SPECIFICATION NO.ELRS/SPEC/LA/0008

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

TECHNICAL SPECIFICATION FOR

LIGHT-NING ARRESTER

FOR 25 KV AC ELECTRICAL MULTIPLE UNITS

NO. ELRS/SPEC/LA/0008 ISSUED IN JULY '1999.

Issued by
RESEARCH DESIGNS & STANDARDS ORGANISATION
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TECHNICAL SPECIFICATION FOR LIGHTNING ARRESTERS FOR 25 KV AC EMUS.

1 SCOPE

1.1 This specification covers the supply of non linear resistor type complete Lightning 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.

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2 SERVICE CONDITION

2..1 The equipment shall operate satisfactorily under the following cliamatic conditions:

!) The ambient temperatures varies from 0 deg. C. to 55 deg. C. with 100% humidity. The maximum sun temprature is 70 deg.C. at an altitude not exceeding 1200 meters 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 will be working in coastal areas with corrosive atmosphere.

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

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

('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 = 25 for value 1 Hz to 10 Hz
f

250
a = ----- for value 10 Hz and upto 50 Hz.
f sq.

2.4 In the direction corresponding to the longitudinal movement of the vehicle, the equipment is subjected for 2 minutes to 50 Hz vibrations of such a value that the maximum acceleration is equal to 3 g (amplitude a = 0.3 mm).

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3. PARTICULARS OF POWER SYSTEM.

3.1 25 KV AC power supply for railway traction is obtained from 132/25 kV single phase power transformers, the primary winding of which is connected between any two phases of 132 kV three phase system. The neutral of three phase system is solidly earthed. One terminal of 25 kV secondary winding is connected to the traction overhead equipment and the other terminal solidly earthed.

3.2 The nominal voltage of the system is 25 kV AC single phase 50 Hz. The voltage supply may vary between 19 and 27.5 kV, the average being 22.5 kV under normal working conditions. However, it is also necessary to provide for stable operations of the equipments when overhead line voltage drops to 17.5 kV for a period not exceeding 10 seconds. The line voltage at location near sub-station can occasionally go upto 29.0 kV for short duration.

3.3 The frequency variation would be +/- 3%.

4. GOVERNING SPECIFICATION

The lightening arrester shall conform to the following specifications as indicated and as modified by this specification.

IS:3070 (Part-I)-1985	:	Specn. for lightening arrester for AC system.
IEC : 99-1 (Part--I) - 1991	:	Non-linear resistor type arresters

IEC : 77-1968 : Rules for electric traction equipment.

4.2 Any deviation from this specification calculated to improve the performance will be given due consideration provided full particulars and technical particulars with justification thereof are furnished in the tender.

5. RATING AND OTHER PARTICULARS

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5.1 The ratings of surge arrester shall be as under :-

Rated voltage	:	42 kV
Rated frequency	:	50 Hz.
Nominal discharge current	:	10,000 Amps.
Min.power frequency sparkover voltage (Dry and Wet)	:	65 kV
Max. 1/50 sparkover voltage	:	110 kV
Max. front of wave impulse sparkover voltage (virtual steepness of front for the value : 335 kV/ micro seconds)	:	130 kV
Max. switch surge sparkover voltage (duration of wave front 1000)		110 kV
Max. residual voltage	:	110 kV(at 5 kA) 120 kV(at 10 kA)
Impulse current withstand capacity		
impulse high current	:	100 kA, twice (4 x 10 micro sec.wave)
Long duratrion current	:	600 A, 20 times (2 micro second rectangular wave)
Operating duty test power frequency	:	Discharge current 10,000 A
	:	120 kV (Dry) 1 min.
	:	80 kV (Wet) 1 min.

Voltage withstand test of
arrester insulation : 91 kV (rms)

6. GENERAL FEATURES

6.1 The lightening arrester shall comprise a number of spark gaps connected in series with resistors of the non-linear type. A voltage grading system with suitable condensers and resistors shall be used so that the potential is distributed equally over the spark gaps in the frequency range in which the arrester is expected to work.

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6.2 The 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 total height of the lightning arrester including the mounting arrangement etc., upto the line terminal shall not exceed 525 mm as indicated in the enclosed drawing No.SK.EL 3233. The arrester may extend below the flange not exceeding 300 mm as indicated in the drawing. A suitable gasket matching with the mounting flange and made of weather-proof material like neoprene bonded cork of 5 mm thickness shall be supplied along with the arrester.

7. MOUNTING AND TERMINAL ARRANGEMENTS

7.1 The arrester base shall be suitably designed for mounting on the base plate with 4-15 mm diameter holes on the pitch circle dia. of 235 mm as indicated in the drawing enclosed. (Pitch dia. will be changed as dia. of proposed arrester is 508 mm (as per firm Drg.No.130 A 703).

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 micro sec. 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.

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

9.0 MARKING

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

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

10. SCHEDULE OF PARTICULARS

10.1 The technical data and the outline drawings, etc. as per Annexure 'A' shall be furnished along with the tender offer.

11. TESTS

11.1 The type, acceptance and routine tests shall be conducted as per IEC:99-1/1991 - IS:3070 (Part I) as applicable.

11.2 Any other test in addition to these specified thereunder to satisfy that the equipment meets with the specification may also be conducted at the request of the purchaser after mutual agreement.

11.3 In case standard equipment already in use without any significant modification is offered, type test data may be furnished to consider dispension of type tests.

11.4 The type, acceptance and routine tests shall be conducted in the presence of representative of Indian Railways.

11.5 In the tender offer it shall be clearly stated that the test programme as prepared is acceptable or needs any modification. In the absence of any such comments, it will be presumed that the tenderer has agreed with the test schedule as suggested.

11.6 **TYPE TEST**	**Reference clauses**.
i) Voltage withstand test of arrester insulation	Clause 7.5 of IS:3070-I :1993
ii) Dry power frequency voltage sparkover test.	Clause 60 IEC:99-1 - 1991
iii) 1.2/50 or 1/50 impulse sparkover test.	Clause 61.2 IEC-99-1 : 1991
iv) Front of wave impulse sparkover test.	Clause 61.3.1 IEC-99-1 : 1991
v) Residual voltage test.	Clause 62 IEC-99-1 : 1991
vi) Current impulse withstand test.	
(a) High current impulse test	Clause 63.2 IEC-99-1 : 1991
(b) Long duration current test corresponding to 600A for 2 micro.sec.	Clause 63.3.2 IEC-99-1 : 1991 The charging voltage Uc shall be so adjusted that the long duration discharge current shall be 600A..
vii) Operating duty test. :	Clause 64 IEC-99-1 : 1991
viii) Pressure relief test :	Clause 65 IEC-99-1 : 1991
ix) Temperature cycle test on porcelain housing :	Clause 7.13 IS:3070 Pt.I - 1991
x) Porosity test on porcelain components. :	Clause 7.14 of IS:3070 Pt.I - 1991.
xi) Galvanising test on metal parts:	Clause 7.15 of IS:3070 Pt.I - 1991
xii) Visual examination of porcelain housing. :	Clause 7.16 of IS:3070 Pt.I. - 1991
xiii) Vibration and shock tests. :	Clause 16 of IEC-77 - 1968
xiv) Encapsulation test on completely assembled arrester. :	As described in Item 11.7

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11.7 **Encapsulation test on assembled arrester.**

It is proposed to conduct leakage tests as described below to check up the quality of scaling arrangements provided on the arrester.

(a) Immerse lightning arrester in oil/water and increase the temperature upto 90 deg.c. Maintain the oil/water temperature 90 deg. C. +/- 5 deg. C for 10 minutes and observe whether there are any air bubbles, if so, it may be considered defective.

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(b) If there are no air bubbles, it may be subjected to alternative immersion in oil/water at 90 deg.C. and 25 deg.C for 24 hours each.

11.8 **ACCEPTANCE TEST**

The following tests shall be conducted as acceptance test.

i) Dry power frequency voltage sparkover test.	:	Clause 60 IEC-99-1
ii) 1.2/50 or 1/50 impulse sparkover voltage test.	:	Clause 61.2 IEC-99-1
iii) Residual voltage test at the terminal dischrge current.	:	Clause 62 IEC-99-1
iv) Temperature cycle test on porcelain housing	:	Clause 7.13 IS:3070 Part-I
v) Porosity test on porcelain components.	:	Clause 7.14 IS:3070 Part-I
vi) Galvanising test on Metal Parts.	:	Clause 15 IS:3070 Part-I
vii) Visual examination of porcelain housing	:	Clause 7.16 IS:3070 Part-I
viii) Verification of dimensions of Insulator.	:	Clause 9.7 IS:3070 Part-I and as per approved drawings.

11.9 **ROUTINE TEST**

i) Dry power-frequency voltage sparkover test.	:	Clause 60 IEC-99-1
ii) Visual examination test porcelain housing	:	Clause 7.16 IS:3070(Part-I)
iii) Encapsulation test	:	Clause 11.7 (a) of this specification.

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12 **SAMPLING PLAN FOR LOT ACEPTANCE**

12.1 The sampling plan for lot acceptance and type tests shall be as per IS:3070(Part-I)-1991.

ANNEXURE 'A'

Schedules of Guaranteed Performance, Technical and Other Particulars.

S.No.	Description	Unit of Measurement.
1.	Name of Manufacture	
2.	Country of origin.	
3.	Standard specn. on which performance is based.	
4.	Manufacturer's type designation.	
5.	Rated voltage (rms)	KV
6.	Rated frequency.	Hz
7.	Nominal discharge current (1/20 wave)	KA
8.	Power frequency (50 Hz) sparkover voltage (rms)	
	(a) Wet	Min.kV
	(b) Dry	Min.kV
9.	Standard Impulse sparkover voltage (1.2/50 wave)	kV
10.	Front of wave voltage impulse sparkover.	
	(a) Magnitude	Max.kV(Peak)
	(b) Rated of rise of voltage.	kV/0.5
	(c) Time of sparkover.	Micro-second
11.	Residual voltage.	
	(a) at 0.5 time normal discharge current.	kV (Peak)
	(b) at twice the nominal discharge current.	kV(Peak)
	(c) at nominal discharge current.	kV(Peak)
12.	High current impulse withstand (4/10 wave)	kV(Peak)
13.	Long duration current rating for virtual duration of peak.	
	(a) 2000 micro-seconds.	
	(b) 1000 micro-seconds.	
14.	Power frequency voltage withstand of arrester insulation.	
	(a) Dry	kV
	(b) Wet	kV
15.	Spark gap size.	mm
16.	Type of voltage grading capacitive, resistive or both	
17.	Type of non-linear resistor disc and voltage rating.	
18.	Nos. of non-linear discs per section of arrester.	Nos.
19.	Nos. of sections in one arrester.	
20.	Is pressure relief device provided, if so, its class.	

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21.	Pressure relief upto fault, current of	kA
22.	Overall dimension.	
	(a) Height	mm
	(b) Diameter	mm
23	Mounting base	
	(a) Number of holes.	Nos.
	(b) Dia of holes	mm
	(c) Pitch circle dia (PCD)	mm
24.	Net weight	
25.	Technical catalogue of the arrester giving description of the constructional design features.	

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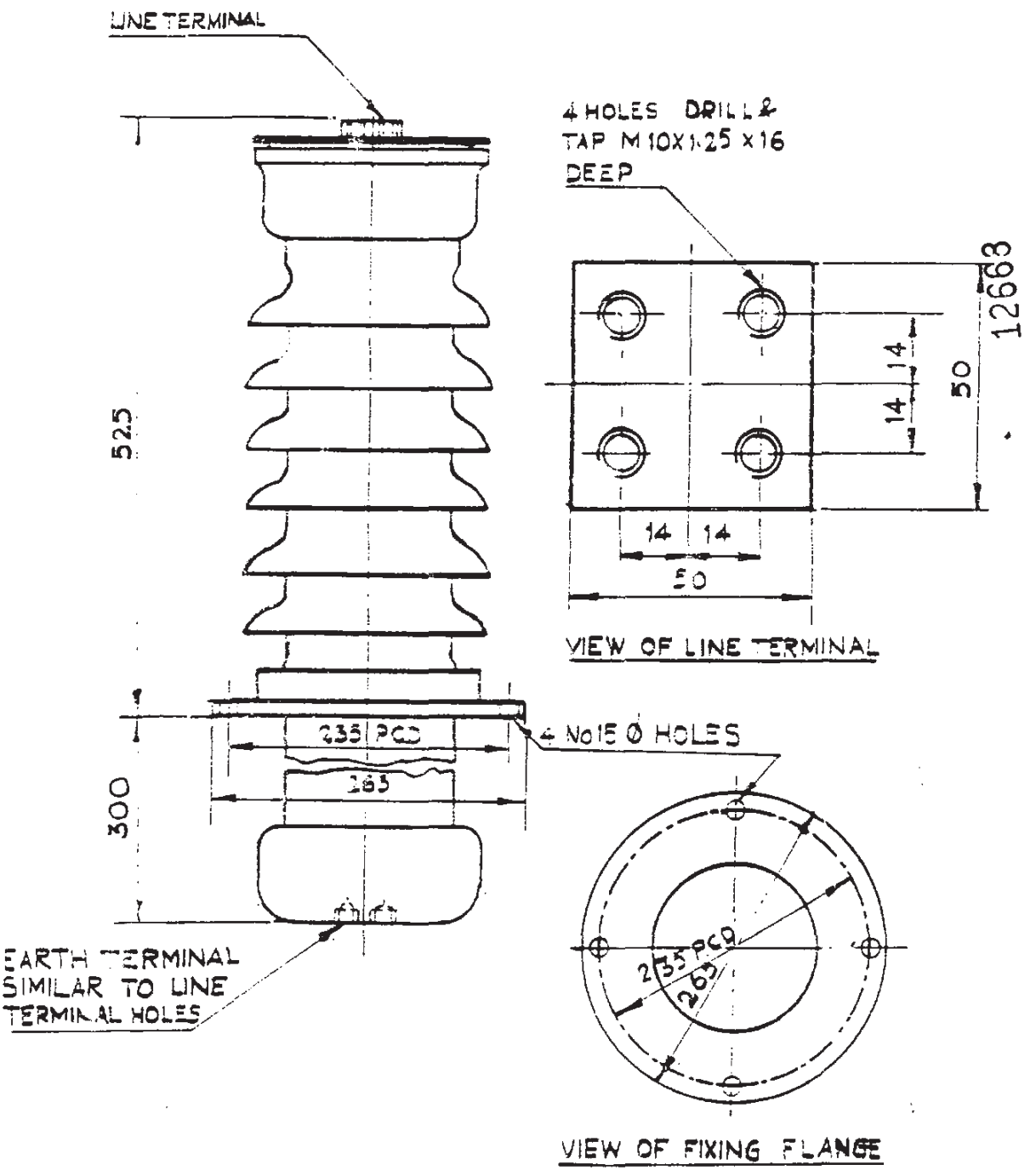
SKEL-3233



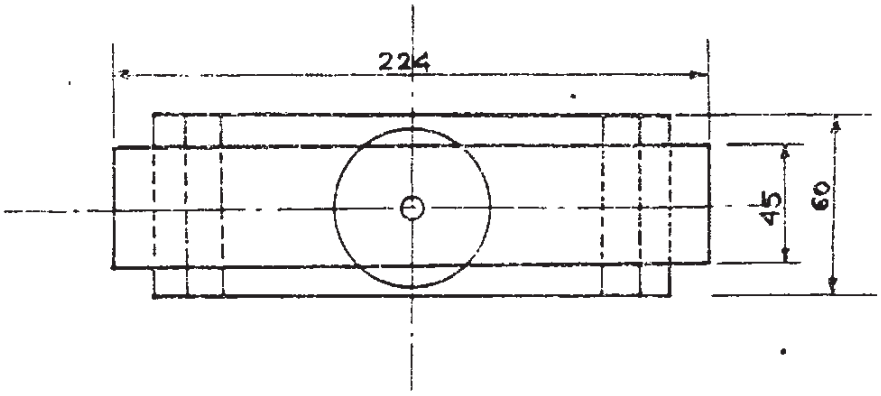
REF:- ICF DRG. NO. ICF/ELEC/042	SCALE:-	APPROVED:- FOR DG.

OUTLINE OF LIGHTNING ARRESTER 25KV LINE TYPE

RDSO. ELEC. DTE.	SKEL-3233 - B

4.7.80

SKEL 3193



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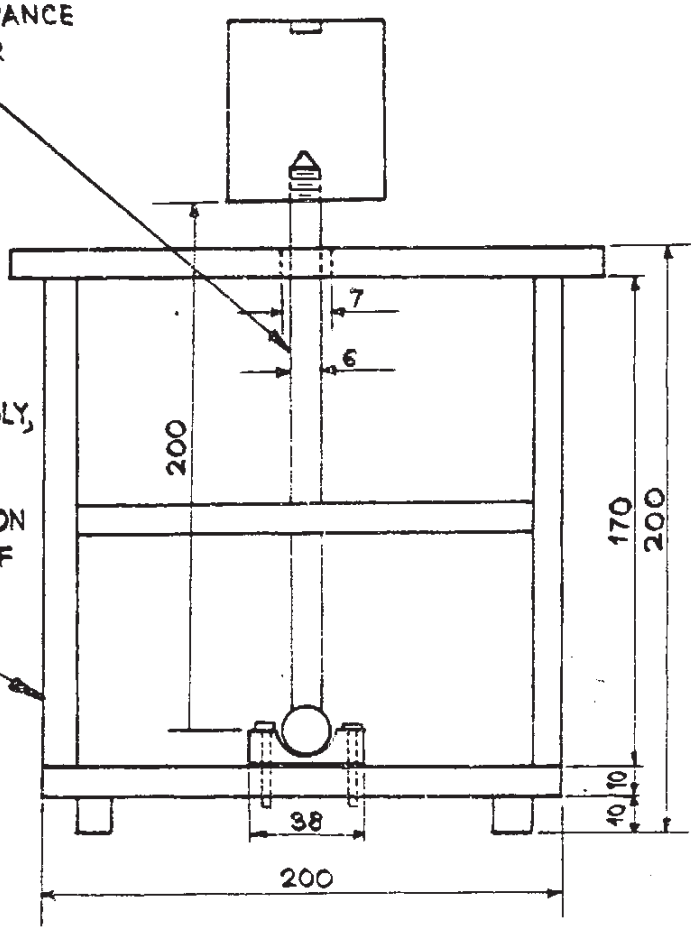
CURVED ELECTRODE ARRGT. FOR THERMAL ENDURANCE OF VARNISHES. AS PER RDSO SKEL-3161.

SUPPORTING FIXTURE FOR ELECTRODE ASSEMBLY, FABRICATED FROM 10 THICK GLASS-FABRIC LAMINATE WITH SILICON BINDER, TYPE SIL 1 OF BS 3953.



ALL DIMENSIONS IN mm.

REF: ASTM STD. D 1830	SCALE: NTS	APPROVED: (FOR DG) ~~KG~~ 14.9.79

FIXTURE FOR HOLDING CURVED ELECTRODE ARRANGEMENT

R. D. S. O., ELECDTE.	SKEL.3193

Dt	14.9.79
D	
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C.	