection is waived off by the employer in writing. In the later case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein has been completed and approved by the employer.
- 30.5. The acceptance of any quantity of material shall in no way relieve the Bidder of any of his responsibilities for meeting all requirements of the specification, and shall not prevent subsequent rejection if such material is later found to be defective.
- 30.6. At least 50% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the following method:
- 30.7. "At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking".

31. SCHEDULE OF DEVIATIONS/VARIATIONS

If the tenderer has any exceptions to any of the clause/s laid down in this specification, these should be clearly stated in the schedule of deviations / variations.

SECTION - II

SPECIFIC TECHNICAL REQUIREMENTS

1. SCOPE

This section of the specification covers climatic and isoceraunic conditions, specific technical particulars, schedule of requirements & desired deliveries, for conductor for 11/33 kV lines.

2. CLIMATIC & ISOCERAUNIC CONDITIONS :

2.2 i) Max. ambient temperature	40°C	
ii) Mean annual / every day temperature	35°C	
2.3 Basic wind speed m/s		
2.4 Relative humidity		
i) Maximum	89%	
ii) Minimum	62%	
2.5 Average Rainfall (Max.) mm per annum		
2.6a) Rainy months	May to October	
2.7 Average number of thunder storm : 50		
2.8 Altitude varying from sea level	: 1000m (above MSL) and above	
2.9 Seismic Intensity : Zone V as per IS 1893		
2.10 System Particulars		
a) Line Voltage (kV)	11KV	33KV
b) Highest System Voltage (kV)	12KV	36KV
c) Number of Circuits	3	3
d) Frequency HZ	50	
e) Neutral		

3. SPECIFIC TECHNICAL REQUIREMENTS

CONDUCTOR:

1. Conductor: Squirrel and Weasel ACSR
IS-398 (part-II) 1996 latest revision
2. IS applicable: revision
3. Wire Diameter
Aluminium
(mm)
Steel(mm)

	Squirrel	Weasel
Aluminium (mm)	6/2.11	6/2.59
Steel(mm)	7/2.11	1/2.59
4. Number of strands:
Steel centre
1st steel layer
1st Aluminium layer

Steel centre	1	1
1st steel layer		
1st Aluminium layer		6

2nd Aluminium layer			
Sectional Area			
5. of	Aluminium	20.98	31.61
	(sq. mm.)		
6. Total Sectional Area(sq.mm.)		61.7	24.48
7. Overall diameter(mm)		10.05	6.33
8. Approximate weight(Kg./Km.)		214	85
Calculated D.C resistance at			
9. 20		0.552	1.394
	degrees C., maximum.		
	(Ohms/Km)		
10. Ultimate tensile strength			
(KN)		18.25	26.91
11. Final modulus of elasticity		79	79
	(GN/sq.m)		
12. Coefficient of linear			
expansion		19.1	19.1
	x 10-6 per°C		

13. Lay ratio		Max	Min	Max	Min
	Steel core 6 wire layer				
	Aluminium Ist layer		14		14
	2 nd layer		10		10

14. Technical Particulars

a. Diameter-mm		Squirrel		Weasel	
		Al	Steel	Al	Steel
Standard(mm)		2.11	2.11	2.59	2.59
Maximum (mm)		2.13	2.09	2.64	2.62
Minimum (mm)		2.15	2.07	2.54	2.56
b. Cross-sectional area of nominal diameter wire (mm ²)		3.497	3.497	5.269	5.269
c. Weight (Kg./Km)		9.45	27.27	41.09	14.24
d. Min. breaking load (KN)					
	Before stranding	0.63	4.60	6.92	0.89
	After Stranding	0.60	4.37	6.57	0.85
e. D.C resistance at min. (Ohm/Km)	C		8.237		5.49

15. Zinc coating of steel core:

- (i) Number of 1 minute dips: 3
- (ii) Minimum weight of Zinc: 260 gms/sqm Coating
- (iii) Process of Galvanizing: Hot dip.
- (iv) Quality of Zinc : IS-209/1979 or latest edition.

16. Joints in strands

16.1 Steel : Not permitted

16.2 **Aluminium:** No joint shall be permitted in the Aluminum wires in the outer most layer of the ACSR conductor. But permitted in the inner layers such that no two such joints are within 15 meters of each other in the complete stranded conductor.

15. Chemical composition of high carbon steel wire:

Element	% Composition
i) Carbon	0.5 to 0.85
ii) Manganese	0.5 to 1.10
iii) Phosphorus	Not more than 0.035
iv) Sulphur	Not more than 0.045
v) Silicon	0.10 to 0.35