

**SPECIFICATION No. ETI/OHE/16 (1/94)**



**TECHNICAL SPECIFICATION**

**FOR**

**25 kV a c Single Pole and  
Double Pole Isolators for  
Railway electrification**

**Specification No. ETI/OHE/16 (1/94)**

**ISSUED BY:**

**TRACTION INSTALLATION DIRECTORATE  
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MINISTRY OF RAILWAYS  
GOVERNMENT OF INDIA  
MANAK NAGAR,  
LUCKNOW – 226 011.**

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**Specification for 25 kV a c Single Pole and Double Pole Isolators for Railway electrification**

1. SCOPE:

1.1 This specification applies to single- pole as well as double-pole as well as double-pole isolator with earthing switch for outdoor use in 25 kV a.c. 50 H, single phase overhead equipment, traction substations and switching station. The specification also applies to the operating mechanism of the isolator and earthing switch. The isolator shall be mounted on a mast/structure as required.

1.2 The isolator shall be complete with all parts, fittings and accessories including mounting frame work and operating mechanism but excluding the insulators, necessary for its efficient operation. All such parts, fittings and accessories shall be deemed to be within the scope of this specification, whether specifically mentioned or not. The isolator shall be of proven design.

2. GOVERNIG SPECIFICATIONS.

2.1 The isolator and earthing switch shall, unless otherwise specified herein, conform to the latest version of the Indian Standards Specification/IEC recommendations/Research Design and Standards Organisation (RDSO) specifications as indicated below and the Indian Electricity Rules, wherever applicable:

i	IS: 1570 (Pt. II) — 1979	Carbon steels (unalloyed steels)
ii	IS: 2071 (Pt. I) — 1974 & (Pt. II) — 1976	General definitions and test requirements and test procedures.
iii	IS: 2108 — 1977	Black heart malleable iron castings.
iv	IS: 2544 — 1973	Porcelain post insulators for systems with nominal voltage greater than 1000 volts.
v	IS: 5561 — 1970	Electric power connectors.
vi	IS: 7608 — 1975	Phosphor bronze wires (for general engineering purposes).
vii	IS: 7906 — 1975	Helical compression springs.
viii	IS: 9921 — 1985 (Pt. I, II, III, & IV)	Alternating current disconnects (Isolators ) and earthing switches for voltage above 1000 V.
ix	IEC: 129 — 1975	Alternating current disconnects (Isolators ) and earthing switches.

x	EIT/OHE/13(4/84)	Specification for hot dip zinc coating on steel masts (rolled and fabricated) tubes and fittings used on 25 kV ac OHE.
xi	EIT/OHE/18(4/84)	Specification for steel and stainless steel bolts, nuts and washers.
xii	EIT/OHE/64(10/88)	Specification for solid Core Cylindrical post insulators for system with nominal voltages of 220 kV, 132 kV, 110 kV & 66 kV.

1.	IS 1570 : PART 2 : 1979 (REAFFIRMED 2016)	:	CARBON STEELS (UNALLOYED STEELS)
2.	IS 2071 : PART 1 : 2016	:	GENERAL DEFINITIONS AND TEST REQUIREMENTS
3.	IS 2108 : 1977	:	Not exist
4.	IS/IEC 60168 : 2000	:	TESTS ON INDOOR AND OUTDOOR POST INSULATORS OF CERAMIC MATERIAL OR GLASS FOR SYSTEMS WITH NOMINAL VOLTAGES GREATER THAN 1 000 V
5.	IS/IEC 60273 : 1990	:	CHARACTERISTIC OF INDOOR AND OUTDOOR POST INSULATORS FOR SYSTEMS WITH NOMINAL VOLTAGES GREATER THAN 1 000 V
6.	IS 5561 : 2018	:	ELECTRIC POWER CONNECTORS-SPECIFICATION
7.	IS 7608 : 1987 (REAFFIRMED 2016)	:	PHOSPHOR BRONZE WIRE FOR GENERAL ENGINEERING PURPOSES
8.	IS 7906	:	HELICAL COMPRESSION SPRINGS
9.	IS/IEC 62271 : PART 102 : 2003 (REAFFIRMED 2018)	:	ALTERNATING CURRENT DISCONNECTORS AND EARTHING SWITCHES
10.	ETI/OHE/13	:	Specification for hot dip zinc coating on steel masts (rolled and fabricated) tubes and fittings used on 25 kV ac OHE
11.	ETI/OHE/18	:	Specification for steel and stainless steel bolts, nuts and washers
12.	ETI/OHE/64	:	Specification for Solid Core cylindrical post insulators for system with nominal voltage of 220kV, 132kV,110kV & 66kV

2.2 Any deviation form this specification proposed by the tenderer, calculated to improve upon the performance, utility and efficiency of the equipment will be given due consideration, provided full particulars of the deviation with justification therefor are furnished. In such a case, the tenderer shall quote according to this specification and deviation, if any, proposed by him shall be quoted as an alternative (s).

In case of any contradiction between the provisions of Indian Standards Specification/recommendations of the IEC and this specification, the latter shall prevail.

### 3 SERVICE CONDITIONS

3.1 The isolator is intended to be used as outdoor line sectioning switches. The isolator shall be used in normally polluted atmosphere subject to dust smoke and effluents from chemical plants. It may also be used in coastal areas.

3.2 ENVIRONMENTAL CONDITIONS:

i)	Maximum temperature of air in shade	45 C
ii)	Maximum temperature of air in shade	0 C
iii)	Maximum relative humidity	100%
iv)	Annual rain fall	Ranging between 1750 mm and 6250 mm
v)	Number of thunderstorm days per annum	85 (maximum)
vi)	Number of dust storm days per annum	120 (maximum)
vii)	Maximum wind pressure	200 kgf/m
viii)	Altitude	Not exceeding 1000 m.

i.	Maximum ambient air temperature	: 55° C
ii.	Minimum Temperature of Air in shade	: (-)10° C
iii.	Average ambient air temperature over a period of 24 hrs.	: 35° 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/m <sup>2</sup>
x.	Altitude above Mean Sea Level	: 2000 meters

The isolator shall be subjected to vibrations on account of trains running on nearby railway tracks. The amplitude of these of 15 to 70 ms, lies in the range of 30 to 150 microns with the instantaneous peak going upto 350 microns.

4. DEFINITIONS.

4.1 Isolator

It is a mechanical switching device which provides, in the open position, an isolating distance between the two contacts in accordance with specified requirements.

An isolator is capable of opening and closing a circuit when either negligible current is broken or made or when no significant change in the voltage across the terminals at each pole of the disconnecter (isolator) occurs it is also capable of carrying currents under normal circuit conditions and carrying for a specified time currents under abnormal conditions such as those of short circuit.

#### 4.2 Earthing switch

A mechanical switching device for earthing part of a circuit capable of withstanding for a specified time currents under abnormal conditions such as those due to short circuit but is not required to carry current under normal conditions of the circuit.

#### 4.3 Main Circuit

All the conducting parts of an isolator or earthing switch included in the circuit which is designed to close or open

#### 4.4 Pole

The portion of an isolator or earthing switch associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide means of mounting and operating all poles together

#### 4.5 Closed positions

The position in which the predetermined continuity of the main circuit is secured.

#### 4.6 Open position.

The position in which the predetermined clearance between open contacts in the main circuit is secured.

#### 4.7 Position indicating device.

A device which indicates, at the location of the isolator or earthing switch, whether the contacts of the main circuit are in open or closed position.

#### 4.8 Inter locking device

A device which makes the operation of the isolator earthing switch dependent upon the position or operation of one or more other pieces of equipment.

#### 4.9 Ambient temperature

The temperature determined under prescribed conditions, of the air surrounding the complete switching device (e.g). for enclosed switching devices, it is the air outside the enclosure).

#### 4.10 Operation cycle.

A succession of operations from one position to another and back to the first position through all other operations through all other operations, if any.

4.11 Dependent Manual Operation

An operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator.

4.12 Rated value

A stated value of any one of the characteristic value that serve to define the working conditions for which the isolator or earthing switch is designed and built.

4.13 Normal current

The current which the main circuit of the isolator is capable of carrying continuously under specified conditions of the use and behavior.

4.14 Short-time withstand current

The current that an isolator or the earthing switch can carry in the closed position during a short specified time period under prescribed conditions of the use and behavior.

4.15 Permissible duration of short-circuit current

The time during which an isolator or earthing switch in the closed position can carry a short-circuit current of specified value.

4.16 Permissible peak withstand current.

The value of peak current that an isolator or earthing switch can withstand in the closed position under prescribed conditions of use and behavior.

4.17 Rated 1 min power frequency withstand voltage.

The r.m.s value of sinusoidal alternating voltage at power frequency which the insulation of the isolator or earthing switch withstands under specified test conditions.

4.18 Rated impulse withstand voltage.

The peak value of the standard (1.2/50 u. s) impulse voltage wave which the insulation of the isolator or earthing switch can withstand under specified test conditions.

4.19 Clearance

The distance between the conducting parts along a string stretched the shortest way between these conducting parts.

4.20 Clearance between poles.

The clearance between any conducting parts of the adjacent poles.

4.21 Clearance to earth

The clearance between any conducting parts and any parts which are earthen or intended to be earthen.

4.22 Clearance between open contacts (gap)

The total clearance between the contacts or any conducting parts thereto, of pole of an isolator or earthing switch in the open position.

4.23 Isolating distance.

The clearance between open contacts or any conducting parts connected thereto in a pole of an isolator meeting safety requirements.

5. RATING AND OTHER PARTICULARS

i	Type	Manually operated, horizontally mounted on pole, vertical break type and suitable for outdoor.
ii	Number of phases	One
iii	Number of poles	One or two (as specified by the purchaser)
iv	Isolating distance (In air)	500 mm (min.)
v	Rated voltage	25 kV (nominal) 30 kV maximum
vi	Rated current:	
	i. Type-I	1250 A ( Isolator used at Sectioning and paralleling post & Sub-sectioning and paralleling post).
	ii. Type –II	1600 A ( Isolator used at Feeding post & Traction substation)
vii	Rated frequency	50 Hz. +/-3%
viii	Rated short time withstand current (Both for main & earthing switch)	20 kA (r.m.s) for 3 s
ix	Rated peak withstand current Both for main & earthing switch)	50 kA for 3s

x. Temperature rise:

The temperature rise of any part of an isolator shall not exceed the maximum temperature rise given below under the conditions specified in the test clauses- 12.5

Nature of parts	Temperature in degree Celsius-	Temperature rise in degree Celsius
i) Copper contacts in air:		
Bare copper or tinned aluminum	75	35
ii) Terminals of isolators to be connected to b by screws or bolts- bare	90	50
iii) Metal parts acting as springs.	The temperature shall not reach a value where the elasticity of the materials is impaired. For pure copper the temperature limit is 75 deg. C.	

xi. Rated impulse ( 1.2/50 micro-second) withstand voltage:

- i. To earth and between the poles. 250 kV (peak)
- ii. Across the isolating distance. 290 kV (peak)

xii. Wet power frequency 1 min withstand voltage.

- i. To earth 95 kV (r.m.s)
- ii. Across isolating distance 110 kV (r.m.s)

**6. DESIGN, CONSTRUCTION AND MOUNTING**

The support and operating rod insulators shall be of solid core type in accordance with the latest specification of RDSO viz. No. ETI/OHE/15 and shall be procured, if included in the order, only from the approved manufacturers as per drawings approved by RDSO.

Note: The insulators shall be supplied by Railways. The tenderers may, therefore quote rates without insulators.

6.2 The isolator shall be robust in construction and so engineered as to ensure smooth operation at all times. The isolator both single and double pole, shall be supplied fully assembled on a suitable rigid frame. For double pole isolators, the cross channels for mounting shall also form part of supply. The support and frame work shall be designed for a wind pressure of 200 kgf/m acting on 150% of the projected area in addition to all other loads. During the opening and operations of the isolator there shall be no shock. There shall also not be a backlash tending to open the isolator after closing, due to the jerk, if any. All poles of the isolator after closing, due to the jerk, if any. All poles of the isolator shall operate simultaneously. Provision shall be made for adjustments, if



required, for the proper alignment of the pole after mounting. All movable joints shall be provided with brass bushed/bearings, which shall be entirely maintenance free.

- 6.3 The blades of the isolator shall be of electrolytic high conductivity copper tubes of adequate strength and cross section to IS:191 (Part V)-1980 to withstand thermal and bending stresses particularly under short circuit fault conditions.
- 6.4 Flexible braided copper, where used, shall have corrosion resistant coating such as tinning or silvering. The connection between the flexible braid and rotating and fixed parts shall be by means of not less than two bolts to prevent any tendency of rotation.
- 6.5 For reasons of safety, the isolator should be so designed that no dangerous leakage current can pass from the terminals of one side to any of the terminals of the other side.
- 6.6 The frame (isolator mounting channel) of each isolator shall be provided with an earthing terminal for connecting to an earthing conductor having clamping screws, suitable for earth fault conditions. The diameter of the clamping screws shall be not less than 12 mm. The connecting point shall be marked with "Earth" ( ) symbol.
- 6.7 When installed, the isolator shall be able to bear on terminals the total forces (including wind load and electrodynamic forces on the attached conductors) related to the application and rating without impairing their reliability or current carrying capacity.
- 6.8 The isolator shall be constructed so as to permit it being pocked both in the open as well as closed positions. It shall not be possible to lock the isolator in any intermediate position.
- 6.9 The fixed contacts of isolator shall be of extruded, rolled or drawn copper strips. The contacts shall be spring loaded. Only non-ferrous or stainless steel components shall be used in the contact assembly.
- 6.10 The springs used in the contact assembly of the isolator shall be of phosphor bronze conforming to IS:7608-1975. To avoid current passing through the springs, nylon strip of suitable size shall be provided for insulation. The characteristics of the springs shall conform to IS:7906 (Pt. II)-1976 and their mechanical properties shall not be affected in any manner on account of rise in temperature during operation.
- 6.11 Bolts, nuts lockouts and other fasteners of 12 mm dia and less shall be of stainless steel. Fasteners of higher size may be made of hot dip galvanised steel. All fasteners shall be procured from approved manufacturers, a list of which may be obtained from Central Organisation for Railway Electrification Allahabad. The fasteners shall conform to RDSO specification No. ETI/OHE/18.
- 6.12 The mounting arrangement and the operating mechanism shall be such that with the isolators mounted in the working position, the hinge pin of the operating handle is at a height of 1.1 m from ground level. The height of base of the rigid frame referred in clause 6.2 would vary, depending on the type of mast/or structure on which the isolator is mounted. The heights for typical masts/structures are given below.:

Location	Height of isolator mounting channel form ground level in mm	
	SP	DP
RSJ/BFB mast.	8310	8160
RSJ with super mast.	9425	9275
R. Portal	9535	9385
N. Portal	9485	9335
O. Portal	9585	9435
Two Track Cantilever	9560	9410
SS, SSP, SP, FP	3262 5425	- 5525

(When busbar height is 5968 mm)

- 6.13 The isolator shall be supplied with operating pipe in exact length for the particular mast/structure, the length being obtained from the purchaser for each type of mast/structure.
- 6.14 The operating pipe shall not have any joint and shall be supplied with four guides unless otherwise specified in the purchase order. The operating pipe shall be obtained from Central Organisation for Railway Electrification/Allahabad.
- 6.15 All malleable cast iron parts shall be of black heart malleable cast iron grade BM-340 conforming to IS: 21081977.
- 6.16 All ferrous parts shall be not dip galvanised in accordance with specification No. ETI/OHE/13(4/84).
- 6.17 The Isolator shall be provided with a terminal pad at each end as shown in Annexure "B" attached. The terminal pad shall have few holes as indicated for being connected to a terminal connector.
- 6.18 The general arrangement of the isolator shall be as shown in Annexure 'B'. The essential dimensions are also indicated in the Annexure 'B'.

## 7. OPERATION

- 7.1 The operating mechanism shall be such that it is possible to fasten the base to which the operating handle is attached, to either of the two mutually perpendicular vertical faces of the supporting structure on which the isolator is mounted.
- 7.2 The operating handle of the isolator shall be so designed as to work in the vertical plane. The isolator shall close when the handle is moved upwards. The free end of moving contact shall be fully housed in the fixed contact when the handle is moved fully upward in which position the isolator can be locked.

7.3 The design of the single pole isolator shall be such as to permit coupling of isolators for gang operation form a single operating handle. Not more than two single pole isolators are required to be coupled.

7.4 Suitable “OFF” and “ON” plates shall be provided on the operating handle to indicate when the isolator is open and closed respectively.

7.5 The general arrangement of operating mechanism shall be as shown in Annexure “B”.

## 8. LOCKING.

8.1 A bolt type integral lock and/or interlock, as specified by the purchaser, of approved type shall be fitted on the isolator to enable the operating handle of the isolator to be locked effectively in the “open” as well as in the “close” position. It shall not be possible to withdraw the key from the integral lock except when the isolator is locked either in the open or in the closed position.

8.2 The operating mechanism shall be so designed as to permit padlocking, in addition to the integral lock and/or interlock, for locking the operating handle of the isolator both in the open as well as in the closed positions.

8.3 In addition to locking arrangement described in Clause 8.1, the design of operating mechanism shall permit its operation in a predetermined sequence related to the operation of other switchgear with the help of suitable interlocks.

8.4 The internal mechanism of integral lock and interlock shall be of stainless steel or non-ferrous material. It shall be of robust construction. The outer housing of the interlock and integral lock shall be chrome plated steel and the construction shall be such that it is not prone to theft. The integral lock and inter lock shall be obtained only from the approved manufacturers.

8.5 Each lock shall be supplied with two keys.

Key/lock number shall be inscribed on the keys/locks.

## 9. EARTH CONTACT ASSEMBLY.

9.1 The design of the isolator frame shall be such that it is possible to incorporate an additional pair of contacts so as to effectively earth the fixed contact of the isolator in open position even at a later date.

9.2 The design of the isolator permit the provision of the earth contact assembly without calling for modification to the frame itself. Two holes of 15.5+0.5 mm dia shall be provided on the mounting channel for connecting the earthing terminals.

9.3 The earth contact assembly shall be rated for the short time current specified in Clause 5 (viii) & (ix).

10. ARCING HORN

10.1 The single pole isolator shall be provided with arcing horns which shall be of bright steel to Gr. 20-C-8 of IS:1570 (Pt. II)-1979. The arcing horns shall make contact before the main contacts close and break contact after the main contacts break.

11. TEST.

11.1 Type tests

Only after all the designs and drawings have been approved and clearance given by RDSO/Chief Electrical Engineer to this effect, to be clearly understood that any changes to be done in the prototype as required by RDSO/Chief Electrical Engineer shall be done expeditiously.

Before giving the call to RDSO/Chief Electrical Engineer for inspection and testing of the prototype, the manufacturer shall submit a detailed test schedule consisting of schematic circuit duration of each test and the total number of the 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 type testing or even later, RDSO/Chief electrical Engineer's representative reserves the right to conduct any additional test (s) beside those specified herein, on any equipment/sub-system or system so as to test the system to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement arises between the manufacturer and RDSO/the Chief electrical Engineer during the process of testing as regards the type test and/or the interpretation and acceptability of the type test results, it shall be brought to the notice of the Director General (Traction Installations), RDSO/Chief Electrical Engineer as the case may be whose decision shall be final and binding.

The following tests shall be carried out on the prototype unit of the isolator and earthing switch at the works of the manufacturer/sub-contractor or at a reputed testing laboratory, in the presence of RDSO/Chief Electrical Engineer's representative (s) in accordance with the relevant governing specification and/or as modified or amplified hereunder against each test.:

- i) Visual examination of isolator and its parts
- ii) Dimensional verification of parts
- iii) Assembly and interchangeability.
- iv) Measurement of resistance of main circuit and/earth circuit (before and after mechanical endurance test.
- v) Temperature rise test (before and after mechanical endurance test)
- vi) Mechanical endurance test.
- vii) Short time rated current test.
- viii) One minute wet power frequency test across the isolating distance and to earth.
- ix) Impulse voltage withstand test across.
- x) Galvanization test.
- xi) Chemical analysis of materials – copper contacts, springs, fasteners and bushes.

- xii) Physical tests on springs and fasteners and copper strips.

11.1.1 Acceptance tests:

11.2.1 For the purpose of acceptance, isolators shall be offered for inspection in lots containing components for not more than 50 assemblies of same type of isolators. The isolators offered for inspection shall first be routine tested by the manufacturer and defective components removed.

11.2.2 The visual examination and measurement of resistance shall be done on all the isolators offered for inspection. The defective ones shall be either attended to or removed before further tests are conducted.

11.2.3 The following shall comprise the acceptance test.:

- i. Visual examination (on every item of the lot)
- ii. Dimensional verification of parts (on 10% sample of the lot, minimum one number)
- iii. Assembly and interchangeability (of minimum 3)
- iv. Galvanisation test (one sample of each item)
- v. Measurement of resistance (all samples)

Note: Number of samples drawn for tests may be increased at the discretion of RDSO/Chief Electrical Engineer's representative (inspector) doing the inspection.

11.2.4 The inspector may, at his discretion, conduct any or all of the tests (Cl. 12.5), (Cl. 12.11) and (Cl. 12.12) for a particular lot. The manufacturer shall arrange for the test.

#### 11.2.5 Acceptance criteria.

11.2.5.1 If during dimensional verification of parts, assembly and interchangeability, any component fails to meet the requirement of this specification, twice the number of the same shall be taken and the tests repeated. If the component (s) fails to meet the requirement again, the lot shall be rejected. The manufacturer may sort out the defective pieces and offer the lot once again. Should there be any failure in the lot offered once again, the lot shall be rejected totally.

11.2.5.2 If the sample fails to meet the requirements of Cl. 12.10 twice the number of samples for same component/assembly shall be drawn and subject to the same test. Should the sample fail in the re-test, the lot of particular component will be rejected. The manufacturer may re-assembly the isolators using new components and offer once again for inspection.

#### 11.2.6 Routine tests.

11.2.6.1 The manufacturer shall carry out the following as routine tests.:

- i. Visual examination.
- ii. Dimensional verification of parts.
- iii. Assembly and interchangeability.

11.2.6.2 The manufacturer shall offer record of the routine tests and acceptance tests carried out by him to ensure quality of raw materials, to the inspector. Unless these are satisfactory, no acceptance test shall be carried out. Mention of routine tests and acceptance tests carried out by the manufacturer shall be made in the tests report and salient extracts reproduced.

### 12 TEST METHODS.

12.1 All components shall be visually examined to check that they are properly manufactured, do not have sharp edges and corners, the tubes are not crooked or bent and galvanisation of ferrous components is free from visible defects mentioned in Appendix 'A' of RDSO specification No. ETI/OHE/13 latest version. The finish of stainless steel fasteners and points shall be smooth and bright.

#### 12.2 Dimension verification

12.1 The components of the isolators, particularly.

- moving contact blade
- the spring of the fixed contact.
- The housing for fixing contact jaws on the post insulators.

The fixed and moving contact jaws, the operating shaft for the operating pipe and the contacts shall be checked with respect to the approved drawings. The components shall be in accordance with the approved drawings.

### 12.3 Assembly and interchangeability

12.3.1 The isolator shall be assembled, using the components picked up at random from different lots. No adjustments shall be required in any component to enable quick assembly of the isolator. After assembly the isolator shall function smoothly without any adjustments.

12.3.2 The components such as the housing for the fixed and moving contacts, the housing for the earth contact assembly shall then be interchanged to ensure that the components are fully interchangeable. Fixing of different components shall be without any difficulty and any special adjustment.

12.3.3 The dimensions of the isolator assembly, particularly the following critical ones shall be verified.:

- i. Minimum clearance between moving blade and the jaw of the fixed contact at free end when the isolator is open.
- ii. The clearance between the earth end of the operating rod insulator with both the live terminals in closed as well as open positions.
- iii. The travel of the moving blade with full travel of operating pipe.
- iv. The distance between the centers of all the holes of the isolator assembly for fixing it on the masts.
- v. When the isolator is in fully closed position the moving contact shall go home fully into the fixed contact and no portion shall remain projecting on the stopper.

### 12.4 Measurement of the resistance of the main circuit / earth circuit

12.4.1 This measurement is made for comparison between the isolator type tested for temperature rise and all other isolators of the same type subjected to acceptance tests.

12.4.2 The resistance shall be measured with direct current.

A direct current of any convenient value between 100 A and the rated normal current shall be passed through the circuit/earthing contact circuit as the case may be and the voltage drop between the two terminals of each pole of the isolator shall be measured to obtain the resistance at the ambient temperature. All values measured/obtained shall be recorded.

12.4.3 The measurement of resistance shall be made before the temperature rise test.

12.4.4 The tests shall also be conducted during acceptance test. The maximum value of resistance shall not exceed 1.5 times the resistance obtained during type tests or  $R \times T/t$ .

Whichever is lower, where-

R= Resistance obtained during type test.

T= Permissible temperature rise (35 deg. C)



t= Temperature rise obtained during type tests at hottest spot.

12.4.5 For the purpose of the acceptance test, the measurement of resistance may be made by using micro-ohm meter calibrated to the satisfaction of the inspector.

## 12.5 **Temperature rise test**

12.5.1 The test for temperature rise of main circuit shall be made on a new isolator with clean contact pieces. The isolator shall be mounted approximately as under usual service conditions, including all normal covers of any part of the isolator, and shall be protected against undue heating or cooling.

12.5.2 Temporary connections to the main circuit shall be such that no appreciable amount of heat is conducted away from or conveyed to the isolator during the test. In case of doubt, the temperature rise of the terminals of the main circuit and at temporary connections at a distance of 1 m from the terminal shall be measured. The difference of temperature shall not exceed 5 deg. C.

12.5.3 The test shall be made with the rated normal current of the isolator (i.e 1250 A for isolators for SSP and 1600 A for isolators to be used at FP and TSS) and at rated frequency (50 Hz) + 3%.

12.5.4 The duration of the test shall be made over a period of time sufficient for the temperature to reach a steady state i.e. when the variation of temperature does not exceed 1 deg. C per hour over three hours.

12.5.5 The temperature of the different parts shall be measured with thermometers, thermocouples or other suitable means, placed at the hottest accessible spot. The following precautions shall be taken when measuring with thermometers or thermocouples.:

- i. Thermocouples or the bulbs of thermometers shall be protected against being cooled from outside during the test. The protected surface area shall, however, be negligible when compared with the cooling surface of the part under test shall be insured.
- ii. Good heat conductivity between the bulb of the thermometers or thermocouples and the surface of the part under test shall be insured.
- iii. Alcohol thermometers shall used as they are accurate for such purposes.

12.5.6 The time for the whole test may be shortened by preheating the circuit with a higher value of current.

12.5.7 In case the temperature rise at any part of the isolator exceeds the values specified in Clause 5 (x), the isolator shall be deemed to have failed in the test.

## 12.6 **Mechanical endurance test.**



12.6.1 The mechanical endurance test shall be conducted in accordance with IS: 9921 (Pt IV) but the number of operating cycles shall be 5000 instead of 1000 as specified therein. The condition of all parts shall be satisfactory after the test. On successful completion, the test shall be continued upto 10000 cycles to determine the weak spots.

12.6.2 For this test, the isolator shall be complete with operating and locking mechanism etc.

12.7 Short time withstand current test.

12.7.1 The test shall be conducted at the current value specified in Clause 5 (viii) for 3s.

12.7.2 The arrangement for the test as shown in Annexure 'C' may be used, both for the single pole as well as for the double pole isolators and associated earthing switches. The distance x between the earthing terminals of the disconnecter and the nearest support of the test connections is equal to three times the distance between pole centres. The distance u and v are as small as possible but not less than y.

12.7.3 The a.c component of the test current shall be equal to the a.c. component of the rated short time withstand current of the isolator or earthing switch. The peak current shall be not less than the rated peak withstand current but shall not exceed it by more than 5% without the consent of the manufacturer.

12.7.4 The value of the test current and its duration shall be such that-

$$I_1^2 \cdot t_1 = I^2 \cdot T$$

Where-

$I_1$  = r.m.s component of test current measured in accordance with Appendix to IS: 9921 (Pt. IV) in A.

$I$  = r.m.s. component of specified short-time current in A ( 20,000A).

$t$  = Specification short-time current duration in seconds (3 s).

$t_1$  = Duration of current in s.

Note.: This test shall be conducted at Central Power Research Institute, Bangalore only, unless otherwise approved by RDSO.

12.7.5 During the test to prove its capability of carrying the rated peak withstand current and the rated short time withstand current, the isolator or earthing switch shall not show undue stress. After the test, the isolator or earthing switch shall not show any material deterioration and shall be capable of operating normally.

12.7.6 Visual inspection and no-load operation of the tested isolator or earthing switch are usually sufficient to check these requirements.

12.7.7 The test may be considered completed successfully if the isolator can be operated manually after tests. There should be no damage, which may affect its mechanical and electrical performance.

12.7.8 If after the test, there is any doubt about its current carrying capability, temperature rise test shall be made before the isolator is reconditioned. The value of temperature rise shall not exceed the figure in Clause 5 (x).

#### 12.8 Wet power frequency voltage withstand test.

12.8.1 The isolator and earthing switch shall be subjected to wet power frequency voltage withstand test in accordance with IS: 2071(Pt. I & II).

12.8.2 The test voltage shall be raised for each test condition to the rated withstand voltage, duly corrected for the ambient atmospheric conditions, specified in Cl. 5 (xii) and shall be maintained for 1 min. No disruptive discharge shall take place during the 1 min period.

12.8.3 The wet power frequency voltage withstand test shall be conducted in accordance with IS:2071 (Pt. I). However, if the water of prescribed resistivity can not be obtained, water of lower resistivity may be used, provided that the isolator passes the test. The actual value of resistivity of the water and the rate of precipitation (both horizontal and vertical components) shall be stated in the test report.

12.8.4 The test shall be conducted in following conditions.

- i. Between isolator and earth: With the isolator in the closed position, the test voltage shall be applied to one of the 25 kV terminals, the support frame-work and the other pole connected together and earthed.
- ii. Across isolating distance: With the isolator in the open position, the test voltage duly corrected for ambient conditions, shall be applied at the moving blade (s) and the other two terminals shall be connected to the earth of the testing transformer. The whole isolator shall be adequately insulated from the ground to prevent possibility of direct flashover.

Note: If the order is for both single pole and double pole isolators, these tests would be conducted on a double pole isolator with earthing switch.

#### 12.9 Lightning impulse voltage tests.

12.9.1 If the order is for both single pole and double pole isolators, this test shall be conducted on a double pole isolator with earth contact assembly. Isolator and earthing

switch shall be subjected to dry lightning impulse voltage test, with both positive and negative polarities using standard 1.2/50 macro-second lightning impulse according to IS: 2071 (Pt. I).

#### 12.9.2 Impulse voltage test between isolator and earth.

With the isolator in closed position and earthing switch open, 15 consecutive impulses of 250 kV duly corrected for the ambient atmospheric conditions, shall be applied between one terminal and the frame, the other pole being connected to the frame. The isolator shall be considered to have passed the test, if number of disruptive discharges to frame or to the adjacent pole does not exceed two.

#### 12.9.3 Impulse voltage test across isolating distance.

The isolator shall be in the open position. The frame-work shall be adequately insulated from earth so as to prevent any disruptive discharges direct to earth. Lightning impulse of 290 kV duly corrected for ambient conditions shall be applied to the moving blade (s). the remaining two terminals shall be connected to the earth. The isolator shall be deemed to have passed the test if there is no disruptive discharge to the opposite terminals.

#### 12.10 Galvanisation test.

12.10.1 In the type test, atleast two samples of each type of component which has been galvanized shall be tested for ensuring that the galvanizing done conforms to specification No. ETI/OHE/13 in regard to adherence, uniformity and mass of zinc coating. The mass of zinc coating shall be not less than  $610 \text{ g/m}^2$

12.10.2 In the acceptance test, one sample of each type of component which has been galvanised shall be tested for ensuring that the galvanising done conforms to specification No. ETI/OHE/13 in the in regard to adherence, uniformity and mass of zinc coating. The mass of zinc coating shall be not less than  $610 \text{ g/m}^2$

#### 12.11 Chemical analysis of materials.

12.11.1 The chemical analysis of phosphor bronze springs, copper tube/strips for moving and fixed contacts and stainless steel fasteners shall be conducted in accordance with IS: 7608, IS: 191 and RDSO specification No. ETI/OHE/18 as applicable. The material shall conform to the requirements specified.

12.11.2 Physical tests on the springs and on copper strips shall be conducted in accordance with IS:7906 (Part II) and IS: 1897 respectively.

#### 13.0 BULK MANUFACTURE

13.1 Only after clear written approval of the results of the tests on the prototype is communicated by RDSO/Chief electrical Engineer to the manufacturer, shall be take up bulk manufacture of the equipment – which shall be strictly with the same material and

process of manufacture as adopted for the prototype. In no circumstances shall material other than those approved in the designs/drawings and/or the prototype be used for bulk manufacture on the pleas that they had been obtained prior to the approval of the prototype.

13.2 If the prototype of an isolator and/or earthing switch conforming to this specification has been approved for earlier supplies to Indian Railways, testing of prototype again may be waived provided that no changes in the design or material (s) used or the process of manufacture have been made.

13.3 Technical data and drawing.

13.3.1 The tenderer shall furnish alongwith his offer the guaranteed performance, data and other particulars shall be complete in all respects. If there is any entry like shall be complete in all respects. If there is any entry like “shall be furnished later or blanks are left against any item of Schedule of guaranteed particulars, the tender is not likely to be considered as such omissions cause delay in finalizing the tender.

13.3.2 The information furnished in the Schedule of guaranteed technical, performance, data and other particulars shall be complete in all respects. If there is any entry like “shall be furnished later” or blanks are left against any item of Schedule of guaranteed particulars, the tender is not likely to be considered as such omissions cause delay in finalizing the tender.

13.3.3 Reports of the type tests, if conducted on the similar equipment shall also be furnished.

13.4 The tenderer shall specifically indicate in a statement attached with his offer, his compliance with each clause and sub-clause of this specification. If any vague remark on any clause or sub-clause of this specification is given by the tenderer, then the tender submitted by him is not likely to be considered. A separate deviation statement shall be furnished with the offer drawing attention to the clause (s) where the tenderer seeks deviation giving detailed remarks/justification thereof. If there are no deviations, a ‘NIL’ statement shall be furnished.

13.5 The tenderer shall furnish alongwith tender the following drawings:

- i) General arrangement drawings showing the outline dimensions of isolators and earthing switch (whenever provided).
- ii) Drawing for support insulators alongwith salient technical particulars.
- iii) Drawing for operating mechanism of main isolator.
- iv) Drawing for operating mechanism of earthing switch.

13.6 The manufacturer shall be required to submit the following detailed dimensioned drawings including drawings already mentioned in clause 8.5 above, as per Railways standards in size of 210 mmx297 mm or in integral multiple thereof, for approval:

- i. details of main contacts.
- ii. Details of earthing contacts.

- iii. Interlocking arrangement.
- iv. Castell type integral lock.
- v. mounting details of isolator.
- vi. terminal connector.
- vii. loads exerted by the isolator & earthing switch (wherever provided) for designing the mounting structure. This drawing should furnish complete information regarding loads and their point of application.

13.7 After approval, six copies of approved drawings alongwith two sets of reproducible prints shall be supplied to each consignee. Two copies of drawings alongwith one set of reproducible prints shall be supplied to the director general (TI), Research Designs and Standards Organisation, Manak Nagar, Lucknow – 226 011.

- i. Procedure for erection and precautions to be taken during the process.
- ii. The details of maintenance practices to be adopted under normal service conditions. The number of operations (or the period) after which different parts of isolator and/or earthing switch requires to be specifically attended to shall be indicated.
- iii. Procedure for overhauling of isolator and/or earthing switch.
- iv. Procedure for replacement of part, like contacts, subject to wear and tear and deterioration during service.
- v. List of spare parts required for 5 years maintenance
- vi. List of special tools required for maintenance/replacement
- vii. Lubrication instructions including type of lubricants and quantity to be used.

## 15. PACKING AND DESPARTCH

15.1 Various components of the isolator and/or earthing switch shall be securely packed in a proper manner in a wooden crate/box. It shall be ensured that one crate/box does not contain components of more than one complete isolator and/or earthing switch. A detailed packing list with weight and overall dimensions of the crate/box shall be furnished for each crate/box indicating the following:-

Crate/Box No.	Description of each component in the crate/box	Gross weight in kg.	Outside dimensions of crate/box.
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15. The weight of a crate/box containing all components shall be such that it can be manually handled conveniently by not more than two persons.

15.3 Necessary instructions for handling and storage shall also be furnished for use at the receiving end.

The specification supersedes Specification No. ETI/OHE/16 (10/86) Rev. 1.

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Annexure-A to Specification  
No. ETI/OHE/16 (1/94).

**SCHEDULE OF GUARANTEED PERFORMANCE DATA  
TECHNICAL AND OTHER PARTICULARS.**

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S. No.	Description	Unit of measurement/ data
1.	Name of manufacturer	
2.	Country of origin	
3.	Standard specification on which performance is based.	
4.	Manufacturer's type designation.	
5.	Rated voltage	kV
6.	Rated current a) Isolator b) Earthing switch	A A
7	Rated frequency	Hz.
8	Rated insulation level a) Rated one minute power frequency wet withstand voltage. i) To earth and between poles ii) Across isolating distance b) Rated on minute power frequency dry withstand voltage. i) To earth and between poles. ii) Across isolating distance. c) Standard lightning impulse (1.2/50 microsecond) withstand voltage- i) To earth and between poles. ii) cross isolating distance.	kV (rms) kV (rms)  kV (rms) kV (rms)  kVp kVp
9	a. Rated short time withstand current (for 3 seconds)- i) Isolator ii) Earthing switch b. Rated short time withstand current (for 1 sec.) i) Isolators ii) Earthing switch	kA (rms) kA (rms)  kA (rms) kA (rms)
10	Dynamic peak withstand current.: i) Isolator ii) Earthing switch.	kAP kAP

11	<p>Maximum temperature rise over an ambient temperature of 40 deg. C when carrying its rated current</p> <p>i) Copper contacts.  ii) Terminal pad of the isolator to be connected to terminal connectors by both.  iii) Metal parts action as spring.</p>	Deg. C
12	Breaking capacity of capacitate current at rated voltage.	A
13	Number of poles	Number
14	Number of breaks per pole	Number
15	Total length of break per pole	mm
16	Centre distance between poles	mm
17	<p>Minimum clearance in air</p> <p>a) Between poles  b) Between the live part and earth  c) Between open contacts of the same pole  d) Isolating distance</p>	<p>mm  mm  mm  mm</p>
18	<p>Contacts</p> <p>a) Material of the moving contact.  b) Material of the fixed contact.  c) Thickness of silver coating.  d) Contact pressure.</p>	<p>Micron.  kg.</p>
19	<p>Operating mechanism.</p> <p>a) Type  b) Can be fitted with power operated device.  c) Height of the operating handle hinge pin from ground level.  d) Weight of the operating mechanism.</p>	<p>m  kg</p>
20	<p>Insulator</p> <p>a) Name of manufacturer.  b) Type designation  c) Standard specification on which performance is based.  d) Number of stack.  e) Weight of one insulator.  f) Number of insulators used.  i) Support.  ii) Rotating/operating</p>	



	<p>g) Wet power frequency withstand voltage (1 minute)</p> <p>h) Dry power frequency withstand voltage (1minute).</p> <p>i) Visible discharge test voltage.</p> <p>j) Impulse withstand vottage</p> <p>k) Wet power frequency flashover voltage.</p> <p>l) Dry power frequency flashover voltage.</p> <p>m) Puncture voltage</p> <p>n) Minimum failing load in bending.</p> <p>o) Minimum failing load tension</p> <p>p) Minimum failing load in torsion.</p> <p>q) Minimum failing load in compression</p> <p>r) Creepage distance in air.</p> <p>s) Shed profile</p>	<p>kV(rms)</p> <p>kV (rms)</p>
21	Type of bearings used in the isolator.	
22	Type and material of terminals	
23	<p>Total weight</p> <p>i) Isolator</p> <p>ii) Earthing switch.</p>	
24	Number of closing and opening operations, the isolator can perform without deterioration of its contacts.	
<b>Additional information :</b>		
25	Is contact silver plated?	Yes/No.
26	Is pad locking arrangement for operating mechanism box provided?	Yes/No.
27	Is mounting arrangement for interlock (s) on isolator operating mechanism provided?	Yes/No
28	Is integral lock on earth mechanism provided?	Yes/No.
29	Is mounting arrangement for inter lock with asociated isolator provided?	Yes/No.
30	Is mechanical interlocking arrangement between earthing switch and the isolator provided?	Yes/No
31	Is the material of fasteners of 12 mm dia and below stainless steel?	Yes/No.
32	Is the material of fasteners above 12 mm dia galvanised stainless steel? If not, what is it?	Yes/No.
33	Is frame work for the isolator made of steel galvanised?	Yes/No



34	Two number each of earthing studs provided for – a) Isolator frame b) Earthing switch frame c) Operating mechanism box d) Earthing symbols provided	Yes/No.
35.	Is height of operating handle hinge pin in earthing switch from ground level 1.1 m?	Yes/No.
36	Is arrangement for keeping the operating handle for isolator in the operating mechanism box provide?	Yes/No
37	Can the isolator be converted to motor operated one shown for modification required? If	Yes/No.
38	Is the operating mechanism box for the isolator is weather, dust and vermin proof?	Yes/No.
39	Is open/Closed indicator provided for- a) Isolator b) Earthing switch	Yes/No
40	Is Padlocking provided for- a) Main rotating shaft of isolator b) Operating handle for earthing switch c) Lid cover for operating mechanism box.	Yes/No.
41	Are the bearings maintenance free.	Yes/No.

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