

115515/2020/O/o PED/TI/RDSO

Specification No. TI/SPC/PSI/MOGTLA/0102 (..../.....)

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

सत्यमेव जयते

SPECIFICATION
FOR
METAL OXIDE GAPLESS TYPE LIGHTENING ARRESTER
FOR USE ON 25kV Side of RAILWAY TRACTION SUBSTATIONS
AND
SWITCHING STATIONS

	PREPARED BY	CHECKED BY	APPROVED BY
SIGNATURE			
DESIGNATION			

ISSUED BY

TRACTION INSTALLATION DIRECTORATE,
RESERARCH DESIGNS & STANDARDS ORGANISATION,
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115515/2020/O/o PED/TI/RDSO**1.0 Scope**

- 1.1. It is to be noted that "The Make in India Policy of Government of India shall be applicable."
- 1.2. This Specification supersedes Specification No. TI/SPC/PSI/ MOGTLA/0101 (02/15) which was superseding the specification no. TI/SPC/PSI/MOGTLA/0100(07/10).
- 1.3. This Specification covers the design, manufacture, testing and supply of Metal Oxide Gapless type Lightning Arresters intended for outdoor installation at Traction Sub-stations and Switching Stations on Indian Railways for protection of various Electrical Equipment, installed at these Stations.

2.0 Governing Specification

- 2.1 The Lightning Arresters shall, unless otherwise specified herein, conform to the latest revision of RDSO Specification, Indian Standard Specifications/IEC Recommendations, as indicated below and the Indian Electricity Rules, wherever applicable.

Sl. No.	Standards	Title of the Standard
1.	IS:1367(Pt-XIII): 1983 (Reaffirmed in 2006)	Technical Supply conditions for threaded Steel Fasteners- Hot Dip Galvanised coating on threaded Fasteners
2.	IS:1570 (Part-V)-1985 (Reaffirmed in 2004 2018)	Schedule for Wrought Steels Stainless and Heat Resisting Steels (Part-V)
3.	IS:2071(Part-I)-1993 (Reaffirmed in 2004 2016)	High Voltage Test Techniques - General definitions and test requirement
4.	IS:2071 (Part-II)-1974 (Reaffirmed in 2006)	Methods of High Voltage Testing - Test Procedures
5.	IS:2099-1986 (Reaffirmed in 2003)	Bushings for Alternating Voltages above 1000 Volts
6.	IS:2629-1985 (Reaffirmed in 2006)	Recommended Practice for Hot Dip Galvanizing of Iron & Steel
7.	IS:2633-1986 (Reaffirmed in 2006)	Methods of Testing uniformity of zinc coating
8.	IS:3070 (Part 1) - 1985 (Reaffirmed in 1999)	Non linear Resistor Type Surge Arresters
9.	IS:3070 (Part III)-1993 (Reaffirmed in 2004) IS:15086 (Part-4):2017 IEC:60099-4:2014	Metal oxide Lightning Arrestors without Gap
10.	IS :5358-1969	Hot Dip Galvanised coating on Fasteners
11.	IS:5561- 1970 2018	Electric Power Connectors
12.	IS:5621-1980 (Reaffirmed in 2004)	Hollow Insulators for use in Electrical Equipment
13.	IS:6209-1982 (Reaffirmed in 2006)	Method for Partial Discharge Measurement
14.	IS:8704- 1995 2018/ IEC:507-1991 (Reaffirmed in 2006)	Methods for Artificial Pollution Test on High Voltage Insulators for use on AC system
15.	IS:15086(Part-3)-2003	Artificial Pollution Testing of Surge Arresters
16.	IEC: 60099-4-2014/	Metal Oxide Surge Arresters, without Gaps for AC

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	IS:15086-4 - 2017	system
17.	IEC: 60099-5:2018/ IS:15086-5 - 2001 (Reaffirmed in 2016)	Surge Arrestor- Selection, Application and Recommendation
18.	RDSO Specification No. ETI/OHE/13 (04/1984)	Specification for Hot Dip Zinc Galvanization of Steel Masts (Rolled & Fabricated), Tubes and Fittings used on 25 kV AC OHE
19.	RDSO Instruction No. TI/MI/0041 dated 27.09.2005	Maintenance instructions for Lightning Arresters
20.	RDSO Instruction No. TI/MI/0048 dated 08.08.2013	Maintenance Instructions for Provision of Disconnecter Assembly to the Lightning Arresters, provided over 25 kV side of Traction System

2.2 Any deviation from this Specification, proposed to improve the performance, utility and efficiency of the Equipment, proposed by the ~~Tenderer~~ vendor, shall be given due consideration, provided full particulars with justification thereof are furnished.

3.0 Traction Power Supply System

3.1 General Scheme

- i.) Single Phase, AC, 50 Hz Power Supply for Railway Traction at 25 kV is obtained from 220/132/110/66 kV 3-Phase Grid Supply, through step down Power Transformers, the Primary winding of which is connected between any two phases of 220/132/110/66 kV three phase effectively earthed Transmission networks of the Supply authorities. In order to reduce the imbalance on three Phase, the Transmission line are tapped in a cyclic order, for feeding successive Traction Sub-stations. The spacing between adjacent Traction Sub-stations varies between 30 to 80 kms, depending upon the density of the traffic and gradients of the Section etc.
- ii.) One Terminal of the 25 kV Secondary winding of the Traction Transformer is connected to the Overhead Equipment (abbreviated as OHE) and the other is solidly earthed and also connected to Traction Rails. The load current flows through the OHE to the locomotives and returns through Rail and earth to the Traction Sub-stations. In the middle of adjacent Traction Sub-stations, a dead zone known as 'Neutral Section' is provided to isolate the two Phases. The power to the OHE on one side of the Traction Sub-station is fed by a Feeder Circuit Breaker. OHE of each track is controlled by an Interrupter. In case of fault on the OHE, the Feeder Circuit Breaker clears the fault.
- iii.) A Schematic of a typical arrangement, showing the General Feeding arrangement of a Traction system, as well as the schematic General Arrangement at a Traction Sub-station is given in Sketch No. ETI/PSI/702-I (enclosed at Appendix-II).
- iv.) The incoming 220/132/110/66 kV supply voltage may vary between +10% to 12.5% as per Rule No. 54 of IE Rules-2003. The supply frequency may vary by $\pm 3\%$

3.2 Protection system

3.2.1 Relays are provided for the protection of Traction Transformers as indicated below.

- a) IDMT Over Current Protection on 220/132/110/66 kV side,
- b) Restricted Earth Fault Protection on 220/132/110/66kV side,
- c) IDMT Over Current on 25 kV side,

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- d) Restricted Earth Fault on the 25 kV side and
- e) Differential Protection.

3.2.2 Relays are provided for the protection of OHE as indicated below.

- a) Distance Protection,
- b) Instantaneous Over Current Protection and
- c) Wrong Phase Coupling Protection.

Note: At some Traction Sub-stations (part or complete), static/ microprocessor based Relays are provided.

3.3 Insulation level

Basic insulation level of the Equipment provided at the Traction Sub-station are given in Appendix-I.

3.4 25 kV OHE and Traction Transformers

3.4.1 The OHE generally consists of a stranded cadmium copper catenary of 65 sq. mm. and a grooved copper contact wire of 107 sq. mm. providing a total of 150 sq.mm. copper equivalent. The loop impedance of the OHE is as under:

3.4.2 The values of loop impedance of OHE without return conductor and booster transformers (BT) –

- Single track OHE $0.41 \angle 70^{\circ}$ ohms/km
- Double track OHE $0.24 \angle 70^{\circ}$ ohms/km
- Triple track OHE $0.18 \angle 70^{\circ}$ ohms/km

The values of loop impedance of OHE with return conductor and booster transformers (BT) –

- Single track OHE $0.70 \angle 70^{\circ}$ ohms/km
- Double track OHE $0.43 \angle 70^{\circ}$ ohms/km
- Triple track OHE $0.27 \angle 70^{\circ}$ ohms/km

3.4.3 In some Sections, Contact wires of 150/161/193 mm sq. are also used. The ~~Tenderer~~ **vendor**, may obtain details of impedances from the Railways, if such wires are used.

3.5 Traction Transformer

Normally 21.6 (ONAN)/30.24 (ONAF) MVA or 30 (ONAN)/42 (ONAF) MVA, 220 or 132 or 110 or 66/27 kV, Single-Phase with maximum of $(12 \pm 0.5)\%$ for 21.6/30.24MVA & $(12.5 \pm 0.5)\%$ for 30/42MVA impedance rating of Traction Transformer is provided at the Traction Sub-station. The Traction Transformers are designed to carry short time overloads to cater for the requirements of varying traction load.

Rating of the Traction transformer

Rated Capacity	Rated Secondary current of the Transformer	
	30 MVA	21.6 MVA
Continuous	1111 Amps	800 Amps
15 Minute	150% i.e 1666.5 Amps	150% i.e 1200 Amps
5 Minute	200% i.e. 2222 Amps	200% i.e. 1600 Amps

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Ability to withstand Short Circuit	Thermal : 5 second Dynamic :0.25 second	Thermal : 5 second Dynamic :0.25 second
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Note: The rating and design of the Traction Transformer may change hence manufacturer/supplier must confirm the ratings and configuration from the Purchaser.

3.6 Clearances

A minimum clearance of 500 mm is provided between any live part at 25 kV and earth in the 25 kV AC Traction Sub-stations as well as in the Switching Stations.

4.0 Nature of faults on the OHE system

4.1 OHE may be subject to frequent earth faults, or snapping of OHE and its touching the Rail or earth, or loose wires carried by birds coming in contact with OHE below over line structures, miscreant activities etc.

Faults are cleared by Feeder Circuit Breakers, which operate alone or with any of the following Relays depending on the proximity of the fault:-

- a) Distance Protection Relay (Pollygonal characteristics),
- b) Instantaneous Over Current Relay,
- c) Inadvertent coupling of two phases between adjacent Traction Sub-stations at the Neutral Section or at intermediate Switching Stations, in case of extended feed may cause short circuits, which are cleared by one of Feeder Breaker at either end of Traction Sub-stations through a "Mho Relay" known as "Wrong Phase Coupling Relay (WPC)".

4.2 Short Circuit level

For different Grid Supply Voltages, Short Circuit level on Primary side of Traction Transformer may vary between 7 to 8 kA depending upon the proximity of the Traction Sub-station to the Generating Station. The level of short circuit on the 25 kV side for a fault in the vicinity of a Traction Sub-station could be around 6-10 kA.

The short- circuit apparent power for various system voltages is as under, however the actual values shall be furnished by Purchaser in consultation with Supply Authority:

Highest System Voltage (in kV)	Short Circuit Apparent Power (in MVA)
52	200
72.5	3500
123	6000
145	10000
245	20000

5.0 Surges

From the tests conducted on the Overhead Equipment, it has been established that short duration switching surges are generated while carrying out various switching operations. Magnitude of these surges as measured during some tests is around 120 to 130 kV peak.

6.0 Environmental conditions

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6.1 All Equipments, suitable for Outdoor/Indoor, shall be suitable for use in tropical climate and in areas subjected to heavy rainfall, pollution due to industrial and coastal climates and severe lightening surges in India.

- i. Maximum Temperature of Air in shade : 55⁰ C
- ii. Minimum Temperature of Air in shade : (-)10⁰ C
- iii. Max. Temperature attainable by an object exposed to Sun : 70⁰ C
- iv. Maximum Relative Humidity : 100%
- v. Annual Rainfall ranging from : 1750 mm to 6250 mm
- vi. Maximum Number of Thunder storm days per annum : 85 days
- vii. Maximum number of Dust Storm days per annum : 35 days
- viii. Number of Rainy days per Annum : 120 days
- ix. Basic Wind Pressure : 200 kgf/m²
- x. Altitude above Mean Sea Level : 2000 meters

6.2 Vibrations

The Equipment is expected to be installed on foundation in the ground or on Steel Structures located by the side of Railway tracks and be subjected to vibrations due to the passage of trains. The amplitude of these vibrations lies in the range of 30 to 150 microns, with instantaneous peaks going up to 350 microns. These vibrations occur with rapidly varying time periods in the range of 15 to 70 milliseconds.

7.0 Technical Specification

7.1 Rating and other Particulars

The technical particulars and performance characteristics of the Lightning Arrester shall be as under:

S.No.	Description	Ratings/Particulars
i.	System	Single Phase AC Traction
ii.	Nominal system voltage	25 kV (Phase to Earth)
iii.	Possible variation in the Traction Supply Voltage	19 kV to 27.5 kV (upto 30 kV at instant, down to 17.5 kV at instant)
iv.	Rated Frequency	50 Hz
v.	Type of Lightning Arrester	Non-linear Metal Oxide Resistor type without Gap
vi.	Line Discharge Class	Class 3
vii.	Continuous Operating Voltage Capability (Phase to Earth)	35kV (rms)
viii.	Maximum Discharge Voltage at Nominal Discharge Current	125 kVp
ix.	Nominal Discharge Current (8/20 μ s wave)	10 kA
x.	Pressure Relief Class	Class 'A'

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xi.	Power Frequency Voltage Withstand for Arrester Insulation	105 kV (RMS)
xii	Rated Voltage	42 kV
xiii	Peak Value of High Current Impulse (4/10 μ s wave)	100 kA

7.2 Construction7.2.1 **(i) LA with Porcelain Housing**

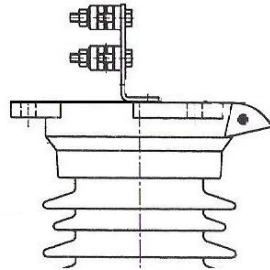
- a. The Lightning Arrester shall comprise of number of non-linear Resistor Blocks, housed inside the Porcelain Housing. Suitable provisions to arrest the relative movement of Blocks shall be provided inside Porcelain Housing.
- b. Lightning Arrester shall be of hermetically sealed construction to prevent moisture ingress inside the Porcelain Housing. A sealing gasket of Silicon Rubber with a Dumbel shaped shall be used.
- c. The Arrestor shall have means for relieving internal pressure to prevent explosive shattering of the housing.
- d. The Pressure Relief Device shall be Class-A as per ~~IS: 3070 (Part III) 1993 (Reaffirmed in 2004)~~ **IS: 15086-4: 2017**.

(ii) LA with Polymer Housing

- a. The Lightning Arrester shall comprise of number of non-linear metal-oxide Resistor Blocks with highly non-linear voltage-current characteristics, connected in series.
- b. The surge arrester with a housing made of polymeric material without air voids neither between the housing and the metal-oxide resistors nor the housing itself. Arresters must have directly moulded housings. Arresters manufactured by slip-on, pre moulded housing will not be accepted in view of the weak interface between the housing and the assembled disc. The polymer material which is used for the arrester housing must be tracking and erosion resistant, stabilized against UV radiation.
- c. **Cage Design of Polymer Surge Arresters to be used:** To accommodate the stack of Metal Oxide elements, the Metal Oxide elements should be used as mechanically supporting part. This should be achieved by clamping them in between the end fittings using a cage of FRP rods. The silicone rubber insulation is then moulded directly onto the MO elements without any internal gas volume left.
- d. **Bonding Between Housing and Metal-Oxide Resistors**
 - i. The adhesion between the polymeric housing and the metal-oxide resistors or any other metallic or non-metallic parts inside the housing must be strong enough, homogeneous, robust and resistant to thermal cycles and environmental stresses.
 - ii. The Lightning Arrestor shall be suitable for outdoor installation, where the maximum temperature attainable by an object exposed to sun is 70°C. If required, the manufacturer shall use Polymer of light color instead of brown color to avoid over-heating of the internal components of the Arrester for its satisfactory service.

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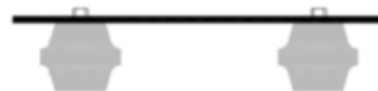
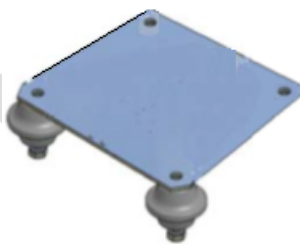
- 7.2.2 The Arrestor shall have base support suitably designed for mounting on a galvanised Base Plate, over a Steel supporting structure with four M-14 Bolts in a rectangular formation on a PCD of 274 mm.
- 7.2.3 The Arrestor shall be provided with a 'Terminal Connector Plate', conforming to IS:5561-~~1970~~-2018. The Connector shall be of robust design and as per approved Drawing, suitable for securing an 'All-Aluminum "Spider" conductor', on the live side. Suitable provision on the 'Earth side' of the Arrestor shall be made for connecting two numbers 50x6 mm Mild Steel flats. An Earthing Pad with two holes of 17.5 mm diameter is preferable. All the Hardware required for mounting the Lightning Arrestor, Insulating base and Surge Monitor etc. shall be supplied by the manufacturer.



- 7.2.4 All Ferrous Parts, used in manufacturing of Lightning Arrestor, its Assembly and the Insulating Base shall be hot-dip galvanised. All Fasteners of diameter up to 12 mm shall be of Stainless Steel, conforming to Grade 04 Cr17Ni 12 Mo2 of IS: 1570 (Part-V)-1985 and those above 12 mm shall preferably be of Stainless Steel or of Mild Steel Hot Dip Galvanised to RDSO's Specification No. ~~no. ETI/OHE/18(4/84)~~ **TI/SPC/OHE/FASTENERS/0120 Rev.01 or latest.**

7.2.5 Insulating Base

One number Insulating Base, made of Porcelain shall be supplied by the manufacturer with each Arrestor. The Insulating Base shall have same mounting dimension as that of Lightning Arrestor.



7.2.6 Surge Monitor

To monitor the healthiness of the Lightning Arrestor, each Arrestor shall be provided with a Surge Monitor. Surge Monitor shall be designed to record directly the number of surges handled by the Lightning Arrestor on a cyclometric counter, and also indicate the leakage current passing through the Lightning Arrestor, on an ammeter, continuously. No Push Button shall be provided in the ammeter circuit, for taking the reading of the leakage current.

Surge monitors shall be interchangeable and suitable for outdoor service. Suitable Terminal Connectors and leads (length should be at least 12 meters) etc. shall be supplied along with the surge monitor, so that these can be installed at a convenient height for ease of visibility. Suitable provision on the earth side of the surge monitor shall be made for connecting two numbers 50 x 6 mm Mild Steel flats. The design of

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'Surge Monitor' shall be such that in the eventuality of its failure, the Lightning Arrester base should automatically be connected to the Earth system.

~~Tenderer~~ Vendor shall provide for each Arrester, insulated connecting lead from Ground Terminal of Lightning Arrester to the Surge Monitor/Earth connection and this shall be of 35 mm², 1100 volts grade, unarmoured PVC Insulated copper cable to enable the on line measurement by clip-on type Portable Equipment to measure third harmonic resistive leakage currents.

~~Tenderer~~ Vendor shall specify the maximum limit of leakage current & Third Harmonic Resistive Current (THRC) of their Lightning Arrester, while in service.

7.2.7 Disconnecter Assembly (to be provided on 25 kV Side at the Railway Traction Sub-stations and Switching Stations)

Each Arrester shall be provided with a Disconnecter with a view to Provide tell-tale sign of failure and also Disconnect failed Lightning Arrester from line, thereby ensuring that tripping of the line does not occur and the system remains live to ensure that the traffic interruption does not occur and also permitting much faster restoration.

Disconnecter Assembly shall, unless otherwise specified, conform to the latest revision of IEC standard IEC: 60099-4 Ed 2.2-2009-05. The Disconnecter Assembly consists of Insulating Base, Adaptor Plate & Earth Plate. The technical particulars and performance characteristics shall be as under:

Sl. No.	Technical Particular (Electrical) of Disconnecter	Particulars
(i)	Long Duration Current Withstand Capability	Up to Class 3
(ii)	Operating Duty Test Capability (High Current 4/10µs wave)	100 KA
(iii)	Operating Time	Less than a Second at current levels specified in IEC Standard

Sl. No.	Technical Particular (Mechanical) of Disconnecter	Particulars
(a)	Ultimate Tensile Strength	Greater than 3kN
(b)	Ultimate Cantilever Strength	Greater than 3kN
(c)	Torque withstand	Min. 40Nm

Construction of Disconnecter

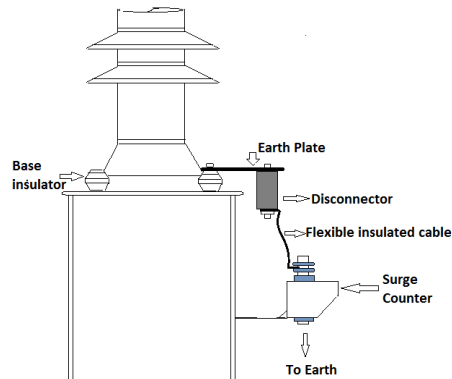
Disconnecter shall be constructed with an internal gap graded with suitable Resistor for performance during various surges appearing in the system. Assembly shall not contain any type of cartridge. Disconnecter shall be designed to operate faster and shall have very low operating time of the order of less than a Second. Tenderer shall submit time v/s current curve, based on the test results obtained after conducting the Type Test as per IEC: 60099-4-~~2004~~ 2014 Standard, in order to prove that the Disconnecter operates quickly.

Disconnecter shall have M12 tapping on both line and ground side with minimum depth of 10mm for connection purpose. All metal parts used in the assembly shall either be Stainless Steel or Galvanised Steel or Aluminium. Disconnecter shall be

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sealed with suitable epoxy in order to avoid moisture ingress to have long term performance and also to have required mechanical strength. Disconnecter shall be suitable for use on any make of Surge Arrester. It shall also be suitable for either Porcelain or Polymeric type Surge Arresters.

In case the Surge Arrester is installed in combination with Surge Monitor and Disconnecter, the Surge Monitor shall indicate leakage current flowing through the Arrester after line charging.



7.3 Name plate

Each Lightning Arrester shall be provided with Name-Plate legibly and indelibly marked with the following information or as per clause No. 3.1 of IS:3070 (Part-III)-1993.

- i.) **Arrester Type - (Porcelain/Polymer)**
- ii.) Continuous Operating Voltage,
- iii.) Rated Voltage,
- iv.) Rated Frequency,
- v.) Nominal Discharge Current,
- vi.) Long Duration Discharge Current,
- vii.) Pressure Relief Class,
- viii.) Manufacturer's Name or Trade-mark, Type and Identification,
- ix.) Month & Year of Manufacture,
- x.) Purchase Order Number and
- xi.) Manufacturer's Serial Number.

7.4 The Lightning Arrester shall be suitable for outdoor installation, where the maximum temperature attainable by an object exposed to sun is 70°C. If required, the manufacturer shall use Porcelain of light color instead of brown color to avoid overheating of the internal components of the Arrester for its satisfactory service.

8.0 Type tests

8.1 Following Type tests shall be carried out in accordance with ~~IS: 3070 (Part III)-1993 (Reaffirmed 2004)~~ **IS: 1508 (Part-4):2017** to prove the general quality of design and its conformity with the Specifications:

SN	Tests	IS:3070 (Part III) IS:1508 (Part-4):2017 applicable clause
1.	Power Frequency Reference Voltage of an Arrester Test	2.36 and 5.3 3.56 & 8.7
2.	Insulation Withstand Test	6.2 8.2

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	i) Lightning Impulse Voltage Test	8.2.6
	ii) Power Frequency Voltage Test	8.2.8
3.	Residual Voltage Tests	6.4 8.3
	i) Steep Current Impulse Residual Voltage Test	6.4.1 8.3.2
	ii) Lightning Impulse Residual Voltage Test	6.4.2 8.3.3
	iii) Switching Impulse Residual Voltage Test	6.4.3 8.3.4
4.	Long Duration Current Impulse Withstand Test Test to verify long term stability under continuous operating voltage	6.5 8.4
5.	Test to verify the repetitive charge transfer rating, Qrs.	8.5
6.	Heat Dissipation Behavior of Test Samples	8.6
7.	Operating Duty Tests	8.7
8.	Power-frequency voltage-versus-time test	8.8
9.	Short-circuit test	8.10
10.	Test of the bending moment	8.11
11.	Environmental tests	8.12
12.	Seal leak rate test	8.13
13.	Test to verify the dielectric withstand of internal components	8.15
14.	Test of internal grading components	8.16
15.	i) Accelerated Ageing Test	6.6
	ii) Switching Surge Operating Duty Test	6.6.2
	iii) Evaluation of Thermal Stability in Operating Duty Test	6.6.3 6.6.5
	iv) Power Frequency Voltage versus Time Characteristics of Arrester	6.6.6 6.6.7
16.	Pressure Relief Test	6.7
17.	Artificial Pollution Test This test is to be carried out as per ANSI/ IEEE C 62.11.1987 Polluted housing test	Annexure J Annexure C
18.	Leakage Test on complete Arrester Assembly to see the efficacy of the sealing system	Every Surge Arrester shall call for into a water bath of 1.5 meter depth for half an hour period on Routine basis. This Test is expected to be detecting sealing defect.
19.	Other miscellaneous Tests i) Galvanizing test on Metal Parts ii) Porosity Test on Porcelain Components iii) Temperature Cycle Test on Porcelain Housing iv) Visual Examination of Porcelain Housing v) Bending Test on Arrester Assemblies.	Annexure H 7.16 of IS:3070 (Part I)

8.2 For polymers housing arresters, the modifications in the type tests mentioned in Para 8.1 above shall be done as detailed in the clause no. 10 of IS: 15086, Part-4:2017.

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Following are the tests which are to be conducted at the time of acceptance of the material as per ~~IS: 3070 (Part III) 1993 (Reaffirmed 2004)~~ **IS: 1508 (Part-4):2017**.

9.1 Measurement of 'Power Frequency Reference Voltage' on the complete Arrester, at the reference current, measured at the bottom of the Arrester. The measured value shall be within the range specified by the manufacturer. For multi-unit Arresters, the value may deviate from the reference voltage of the Arrester.

9.2 'Lightening Impulse Residual Voltage Test' on the complete Arrestor or Arrestor unit at Nominal Discharge Currents, if possible or at current value in the range of 0.01 to 0.25 times Nominal Discharge Current of the Lightning Arrestor.

9.3 Partial Discharge Test

The Power Frequency Voltage applied to the Arrestor shall be increased up to its rated voltage and after less than 10 seconds decreased to 1.05 times its 'Continuous Operating Voltage'.

9.4 **Measurement of IR values of the Lightning Arrestor and it should be greater than 1Gohm.**

10.0 Routine Tests

Following are the tests which are to be conducted as Routine Tests on the material as per ~~IS: 3070 (Part III) 1993 (Reaffirmed 2004)~~ **IS: 1508 (Part-4):2017**.

- (i) Visual examination
- (ii) Measurement of Power Frequency Reference Voltage
- (iii) Measurement of Leakage Current at 'Continuous Operating Voltage'
- (iv) Lightning Impulse Residual Voltage Test either on complete Arrestor, assembled Arrestor unit or on Single or 'Several Register Elements' at a suitable Lightning Impulse current, of the range between 0.01 & 2 times the 'Nominal Current' at which the Residual Voltage is measured
- (v) Leakage check to see the efficacy of the sealing system and
- (vi) Satisfactory absence from 'Partial Discharges' and 'Contact Noise' by any sensitive method.

11.0 Tests on Surge Monitor and Insulating Base

While carrying out the prototype tests on the lightning arrester, following tests shall also be done on the surge monitor and insulating base.

11.1 Surge Monitor

- i) Tests for satisfactory operation of 'Surge Counter' while discharging surges.
- ii) Tests for correctness of 'Leakage Current Meter' before and after the passage of surges.
- iii) Visual Examination.

The above tests shall also form part of the routine tests.

12.0 Tests on Disconnecter Unit

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- (i) Visual examination
- (ii) Disconnecter Operation Test

13.0 Before giving the call to ~~RDSOCORE~~/ the Chief Electrical Engineer for inspection and testing of the Prototype of Lightning Arrester, the manufacturer shall submit a detailed test schedule consisting of schematic circuit diagrams for each of the test, nature of the test, venue of the test, duration of each test and the total number of days required to complete the test at one stretch. Once the schedule is approved, the test shall invariably be done accordingly.

However, during the process of Prototype Test or even later, ~~RDSO-CORE~~ representative reserves the right to conduct any additional test(s) besides those specified herein on any Equipment/ sub-system or system so as to test the system to their satisfaction or for gaining additional information and knowledge. In case, any dispute or disagreement arises between the manufacturer and ~~RDSO-CORE~~/Chief Electrical Engineer, during the process of testing as regards the Prototype Tests and/or the interpretation and acceptability of the Prototype Test results, it shall be brought to the notice of the ~~Director General (Traction Installations), RDSO/CORE~~/Chief Electrical Engineer as the case may be, whose decision shall be final and binding.

14.0 Technical Data and Drawings

14.1 The ~~Tenderer Vendor~~ 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 Offer of the Tenderer deviates from the provisions of the clauses, they shall furnish their detailed remarks.

14.2 The ~~Tenderer Vendor~~ shall furnish Guaranteed Performance data, Technical and other Particulars for the Lightning Arrester in the proforma attached as Annexure-A.

The information furnished in 'Schedule of Guaranteed Technical Performance Data' and other Particulars shall be complete in all respects.

14.3 Drawings showing the overall dimensions of the Lightning Arrester, a cross-sectional view indicating non-linear Resistor Blocks, Retainer arrangement, Terminal details, method connecting high tension & earthing leads, mounting arrangements and evidence in the form of Prototype Test reports for the Arrester, if available, shall be submitted along with the Tender.

14.4 The ~~successful Tenderer vendor~~ shall be required to submit the above mentioned detailed Dimension Drawings for approval and shall also furnish six copies of the approved Drawings, as per Railway standards.

14.5 The ~~successful Tenderer vendor~~ shall also submit the copies of Technical Booklets, Information Manuals, Test Reports etc.

15.0 ~~Technical collaboration and indigenisation~~

~~Progressive indigenisation of Lightning Arrestors, covered by this Specification is contemplated. Design calculations, detailed manufacturing process and all relevant information pertaining to transfer of technical know-how in this regard shall be carried out in such a manner between the overseas manufacturer and the Indian manufacturer as to ensure that the indigenous content of the Lightning Arrester made in India increases progressively and rapidly without sacrificing quality and reliability. Research Designs & Standards Organisation of the Indian Railways is to be associated at various~~

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~~stages of indigenisation so as to take into account service experience while attempting progressive indigenization.~~

~~The information exchanged between the overseas manufacturer and the Indian manufacturer is not ordinarily required to be passed on to the Indian Railways. However, the authorised representative of the Indian Railways shall have access to the above information at the manufacturer's works, overseas or the manufacturer's works/Design office in India, whenever it becomes necessary for the purpose of inspection and acceptance of the product at the manufacturer's works or for the purpose of analysis/investigation for overcoming difficulties and problems and for improving the performance reliability in service.~~

16.0 Performance monitoring and Post Installation Support

- 16.1 The Supplier shall make necessary arrangements for close monitoring of performance of Lightning Arresters, thorough periodical visits to Traction Sub-stations/Switching Stations for observations.
- 16.2 Technical guidance and assistance for proper operation and maintenance, trouble-shooting investigation and generally all aspects of technical liaison that may be required, shall also be organised by the supplier.

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ANNEXURE-A

SCHEDULE OF GUARANTEED PERFORMANCE , TECHNICAL AND OTHER PARTICULARS

Sl. No.	Description		Unit of Measurement
1.	Name of Manufacturer		
2.	Country of origin		
3.	Standard Specification on which performance is based		
4.	Manufacturer's Type Designation		
5.	Rated Voltage (RMS)		kV
6.	Rated Frequency		Hz
7.	Continuous Operating Voltage		kV
8.	Watt-loss at Continuous Operating Voltage		Watt/kV
9.	Watt-loss at Rated Voltage		Watt/kV
10.	Leakage current at Continuous Operating Voltage		mA
11.	Leakage Current at Rated Voltage		mA
12.	Rated Voltage of the Section (Metal Oxide Disc)		kV
13.	Maximum Power Frequency Reference Voltage of the Section		kV
14.	Minimum Power Frequency Reference Voltage of the Section		kV
15.	Reference Current of the Lightning Arrester		mA
16.	Nominal Discharge Current (8/20 μ s wave)		kA
17.	Residual Voltage	At 0.5 times Nominal Discharge Current	kV (Peak)
		At Nominal Discharge Current	kV (Peak)
		At twice the Nominal Discharge Current	kV (Peak)
18.	Switching Impulse Residual Voltage Test with 45/90 μ s Current wave of 250 Amps and 1000 Amps.		kVp
19.	Steep Current Impulse Residual Voltage with 1.0 μ s Front time & Current wave of 10 kA _{peak} .		kVp
20.	High Current Impulse withstand (4/10 μ s wave)		kAp
21.	Long duration Current Impulse Rating	Peak current	A
		Virtual Duration of peak	μ s
		Line Discharge class of the Arrester	
22.	Power Frequency Voltage Withstand of Arrester Insulation (RMS)	Dry	kV
		wet	kV
23.	Lightening Impulse Withstand Voltage of Arrester		kVp
24.	Type of non-linear Resistor Disc, size (Diameter, Height) and Voltage rating		kV
25.	Number of non-linear Discs per Section of Arrester.		Nos.
26.	Number of sections in one arrester.		Nos.
27.	Material of Retainer used inside Lightning Arrester Bakelite, Ceramic, Rubber or other material		
28.	Is Pressure Relief Device provided, if so, it's class?		
29.	Overall Dimensions	Height	mm
		Diameter	mm
30.	Net weight		Kg.
31.	Mounting Base	No. of holes	No.
		Diameter of holes	mm
		Pitch circle diameter	mm

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32.	Temporary Over Voltage capability for	0.1 second	kV _{rms}
		1.0 second	kV _{rms}
		10.0 second	kV _{rms}
33.	Surge Monitor		
	(i)	Make	
	(ii)	Model	
	(iii)	Type	
	(iv)	Sensitivity of Surge Counter (Minimum current at which the Counter operates)	
	(v)	Nominal discharge current	
	(vi)	Max. current to be withstood by the surge monitor	
	(vii)	Counter operation	
	(viii)	Safe leakage current indication	
	(ix)	Indication of deterioration of surge arrester	
	(x)	Net weight	
34.	Disconnecter		
	Technical Particular - Electrical		
	Long Duration Current withstand capability		
	Operating Duty Test capability (High Current 4/10 μ s wave)		KA
	Operating Time		
	Technical Particular - Mechanical		
	Ultimate Tensile Strength		kN
	Ultimate Cantilever Strength		kN
	Torque withstand		Nm
35.	Whether the live and earth ends of Arrester suitable for Jumper/ Flats as specified?		
36.	Whether grading rings provided?		
37.	Voltage-Current Characteristic Curves of the Zinc Oxide Element at different temperatures		
38.	Any other Technical data, the Manufacturer may like to furnish		

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APPENDIX-I

Various Electrical Equipments provided at the Traction Substations and Switching Stations and their Basic Insulation Level

Sl. No.	Equipments	Standard lightning impulse withstand	Power frequency withstands voltage for one minute.
i.	Traction Transformer (Secondary Side)	250 kVP	95 kV RMS
ii.	25 kV Circuit Breaker	250 kVP	95 kV RMS
iii.	25 kV Current Transformer	250 kVP	95 kV RMS
iv.	25 kV Potential Transformer, (Protection Type) (Type-II)	250 kVP	95 kV RMS
v.	25 kV Single Pole Isolator	250 kVP	95 kV RMS
vi.	25 kV bus bars	250 kVP	-
vii.	25 kV Shunt Capacitor	250 kVP	105 kV RMS
viii.	10/25 kVA, 25 kV/230 V Auxiliary Transformer	190 kVP	70 kV RMS
ix.	25 kV Interrupter	250 kVP	95 kV RMS
x.	25 kV Potential Transformer, (Indication Type) (Type-I)	190 kVP	80 kV RMS

