

## **SECTION-VII**

# TECHNICAL SPECIFICATIONS

## SECTION-VII

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## TECHNICAL SPECIFICATIONS

### SECTION - VII

#### 1.0 Technical description of disc insulators

#### 1.1 Details of disc insulators

1.1.1 The insulator strings shall consist of standard discs for a three phase, 50 Hz, effectively earthed 132 KV transmission system in a lightly polluted atmosphere. The discs shall be cap and pin, ball and socket type.

1.1.2 Supplier may quote for disc insulator, made of either electro-porcelain or toughened glass.

1.1.3 The size of disc insulator, minimum creepage distance, the number to be used in different type of strings, their electromechanical strength and mechanical strength of insulator string along with hardware fittings shall be as follows:

Sl. no.	Type of string	Size of disc insulators (mm)	Minimum creep age distance of each disc (mm)	No. of disc	Electro-mechanical strength of insulator disc(kN)	Mechanical strength of insulator string along with Hardware fittings (kN)
1	Single 'I' suspension	255x145	292	1x 9	90	90
2	Single Tension	255x145	292	1x 10	120	120
3	Double Tension	255x145	292	2 x 10	120	2 x 120

#### 1.2 Pin and cap

1.2.1 Pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric, of such design that it will not yield or distort under load conditions.

1.2.2 The pin ball shall move freely in the cap socket but without danger of accidental uncoupling during erection or in position. The design of the disc should be such that stresses due to expansion or contraction in any part of the insulator shall not lead to deterioration.

#### 1.3 Security clip

1.3.1 Security clip for use with ball and socket coupling shall be of R-shaped hump type which shall provide positive locking of the coupling as per IS:2486-(part-III)/IEC : 372. The legs of the security clips shall be spread after installation to prevent complete withdrawal from the socket. The locking device should be resilient, corrosion resistant and of suitable mechanical strength. There shall be no risk of

the locking device being displaced accidentally or being rotated when in position. Under no circumstances shall locking device allow separation of insulator units or fittings.

- 1.3.2 The hole for the security clip shall be countersunk and the clip shall be of such design that the eye of clip may be engaged by a hot line clip puller to provide for disengagement under energised conditions. The force required to pull the security clip into its unlocked position shall not be less than 50N (5 kg) or more than 500N (50 kg).

#### 1.4 **Ball and socket designation**

The dimensions of the balls and sockets shall be of 16/20mm designation for 90 & 120 kN disc insulators in accordance with the standard dimensions stated in IS:2486-(Part-II)/IEC:120.

#### 1.5 **Dimensional tolerance of insulator disc (standard)**

It shall be ensured that the dimensions of the disc insulators are within the limits specified below:

Sl. no.	Particulars	Standard	Maximum	Minimum
1	Diameter of disc (mm)			
	90 kN disc	255	266	244
	120 kN disc	255	266	244
2	Ball to ball spacing between disc			
	90 kN disc	145	149	141
	120 kN disc	145	149	141

#### 1.6 **Interchangeability**

The disc insulators inclusive of the ball and socket fittings shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant Indian/International standards.

#### 1.7 **Corona and RI performance**

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

#### 1.8 **Maintenance**

- 1.8.1 The disc insulators offered shall be suitable for employment of hot line maintenance techniques so that the usual hot line operations can be carried out with ease, speed and safety.

- 1.8.2 Bidders shall indicate the methods generally used in the routine hot and dead line maintenance of EHV Lines for which similar disc insulators have

been supplied by them. Bidders shall also indicate the recommended periodicity of such maintenance.

## **1.9 Materials**

### **1.9.1 Porcelain**

The porcelain used in the manufacture of shells shall be sound, free from defects thoroughly vitrified and smoothly glazed.

### **1.9.2 Glaze**

The finished porcelain shall be glazed in brown colour. The glaze shall cover all exposed parts of the insulator and shall have a good lusture, smooth surface and good performance under the extreme weather conditions of a tropical climate. It shall not crack or chip by ageing under the normal service conditions. The glaze shall have the same coefficient of expansion as of the porcelain body throughout the working temperature range.

### **1.9.3 Toughened glass**

The glass used for the shells shall be sound, free from defects such as flaws, bubbles, inclusions etc. and be of uniform toughness over its entire surface. All exposed glass surfaces shall be smooth.

### **1.9.4 Cement**

Cement used in the manufacture of the insulator shall not cause fracture by expansion or loosening by contraction. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as small and uniform as possible. Proper care shall be taken to correctly centre and locate individual parts during cementing.

### **1.9.5 Pins and caps**

Pins and caps shall be made of drop forged steel and malleable cast iron/spheriodal graphite iron/drop forges steel respectively, duly hot dip galvanised and shall not be made by jointing, welding, shrink fitting or any other process from more than one piece of material.

### **1.9.6 Security clips**

Security clips shall be made of good quality stainless steel or phosphor bronze as per IS:1385. 2.5% extra security clip shall be provided.

## **1.10 Workmanship**

1.10.1 All the material shall be of the latest design and conform to the best modern practices adopted in the extra high voltage field. Suppliers shall offer only such insulators as are guaranteed by him to be satisfactory and suitable for 132kV transmission lines and will give continued good service.

1.10.2 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 to limit corona and radio interference.

- 1.10.3 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.
- 1.10.4 Metal caps shall be free from cracks, seams, shrinks, air holes, burrs and rough edges. All surfaces of the metal parts shall be perfectly smooth with no 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.
- 1.10.5 All ferrous parts shall be hot dip galvanised to give a minimum average coating of zinc equivalent to 600 gm/sqm and shall be in accordance with the requirement of IS:2629 and shall satisfy the tests mentioned in IS:2633. The zinc used for galvanising shall be of grade Zn 99.95 as per IS:209. 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 galvanised metal parts shall be guaranteed to withstand at least six successive dips each lasting for 1(one) minute duration under the standard Preece test.
- 1.10.6 Before ball fittings are galvanised, all die flashing on the shank surface of the ball shall be carefully removed without reducing the dimensions below the design requirements.
- 1.10.7 The design of the insulators shall be such that the shell shall not engage directly with hard metal. The design shall also be such that when units are coupled together there is no contact between the shell of one unit and metal of the next adjacent unit. The design of the shell ribs shall be such that the security clip of the insulator can be engaged and disengaged easily with hot stick without damaging the shell ribs.
- 1.10.8 Insulator units after assembly shall be concentric and co-axial within limits as permitted by the relevant Indian standards.
- 1.10.9 The manufacturer of the insulators shall guarantee an insulator failure rate not exceeding 1 (one) per 10000 (ten thousand) per year for disc insulator per year. In case the annual failure rate during the first ten years of service exceeds the above figure, under normal operating condition, as will be determined by check to be conducted as per mutually agreed procedure and conditions up to ten years, (as permitted by the operating situation), the supplier shall supply to the owner free of cost spare insulators equal to 10 time the excess failure.
- 1.10.10 The supplier shall guarantee that there shall not be any de-capping/breaking of insulators on line under normal operating conditions. In the event of any de-capping/breaking and subsequent line drop, during the first ten years of service the supplier shall have to pay Rs. 50,000/- (Rs. fifty thousand only) per dropped string towards expenditure to be incurred by owner for this line repair.

## **2.0 Equipment marking**

- 2.1 Each insulator disc unit shall be legibly and indelibly marked with the trade mark of the manufacturer, name of owner and month & year of manufacture. The guaranteed combined mechanical and electrical strength shall be indicated in kilo Newton followed by the word 'kN' to facilitate easy identification and to ensure proper use.
- 2.2 For porcelain insulator, the marking shall be on porcelain. The marking shall be printed, not impressed and shall be applied before firing. For toughened glass insulators the marking shall be on the metal parts.
- 2.3 One 10 mm thick ring or 20 mm thick spot of suitable quality of paint shall be marked on the cap of each insulator porcelain disc of particular strength for easy identification of the type of insulator. The paint shall not have any deteriorating effect on the insulator performance. Following codes shall be used as identification mark:
- |                      |   |        |
|----------------------|---|--------|
| For 90 kN disc unit  | : | Red    |
| For 120 kN disc unit | : | Yellow |

## **3.0 Bid drawings**

- 3.1 The bidder shall furnish full description and illustration of the material offered.
- 3.2 The bidder shall furnish along with the bid the outline drawing (6 copies) of each insulator unit including a cross sectional view of the insulator shell. The drawing shall include but not limited to the following information:-
- (a) Shell diameter and ball to ball spacing with manufacturing tolerances
  - (b) Minimum Creepage distance with positive tolerance
  - (c) Protected creepage distance
  - (d) Eccentricity of the disc
    - (i) Axial run out
    - (ii) Radial run out
  - (e) Unit mechanical and electrical characteristics
  - (f) Size and weight of ball and socket parts
  - (g) Weight of unit insulator disc/long rod units
  - (h) Materials
  - (i) Identification mark
  - (j) Manufacturer's catalogue number
- 3.3 After placement of award, the supplier shall submit full dimensioned insulator drawings containing all the details as given in clause No. 3.2 above, in 4(four) copies to owner for approval. After getting approval from owner and successful completion of all the type tests, the supplier shall submit 20 more copies of the same drawing to the owner for further distribution and field use at owner's end.

- 3.4 After placement of award the supplier shall also submit fully dimensioned insulator crate drawing for different type of insulators.
- 3.5 After placement of award, the supplier shall submit full dimensioned manufacturing drawing of insulator cap, pin and insulator shell in 6(six) copies to the owner for reference and record.

#### 4.0 Tests and standards

The above line materials shall be of proven design/type tested. Type tested material shall mean that all such type tests which are specified herein below and have been successfully carried out during last five years to prove the process of manufacture and general conformity of the material to this specification. The bidder shall be required to submit the copies of type test reports of these materials. The test reports submitted shall be for the tests conducted within last 5 (five) years prior to the date of bid opening. The type tests conducted earlier should have been conducted in accredited laboratory (accredited based on ISO/IEC guide 25/17025 & EN 45001 by the national accreditation body of the country where the laboratory is located) or witnessed by the representative(s) of the owner or any other utility.

In case the tests have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e. any test report not applicable due to any design/manufacturing charge including substitution of components or due to non-compliance with the requirement stipulated in the technical specifications) the tests shall be conducted by the contractor at no extra cost to the owner.

#### 4.1 Type tests

The following type tests shall be conducted on a suitable number of individual standard disc insulators units, components, materials or complete strings:

##### 4.1.1 On unit disc insulators

Sl. no.	Type of test	Remarks
1	Verification of dimensions	As per IEC :60383
2	Thermal mechanical performance test	As per annexure-A
3	Power frequency voltage withstand and flashover test under (i) dry & (ii) wet condition	As per IEC : 60383
4	Impulse voltage withstand and flashover test (dry)	As per IEC : 60383
5	Visible discharge test (dry)	As per IS:731, Cl. 10.2
6	RIV test (dry)	As per IEC:60437
7	Residual strength test	As per annexure-A
8	Steep wave front test	As per annexure-A
9	Impact test	As per annexure-A

#### 4.1.2 On the complete disc insulator string with hardware fittings

Sl. no.	Type of test	Remarks
1	Power frequency voltage withstand test with corona control rings/grading ring and arcing horns under wet condition	As per IEC : 60383
2	Impulse voltage withstand test under dry condition	As per IEC : 60383
3	Impulse voltage flash over test under dry condition	As per IEC : 60383
4	Voltage distribution test	As per annexure-A
5	Mechanical strength test	As per annexure-A
6	Vibration test	As per annexure-A

4.1.3 All the type test given in clause No. 4.1.2 for disc insulator string shall be conducted on single 'T' suspension and single tension insulator string along with hardware fittings.

4.1.4 All the type tests given under clause No. 4.1.2(1) to (5) for disc insulator string shall also be conducted on single suspension pilot, double tension string.

4.1.5 Type tests specified under clause 4.1.2(1) to (3) shall not be required to be carried out if a valid test certificate is available for a similar design, i.e., tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO/IEC vide 25/17025 or EN 45001 by the National accreditation body of the country where laboratory is located) or witnessed by the representative(s) of the owner or utility. The test reports submitted shall be for the tests conducted within last 5 (five) years prior to date of bid opening.

In case the test have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e., any test not applicable due to any design/manufacturing change including substitution of components or due to non-compliance with the requirement stipulated in the technical specifications), the tests shall be conducted by the supplier at no extra cost to the owner.

## 4.2 Acceptance tests

### 4.2.1 For disc insulators (both porcelain and glass)

Sl. no.	Type of test	Remarks
1	Visual examination	As per IEC : 60383
2	Verification of dimensions	As per IEC : 60383
3	Temperature cycle test	As per IEC : 60383
4	Galvanising test	As per IEC : 60383
5	Mechanical performance test	As per IEC:60575C1 4.0

6	Test on locking device for ball and socket coupling	As per IEC:60372
7	Eccentricity test	As per IEC:60383
8	Residual strength test	As per IEC:797 clause 4.4, 4.5
9	Metallurgical test (for metal fittings only in black condition)	As per Annexure-A
	Grain size	
	Inclusion rating	
	Chemical analysis	
	Microstructure	
10	Chemical analysis of zinc sleeve	As per annexure - A
11	IR measurement	As per annexure - A
12	Impact test	As per annexure - A
13	Steep wave front test	As per annexure - A
14	Thermal mechanical performance test	As per annexure - A

**Note :** Tests specified under clause 4.2.1 (13) & (14) above shall be performed as acceptance tests once for every supply of 25,000 nos. of a particular rating

#### 4.2.2 For porcelain disc insulators only

Sl. no.	Type of test	Remarks
1	Electro-mechanical strength test	as per annexure-A
2	Porosity test	as per IEC : 60383
3	Puncture test	as per IEC : 60383

#### 4.2.3 For glass insulators only

Sl. no.	Type of test	Remarks
1	Thermal shock test	as per IEC : 60383
2	Steep wave front test/puncture test	as per annexure -A
3	Mechanical failing load test	as per annexure -A

### 4.3 Routine tests

#### 4.3.1 For disc insulators

Sl. no.	Type of test	Remarks
1	Visual examination	as per IS:731, clause 10.13
2	Mechanical routine test	as per IS:731, clause 10.14
3	Electrical routine test (for porcelain disc insulator only)	as per IS:731, clause 10.15
4	Thermal shock routine test (for glass insulator only)	as per IEC : 60383
5	Polarised light inspection (for glass insulator only)	as per annexure-A

### 4.3.2 Tests during manufacture

On all components as applicable

Sl. no.	Type of test	Remarks
1	Chemical analysis of zinc used for galvanising	as per annexure – A
2	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings	as per annexure – A
3	Chemical analysis hardness tests and magnetic particle inspection for forgings	as per annexure – A
4	Hydraulic internal pressure tests on disc insulator shells	as per annexure – A
5	Autoclave test on cement	as per annexure – A

### 4.4 Testing expenses

- 4.4.1 For type tests which involves the tests on the complete insulator string with hardware fitting the contractor of hardware fittings shall supply the necessary number of sets of hardware fittings at the place of testing free of cost.
- 4.4.2 In case of failure in any type test the bidder whose material has failed is either required to modify the design of the material & successfully carryout all the type tests as has been detailed out in clause 4.1.2 of this specifications or to repeat that particular type test at least three times successfully at his own expenses. In case of failure of the complete string in any type test, the manufacturer whose product has failed in the use shall get the test repeated at his cost. The supplier whose material has not failed in the test shall be required to supply the requisite quantity of material (that is insulator or hardware fittings as the case may be) required for repeat testing at the place of testing and the cost of supply shall be borne by the supplier whose material has failed in testing.
- 4.4.3 Supplier shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that adequate facilities are available in the laboratory and the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule.
- 4.4.4 The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted ex-works price.
- 4.4.5 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/ owner's representative shall be deducted from the contract price. Also if on receipt of the supplier's notice of testing, the owner's representative does not find 'plant' to be ready for testing the

expenses incurred by the owner for re-deputation shall be deducted from contract price.

- 4.4.6 The supplier shall intimate the owner about carrying out of the type tests alongwith detailed testing programme at least 3 weeks in advance (in case of domestic supplier) and at least 6 weeks advance (in case of foreign supplier) 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.

#### **4.5 Sample batch for type testing**

- 4.5.1 The supplier shall offer material for sample selection for type testing only after getting quality assurance programme approved by the owner. The supplier 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.

- 4.5.2 Before sample selection for type testing, the supplier shall be required to conduct all the acceptance tests successfully in presence of owner's representative.

#### **4.6 Schedule of testing**

The bidder has to indicate the schedule of following activities in their bids:

- (a) Submission of drawing for approval.
- (b) Submission of quality assurance programme for approval.
- (c) Offering of material for sample selection for type tests.
- (d) Type testing.

#### **4.7 Repeat E&M strength test**

- 4.7.1 E&M test on 20 nos. for disc insulator of samples for every lot of 10,000 nos. received at site shall be conducted. Testing expenses have to be borne by the supplier and shall be included in quoted ex-works price. In case of failure, it will be repeated on double no. of samples and if it again fails, the whole lot should be rejected and shall be replaced by the supplier. The samples have to be taken at random after segregating insulators damaged in transportation or otherwise.

- 4.7.2 The owner reserves the right of having at his own expenses any other test(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.

- 4.7.3 The owner 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 centre. 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 correction of deficiencies or replacement of defective items, all without any extra cost to the owner.

#### **4.8 Co-ordination for testing**

The contractor 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.

#### **4.9 Guarantee**

The supplier of insulators shall guarantee overall satisfactory performance of the insulators with the hardware fittings.

#### **4.10 Test reports**

4.10.1 Copies of type test reports shall be furnished in at least 6 (six) copies along with one original. One copy shall be returned duly certified by the owner only after which the commercial production of the concerned material shall start.

4.10.2 Copies of acceptance test reports shall be furnished in at least 6 (six) copies. One copy shall be returned duly certified by the owner, only after which the material shall be dispatched.

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

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

#### **4.11 Inspection**

4.11.1 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.

4.11.2 The material for final inspection shall be offered by the supplier only under packed condition as detailed under clause for 'packing and marking' in the specification. The owner shall select samples at random from the packed lot for carrying out acceptance tests. Insulators shall normally be offered for inspection in lots not exceeding 10,000 nos. for disc insulator. The lot should be homogeneous and should contain insulators manufactured in 3-4 consecutive weeks.

4.11.3 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.

4.11.4 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 latter case also the material shall be dispatched only after satisfactory testing for all tests specified herein have been completed.

- 4.11.5 The acceptance of any quantity of material shall be 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.

#### **4.12 Packing and marking**

- 4.12.1 All insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates along with the material shall not normally exceed 200 Kg to avoid handling problem. For marine transportation crates shall be palletted.
- 4.12.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- 4.12.3 Suitable cushioning, protective padding, or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- 4.12.4 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 shall have all the markings stencilled on it in indelible ink.

#### **4.13 Standards**

The insulator strings and its components shall conform to the following Indian/ International standards which shall mean latest revision, with amendments/ changes adopted and published, unless specifically stated otherwise in the specification.

- 4.13.1 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 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	IS:209-1992	Specification for zinc	BS:3436
2	IS:406-1991	Method of chemical analysis of Slab Zinc	BS:3436
3	IS:731-1991	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V	BS:137- (I&II) IEC:60383
4	IS:2071 part (I) – 1993 (part(II) - 1991 part(III) - 1991	Methods of high voltage testing	IEC:60060-1

5	IS:2486 Part- I-1993 Part- II-1989 Part-III-1991	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V general requirements and tests dimensional requirements locking devices	BS:3288 IEC:60120 IEC:60372
6	IS:2629-1990	Recommended practice for hot, dip galvanisation for iron and steel	ISO-1461 (E)
7	IS:2633-1992	Testing of uniformity of coating of zinc coated articles	
8	IS:3188-1988	Dimensions for disc insulators	IEC:60305
	IS:6745-1990	Determination of weight of zinc coating on zinc coated iron and steel articles	BS:433-1969 ISO:1460-1973
10	IS:8263-1990	Methods of RI test of HV insulators	IEC:60437 NEMA Publication No.07/ 1964/ CISPR
11	IS:8269-1990	Methods for switching impulse test on HV insulators	IEC:60506
12		Thermal mechanical performance test and mechanical performance test on string insulator units	IEC: 60575
13		Salt fog pollution voltage withstand test	IEC:60507
14		Residual strength of string insulator units of glass or ceramic material for overhead lines after mechanical damage of the dielectric	IEC:60797
15		Guide for the selection of insulators in respect of polluted conditions	IEC:60815
16		Tests on insulators of ceramic material or glass or glass for overhead lines with a nominal voltage greater than 1000V	IEC:60383
17		Standard test method for autoclave expansion of portland cement	ASTM C151-93-a
18		American national standard for insulators wet process porcelain and toughened glass suspension type	ANSI C29-2-1992

The standards mentioned above are available from:

Reference abbreviation	Name and address
BS	British standards, British standards institution 101, Pentonvile road, N - 19-ND, UK
IEC/CISPR	International electro technical commission, Bureau central de la commission, Electro technique international, 1 Rue de verembe, Geneva, Switzerland.
BIS/IS	Beureau of Indian standards. Manak bhavan, 9, Bahadur shah zafar marg, New Delhi – 110001, India
ISO	International organisation for standardization. Danish board of standardization Danish standardizing sraat, Aurehoegvej-12 DK-2900, Heeleprup, Denmark.
NEMA	National electric manufacture association, 155, east 44th street. New York, NY 10017, U.S.A.
ASTM	American society for testing and materials, 1916 race St. Phelledelphia, PA19103, USA

**1.0 Tests on complete strings with hardware fittings****1.1 Voltage distribution test (for disc insulator strings only)**

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed 20% for suspension and tension insulator strings.

**1.2 Mechanical strength test**

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to, remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

**1.3 Vibration test**

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30metres. In the case of suspension string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string along with hardware fittings and single conductor tensioned at 1859 kg in case of ACSR PANTHER shall be secured with clamps. The system shall be suitable to maintain constant tension on the conductor throughout the duration of the test. Vibration dampers shall not be used on the test span. Both the sub-conductors shall be vertically vibrated simultaneously at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the anti-node point, nearest to the string, shall be measured and the same shall not be less than  $1000/f^{1.8}$  where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware shall be examined for looseness, fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and insulators after the vibration test. The insulators shall be subjected to the following tests as per relevant standards:

Sl. no.	Tests percentage of	Percentage of disc insulators unit to be tested
1	Temperature cycle test followed by mechanical performance test	60
2	Puncture test/steep wave front test	40

## **2.0 On disc insulator units**

### **2.1 Steep wave front test for disc insulator**

Test following test shall be performed on 10 insulator units in case of disc insulators selected at random from the lot offered for selection of sample for type test.

(a) Each insulator unit shall be subjected to five successive positive and negative impulse flashovers with a wave having minimum effective rate of rise of 2500 KV per microseconds.

(b) Each unit shall then be subjected to three dry power frequency voltage flashovers.

#### **Acceptance criteria**

An insulator shall be deemed to have met the requirement of this test if, having been successfully subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry/power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency flashover voltage.

An insulator shall be deemed to have failed to meet the requirement of above testing if,

(a) It has not flash over when the oscillogram or peak voltage indicator shows a marked reduction in voltage.

or

(b) Any one of the subsequent three dry power frequency voltage flashover value is less than 80% of the value specified.

Failure of any one unit either in the steep wave front or subsequent low frequency voltage test shall cause for testing on double number of units.

### **2.2 Polarised light inspection (only for glass disc insulator)**

The disc insulator shall be held over a polarised light source and the stress lines viewed thereon. There shall be no uneven stress distribution in the toughened glass insulators. This shall be carried out on 100% glass shells.

### **2.3 Hydraulic internal pressure test on shells (only for disc insulator)**

The test shall be carried out on 100% shells before assembly. The details regarding test will be as discussed and mutually agreed to by the supplier and owner in quality assurance programme.

## 2.4 Thermal mechanical performance test

Thermal mechanical performance test shall be performed in accordance with IEC-60383-1 clause 20 with the following modification:

- (1) The applied mechanical load during this test shall be 70% of the rated electromechanical or mechanical value.
- (2) The acceptance criteria shall be
  - (a)  $X$  greater than or equal to  $R + 3S$ .  
Where  
 $X$  = Mean value of the individual mechanical failing load.  
 $R$  = Rated electro-mechanical / mechanical failing load.  
 $S$  = Standard deviation.
  - (b) The minimum sample size shall be taken as 20 for disc insulator units and 5 units for long rod units.
  - (c) The individual electromechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

## 2.5 Electromechanical/mechanical failing load test

This test shall be performed in accordance with clause 18 and 19 of IEC 383 with the following acceptance

- (i)  $X$  greater than or equal to  $R + 3S$   
Where  
 $X$  = Mean value of the electro-mechanical/mechanical/ failing load.  
 $R$  = Rated electro-mechanical / mechanical failing load.  
 $S$  = Standard deviation.
- (ii) The minimum sample size shall be taken as 20 for disc insulators units and 5 for long rod units. However, for larger lot size, IEC 591 shall be applicable.
- (iii) The individual electro-mechanical/mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

## 2.6 Residual strength test (for disc insulators only)

The above test shall be performed as per clause 4.4 and 4.5 of IEC 797 preceded by the temperature cycle test, on both glass and porcelain disc insulators. The sample size shall be 25 and the evaluation of the results and acceptance criteria shall be as per clause No. 4.6 of IEC:797.

## 2.7 Chemical analysis of zinc sleeve

The purity of the zinc used in zinc sleeve shall be tested as per IS:209. The purity of zinc shall not be less than 99.8%.

## **2.8 IR measurements**

IR measurement shall be carried out by the instrument operating at 1 kV DC. IR value when measured under fair weather condition, shall not be less than 50 M-ohm.

## **2.9 Impact test**

The impact test shall be carried out in accordance with ANSI-C-29.2 clause 8.2.8 with the following modification.

The breaking point of the pendulum shall be so adjusted that, when released the copper nose will strike the outer rim of the shell or the most protuded rim of the shell squarely in a direction parallel to the axis of the unit and towards the cap.

The test specimen shall receive an impact of 7 N-m for 90 kN & 120 kN disc insulators by releasing the pendulum.

## **3.0 Tests on all components (as applicable)**

### **3.1 Chemical analysis of zinc used for galvanizing**

Samples taken from the zinc ingot shall be chemically analysed as per IS:209-1979. The purity of zinc shall not be less than 99.95%.

### **3.2 Tests for forgings**

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the supplier and owner in quality assurance programme.

### **3.3 Tests on castings**

The chemical analysis, mechanical and metallographic tests and magnetic, particle inspection for castings will be as per the internationally recognised procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the supplier and owner in quality assurance programme.

### **3.4 Autoclave test**

For cement used in the assembly of the insulators six samples from different batches shall be tested in accordance with ASTM C-151. The cement shall have an expansion less than 0.12%.

**END OF SECTION - VII**