

## SCHEDULE-II

### TECHNICAL SPECIFICATION OF 11KV & 33 KV D.O. FUSE UNITS WITH ERFG BARRELS

1. **SCOPE:** - This specification provides for manufacture, pre-despatch testing at works and supply of out-door Droop-Out expulsion type fuses suitable for installation in 50 Hz 11KV & 33KV distribution system.
2. **APPLICATION:-** The D.O. Fuses are intended for use on Distribution transformers for protection/isolation of the same during overload or fault conditions of lines.
3. **APPLICABLE STANDARD:-** Unless otherwise modified in this specification, the drop out fuse shall conform to IS:9385 (Part-I to III) as amended from time to time.
4. **CLIMATIC CONDITIONS:** - The climatic conditions at site under which the equipment shall operate satisfactorily, are as follows:-
  - (i) Peak Ambient temperature in shade : 48°C
  - (ii) Maximum average ambient temperature in 24 hours period in shade. : 45°C
  - (iii) Minimum ambient temperature : 4°C
  - (iv) Maximum relative humidity : 95%  
(some time approaches saturation point)
  - (v) Average number of thunder storm days per annum : 40 days
  - (vi) Average number of rainy days per annum. : 90 days
  - (vii) Average annual rainfall : 125 Cm
  - (viii) Number of months of tropical monsoon conditions per annum : 3

For the purpose of specifications, the reference ambient temperature shall be 40°C.

5. **DROP OUT FUSES:-** The drop-out fuses shall be expulsion type. This shall be 'D' type and out-door lift off type suitable for manual operation by an operating rod from the ground level. The drop out operation will be angular in vertical plan.
- 5.1 The equipment offered by the tenderer shall be suitable for 11KV & 33KV three phase 50 C/S solidly grounded earthed neutral systems. It shall be designed for a normal current rating of 200 Amps.

- 5.2 The drop out fuses are required with Post Insulators. These shall be suitable for mounting on the structure. The bracket/channel hardwares for D.O. Fuses shall be provided with adequate sizes of nuts, bolts and washer for mounting on the structures of the purchaser.
6. **POST INSULATORS:** - Each 11KV D.O. Fuse shall have two nos. 11 KV Post Insulators. Similarly each 33KV D.O. Fuse shall have two nos. 33KV Post Insulators. The insulators shall conform to IS:2544 of 1973 with latest amendments. The porcelain used for manufacture of D.O. Fuse shall be homogeneous, free from flaws or imperfections that might effect the mechanical or dielectric strength adversely. They shall be thoroughly vitrified tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown colour free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.
- 6.1 The porcelains and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts through range of temperature variation shall not loosen parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base pin shall be made of high grade cast steel or malleable steel casting and they shall be machine faced and smoothly galvanized. The cap and base shall be properly cemented with insulators to give perfect grip. Excess use of cement shall be avoided.
- 6.2 Each 11KV & 33KV Post Insulators should have technical particulars as detailed below:-

	<u>11KV</u>	<u>33KV</u>
(i) Nominal system voltage KV (rms)	11	33
(ii) Highest system voltage KV (rms)	12	36
(iii) Dry Power Frequency one KV (rms) minute withstand voltage	35	75
(iv) Power Frequency puncture KV (rms) Voltage	1.3 times the actual dry flashover voltage	
(v) Impulse withstand voltage KV (rms)	75	170
(vi) Visible discharge voltage KV (rms)	9	27
(vii) Creepage distance in mm (minimum)	320	580
(viii) Cantilever strength (KN)	6.60	10

7. As stated above unless otherwise modified in this specification the drop out fuse shall conform to IS:9385 (Part-I to III) and as amended from time to time.
- 7.1 **RATED VOLTAGE:-** The rated voltage shall be 11KV and 33KV for 11KV and 33KV D.O. Fuses respectively.
- 7.2 **RATED CURRENT:** - The rated current shall be 200 Amps for 11KV and 33KV D.O. Fuses.

**7.3 RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE VALUES FOR THE FUSE BASE:-**

The rated lightning impulse withstand voltage both for positive and negative polarities shall be as given below:-

	<u>11KV</u>	<u>33KV</u>
a) To earth and between pole	75 KV Peak	170 KV Peak
b) Across the isolating distance of fuse base.	85 KV Peak	195 KV Peak

**7.4 RATED ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (DRY AND WET) VALUES FOR THE FUSE BASE**

	<u>11KV</u>	<u>33KV</u>
a) To earth and between pole	28 KV Peak	75 KV Peak
b) Across the isolating distance of fuse base	32 KV Peak	80 KV Peak

**7.5 TEMPERATURE RISE LIMIT IN AIR ABOVE AMBIENT TEMPERATURE**

A	Brass contacts silver faced	65°
a)	Terminals	50°
b)	Metal parts acting as spring	The temperature shall not reach such a value that elasticity of the metal is changed.

**7.5 RATED BREAKING CAPACITY:** The rated breaking capacity shall be 8KA (A symmetrical). Submission of type test certificate of rated breaking capacity in case of 11KV D.O. Fuse Unit is very essential (otherwise offers may be rejected). In case of 33KV DO Fuse Unit, breaking current test is optional.

**8. MAIN CONTACTS:** The main contacts of the D.O. Fuse shall be suitable for heavy duty, properly aligned, made from Brass material. These shall have good finish and smooth surface and shall be silver plated. All the sharp edges shall be rounded off. These contacts shall be so designed to withstand highest short circuit breaking current that may be encountered during service. In nut-shell the contact assembly shall ensure:-

- i. Electrodynamic withstand ability during short circuit without any risk of repulsion of contact.
- ii. Thermal withstand ability during short circuits.
- iii. Constant contact pressure even when the lower parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar or flexible conductors either because of temperature variation or strong winds.
- iv. Proper alignment to ensure smooth operation of D.O. Fuse without adjustment.

9. **CONNECTORS:** The connectors shall be made from Brass suitable for ACSR/AAA Squirrel/Weasel & Rabbit, Raccoon & Dog. The connectors should be bolted type having 4 bolts & groove to hold the conductor. All brass parts should be silver plated for corrosion resistance and efficient current flow. All ferrous parts should be hot dip galvanized as per the latest version of IS:2633. Nuts and bolts shall conform to IS:1364 and should be hot dip galvanized. Spring washer should be electro galvanized.
10. **FLY NUTS:-** These shall be provided at both the ends of Epoxy Resin Fiber Glass (ERFG) tube for tightening the fuse element. The nut shall be provided with one flat washer of 1 mm thickness. The arrangement shall be made to ensure that the fuse wire runs centrally inside the ERFG tube after tightening. The fly nuts should have at least 4 threads with adequate wall thickness.
11. **SPRING STRIPS:-** The spring strips shall be of phosphor bronze multi line brush type having a high pressure contacts and should retain its tension under minimum continuous service current of 200 Amps at 90° C.
12. **OPERATING HOOKS:-** The brass operating hook shall be fixed in such a way that the barrel can be removed for replacing the fuse element by operating rod from the ground level. Two number screws of size 6 mm dia shall be provided on each operating hook and barrel take out hook to hold the barrel rigidly.

The drop out fuse units shall operate efficiently; speed of operation shall not depend on the inclination of the fuse. However, the inclination of the fuse barrel shall be adjusted in such a way that the barrel does not drop by gravitational force.

13. **D.O. BARRELS (CARRIER TUBES):-** The carrier tube made of Epoxy Resin Fibre Glass (ERFG) and conforming to the following specification shall be used for 33KV & 11KV D.O Sets:-
- 13.1 **GENERAL:-** This specification governs the requirement for an electrical grade tube with good mechanical and high heat resistance properties, made from fine woven glass fibre cloth, impregnated with epoxy resin. Tube shall be well consolidated of circular cross section and uniform wall thickness with ends trimmed smoothly at right angles to the axis of the tube. The external surfaces shall be brown in colour and shall be uniformly finished with polyuret and varnish or epoxy resin. The tube has a temperature index of at least 155°C.
- 13.2 **APPLICATION:-** Used as fuse carrier in 33KV & 11KV Drop Out Fuses.
- 13.3 **COMPLIANCE WITH:-** Indian Standard Specification no.10192.

13.4 **DIMENSIONS AND TOLERANCES:-**  
ID x OD x Length of the tube shall be as under:-

Standard Sizes	For 11KV D.O. Set	For 33KV D.O. Set
ID x OD x Length	19mmx25mmx330mm	19mmx25mmx510mm
Tolerances on dimensions:-		
Inside Diameter (ID)	± 0.05 mm	
Outside Diameter (OD)	± 0.25 mm	
Wall Thickness (WT)	± 0.15 mm	
Length	± 1.0 mm	

13.5 **WARPING:-** The tube shall be placed on a flat steel plate and rolled until the maximum gap between the tube and plate occurs with both ends of the tube in contact with plate. This gap, measured by a feeler guage, when computed as percentage based on the length of the tube shall not exceed 0.1% of all the sizes of tube.

13.6 **FINISH:-** The tube shall have uniform and smooth finish and be free from splits, inclusions or foreign bodies visible defect and voids.

13.7 **IDENTIFICATION OF SURFACE VARNISH:-** The surfaces finish shall be of polythene or epoxy resin varnish when identified by informed spectra-photometer or by any conventional method.

13.8 **TEST METHOD:-** Unless otherwise specified, the tests shall be conducted in accordance with the relevant methods of BS:2782/IS:10192.

13.9 **SAMPLE FOR TEST:-** 3 nos. of ordered tube shall be supplied for approval purposes.

13.10 **PHYSICAL PROPERTIES:-** Density (method 509A) : 1.7g/CC Min.  
Water Absorption (Method 520E) : 0.5 mg/cm<sup>2</sup>

13.11 **MECHANICAL PROPERTIES:-**

Proof load (1 minute): 105t2N

Failure Load : 210t2n

Where  $t$  = wall thickness of tube in mm & N load in

Newton

13.12 **ELECTRICAL:-** Electric strength (proof) in air at 27°C shall be as under:-  
Radial (Perpendicular) : 5KV  
Axial : 28 KV

13.13 **CERTIFICATE:-** The supplier shall furnish the test certificate for the fuse barrels offered for use in Drop Out Fuses along with each lot offered for inspection. The test certificates of ERFG barrel should indicate the following results:-

i. **Dimension:-**

- |                    |   |    |
|--------------------|---|----|
| (a) External dia   | : | mm |
| (b) Wall thickness | : | mm |
| (c) Internal dia   | : | mm |
| (d) Length         | : | mm |
- ii. Warping Test of the tube :  
iii. Finish of the tube :  
iv. Physical properties : Density & water Absorption  
v. Mechanical properties. : Proof load (1 minute) & Failure load  
vi. Electric strength (proof) : Radial (perpendicular) & Axial

13.14 The supplier should indicate the name of manufacturer of ERFG tubes from where they will purchase the barrels to make available the above test certificate. The barrels should have the property to resist fire whenever the fuse is blown off. It would not catch fire easily during blowing off of fuse element inside the barrel, which causes short time high temperature.

13.15 **METHOD OF APPLICATIONS OR ELECTRIC PROOF STRESS IN RADIAL DIRECTION:-**

Wrap a piece of metal foil e.g. 0.05 to 0.1mm thick copper or Aluminium of width equal to 1.5 times the circumference of the tube and of length 25mm less than the length of the tube, to act as the external electrode position the coil centrally along the length of the tube, and secure it in this position with self adhesive tapes or other suitable means.

If the tube is not presented for test on the winding mandrel, select a round clean metal rod at least 50 mm longer than the tube and of diameter not less than  $(d-0.75 \text{ mm})$  where 'd' is the inside diameter in millimeters of the tube, to act as the internal electrode. Insert the select rod (which would be a snag fit) into the bore of the tube and position the tube centrally along the length of the rod.

Apply a 50 Hz voltage between the electrode and raise it from zero to 6 KV rms as quickly as possible consistent with avoiding transient over voltages. Maintain this proof voltage for 1 minute before reducing the voltage to zero and switching off the test set.

13.16

**METHOD OF APPLICATION OR ELECTRIC PROOF STRESS IN AXIAL DIRECTIN:-**

Copper plates should be fitted at both ends of the tube at specified length. Apply 50 Hz voltage between two ends and raise it from zero to 28 KV rms as quickly as possible. Maintain this voltage for at least one minute.

14. **DESIGN, MATERIALS AND WORKMANSHIP:** - The successful tenderers shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and material. All similar parts should be accurately finished and interchangeable. The connecting of cap and pin with

insulator should be perfect to avoid any kind of loosening. After cementing the insulator should be cured adequately in water to attain good gripping.

**15. GUARANTEED DATA AND OTHER TECHNICAL PARTICULARS:-**

Please ensure that the guaranteed data and other technical particulars as asked for are submitted duly filled in. Any other particulars considered necessary by the supplier may also be given in addition to those listed in the schedule.

**16. TESTS:** Each D.O. Fuse shall strictly comply with requirement of all the type tests and shall be subjected to all routine tests stipulated in the relevant standard. All tests shall be made prior to despatch in the presence of the representative of the purchaser. No material should be dispatched without prior approval of the tests certificate by the purchaser.

Along with the inspection report of D.O. Fuse Units, the supplier should invariably furnish Routine Test certificate of D.O. Fuse barrels & Post Insulator of their manufacturers.

**17. PACKING & MARKING:-**

- (i) All the accessories of D.O. Fuse Unit should be listed out clearly.
- (ii) Each D.O. Fuse shall be provided with name plate of size 2"x1" on steel strip in case of 11KV D.O. Fuse and size 4"x2" on steel channel in case of 33KV D.O. Fuse and shall be riveted or bolted. The following shall be indicated on the plate:-

Name of manufacturer  
 Order no. & date  
 Sl. No. of the equipment  
 Rating..... Amps..... KV  
 Name of purchaser, Discom-EZ

Please note that paper should not be used for name plate. The material should be packed in wooden cartoons in 3 or 6 nos. so as to make set of three. It may be ensured that D.O. Fuse Units or ERFG Barrels with similar markings shall not be sold to any other agency other than Discom-EZ.

**18. DIMENSIONS, DRAWING & TOLERANCES:-**

SNo	Particulars	DIMENSION OF D.O.FUSE UNIT IN MM WITH TOLERANCE OF $\pm 5\%$	
		11KV	33KV
1.	Drawing No.	CMD/EZ/Pur/1 (revised) dtd.29.7.05	CMD/EZ/Pur/2 (revised) dtd.29.7.05
2.	M.S. Flat	245x25x6	600x50x6
3.	M.S. Channel	---	600x100x50x6
4.	Fuse Barrels	330x25x19	510x25x19
5.	Lower Contact Hinge of Barrel.		
	(i) Connectors	60x60x6	60x60x6
	(ii) Hinge Contact Length	95	95
	(iii)—do--- Width	85	85
	(iv) Thickness of Hinge		
	Outer	5	5

SNo	Particulars	DIMENSION OF D.O.FUSE UNIT IN MM WITH TOLERANCE OF $\pm 5\%$	
		11KV	33KV
	Inner	4	4
6.	Barrel take out hook		
	(i) Width	25	25
	(ii) Thickness	4	4
	(iii) Length	30	30
	(iv) Inner dia meter	25	25
	(v) Thickness between inner outer dia	3 mm	3 mm
	(vi) Weith	170 Grms	170 Grms
7.	Operating Hook		
	(i) Width	18	18
	(ii) Thickness	3	4
	(iii) Inner Radius	19	2025
	(iv) Outer Radius	22.5	25
	(v) Weight	350 Grms	450 Grams
8.	Female contact		
	(i) Main contact width	65	70
	(ii) Strip thickness	1.5	1.5
	(iii) Strip length	100	100
	(iv) Width	20	20
	(v) Female contact height	75	75
9.	Female Contact Holder:-		
	(i) Length	74	74
	(ii) Upper width	34	34
	(iii) Lower width	40	40
10.	Creepage of insulator (mm)	320	580

19. The specification of 11 KV & 33KV ERFG D.O. fuse barrel with metal parts shall be as stated in Clauses 13 & Clause-18 above.

**Note:** Post Insulators of following standard makes will be used for manufacturing of D.O. Fuses.

- (i) M/s Allied Ceramics Pvt. Ltd. Kolkata
- (ii) M/s Birla NGK Insulators Pvt. Ltd., Rishra
- (iii) M/s India Potteries Ltd. Kolkata
- (iv) M/s Bharat Heavy Electricals, Bangalore.

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