SPECIFICATION NO.ELRS/SPEC/LA/0005

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

TECHNICAL SPECIFICATION FOR

GAPLESS LIGHT-NING ARRESTER

FOR 25 KV AC ELECTRIC LOCOMOTIVES

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TECHNICAL SPECIFICATION FOR GAPLESS LIGHTENING ARRESTER FOR 25 KV AC ELECTRIC ROLLING STOCK

1. SCOPE

1.1 This specification generally covers the supply of metal oxide gapless lightening arrester for use on rolling stock working on single phase 25 KV AC 50 Hz system. The arrester is for protection of 25 KV equipment of the rolling stock from voltage surges.

2. SERVICE CONDITION

2.1 The equipment shall operate satisfactorily under the following climatic conditions :-

I) The ambient temperature vary from 0 deg.c. to 55 deg.c. with 100% humidity. The maximum sun temperature is 70 deg.c. at an altitude not exceeding 1200 metres above mean sea level.

ii) The rain fall is fairly heavy and the country is subjected to thunder storms.

iii) During dry weather the atmosphere is dusty.

iv) The equipment shall be working in coastal areas with corrosive atmosphere and also subject to chemical pollution, exhaust of steam and diesel locomotive.

2.2 The lightening arrester and its mounting arrangement shall be of robust design and duly approved by RDSO for traction duty and shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below :-

a) Max. vertical acceleration : 1.0g
b) Max. longitudinal acceleration : 3.0g
c) Max. transverse acceleration : 2.0g

('g' being acceleration due to gravity)

2.3. The vibrations are of sine wave form and the frequency of vibration is between 1 Hz and 50 Hz. The amplitude 'a' expressed in millimeters is given as a function of 'f' by equation.

$$a = \frac{25}{f}$$ for values 1 Hz to 10 Hz

$$a = \frac{250}{f2}$$ for values 10 Hz and upto 50 Hz

2.4 In the direction corresponding to the longitudinal movement of the vehicle, the equation is subjected for 2 minutes to 50 Hz vibration of such a value that the maximum acceleration is equal to 3g (amplitude 'a' = .8 mm).

3. PARTICULARS OF POWER SYSTEM AND ELECTRIC LOCOMOTIVE

3.1 Please refer to Drg.No.ETI/PSI/702 (Annexure-B). Fault level expected in the vicinity of substation on 25 kV side would be around 100 MVA. Switching surges of short duration to the tune of 120 to 130 kV peak have been measured on this system.

3.2 Basic insulation level of locomotive transformer is 130 kV peak for standard lightening voltage impulse and 60 kV (rms) for power frequency voltage.

3.3 Existing locomotive is protected through a 200 mm (ET1) rod gap for roof equipment and 76 mm rod gap for loco (ET2) transformer etc. It is proposed to work the lightening arrester in conjunction with ET2 which will be increased suitably.

4. GOVERNING SPECIFICATION

4.1 The lightening arrester shall generally conform to the following specification as indicated and as modified by this specification :-

i)	IS : 3070(1985) :	Specification for lightening arrester for AC system.
ii)	IEC:77-1968 :	Rules for electric traction equipment.

iii) IS : 2629-1985 :	Recommended practice for hot dip galvanising of iron and steel.
iv) IS:2633-1986 :	Methods of testing uniformity of coating on zinc coated articles (1st Rev.)
v) IS : 3358-1991 :	Hot dip galvanised coating on fasteners.
vi) IS : 2099-1983:	Bushings for alternating voltages above 1000 Volts (1st Rev.) with Amendment No.1.
vii) IS : 5621-1980:	Hollow insulators for use in electrical equipment (1st Rev.)
viii) IS:5561-1970 :	Electric power connectors.
ix) IEC Tech.Committee 37 : (Working Group 4) Doc Sept. 1981	Metal oxide surge arresters for AC system.
x) IS:1570 (Pt.V)-1972	Schedules for rod steel, stainless and heat resisting stools.

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RATING AND OTHER PARAMETERS.

Nominal system voltage	-	25 kV, phase to earth.
Permissible variation in	-	25.0 +/- 10% (occasionally touching 17.5 and 30 kV)
System frequency	-	50 Hz +/- 3%
Type of L.A.	-	Non-linear metal oxide gapless type (Heavy duty Class III).
Nominal discharge Current	-	10 K Amps (8/20 wave)
Continuous operating voltage capability.	-	33 kV

Maximum discharge voltage at nominal discharge current.	-	85 kV
Power frequency voltage withstand for arrester insulation	-	105 kV (rms)
Standard lightning impulse voltage withstand for arrester insulation.	-	250 kV peak

6. GENERAL FEATURES

6.1 The lightening arrester shall comprise a number of nonlinear blocks, housed inside the porcelain housing. Suitable provision to arrest the relative movement of blocks. shall be provided inside the porcelain housing. Lightening arrester shall be of thermetically sealed construction to prevent moisture ingress. The arrester shall have means for relieving internal pressure to prevent explosive shattering of the housing following prolonged passage of follow-on current of internal flashover of the arrester. The pressure relief device shall be of the Class-A as per IS : 3070 (Pt.I) - 1985

6.2 Lightening arrester shall be of the outdoor type suitable for mounting on the roof of the coach and designed for continuous duty and repeated operations.

6.3 The arrester shall be provided with a terminal connector conforming to IS:5561.(1970)

6.4 The total height of the lightening arrester including the mounting arrangement. etc.. upto the line terminal shall not exceed 650 mm.

6.5 All ferrous parts used in manufacture of lightening arrester or its asembly shall be hot-dip galvanised. hardwares of dia. less than 12 mm shall be made out of stainless steel conforming to Grade 04 Cr. 17 Ni. 12 MO2 of IS:1570 (Pt.V)-1972.

7. MOUNTING AND TERMINAL ARRANGEMENTS

7.1 The arrester base shall be suitably designed for mounting on the base plate with 4-15 mm dia. holes on the pitch circle dia of 235 mm.

7.2 The arrester shall be provided with terminals and or connectors suitable for connection to 65 sq.mm (19 / 0.108 mm) stranded copper conductor on the 25 kV side and 40 mm x 6 mm m.s. flat on the earth side.

8. CONSTRUCTION

8.1 The construction of the lightening arrester shall be explosion proof and for this purpose, suitable pressure relief device shall be provided to prevent explosive failure of the porcelain.

8.2 The lightening arrester shall be of rugged construction, insensitive to vibration to suitable for mounting on the rolling stock. The special design and constructional feature incorporated to make the lightening arrester suitable for rolling stock application shall be indicated in the tender offer.

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8.3 As the maximum temperature attainable in an object exposed to the sun may reach 65 deg C. manufacturer may, if required, use light colour porecelain instead of brown colour to avoid overheating of internal components of the arrester for its satisfactory operation.

9.0 MARKING

Each lightening arrester shall be provided with a name plate or plates legibly and indelibly marked with at least the following information :-

(a) Name or trade mark of the manufacturer.
(b) Type/Designation/Serial Number
(c) Rated voltage.
(d) Frequency
(e) Continuous operating voltage.
(f) Nominal discharge current.
(g) Pressure relief class.
(h) Long duration discharge current.
(i) Year of manufacturer.

10. TECHNICAL DATA AND DRAWING

10.1 The tenderer shall indicate his compliance or otherwise against each clause and sub-clause of the technical specification. The tenderer shall for this purpose enclose a separate statement, if necessary, indicating the clause reference and compliance or otherwise. Wherever the tenderer deviates from the provisions of the clauses, he shall furnish his detailed remarks.

10.2 The tenderer shall furnish guaranteed performance data, technical and other particulars for the lightening arresters in the proforma attached as Annexure "A"

10.3 Drawings showing the overall dimensions of the lightening arrester, a cross-sectional view indicating non linear resistor blocks, retainer arrangement, terminal details, method of connecting high tension and earthing loads and mounting arrangements and evidence in the form of type test reports for the arrester, if available, shall be submitted along with the tender.

10.4 The successful tenderer shall also be required to submit, copies of the technical booklets, information manuals, test reports etc.

11. TYPE TESTS

11.1 Residual voltage test.
11.1.1 Lightening impulse residual voltage test.
11.1.2 Switching impulse residual voltage test.
11.1.3 Steep current impulse residual voltage test.
11.2 Long duration current impulse withstand test.
11.3 Operating duty tests.
11.3.1 Nominal current operating duty test.
11.3.2 High current operating duty test.
11.3.3 Combined operating duty stability test.
11.4 Pressure relief test.
11.5 Power frequency reference voltage test.
11.6 Polluted housing tests.
11.7 Long term stability tests.
11.8 Galvanising test on metal parts.
11.9 Tests : to be carried out on porcelain housing
11.9.1 Visual examination of porcelain housing.
11.9.2 Voltage withstand test of arrester insulation.
11.9.3 Temeperature cycle test on porcelain housing.
11.9.4 Porosity test on porcelain components.

12. ACCEPTANCE TESTS

12.1 The following acceptance tests shall be conducted as per IEC TC.37 on samples selected at random from the lot :

(i) Residual voltage test at the nominal discharge current on the complete arrester or Section.
(ii) Measurement of leakage current at continuous operating voltage.
(iii) Galvanising test on metal parts.
(iv) Visual examination.

12.2 (i) Temperature cycle test on porcelain housing.

(n) Porosity test on porcelain components.

13. **ROUTINE TESTS**

13.1 Besides any other test which the manufacturer may consider necessary, visual examination test and measurement shall be carried out for each of the arrester. **for leakage current at continuous operating voltage.**

14. **OPTIONAL EQUIPMENT**

Tenderer may also quote for suitable surge counters to be fixed in conjunction with these lightening arresters. Indian Railways may choose to procure equal number of these counters to be fitted on each of the lightening arresters or lesser number for representative measurement of different lots.

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15. **EXPERIENCE**

Tenderer may indicate experience regarding equipment supplied by him for rolling stock applications indicating at least the following details :

(i) Nos. supplied.
(ii) Nos. in service.
(iii) Type of rolling stock.
(iv) Type of power supply system.
(v) Country of operation.
(vi) Year of commissioning.
(vii) Failure data and any other feed back.

16. **WARRANTY**

Tenderer may indicate warranty clauses applicable for the goods supplied.

Schedule of guaranteed performance, technical and other particulars.

S.No.	Description	Unit of measurement.
1	Name of the manufacturer	
2.	Country of origin	
3.	Standard specifications on which performance is based.	
4.	Manufacturer's type designation.	
5.	Rated voltage (rms)	kV.
6.	Rated frequency.	Hz
7.	Continuous operating voltage	Watt/kV
8.	Watt loss at continuous operating voltage	Watt/kV
9.	Watt loss at rated voltage	mA
10.	Leakage current at continuous operating voltage	mA
11.	Leakage current at rated voltage.	kA
12.	Nominal discharge current (8/20 Wave)	
13.	Residual voltage	
	(a) at 0.5 times nominal discharge current	kV (peak)
	(b) at nominal dischage current	kV (peak)
	(c) at twice the nominal discharge current	kV(peak)
14.	Switching impulse residual voltage test with 45x90 micro-second current wave of 3 kA peak.	kVp
15.	Steep current impulse residual voltage test with 0.6x1.5 micro-second current wave of 10 kA peak.	kVp
16.	High current impulse withstand (4/10 wave).	kAp
17.	Long duration current rating for virtual duration of peak	
	(a) 8000 micro-seconds.	
	(b) 1000 micro-seconds.	
18.	Power freqency voltage withstand of arrester insulation (rms) :	
	(a) Dry	kV
	(b) Wet	kV
19.	Type of non-linear resistor disc and voltage rating	kV
20.	No. of non-linear discs per section of arrester.	No

21 No of sections in one arrester

22. Material of retainer used inside lightening arrester bakelite, ceramic, rubber or other material.

23 Is pressure relief device provided ; and if so, its clas.

24. Overall dimensions . (a) Height mm
(b) Diameter mm

25. Net weight kg

26. Mounting base (i) No. of holes No
(ii) Dia of holes mm
(iii) Pitch circle dia mm

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27. Are the live and earth ends of arrester suitable for jumper as specified ?

28. If the lightening arrester has already been type tested, give reference and date of test.

29. Are grading rings provided ?

30. Any other technical data, the Manufacturer may like to furnish.

31. V.I. Characteristic curves of zinc oxides element at different temperatures. Please indicate diameter and thickness of elements also.

32. Condition monitoring of L.A. and methodology for rectification of equipment of feasible.