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GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

SPECIFICATION  
FOR  
25 KV SINGLE POLE, DOUBLE POLE,  
POLE MOUNTED, OUTDOOR  
VACUUM CIRCUIT BREAKER (VCB)  
AND  
VACUUM INTERRUPTER (BM)  
FOR  
INDIAN RAILWAY

SPECIFICATION NO. TI /SPC/PSI/LVCBIN/0120  
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## 1. SCOPE

1.1. This Specification applies to following, for use in Railway Traction Sub-Stations / SPs / SSPs, for controlling Power Supply to the 25kV AC 50 Hz single phase Traction Overhead Equipment and 2x25 kV AC 50 Hz AT Feeding System for Traction Overhead Equipment (OHE):

- 1.1.1. Outdoor Type Single Pole, Vacuum Circuit Breaker (CB) and Vacuum Interrupter (BM).
- 1.1.2. Outdoor Type Double Pole, Vacuum Circuit Breaker (CB) and Vacuum Interrupter (BM).
- 1.1.3. Outdoor Type Single Pole, Pole Mounted Vacuum Circuit Breaker (CB) and Vacuum Interrupter (BM).

1.2. This Specification supersedes the following Specifications:

Sl.No.	Specification No	Description
(i)	ETI / PSI /167 (9/ 97 ) with A&C Slip 1-2	25 kV, Single Pole, Outdoor Interrupter
(ii)	TI/SPC/PSI/CIRCUIT BREAKER/0000 with A&C Slip 1-5	Outdoor Circuit Breaker
(iii)	TI /SPC / PSI/ VACINT /0040	25 kV, Single Pole Outdoor Vacuum Interrupter with Magnetic Actuated Operating Mechanism
(iv)	TI/PSI/93(5/94)	25 kV, Single Pole SF <sub>6</sub> Circuit Breaker
(v)	ETI/PSI/46(9/94)	25 kV, Single Pole Vacuum Circuit Breaker
(vi)	ETI/ PSI/ 131(8/89)	25KV, Double Pole, Outdoor SF <sub>6</sub> Circuit Breaker for 2x25 KV AT Feeding System
(vii)	ETI/PSI/132 (8/ 89)	25KV, Double Pole, Outdoor, Vacuum Interrupter for 2x25 KV AT Feeding System
(viii)	ETI /PSI /139 (12/89)with A&C Slip No.1-4	25KV,Double Pole, Outdoor SF <sub>6</sub> Interrupter for 2x25 KV AT Feeding System
(ix)	ETI / PSI /159 (10 / 94)	25KV, Single Pole, Outdoor Pole Mounted, Vacuum Interrupter

1.3. The Vacuum Circuit Breaker/Interruptor shall be complete with all Parts, Fittings, Vacuum Bottle and accessories necessary for its efficient operation including mounting, frame work of steel. All such Parts, Fittings and Accessories shall be deemed to be within the scope of this Specification, whether specifically mentioned or not. The Vacuum Circuit Breaker/ Interrupter shall be of proven design. If there

is any additional change in design, it shall be advised by RDSO as and when the need arises.

- 1.4. The Vacuum Circuit Breaker/Interruptor shall be erected by the Purchaser. However, in case a defect / deficiency are noticed, the manufacturer / successful Tenderer shall have to depute their Engineer for necessary remedial action without any cost to the Railways. In all the cases, in which an order is placed either on new Manufacturer or for a new type/ design of Vacuum Circuit Breaker/Interruptor, the services of Manufacture's Engineer shall be made available, free of cost, during the erection and proving / pre-commissioning test for the first order of their Vacuum Circuit Breaker / Interruptor. For this purpose, prior intimation regarding the date and the location shall be intimated by the purchaser to the successful Tenderer / manufacturer.

## 2. Governing Standards, Specification

- 2.1. The Vacuum Circuit Breaker/Interruptor shall unless otherwise specified herein, conform to the "following Specifications and Indian Electricity Rules, wherever applicable, in line with Standard Engineering Practice, unless specifically brought forth:

Sl.No.	IS/IEC/RDSO Specification	Description
(i)	IEC: 62271-1(2007)+A1:2011	High Voltage Alternating Current Circuit Breaker -General
(ii)	IEC: 62271-100 (2008)+A1:2012	High Voltage Alternating Current Circuit Breaker
(iii)	IEC 62271-104 (2009)	Common clauses for High Voltage Switchgear and Control Gear Standards.
(iv)	IS: 456(1978)	Code of Practice for plain and reinforced Concrete.
(v)	IS: 996(1979)	Specification for Single Phase Small AC and Universal Electric Motors.
(vi)	IS: 2099(1973)	Specification for Bushing for Alternating Voltages above 1000V
(vii)	IS: 2544(1979)	Specification for Porcelain Post Insulators for System with nominal voltages greater than 1000 Volts.
(viii)	IS: 5561(1978)	Specification for Electric Power Connectors.
(ix)	IS: 5621(1980)	Specification for Hollow Insulators for use In Electric Equipment.
(x)	IS:13947(Part-V-2004)	Specification for Control Switches (Switching Device Control and Auxiliary Circuits including contactor Relay) for Voltages up to and including 1000 V AC and 1200 DC-

		General requirements and Tests
(xi)	IS: 7906(Pt. I-1976)	Specification for Helical Extension Springs
(xii)	IS: 7907(Pt. I-1976)	Specification for Helical Extension springs
(xiii)	IS: 13118 (1991)	Specification for high voltage Alternating Current Circuit Breakers.
(xiv)	IS: 1554(Pt. V-1988)/ IS:694/90	Specification for PVC Insulated Electric Cables for working voltage up to including 1100 Volts
(xv)	IS: 808(1989)	Dimension for Hot Rolled Steel Beam, Column Channel and Angle Sections.
(xvi)	IEC-60529-1989/ IS:13947(Part-1) 1993 & latest	Degree of Protection provided by Enclosures for Low Voltage Switchgear.
(xvii)	RDSO Specification NO.ETI/OHE/13(4/84) with A&C Slip No.1to3	For Hot Dip Galvanization.
(xviii)	RDSO Specification No.ETI/OHE/18(4/84) with A&C Slip No.1to4	For Steel and Stainless Steel Bolts, Nuts and Washers
(xix)	RDSO Specification No. M&C/PCN-102/ 2009	For Epoxy Bases Zinc Phosphate Primer(Two Pack)
(xx)	RDSO Specification No.M&C/PCN-110/ 2006	For Polyurethane based Aluminium Paint ( three pack)
(xxi)	IS 9920	Specification for Alternating Current Switches above 1000 Volts.
(xxii)	IS 2633 (1972)	Method of Testing uniformity of Zinc Coated Articles
(xxiii)	AC Traction manual	(Issued in 1994)

2.2. Any deviation from this Specification as proposed by the Tenderer to improve upon the performance, utility and efficiency of the Equipment shall be given due consideration, provided full particulars of the deviation along with justification are furnished thereof; subject to approval of RDSO. In case of any contradiction between the provision of the Indian Standards/IEC standards and this Specification, the latter shall prevail.

### 3. DUTIES OF THE VACUUM CIRCUIT BREAKER AND INTERRUPTER

#### 3.1. DUTIES OF THE VACUUM CIRCUIT BREAKER

3.1.1. The Vacuum Circuit Breaker is used at the following locations in the 25 kV AC, 50Hz Traction System.

- (i) As 25 kV Transformer VCB on the secondary side of Traction Power Transformer
- (ii) As 25 kV Feeder VCB for controlling Power Supply to Overhead Equipment through Interrupters
- (iii) As 25 kV Shunt Capacitor Bank VCB for controlling Power Supply to Shunt Capacitor Bank
- (iv) For controlling 25 kV Power Supply to major yard or Electric Loco Sheds

3.1.2. SPECIAL DUTY TO BE PERFORMED BY 25 kV Vacuum Circuit Breaker

- (i) The 25 kV VCB shall be called upon to trip under Short- Circuit conditions. On an average, the number of fault tripping seen by the Feeder Vacuum Circuit Breaker per month is about 40, but in exceptional cases the number of fault trappings per month may go as high as 120 numbers. The magnitude of short circuit current to be interrupted is generally in the range of 2 kA to 8 kA. The, VCB shall also be called upon to clear Wrong Phase Coupling on the OHE when two Sections of the OHE fed by different Phases from adjacent Traction Sub-Station are accidentally shorted.
- (ii) The design and construction of the 25 kV VCB shall be such that it is capable of a cumulative duty  $nI^2$  (where 'n' is the number of 'C - O' Operations at a current of I kA rms) of 20,000  $kA^2$  in service without adjustment/ change of any part/ contacts of Vacuum Bottle.  
Lubrications and tightening of moving parts in the Operating Mechanism and cleaning of Porcelain Insulators can, however, be done as per Manufacturer's recommendations.
- (iii) Manufacturer shall supply graphs, in support of suitability of offered Vacuum Circuit Breaker, to perform above duties at the tender stage, indicating the cumulative duty which can be performed by offered Vacuum Circuit Breaker without any maintenance/ replacement of any components.
- (iv) 25 kV VCB is also required to interrupt the line charging and magnetising current of locomotive transformers without restrike. Values of line charging current are of the order of 10 A and values of magnetising current for locomotive/ EMU are likely to be as under:
  - (a) Locomotive - 6.38 A
  - (b) EMU - 6.0 A

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- (v) The 25kV VCB are normally operated through Remote Control. A single shot Auto re-closing scheme shall be provided to facilitate for re-closing of the VCB automatically, once, within the preset "dead time" after the tripping of the VCB on an OHE faults. This feature helps in quick restoration of Power Supply to the OHE if the fault is of a transient nature. The "Dead Time" is the periods taken by the Auto re-closure mechanism to close the VCB after the same has tripped on fault and is set at 0.5 second.

### 3.2. DUTIES OF VACUUM INTERRUPTER

- 3.2.1. The Interrupter is used at the following locations in the 25 kV AC 50 Hz, Traction Systems: -
  - (i) As Sectioning Interrupter at Sub Sectioning and Paralleling Posts (SSP)
  - (ii) As Paralleling Interrupter at Sectioning Post (SP) and Sub Sectioning and Paralleling Post (SSP)
  - (iii) As Bridging Interrupter at Sectioning Post (SP) and
  - (iv) As Feeding Interrupter at Feeding Post (FP)
  - (v) As Bus Coupler Interrupter at Traction Sub Station (TSS)
  - (vi) For controlling Power Supply to Major Yards / Loco Sheds
- 3.2.2. The Interrupter is called up on to perform the following duties: -
  - (i) Carrying short circuit current.
  - (ii) Making and Breaking Traction load currents from very low Capacitive or Inductive Current to Rated Normal Current.
  - (iii) Carrying normal rated current continuously.
  - (iv) Carrying short circuit current until the fault is cleared by the Vacuum Circuit Breaker up- stream.
- 3.2.3. The Vacuum Circuit Breaker/Interruptor would be subjected to vibrations on account of trains running on nearby Railway Tracks. The amplitude of these vibrations which occur with rapidly varying time periods are in the range of 15ms to 70ms lie

in the range of 30 to 150 microns at present, with the instantaneous peak going up to 350 microns.

#### 4. TECHNICAL SPECIFICATION

4.1. The VCB shall be designed for the following rating and other Particulars:

Sl. No.	Particulars	RATED SYSTEM VOLTAGE (kV)					
		Vacuum Circuit Breaker			Vacuum Interrupter		
		25kV SP	2x25 DP	25kV Single Pole Mounted	25kV SP	2x25 kV DP	25kV Pole Mounted
(i)	No. of Poles	1	2	1	1	2	1
(ii)	Nominal system voltage(kV)	25kV subject to variation from 19kV to 27.5kV occasionally touching 30kV					
(iii)	Rated voltage(kV)	-----52 kV-----					
(iv)	Rated insulation level	-----95 kV(rms)-----					
	(a) Rated 1min wet power frequency withstand voltage	-----250 kV(peak)-----					
	(b) Rated impulse (1.2/50µs) withstand voltage						
(v)	Rated frequency	-----50Hz ± 3%-----					
(vi)	Rated normal Current	2000A			1600A/2000A		
(vii)	Rated short circuit breaking current	20 kA	20 kA	20 kA	----- NA -----		
(viii)	Rated breaking capacity (symmetrical)	550 MVA	550 MVA	550 MVA	----- NA -----		
(ix)	Out of phase breaking current	-----5 kA(rms)-----			-----NA-----		
(x)	Rated single capacitor bank breaking current	-----150A-----			-----NA-----		
(xi)	Rated line charging breaking current	----- 10A -----					
(xii)	Rated small inductive breaking	----- 10A -----					



	current						
(xiii)	Rated making current	---- 50kA (peak)-----			20 kA	20kA	20 kA
(xiv)	Rated operating sequence	O - 0.3s – CO – 15 sec– CO			CO – 15 sec- CO		
(xv)	Total beak Time	---Not more than 80ms---			---Not more than 90ms----		
(xvi)	Rated short time current	-----20kA for 3 sec-----			8 kA for 3 sec	8kA for3 sec	8 kA for 3 sec
(xvii)	First pole to clear factor	NA	1.5 for 2 parameters	NA	NA	1.5 for 2 param eters	NA
(xviii)	Rating of auxiliariy switch contacts						
	(a) Rated voltage	----- 110 V DC -----					
	(b) Rated current (continuous)	----- 10 Amps -----					
	(c) Rated breaking current	- 2 A at 220V DC with 20 ms circuit time constant --					

#### 4.2. CLEARANCES

The design of the Vacuum Circuit Breaker/Interruptor shall be such that when it is erected on the Supporting Structure, the following clearances / distance of lowest live part of the Vacuum Circuit Breaker/Interruptor from the ground level or earth is achieved:

Sl. No.	Clearance/distance	22/25KV
(i)	Minimum height of lowest live part of the VCB/BM from ground level	3800 mm
(ii)	From a point where a man may be required to stand for operation or for attending the breaker (sectional clearance).	3000 mm
(iii)	Minimum height of the bottom most part of any insulator from the ground level.	2500 mm
(iv)	Minimum clearance between live part and earth part.	500 mm
(v)	Distance between pole centers for 2 poles	1500 mm

## 5. TYPE AND GENERAL CONSTRUCTION

### 5.1. Design and Construction

- 5.1.1. Vacuum Circuit Breaker/Interruptor shall be such that it is capable of performing following, in service operations, without adjustment /change of any part/contacts of Vacuum Bottle. Lubrication / Adjustments / Tightening of moving parts in the operating mechanism and cleaning of Porcelain insulators can be done as per Manufacturer's recommendation.

Sl.No.	Equipment Name	No. of operations	
		Mechanism	Vacuum Bottle
1.	25kV SP / DP /Pole Mounted Vacuum Circuit Breaker/ Interruptor with spring spring operating mechanism.	10,000	20,000
2.	25kV SP / DP /Pole Mounted Vacuum Circuit Breaker/ Interruptor with magnetic Actuated Operating Mechanism.	20,000	20,000

- 5.1.2. The Vacuum Circuit Breaker/Interruptor shall be of outdoor type suitable for mounting on steel structure /Pole. The 25 kV Vacuum Circuit Breaker/Interruptor shall be of Single Pole or Double Pole identical to single pole unit operated through common / two operating mechanisms suitably connected for instep operation. The Vacuum Circuit Breaker/Interruptor shall comprise of

- (i) The pole (Interrupting chamber and Hollow Insulators)
- (ii) Operating mechanism (cubicle / cubicles) and
- (iii) Mounting Steel Frame suitable for mounting on Foundation/Pole

### 5.2. THE POLE (INTERRUPTING CHAMBER AND HOLLOW INSULATORS)

#### (a) INTERRUPTING CHAMBER

The operating mechanism (spring-spring or magnetic actuator ), the pole assembly and supporting structure of Vacuum Circuit Breaker/Interrupter shall preferably be separate and erected in sequence and can be capable of being packed and handled individually and erected in sequence or in single unit. The pole shall comprise the

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interrupting chamber and the hollow insulator. The interrupting chamber shall consist of Vacuum Bottle contained in porcelain hollow insulator. The Vacuum Bottle shall comprise a vessel sealed for life time with insulating side walls and metal ends containing the fixed and moving contacts. The movement of the moving contact in the vacuum enclosure shall be guided by means of metal bellows. Suitable metallic shields shall be provided for preventing heat and metal vapor from arcing zone affecting the insulating envelope. These shields will also control the electric field when contacts are open and voltage is appearing across the Vacuum Circuit Breaker/Interrupter contacts. This will mask high internal stress points and produce an almost linear axial grading of the external insulating surfaces. A shield shall also be provided to protect the bellows. The design and construction of Vacuum Bottle of the Vacuum Circuit Breaker/Interrupter shall be such that the current chopping level is kept to the minimum and shall not produce any appreciable switching over voltages.

(b) HOLLOW INSULATOR

The Porcelain/Composite Hollow Insulators, used as the support insulators and interrupting chamber insulator for the Vacuum Circuit Breaker/Interrupter, shall be outdoor type conforming to IS: 5621: 1980. The Hollow Insulator shall be of single piece construction i.e. there shall be no joint. The shed profile shall have a lip at the extremity but free from ribs on the underside so as to avoid accumulation of dust and pollutants and permit easy cleaning. These insulators shall be procured from reputed sources only. The Test Certificate of these shall be verified during Prototype Testing. Vacuum Circuit Breaker/Interrupter manufacturer shall declare make of the Hollow Insulator used in QAP and SOGP (to be approved by RDSO). Both the hollow insulators for the support and interrupting chamber shall have a minimum creepage distance of 1300 mm.

(c) TERMINAL CONNECTORS

The Vacuum Circuit Breaker/Interruptor shall have Aluminum Terminal Pads and shall be Supplied with the flexible Terminal connectors, as per RDSO Drawing No.ETI/PSI/11060 Mod 'E' and ETI/PSI/P/6570 Mod 'F' , suitable for connection to 80 mm/ 50 mm / 36 mm outside diameter Aluminum Tubular Bus Bar for 25kV Vacuum Circuit Breaker/Interrupter respectively.

(d) The Connectors shall conform to IS:5561-1978 / RDSO approved Design shall be such, so as to be connected to the equipment Terminal Pads, with minimum four 12 mm diameter Bolts, Nuts,Lock-Nuts of stainless steel conforming to IS: 1570(Pt.V)- 1978 grade 04Cr,17Ni and Mo2.Each of these bolts shall have two flat washers.

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(e) CONTACTS FOR BOTH VACUUM CIRCUIT BREAKER / INTERRUPTER

(i) MAIN CONTACTS

The main, fixed and moving contacts of the Vacuum Circuit Breaker/Interrupter shall have ample cross-section and contact pressure for carrying the rated current and short time current without excessive temperature rise, pitting and welding. Internal arcing contacts of Vacuum Bottle shall be made of suitable material.

Suitable means for checking the contact wear condition shall be provided.

(ii) AUXILIARY SWITCH CONTACTS

Apart from the Auxiliary Switch, contacts required exclusively by the manufacturer for the functioning of the Vacuum Circuit Breaker/Interrupter. At least 6 pairs of normally open (NO) contacts and 6 pairs of normally closed (NC) contacts shall be provided additionally for the exclusive use of the purchaser. The Auxiliary contacts, which are operated in conjunction with the main contacts, shall be positively driven in both the directions.

5.3. OPERATING MECHANISM CUBICLE / CUBICLES

(a) SPRING-SPRING TYPE OPERATING MECHANISM

(i) The Vacuum Circuit Breaker/Interrupter shall be operated by a motor charged by spring's stored energy. Both opening and closing operations shall be done by the stored energy of spring (s). The motor shall be so rated that the time required for fully charging the closing spring is not more than 15 seconds. The closing action of the Vacuum Circuit Breaker shall charge the opening spring so that the Vacuum Circuit Breaker is ready for opening, at any time thereafter. The spring shall be of robust design, using tested steel as per IS: 7906-Pt. I-1976 or IS: 7907-Pt.I-1976. The ends of the compression springs, if used, shall be flattened to enable proper fixing and shall minimise the possibility of misalignment.

(ii) The motor for spring charging shall be suitable for operation on 110V DC power from a Battery. The voltage at motor terminal is likely to vary between 110% and 85% of the normal value. The Carbon brushes, shall have copper pigtailed for carrying motor current. A miniature Circuit Breaker / HRC Fuses, of adequate ratings and of reputed make, shall be provided in the motor circuit for protection of the motor against over current and earth faults.

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(b) MAGNETIC ACTUATOR BASED OPERATING MECHANISM

The Magnetic Actuator mechanism shall be provided with two well designed magnetic coils /solenoids; one for closing and other for the tripping operations. The latching of mechanism in its two end positions shall be ensured by specially designed, permanent magnets, designed to operate with minimum hysteresis loss. The Tenderer shall indicate the maximum service temperature i.e., the maximum temperature to which the magnet may be exposed with no significant long range instability or structural changes and Curie temperature i.e., the transition temperature above which material loses its magnetic properties. The temperature rise expected to be attained by the magnets during service shall be indicated by the Tenderer. Supplier's catalogs / test certificate for this have to be furnished.

The Vacuum Circuit Breaker shall be provided with arrangements for trip and close circuits to be compatible with either 110 Volt DC potential or potential free contacts from Control and Relay Panel. This feature shall enable use of this Vacuum Circuit Breaker/Interruptor in place of existing Vacuum Circuit Breaker/Interruptor, where potential free contacts do not exist.

- (c) The operating mechanism shall be designed so that the Vacuum Circuit Breaker/Interruptor can be operated from the operating mechanism cubicle itself as well as remotely from the Control Panel of the Traction Sub-station and also from the Remote Control Centre (RCC), which is situated away from the Vacuum Circuit Breaker/Interruptor.

For this purpose 'LOCAL/REMOTE' two way Selector switch shall be provided in the operating mechanism cubicle. When the switch is in the 'LOCAL' position, the Vacuum Circuit Breaker/Interruptor can be operated locally and when it is in the 'REMOTE' position the Vacuum Circuit Breaker/Interruptor can be operated from the Control Panel or from the Remote Control Centre. The Selector switch shall be spring loaded for snap action and stay put type so that it stays to the 'LOCAL' or 'REMOTE' position.

For closing and opening the Vacuum Circuit Breaker/Interruptor from the Operating Mechanism cubicle itself, the Switch shall be of the Push Button type or Knob type.

- (d) The operating mechanism shall also be provided with a suitable emergency device to manually open the Vacuum Circuit Breaker/Interruptor in the failure of any part of DC control circuit including the opening coil in the operating Mechanism.

- (e) The operating mechanism shall also be provided with a suitable device to close the Vacuum Circuit Breaker/Interruptor in spring-spring operating mechanism manually. In addition, a detachable handle/crank shall be provided for manual charging the closing spring. The height from ground/ platform level at which the handle/ crank is to

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be inserted in the operating mechanism shall be between 1500 mm and 2000 mm so as to enable its operation conveniently by the operator standing on the round/Platform. The height of other devices like interlock, ON-OFF switches, selector switches etc. to be operated from ground/ Platform. Platform shall also be at a height between 1500 mm and 2000 mm.

- (f) In addition to the manually operated local mechanical opening and Closing devices as indicated in clause d & e above, provision shall also be made by means of a suitable crank or handle for slow closing and slow opening of the Vacuum Circuit Breaker/Interruptor in spring-spring operating mechanism for Maintenance purposes.
- (g) The closing coil and opening coil in the operating mechanism shall be suitable for operation from 110V dc power supply from a battery. The closing coil shall be suitable for operating at a Voltage variation of +10% to -15%, while the opening coil shall be suitable for operating at a voltage variation of +10% to -30%.
- (h) The VCB shall be fitted with an electrical anti-pumping device, to give priority to tripping command in case of a persisting closing Command being simultaneously present.
- (i) Facility for trip circuit supervision shall be provided in Control Panel of TSS with indication to Remote location (RCC) in Vacuum Circuit Breaker.
- (j) An operation counter having minimum five digit recording mechanism for the number of tripping operation shall be provided at a suitable place so as to be conveniently read by the operator standing on the Ground. The operation counter shall be of lock type and shall not have reset.
- (k) Mechanical indicators clearly visible from ground shall be provided for 'CLOSED' and 'OPEN' conditions of the Vacuum Circuit Breaker / Interrupter.
- (l) All working parts of the operating mechanism shall be of Corrosion Resisting Material. Bearings, if any, shall be sealed type. Bearing pins, bolts, nuts and other parts shall be adequately locked to prevent loosening.
- (m) In case operation of closing device when Vacuum Circuit Breaker is already in "CLOSED" Condition shall not cause damage to any part of the Vacuum Circuit Breaker or endanger the Operator standing near the Vacuum Circuit Breaker. The Average Power requirement for Tripping coil / Closing coil in Spring-Spring Mechanism shall not exceed 200 W and Power Requirement at any time including Spring

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Charging / Capacitor Charging in spring – spring / Magnetic Actuator Mechanism shall not exceed 1000 W.

- (n) In the event of 110V battery supply voltage dropping below  $85V \pm 3$  Volts which is the minimum voltage prescribed for operation of Tripping coil to trip the Vacuum Circuit Breaker, the Vacuum Circuit Breaker should Trip automatically by means of a suitable arrangement like Capacitive Trip Device(CTD).
- (o) Shock absorbers used (if any) shall not require any maintenance during the entire life of the Vacuum Circuit Breaker / Interrupter
- (p) The operating mechanism and associated accessories shall be enclosed in weather proof, dust proof and vermin proof cabinet or cubicle. The cubicle made of at least 2 mm thick sheet steel (of tested quality) with provision for pad locking. Alternatively minimum 3 mm for load bearing members and bottom, 2 mm for top and 1.6 mm for side covers. The cubicle shall be tested for dust and water proofing as per IP55 and as per IEC: 60529-1989/IS: 13947(Part-1)1993 or latest from any national laboratory.
- (q) Suitable heaters(s) shall be provided in operating mechanism cubicle to operate at 240V ac, 50Hz single phase supply to prevent condensation of moisture during monsoon/ winter. A 240V ac, 5A, 3 pin socket outlet for an inspection lamp shall also be provided. Miniature Circuit Breaker/ Switch with thermostat of reputed make and of adequate rating shall be used for protection of heater circuit for overload and earth fault.
- (r) The entry of all cables into the operating mechanism cubicle shall be only through suitable cable glands which shall not allow ingress of vermin etc. into the cubicle. The cable glands shall be supplied with the Vacuum Circuit Breaker/Interrupter. Five cable glands shall be provided of which three shall be of 16.5 mm outside diameter while the Balance two glands shall be for cable of 14 mm outside diameter.
- (s) The wiring inside the operating mechanism cubicle shall be with 1100 V grade PVC insulated single core / multistrand cable conforming to IS: 1554 (Pt. I- 1988) or IS 694 (2010), with stranded copper conductors of adequate cross-section (with min 2.5 sq.mm strand copper) so proportioned as to reduce voltage drop and  $I^2R$  losses to minimum. Wiring for electronic controller & proximity switches shall be of 660V grade insulation with stranded copper conductor with at least 0.5 sq. mm cross section. The ends of wires shall be terminated with crimped eye type lugs or without crimping in self-locking spring loaded terminal blocks. The wiring of 110V dc control circuit and 240V ac circuit shall be segregated and properly identified. The positive and negative wires of dc circuits shall also be segregated. The length of the cables used shall be kept to the minimum. Wire inside the cubicle

shall be properly laid on trays or anchored to avoid breakage during vibration.

- (t) The terminal end of all wires shall be provided with numbered interlock type Ferrules which shall be of PVC or other durable material with marking (numbers) either engraved or punched so as to be indelible. The ferrules shall be of white/yellow color with lettering thereon black. All wiring shall be properly supported and suitably protected to avoid rubbing against any Metallic part.
- (u) Terminal blocks of standard type shall be provided in the operating mechanism. There shall be insulating barriers between adjacent terminals. The terminals shall be stud type with spring washers/self-locking spring loaded type. Suitable dust proof shrouds of unbreakable transparent material shall be provided on each stud type terminal block. The terminal blocks used for DC and AC circuits shall be clearly distinguished and separated from each other. Similarly positive and negative Terminations of the wiring of the dc circuit shall be segregated and Separated by insulating barriers.
- (v) For earthing of the operating mechanism cubicle, two earthing terminals of adequate capacity to carry the rated short circuit current shall be provided with 17.5 +0.5/-00 mm diameter stud/hole for fixing the Earthing Flat.

## 6. STEEL SUPPORTING FRAME

- 6.1. The steel supporting frame for Vacuum Circuit Breaker/Interruptor shall be designed with a factor of safety not less than 2.5 with respect to the yield point under conditions of maximum loading for a basic wind pressure of 200 kg/m<sup>2</sup> on 1.5 times the projected area of each member of one face and taking into account to IS: 808 (1989) and test certificate shall be furnished to RDSO. The required fixing distance for steel supporting frame on the foundation is tabulated below:

Type of Breaker	Type of Structure	Dimension
Single Pole	Single Vertical	650 x 725 mm
Double Pole	Double Vertical	650 x 725 mm
Double Pole	Single Vertical	300 x 300 mm

In any case, design shall require prior approval of RDSO.

- 6.2. Typical design calculations for the steel supporting frame shall be furnished by the manufacturer to the RDSO during design approval stage for checking the safety of the supporting frame proposed to be used.
- 6.3. For earthing at least 2 legs of the steel supporting frame shall be provided with stud/hole type earthing terminals of adequate capacity



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to carry the rated short circuit current safely. The earthing shall be provided with 50 x 8 mm MS flat. The terminal shall be provided with 17.5 +0.5mm diameter stud/hole for fixing the earthing flat.

## 7. FOUNDATIONS

Gravity foundation of plain mass concrete to M10 mix as per IS: 456 (2000) shall be designed considering the normal impact loading in opening/closing operations. The basic wind pressure shall be taken as 200 kgf/m<sup>2</sup>. Two alternative design of foundations, one for a normal soil of bearing capacity 5500 kgf/m<sup>2</sup> and other for black-cotton soil of bearing capacity 16500 kgf/m<sup>2</sup> shall be furnished by the manufacturer. The foundation block design shall give complete details of its size and size of pockets provided for grouting the fixing bolts. Detailed design calculation for proposed foundation shall be submitted to DG (TI) RDSO for scrutiny and approval.

## 8. FOOT PRINTS AND FOUNDATION

The dimension of steel frame has to match with the sketch no. TI/DRG/PSI/25KVCIRCUIT BREAKERINT/COMFDN/00365/Rev.0. This is to facilitate common foundation and interchangeability of interrupters of different makes.

## 9. POLE (MAST) FOR POLE MOUNTED CIRCUIT BREAKER/INTERRUPTER

- 9.1. The pole (mast) for mounting the Interrupter shall be either steel Mast or a round tapered prestressed spun concrete mast. The detail of pole (mast) for mounting the Interrupter shall be supplied by the purchaser. Mounting Brackets of the Pole Mounted Vacuum Circuit Breaker/Interrupter shall form the part of in the scope of supply of Vacuum Circuit Breaker/Interrupter. Bracket shall be suitable for mounting on the Mast.
- 9.2. Typical design calculations shall be furnished by the manufacturer for checking the safety of the pole (mast) proposed to be used. The design calculation for steel mast shall be based on a factor of safety of not less than 1.67 with respect to the yield point under conditions of maximum loading allowing for a basic wind pressure of 200kgf/m<sup>2</sup> on 1.5 times the projected area of each member of one face and taking into account the dead and impact loads of Interrupter/Vacuum Circuit Breaker.

## 10. CORROSION PREVENTION SYSTEM

### 10.1. GALVANIZING

The operating mechanism cubicle and steel supporting frame shall be hot dip galvanized in accordance with RDSO Specification

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No.ETI/OHE/13(4/84) with A&C Slip No.1 to 3 and the weight of zinc coating shall not be less than 1000 gm/m<sup>2</sup>.

## 10.2. PAINTING

If the successful tenderer/manufacturer is not able to hot dip Galvanize the operating mechanism cubicle and the steel supporting Frame as per Clause 10.1, it shall be painted conforming to RDSO's Specification No. M&C/PCN/ 110/2006 for polyurethane based aluminum paint (three packs) and Specification no. M&C/PCN/102/2009 for epoxy based zinc phosphate primer (two packs).

## 10.3. FASTENERS

All fasteners of 12 mm diameter and less exposed to atmosphere shall be of stainless steel and those above 12 mm diameter shall be of preferably stainless steel or of mild steel hot dip galvanized, to RDSO's Specification No. ETI/OHE/18(4/84) With A&C Slip No.1 to 4.

## 11. PARTS, FITTINGS AND ACCESSORIES

11.1. The following parts, fittings and accessories shall be provided for each Circuit Breaker/Interrupter:

- (i) Contacts wear indication as per Clause No. 5.3 (d).
- (ii) Operating mechanism cubicle door padlocking arrangement with padlock.
- (iii) Local operated mechanical opening and closing device for spring-spring operating mechanism.
- (iv) Local/Remote Selector Switch as per Clause No. 5.3(c).
- (v) Local operated electrical closing and opening device (push or knob).
- (vi) Operation counter.
- (vii) Interlocking device (as required)
- (viii) Terminal connectors.
- (ix) Earthing terminals
- (x) Name/ rating plate.
- (xi) Mechanical 'ON' and 'OFF' position indicators.

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- (xii) Handle/crank for closing and opening of Vacuum Circuit Breaker/Interruptor for spring-spring operating mechanism.
- (xiii) Supporting frame work.
- (xiv) Tripping device in case of  $85 \text{ V} \pm 3 \text{ V}$ , DC failure (CTD) for Vacuum Circuit Breaker
- (xv) Anti-pumping device.
- (xvi) Foundation Bolts.
- (xvii) Handle/crank for charging the closing spring manually for spring-spring operating mechanism.

11.2. Each Vacuum Circuit Breaker/ Interrupter shall be provided with rating plates (Hindi /English) of weather proof material fitted in a visible position showing the items Indicated below. The letters/numbers on the plate shall be indelibly marked by etching/engraving.

- (i) Manufacturer's name and country of origin.
- (ii) Type designation and no. of pole.
- (iii) Serial number
- (iv) Rated voltage
- (v) Rated normal current
- (vi) Rated frequency
- (vii) Rated short circuit breaking current.
- (viii) Rated short circuit peak making current
- (ix) Rated single capacitor bank breaking current
- (x) Rated out of phase breaking current.
- (xi) Rated short time withstand current and its duration.
- (xii) Rated insulation level.
- (xiii) Rated operating sequence.
- (xiv) Control circuit voltage with permissible variation for
  - (a) Closing coil
  - (b) Opening coil

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(c) Motor voltage

(xv) Total weight of Circuit Breaker/Interrupter

(xvi) Specification conforming to

(xvii) Vacuum level in Torr

(xviii) Order reference

(xix) Month/Year of manufacture

## 12. TESTING

### 12.1. GENERAL

#### 12.1.1. BEFORE MANUFACTURE OF PROTOTYPE

The successful Tenderer has to offer drawing & design for approval of RDSO including QAP, SOGP, and Design Calculations as required and mentioned in relevant Clauses of Specification.

Only after all submitted documents have been approved and clearance given to this effect by RDSO, the manufacturer shall take up manufacture of the prototype for inspection/testing by RDSO. It is to be clearly understood that any changes to be done on the prototype as required by RDSO, the same shall be done expeditiously.

#### 12.1.2. PROCEDURE FOR OFFERING PROTOTYPE

Prior to giving a call to the Purchaser/Director General Traction Installations, Research Designs and Standards Organization, Lucknow(DG/TI/RDSO, Lucknow) for inspection and testing of the prototype, the successful Tenderer/manufacturer shall submit a detailed test protocol consisting of list of tests, test procedures with schematic circuit diagrams items/ parameters to be checked and values required as per Specification for each of the tests and the number of days required to complete all the tests at one stretch.

The schedule shall also indicate the venue of each of the test. Once the schedule is approved, the test shall invariably be done accordingly.

However, during the process of type testing or even later, the Purchaser/DG/TI/RDSO, Lucknow reserves the right to conduct any additional test(s), besides those specified herein, on any equipment so as to test the equipment/ item to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement arises between the successful Tenderer/manufacturer and the representative of

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Purchaser/ DG /TI/ RDSO , Lucknow during the process of testing as regards the procedure for type tests and for the interpretation and acceptability of the results of type tests. It shall be brought to the notice of the DG/TI/ RDSO, Lucknow whose decision shall be final and binding. Only after the prototype of the equipment is manufactured and ready in all respects, shall the successful Tenderer/manufacturer give the actual call for the inspection and testing with at least 15 days' notice for the purpose.

- 12.1.3. In the event of the test not being carried through to completion at one stretch for any reason attributable to the successful Tenderer /manufacturer and it is required for the representative of the Purchaser /DG/TI/ RDSO to go again or more numbers of times to the works of the successful Tenderer/manufacturer or to any reputed testing house/laboratory where tests are being done for continuing and/ or completing the tests on the prototype(s) of the equipment, the successful Tenderer/manufacturer shall reimburse to the Purchaser /DG/TI/ RDSO the cost for the representative(s) having to visit the works or other place(s) for the tests more than once. The cost as claimed by the Purchaser /DG/TI/ RDSO ,Lucknow shall be paid thorough a Demand Draft to the concerned Accounts Officer of the Purchaser/ Purchaser /DG/TI/ RDSO, Lucknow as shall be advised to the successful Tenderer/manufacturer.
- 12.1.4. The tests shall be conducted on the prototype of the Vacuum Circuit Breaker/ Interruptor at the works of the successful Tenderer/ manufacturer or at any reputed testing laboratory in the presence of Purchaser /DG/TI/ RDSO, Lucknow or his authorized representative. The prototype shall be complete in all respects, including the terminal connectors as would be supplied if it had passed the tests. The tests shall be conducted as per relevant governing Specification and as modified or amplified herein. In case of test being conducted at government test laboratory, the presence of Purchaser's representative for witnessing the test may be waived off subject to the discretion of the Purchaser /DG/TI/ RDSO, Lucknow.
- 12.1.5. For the tests which are conducted in the laboratories of Central Power Research Institute, Bhopal/Bangalore, Electrical Research Development Association, Vadodara or any such testing house or laboratory a clear certificate to the effect that the equipment has passed the tests as per the Specification shall be obtained by the manufacturer and submitted to the Purchaser/DG (TI)/RDSO, Lucknow. Full details of the tests and the test parameters shall be furnished along with the test reports.

## 12.2. Type Tests

12.2.1. The type tests comprises of:

Sl.No.	Description of Test	Refer in
i.	Mechanical operation test with Vacuum Bottle	Clause 12.2.2
ii.	Mechanical Endurance Test of Operating Mechanism (Magnetic Actuator) without Vacuum Bottle	Clause 12.2.2.4
iii.	Temperature rise tests	Clause 12.2.3
iv.	Dielectric tests  (a) Rated lightning impulse voltage withstand test  (b) Rated one minute power frequency wet withstand voltage test	Clause 12.2.4 Clause 12.2.4.1  Clause 12.2.4.2
v.	Rated short circuit making and breaking capacity test (basic short circuit test duties) for Vacuum Circuit Breaker	Clause 12.2.5
vi.	Making and breaking test for Interrupter  (a) Test Duty 1- Making and breaking test at 100 % of mainly active load.  (b) Test Duty 2- Closed loop make break test  (c) Test Duty 2a- Transmission circuit closed loop make break operation test.  (d) Test Duty 2b-Parallel transformer circuit makes break operation test.  (e) Test Duty 3- Making and breaking test at 5% of mainly active load  (f) Test Duty 4b-Line charging make break operation test  (g) Test Duty 6- Short circuit making current.	Clause 12.2.6
vii.	Rated short time withstand current & peak withstand current test for Vacuum Circuit Breaker and Interrupter	Clause 12.2.9
viii.	Line charging breaking current test for Vacuum Circuit Breaker	Clause 12.2.10

ix.	Test to prove the rated transient recovery voltage (TRV) and rate of rise of recovery Voltage (RRRV)	Clause 12.2.11
x.	Out of phase making and breaking test for Vacuum Circuit Breaker	Clause 12.2.12
xi.	Capacitor current switching test for Vacuum Circuit Breaker	Clause 12.2.13
xii.	Special electrical test – applicable for 25kV Vacuum Circuit Breaker only	Clause 12.2.14
xiii.	Selected EMC(Electro Magnetic Compatibility) preliminary tests as per IEC 61000 and IEC 60694-1996 / latest for Magnetic Actuated Vacuum Circuit Breaker and Interrupter (a) EM radiated field immunity test. (b) Fast transient immunity test. (c) Surge immunity test. (d) Radio frequency conducted immunity test. (e) HF disturbances: damped oscillatory wave 1 MHz-100 kHz immunity Test. (g) Radiated emission test.	Clause 12.2.17

#### 12.2.2. Mechanical Operation test with Vacuum Bottle.

12.2.2.1. The test shall be conducted in accordance with clause 6.101 of IEC 62271-100 but the number of operations shall be 10,000 in case of 25kV Vacuum Circuit Breaker/ Interrupter instead of 2000 specified therein for 25 kV VCB/BM with spring – Spring Mechanism and 20,000 for Vacuum Circuit Breaker/ Interrupter with Magnetic Actuator Mechanism. For this purpose, Vacuum Circuit Breaker/ Interrupter shall be tested in accordance with Table XII of IEC 62271- 100 However, the sequence shall be repeated 5 times to complete 10,000 operations in case of 25kV Vacuum Circuit Breaker/ Interrupter with spring – spring mechanism and 10 times to complete 20,000 operations for Vacuum Circuit Breaker/ Interrupter with Magnetic Actuator Mechanism.

Following checks/ tests shall be done before the commencement of Mechanical operation test.

- (i) General visual inspection of the equipment to check its conformity with the approved drawings.
- (ii) Operation of various circuits and devices of the Vacuum Circuit Breaker
- (iii) Measurement of dimensions of components liable to wear, dimension of opening, closing and wipe springs,

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lift of tripping and closing coil plunger, and clearances of opening and closing coil armatures.

- (iv) Measurement of insulation resistance of auxiliary and motor circuits with 500V insulation resistance tester.
- (v) Measurement of contact resistance of main circuit by dc voltage drop.
- (vi) Mechanical operation comprising 5 closing and 5 opening operations at the specified, normal, minimum and maximum control voltages.
- (vii) Closing and opening travel characteristics of contacts to record the Following at the specified, normal, minimum and maximum control Voltages.
  - Opening speed ( Opening Velocity ) & time
  - Closing speed ( Closing Velocity ) & time
  - Contact bounce &
  - Contact travel

12.2.2.2. The measurement of items (v) & (vii) above shall be repeated after every 5000 operations for 25kV Vacuum Circuit Breaker/ Interruptor and observations made/ results obtained shall be evaluated by comparing with the figures and the tolerances given by the successful Tenderer/manufacturer in the SOGP.

12.2.2.3. After completion of 10,000 operations in case of 25kV Vacuum Circuit Breaker/Interruptor with spring – spring and 20,000 for magnetic Vacuum Circuit Breaker/ Interruptor before dismantling the Vacuum Circuit Breaker/ Interruptor for internal inspection, the following checks/tests shall be performed.

- (i) Dielectric tests on control and auxiliary circuit (110Vdc) by applying 2kV (rms) fo1 min. after disconnecting the motor.
- (ii) Spring charging motor shall be tested at 1kV (rms) for 1 min.
- (iii) Power frequency dry withstand voltage test on complete Vacuum Circuit Breaker/ Interruptor for 1 minute.
- (iv) Temperature rise test on opening and closing coils as per clause 12.2.3.2.



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- (v) Closing and Opening Travel characteristics of contacts to record the Following at the specified normal , minimum and maximum control voltages
- Opening speed ( Opening Velocity )& time
  - Closing speed ( Closing Velocity ) & time
  - Contact bounce &
  - Contact travel

The above parameters shall be within the specified limits declared by the manufacturer in SOGP.

#### 12.2.2.4. Mechanical Endurance of Operating Mechanism without Vacuum Bottle (for Magnetic Actuator Operating Mechanism Only)

- (i) Mechanical endurance for operating mechanism without Vacuum Bottle shall be tested for 1, 00,000 operation for Vacuum Circuit Breaker/ Interrupter with Magnetic Actuator Mechanism.
- (ii) The test shall be performed on the prototype unit in accordance with IEC 62271-100, clause 6.101.1.2 (component tests) & as per 6.101.2.4 (extended mechanical endurance tests) for special service requirements. At the beginning of the design test, the characteristics of the magnetic actuator shall be established as the reference characteristics for the actuator. The purpose of this reference is to characterize the behavior of the magnetic actuator. The following characteristics shall be measured and recorded before and after the tests:
- (a) Resistance of the coils (Both closing & opening coils in the case of double coil magnetic actuators)
  - (b) Ambient temperature at the time of measurement of resistance of the coil.
  - (c) Insulation level of the coils, i.e., 2kV (rms) frequency voltage applied on to the coils across the body of the actuator.
- (iii) Since the parts of auxiliary and control equipment's which have been manufactured in accordance with relevant standard and also test along with the operating mechanisms of conformance to these standards, the proper functions of such parts in connection with the functions of the other parts of the magnetic actuator need not be verified separately.

- (iv) Condition of the magnetic actuator during and after the tests during and after the tests, the actuator shall be in such a condition that it is capable of operating at the rated voltage as per clause 4.0 of the Specification. In general, these requirements are fulfilled, if
- (a) During the test, the actuator operates on command and does not operate without command.
  - (b) After the test, all parts do not show undue wear.
  - (c) During and after the tests, any distortion of the mechanical part is not such that it adversely affects the operation of the actuator.
  - (d) After the tests, the insulating properties of the actuator coils shall be in essentially in same condition as before the tests. Visual inspection of the actuator after the test is usually sufficient for verification of the insulating properties

(v) Procedure

The mechanical operation tests on magnetic actuator shall be made at the ambient air temperature of the test location. The ambient temperature should be recorded in the test reports. Auxiliary equipments, forming parts of the operating devices are being tested with the equipment, shall be included as a part of evaluation for this test. The actuator for the test shall be mounted on its own support. Any springs mounting arrangement required to simulate the tripping condition of the breaker shall be made part of the mounting arrangement.

The mechanical operation test shall consist of 100000 operating sequence

Operating sequence: "C – t<sub>a</sub> – O - t<sub>a</sub>"

Supply voltage / operating pressure	No. of operating sequence
Minimum	10000
Rated	90000

"O" = Opening, "C" = Closing

t<sub>a</sub> = Time between two operation which is necessary to re store the initial condition and /or to prevent undue heating of parts of the actuator (this time can be different according to the type of operation and shall not exceed 15 second).

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Between the test series specified, some maintenance such as lubrication and mechanical adjustment, is allowed, and shall be performed in accordance with the manufacturer's instructions. Change of parts is not permitted.

The programme of maintenance during the tests shall be defined by the manufacturer before the tests and recorded in the test report.

### 12.2.3. Temperature rise test for Vacuum Circuit Breaker / Interruptor

#### 12.2.3.1. On main contact

(a) The temperature rise test on the main circuit (contacts) and terminal connectors shall be carried out IEC 62271-1(2007) or latest. Contact resistance of the main circuit shall be determined by dc voltage drop and recorded before and after this test.

#### (b) Procedure

Unless otherwise specified, temperature rise on the main circuit shall be made on a new Vacuum Circuit Breaker/ Interruptor in closed position with clean contacts. The test shall be made with rated normal current. The test shall be done in indoor environment substantially free from air currents, except those generated by heat from the Vacuum Circuit Breaker being tested. Temporary connections to the Vacuum Circuit Breaker terminals shall be such that no significant amount of heat is conducted away from, or conveyed to the Vacuum Circuit Breaker/ Interruptor during the test. The temperature rise at the terminal of main circuit and the temporary connections at a distance of 1m from the terminal shall be measured. The difference of temperature rise shall not exceed 5°C. The type and sizes of temporary connections shall be recorded in the test report.

(c) The maximum temperature rise of contacts, terminals for Connection to external conductors by bolts, material used as Insulation and metal parts in contact with insulation shall not exceed the values given in Table 3 of IEC 62271-1(2007) +A1:2011 or latest when carrying Rated Normal current continuously. These values shall be Conforming to IEC 62271-1(2007) +A1:2011 or latest.

(d) In case a layer of coating of silver over the contact area is not maintained at the end of any tests the contacts shall be regarded as bare for the purpose of temperature rise limits.

#### 12.2.3.2. On Auxiliary equipment (Closing & Opening coils)

(a) The temperature rise test on the coils shall be carried out as per IEC 62271-1(2007) or latest.

(b) Procedure

The temperature rise on auxiliary equipment (Closing and Opening coils) shall be made by the method of measuring Variation of resistance before and after energisation at 110V dc. For this purpose the coil(s) shall be energized 10 times for 1 second, the interval between the instant of each energizing being 2 second. The resistance of the coil shall be measured immediately before and after such energisation. The value of Temperature rise, over the ambient shall be computed.

(c) The maximum temperature rise shall be as per IEC: 62271-1(2007) or latest considering the insulating material of the Coil. The temperature rise shall not exceed the value as Guaranteed by the manufacturer in SOGP.

#### 12.2.4. Dielectric tests Vacuum Circuit Breaker/ Interruptor

Dielectric tests shall be carried out generally as per IEC 62271-1(2007) or latest. Humidity and air density Correction factor if less than 1.0 shall not be applied.

##### 12.2.4.1. Rated Impulse withstand voltage test

The Vacuum Circuit Breaker/ Interruptor shall withstand its rated impulse voltage 250 kV (peak) of 1.2/50 $\mu$ s wave shape.

12.2.4.2. Rated one minute wet power frequency voltage withstand test for Vacuum Circuit Breaker/ Interruptor. The Vacuum Circuit Breaker/ Interruptor shall withstand rated one minute wet power Frequency withstand voltage of 95 kV.

##### 12.2.5. Basic short circuit test duties for Vacuum Circuit Breaker

The basic short circuit test duties 1 to 5 shall being accordance as per IEC – 62271-100 or latest. The Power Frequency Recovery Voltage shall be as per IEC -62271-100 or latest.

##### 12.2.6. Making and breaking test for Vacuum Interrupter

These tests shall be conducted in accordance with IEC-62271-104 -1(2009) or latest as Modified or amplified here. The test

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set up shall be for single phase System with earthed neutral. Only the following test duties shall be performed in any convenient order without any adjustment or Change of part of lubrication or re-conditioning of the interrupter.

12.2.6.1. Making and breaking test at 100% mainly active load (Test duty No.1.0)

Five hundred make-break operations shall be conducted at 800A/1600A/2000A (rms) at a test voltage of not less than 27.5 kV. The supply circuit shall have a power factor not exceeding 0.2 and the load circuit shall have a power factor between 0.65 and 0.75. Prospective TRV Parameters shall be set in accordance with Table III of IEC-62271-104-1(2009). The test may be interrupted after every 10 operations, if necessary, to enable the components to cool down to the ambient temperature.

12.2.6.2. Closed loop make –break operations (Test Duty No.2a & 2b)

If TRV parameters achieved in test duty 1 are equal or more severe than the TRV parameters prescribed in Table IV-A of IEC 62271-104-1(2009) for test duty 2a and 2b then test duty 2a and 2b need not be performed, otherwise tests comprising test duties 2a and 2b described as under shall be performed:

- (i) Transmission circuit closed loop make-break operation test (Test Duty No.2a)-10 make-break operations shall be performed at 800A/1600A/2000A.
- (ii) Parallel transformer circuit make-break operation (Test Duty No.2b)-10 make break operation shall be performed at 800/1600/ 2000 A.

12.2.6.3. Making and breaking test at 5 % of mainly active load (Test duty No.3).

Twenty make break operations shall be performed at 5 % of the rated normal current with a test voltage of not less than 27.5 kV.

12.2.6.4. Line charging make-break operation (Test Duty No.4b)

Test shall be made at 100% and from 20% to 40% of rated line charging current. 12 make-break operations at each current shall be performed with contact separation distributed at intervals of approximately 30 electrical degrees. If this is not possible then 30 make break operations shall be performed at random contact separation. The over voltages

produced during switching shall not exceed 77.7kV (peak) at single phase test voltage of 27.5 kV (rms) with earthed neutral.

12.2.6.5. Short circuit making current test (Test Duty No.6)

Twenty close operations at 20 kA (peak) shall be performed. Opening of the interrupter shall be done with supply disconnected.

12.2.7. All the making and breaking tests shall be done on a single Interrupter and no maintenance or reconditioning of the contacts shall be permitted during the above test series.

12.2.8. Condition of the interrupter during make-break tests and short time withstand current test:

12.2.8.1. During the test the interrupter shall neither show signs of excessive distress nor endanger the operator. No disruptive discharge between energized parts and earth shall occur during the tests. There shall be no indication of significant leakage current to the interrupter earthed structure or screens whenever fitted during the tests. The earthed parts should be connected to earth through a fuse consisting of a copper wire of 0.1mm diameter and 5 cm length. The fuse wire shall be intact after the tests.

12.2.8.2. Condition of the interrupter after make-break tests and Short time withstand current test:

The mechanical functions and the insulation of the interrupter shall be essentially in the same condition as before the tests. The wear of the contacts shall not be disproportional. The interrupter shall be capable of carrying rated normal current and also capable of performing assigned duty provided in the Clause 3.5 and 3.7 of the Specification. The interrupter should withstand 95kV (rms) for 1 min in dry conditions

12.2.9. Rated short time withstand current & peak current withstand test

This test shall be conducted as per IEC 62271-1(2007) or latest. ie, 20kA (rms) for 3 seconds and 50 kA (peak) for Vacuum Circuit Breaker, 8kA (rms) and 20 kA (peak) for Interrupter.

12.2.10. Line charging current switching test for Vacuum Circuit Breaker.

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This test shall be conducted as per clause 6.111.5.1 of IEC 62271-100 or latest. Test values shall conform as given in SOGP.

12.2.11. Test to prove rated transient recovery voltage (TRV) for Vacuum Circuit Breaker The measurement shall be done as per IEC: 62271-100 or latest.

12.2.12. Out of phase making and breaking test for Vacuum Circuit Breaker This test shall be conducted as per IEC 62271-100 or latest at its rated out of phase breaking current.

12.2.13. Capacitor bank breaking current test for Vacuum Circuit Breaker

The test shall be carried out at rated single Capacitor Bank Breaking Current generally as per IEC 62271-100 or latest. No restriking shall occur during the test. The breaking current shall conform to the guaranteed value.

12.2.14. Special Electrical Test (applicable for 25kV, VCB only)

Vacuum Circuit Breaker shall be subjected to short circuit making and breaking capacity test at a current of 6.25kA for duty cycle CO-15s-CO for 200 close-open operations. During this test no part of Vacuum Circuit Breaker shall require any inspection/maintenance, change of Vacuum Bottle or any other part. The standard value of prospective TRV shall be taken as 64kV other conditions shall be similar to short circuit test duties specified in IEC 62271-100 or latest. The test may be interrupted once after every 10 CO operations if need arises to enable the components to cooled down to ambient temperature.

12.2.15. Condition of Vacuum Circuit Breaker during the tests conducted as per clause no. 12.2.5, 12.2.9, 12.2.10, 12.2.11, 12.2.12, 12.2.13, and 12.2.14 of this Specification shall conform as under:

12.2.15.1. During these tests the Vacuum Circuit Breaker shall neither show signs of excessive distress nor endanger the operator. No disruptive discharge between energized parts and earth shall occur during the test. There shall be no indication of significant leakage current to the earth structure or screens whenever fitted during the test. The earthed part shall be connected to earth through a fuse consisting of copper wire of 0.11mm diameter and 5cm length. The fuse wire shall be intact after the test.

12.2.16. Condition of Vacuum Circuit Breaker during the tests conducted as per clause No.12.2.5, 12.2.9, 12.2.10, 12.2.11, 12.2.12,

12.2.13, and 12.2.14 of this Specification shall conform as under:

12.2.16.1. The mechanical functions and insulation of Vacuum Circuit Breaker shall be essentially in the same condition as before the test. The wear of the contacts shall not be disproportionate to its original shape and size. The Vacuum Circuit Breaker shall be capable of carrying its rated normal current and also capable of performing its assigned duty provided in clause 3.7 of the Specification The Vacuum Circuit Breaker shall withstand for 1 minute dry power frequency withstand voltage 95KV rms.

12.2.17. Selected EMC preliminary test for Vacuum Circuit Breaker/Interrupter for Magnetic actuated operating mechanism

Cl.No.	Name of the Test & Description	Applicable standards/Specification	Criteria for successful passing of the tests
12.2.17.1.	EM radiated field immunity test. (80-10000 MHz).	IEC/EN 61000-4-3 / latest	(a) No unwanted trip in all frequency range with both open and close position of the VCB/BM.  (b) Correct trip at stepped frequency 80-100-120-180-240-320-480- 40-960 MHz for following operation: C/O; C/Auxiliary O; C/Protection Trip O; C/Open Lock; c/Under voltage O; Reclose function.
12.2.17.2.	Fast transients immunity tests shall be done for severity level 4 for AC main (+/- 4 kV) and Binary Input, Output (+/- 2kV) of different modes. Criteria	IEC/EN 61000-4-4 / latest	(a) No unwanted trip during disturbance injection with both open and close position of VCB/BM (b) Correct trip (absence of anomalies) with open VCB/BM for C/O operations.
12.2.17.3.	Surge immunity test latest shall be done for different severity levels from 1 to 4 for AC Main (+/- 4 kV) and Binary Input/output (+/- 2 kV) of different modes.	IEC/EN 61000-4-5 / latest	No degradation of performance shall occur during the injection of disturbances.
12.2.17.4.	Radio frequency conducted immunity tests	IEC/EN 61000-4-6/ latest	No unwanted trip during disturbance injection with both open and close Position of VCB/BM



			Correct trip (absence of anomalism) with open VCB/BM for C/O operations.
12.2.17.5.	HF disturbances: damped oscillatory wave 1 MHz – 100 kHz immunity tests	IEC/EN61000-4-10 / latest	No unwanted trip during disturbance injection with both open and close Position of VCB/BM. Correct trip (absence of anomalism) with open VCB/BM for C/O operations.
12.2.17.6.	Radiated emission test	Class 9.1 of normative EN 55011/CISPR 11/ latest for class A groups I equipment's	As per EN 55011/CISPR 11/ latest for class A – Qualipeak Limits- 40.00 dBmV/m of VCB/BM

12.3. The Tenderer may quote separately the charges for short circuit test Duties, short time withstand current and peak current withstand test, line charging breaking current tests, test to prove rated TRV, short line fault tests, out of phase making and breaking tests, capacitor bank breaking current test, measurement of RIV level and special electrical tests as per clause 12.2.5, 12.2.6, 12.2.7, 12.2.8, 12.2.9, 12.2.10, 12.2.11, 12.2.12. No test charge shall be payable for any other test.

12.4. If the prototype of the Vacuum Circuit Breaker/Interruptor conforming to the Specification has been approved for earlier supplies to Indian Railways, testing of prototype again may be waived provided that no changes in the design and/ or materials used have been made. For this purpose the successful Tenderer/manufacturer shall approach Purchaser/DG (TI), RDSO Lucknow with complete documents to ascertain whether the equipment is identical to the prototype approved earlier. Once prototype approval is accorded after conducting all or part of the type tests by RDSO, the prototype approval shall normally be valid subject to the no change of design, material and the process adopted for prototype.

Normally, once complete prototype test are performed, at the time of renewal, only in-house type tests shall be done. However, RDSO may demand conducting consistency type test

12.5. Only after clear written approval of the prototype is communicated by Purchaser/DG/TI/, RDSO Lucknow to the successful Tenderer/manufacturer, they shall take up bulk manufacture of the Vacuum Circuit Breaker/Interruptor which shall be strictly with the same design, material and process as adopted for the prototype. In no

circumstances the material from sources other than those approved in the design/drawings and / or the prototype shall be used for bulk manufacture.

12.6. The successful Tenderer/manufacturer can furnish copies of type test reports as per relevant IS/IEC for all the important items including items listed at Annexure 'B'. Suitable monogram in the form of engraving/embossing or other similar means shall be provided for each of these items to identify their manufacturer/ source and shall be verified during the prototype inspection.

12.7. Details of the important parts and sub-assemblies listed at Annexure B shall be furnished by the successful Tenderer/manufacturer to DG/(TI), RDSO Lucknow for record.

12.8. Routine tests

Every Circuit Breaker/ interrupter shall be subjected to the routine tests at the manufacturer's works as per Clause 7 of IEC 62271-100 or latest. Routine test reports of items / components used shall be made available to the testing authority. The routine test comprise –

Sl.No.	Name of the Test	Refer Clause
(i)	Rated one minute power frequency dry withstand voltage test on the Main circuit	12.8.1
(ii)	Dielectric test on control and auxiliary circuits	12.8.2
(iii)	Measurement of contact resistance of main circuit	12.8.3
(iv)	Mechanical operation tests	12.8.4
(v)	Design and visual checks	12.8.5

12.8.1. Rated one –minute Power Frequency Dry withstand Voltage Test

The VCB/BM Power frequencies dry withstand voltage. Test on complete Circuit Breaker/Interrupter by applying 95kV for 1 minute.

12.8.2. Dielectric tests on control and auxiliary circuits

The control and auxiliary circuits shall withstand 2000V ac for one minute after disconnecting spring charging motor. The spring charging motor shall Withstand 1000 V ac for one minute.

12.8.3. Measurement of contact resistance of main circuit

The resistance shall be measured by dc voltage drop. The measured Value shall not exceed 1.2 times the value of

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resistance recorded before Temperature rise test during the type tests approved by DG/(TI), RDSO.

#### 12.8.4. Mechanical operation test

The test comprising five opening and five closing operations at each of the rated, maximum and minimum control voltages ie. at 110V dc, +10% and -15% for closing operations and at 110V dc -30% for opening Operations shall be performed. The contact travel characteristics shall be recorded for each closing and opening operations. The characteristics shall be within the tolerances specified in SOGP/ type test values Approved by DG/(TI), RDSO.

#### 12.8.5. Design & visual check

The Circuit Breaker shall be checked to verify its complaints with this Specification.

In particular following items shall be checked:

- (i) Verification of dimension of equipment and assembly as per drawings/datasheet approved by RDSO.
- (ii) Verification of operation under local and remote.
- (iii) Verification of clearances as per approved drawing.
- (iv) Visual check of Quality of painting / galvanizing of cubicles and mounting structure.
- (v) Cubicle shall be dust and vermin proof conforming to IP 55 of IEC: 60529-2001/IS: 13947(Part-1) 1993.
- (vi) Fasteners used in various assemblies shall be of stainless steel for 12mm dia or below and those above 12mm may be hot dip galvanized or stainless steel.
- (vii) Verification of behavior under local electrical command while on  
Local/ remote selector switch is in remote and vice versa, the Vacuum Circuit Breaker/ Interrupter should not operate.
- (viii) Verification of manual opening and closing operation for spring-spring operating mechanism.
- (ix) Verification of emergency device for opening of Vacuum Circuit Breaker in the event of failure as per clause 5.3 (d).

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- (x) Verification of rated operating sequence.
- (xi) Verification of Interlocking.  
  
The Vacuum Circuit Breaker should not close either on remote or on local (Mechanical or Electrical) if key of the Interlocking key is removed from the Vacuum Circuit Breaker operating mechanism.
- (xii) Measurement of spring charging time for spring-spring operating mechanism.
- (xiii) Verification of contact wear indicator.
- (xiv) Measurement of current drawn by the motor for spring-spring operating mechanism.
- (xv) Verification of function of tripping device in the event of 110 V DC Supply failure (CTD) or DC voltage dropping below  $85 \pm 3V$  in CTD of Vacuum Circuit Breaker.
- (xvi) Verification of function of anti-pumping device for Vacuum Circuit Breaker
- (xvii) Measurement of resistance of operating coils.
- (xviii) Verification of wiring and numbering of cables.
- (xix) Verification of signal positions for close/ trip and spring charged/ spring discharged.
- (xx) Verification of make, type designation and rating of Parts/ Components.
- (xxi) Verification of name plate details.
- (xxii) Verification of type and routine test reports of parts/ components used.
- (xxiii) Checking of proper fixing and support of springs, relays, Gauges and tripping/ closing coils.
- (xxiv) Checking of free movement of armature of opening and closing Coils for spring-spring operating mechanism.

13. The Tenderer shall specifically indicate in a statement attached with his offer, his compliance with each clause and sub clause of the Specification. A separate statement shall be attached either the offer indicating references to the clauses where the Tenderer deviate there

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from together with the detailed remarks/justification. If either the statements of the compliance or a statement of deviation is not attached with the offer, it is not likely to be considered. For the reason that it is an incomplete offer which can not be properly evaluated and compare with other offers if any. If there are no deviations, a 'NIL' statement shall be attached.

14. Following drawings/ documents to be furnished along with the tender:
- (i) Full dimensioned General Arrangement drawing indicating clearances, fixing arrangement of the mounting structure on the foundation.
  - (ii) Schematic drawing.
  - (iii) QAP for the equipment
  - (iv) ISO certification
  - (v) List of essential plant, machinery and testing facilities.
  - (vi) Type test report for relevant rating as per RDSO /IEC Specification.
  - (vii) List of supplies and performance reports for the tendered equipment from user railway/ other customer.
  - (viii) Information furnished in the schedule of guaranteed technical performance, data and other particulars (Annexure A & B) shall be complete in all respects. If there is any entry like 'shall be furnished later' or blanks are left against any item, the tender is not likely to be considered as such omissions cause delays in finalizing the tender.
15. Technical data and drawing to be furnished by successful Tenderer/ manufacturer
- 15.1. Details of the important parts and sub-assemblies listed at Annexure B shall be furnished by the successful Tenderer/ manufacturer to RDSO after award of contract.
- 15.2. The successful Tenderer shall submit the following details/ dimensioned drawings as per Indian Railways Standard in sizes of 210mm x 297mm or any integral multiples thereof for approval.
- (i) Name / rating plate both in English and Hindi
  - (ii) General assembly showing mounting arrangement and overall Dimensions and bill of materials as per SOGP.

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- (iii) Schematic and wiring diagram with explanation sheet.
  - (iv) Cross-section of interrupting chamber indicating the arcing/ main Contacts and nozzle (s) or of the Vacuum Bottle a case may be.
  - (v) Details of main, fixed and moving contacts and arcing contacts.
  - (vi) Operating and coupling mechanism of complete Vacuum Circuit Breaker along with schematic diagram showing the mechanical linkages with explanation sheet.
  - (vii) Detailed drawings for springs for closing and opening.
  - (viii) Full details of all sealing points with details of O rings and gaskets.
  - (ix) Details of Terminal Connector.
  - (x) Details of porcelain hollow insulators for support and interrupting chamber.
  - (xi) Plain mass concrete foundation, drawing and design calculations.
  - (xii) Design calculation for structural safety along with the details of Supporting Structure.
  - (xiii) Erection, Commissioning, Operation and maintenance manual.
  - (xiv) Details of main parts/ sub assembly as per Annexure B.
  - (xv) Any other drawing considered necessary by the successful tender/ manufacturer and / or Purchaser.
- 15.3. Numbering of drawings shall be so structured as to give information about total number of drawings , data sheets/ instructions sheets relating to the contract for example a drawing designated as "D307 [4-12] sheet 2 of 5" denotes that :
- (i) D 307 is the drawing number – the choice of which is left to the successful Tenderer.
  - (ii) It is the 4<sup>th</sup> drawing out of a total set of 12 drawings / datasheet the contract.
  - (iii) It is the 2<sup>nd</sup> sheet out of total 5 sheets and

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- 15.4. Cross reference of identical drawing if approved for earlier contract shall be given in the drawing information required during commissioning and maintenance of equipment shall be shown in greater detail.
- 15.5. After approval, six copies of approved drawings along with 2 set of reproducible prints shall be supplied to each consignee. Drawings shall be made in Auto CAD, for approval to RDSO. Two sets of approved drawings of hard copies, one copy of RTF and one set in pen drive in Auto CAD R14 / latest shall be sent to RDSO for record.
- 15.6. Space earmarked for assigning RDSO's drawing number shall be available on the right hand top side of each drawing. Numbering shall be allotted by RDSO after approval of drawing.
- 15.7. Five copies of the approved erection, commissioning, operation and maintenance manual shall be supplied to each consignee, in case order is more than 10 nos. In case order is less than 10 nos two copies of manual shall be supplied. Two copies of manuals shall be supplied to the Purchaser/DG (TI), RDSO, Lucknow (India) for record.
- 15.8. Drawings approved by RDSO after prototype approval shall be submitted for the future contracts also till the validity of prototype approval with a clear certification on the drawing that design, process and material have not been changed in the design of the subject equipment from the prototype already approved by RDSO.

16. Erection, Testing and commissioning

The Circuit Breaker/Interrupter shall be erected and commissioned by the Purchaser / manufacturer. However, in case a defect/ deficiency is noticed, the manufacturer/ successful Tenderer will have to depute his engineer for necessary remedial action without any cost to the Railways. In all the cases in which an order is placed either on new manufacturer or for a new type/ design of the Circuit Breaker/Interrupter, services of manufacturer's engineer shall be made available during the erection and proving/ pre commissioning test for the first order of their Vacuum Circuit Breaker/Interrupter free of cost. For this purpose, prior intimation regarding the date and location shall be given by the purchaser to the successful Tenderer/ manufacturer.

17. Spares

The Tenderer shall furnish along with his offer, a list of spares (with cost) Recommended by him for maintenance of Circuit Breaker/Interrupter for a period of 10 years. The list should include gaskets/ O rings, parts which are likely to wear and items requiring replacement/ replenishment, besides other items recommended by the

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manufacturer. The successful Tenderer shall give an undertaking to the effect that he shall supply the required spares for the total life of the equipment (i.e. 25 years approx.).

18. Training of Indian Railway's Engineers

The offer shall include the training of two engineers of the Indian Railways free of cost at the manufacturer's works in India or abroad and at the maintenance depots/ workshops on a railway system or other public utility where Vacuum Circuit Breaker/Interruptor of similar/ identical design are in operation. The total duration of training for each engineer shall be two weeks of which approximately one weeks will be at manufacturer's works and one weeks on a railway system or other public utility. If the country of manufacturer is not India, the cost to travel to that country and back will be borne by the Indian Railways. Other details shall be settled at the time of finalizing the contract/ Purchase order.

19. After sales - service

19.1. The successful Tenderer shall make necessary arrangements for closely monitoring the performance of the Vacuum Circuit Breaker/Interruptor through periodical (preferably once in two months during warranty period) visit to the locations where they are erected for observations and interactions with operating and maintenance personnel of Indian Railways. Arrangements shall also be made by the successful Tenderer/ manufacturer for emergency/ stand by spare parts being kept readily available. To meet exigencies warranting replacements so as to keep the Vacuum Circuit Breaker/Interruptor in service with listed on time.

19.2. Successful Tenderer/ manufacturer shall respond promptly and in a work man like manner to any call given by Indian Railway for any assistance by way of attending to failures, investigations into the causes of failures including the tests, if any, to be done and such other items with a view to seeing that the Vacuum Circuit Breaker/Interruptor serves for the purpose for which it is procured. Besides, technical guidance to ensure proper operation and maintenance of the Vacuum Circuit Breaker/Interruptor shall be constantly rendered.

20. Packing and dispatch

20.1. The various components of each Vacuum Circuit Breaker/Interruptor shall be securely packed in wooden crates/ boxes. General packing list, together with weight and overall dimensions of each packing case shall be furnished for each Vacuum Circuit Breaker/Interruptor indicating the following.



Crate/ Box No.	Description of item/ component in the crate/ box	Gross weight in kg	Approximate outside dimensions

- 20.2. As far as possible, the gross weight of a crate/ box shall be so kept that it shall be possible to manually handle it by two persons.
- 20.3. In case of overseas supplies, packing shall be sea worthy.
- 20.4. Necessary instructions for handling and storage shall also be furnished for use at receiving end.
- 20.5. Porcelain housing/ support insulator shall be supplied securely packed in wooden crates. Not more than two porcelain housing/ support insulators shall be packed in a crate in order to facilitate manual loading and unloading.

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Annexure 'A'

Schedule of Guaranteed Performance Technical and other particulars for 25 kV, Single Pole/Double Pole/Pole Mounted Outdoor Type, Vacuum Circuit Breaker / Interrupter, Guaranteed particulars are to be established by test reports/ actual tests.

S.No.	Description	Unit of measurement	Values to be supplied by manufacturer
1.	Maker's Name		
2.	Country of Manufacture		
3.	Manufacturer's type Designation (i) Vacuum Circuit Breaker/ Interruptor pole (ii) Operating mechanism		
A	RATING		
4.	Number of poles	No.	
5.	Rated voltage	kV	
6.	Voltage rating class as per standard	kV	
7.	Rated normal current	A	
8.	Rated frequency	Hz	
9.	Rated insulation level of the Vacuum Circuit Breaker/Interruptor One minute dry and wet power frequency withstand voltage  (i) Switching surge withstand voltage (ii) Standard lighting impulse withstand voltage 1.2/ 50 $\mu$ s waveform ( full wave) (iii) Corona extension voltage	kV (rms)  kV (p) kV (p) kV (rms)	
10.	Rated short circuit breaking current (i) Symmetrical at a recovery voltage of not less than the highest system voltage (ii) Asymmetrical at a recovery voltage of not less than the highest system voltage (iii) Breaking capacity (symmetrical)	kA kA MVA	
11.	Rated making current	kA peak	

12.	Rated line charging breaking current	A	
13.	Rated cable charging breaking current	A	
14.	Rated small inductive breaking current	A	
15.	Rated capacitor bank breaking current	A	
16.	Rated short time current (i) for 1 s (ii) for 3 s	kA kA	
17.	Rated operating sequence		
18.	Rated transient recovery voltage	kV	
19.	Breaking current on out of phase condition	kA (rms)	
B	CONSTRUCTIONAL FEATURES		
20.	Number of breaks per pole		
21.	Total length of break per pole	mm	
	Contact travel characteristics (i)Length of contact travel (ii)Closing speed(60% contact travel ) (iii)Opening speed 60% contact travel) (iv)Contact bounce (v)Bounce duration (Please furnish a graph showing contact travel characteristics)	mm m/s m/s mm (max) s (max)	
22.	Type of main contacts		
23.	Type of arcing contacts		
24.	Details of Vacuum Bottle Make Type designation Voltage class Total weight	kV kg	
25.	Weight of pole assembly per pole per Vacuum Circuit Breaker/Interruptor	kg	
26.	Weight of operating mechanism	Kg	
27.	Total weight of Vacuum Circuit Breaker/ Interruptor	Kg	
28.	Minimum electrical clearance (i) between poles (ii) between live part and earth	mm mm	
29.	Minimum sectional clearance between lowest live part and any part where a person may stand	mm	
30.	Minimum height of bottom most part of any insulator from ground level	mm	

31.	Distance between centers of pole for Double Pole Vacuum Circuit Breaker	mm	
32.	Overall dimensions of the Vacuum Circuit Breaker/Interruptor complete with insulators, operating mechanism cubicle etc. Mounted on the supporting structure. (i) Length (ii) Width (iii) Height (Please furnish the General Arrangement drawing with overall dimension)	mm mm mm	
C	OPERATING PARTICULARS		
33.	Closing time from the instant of closing coil energisation (max)	Ms	
34.	Opening time from the instant of trip coil energisation(max)	Ms	
35.	Make Time (max)	Ms	
36.	Arcing Time (i) At rated normal current (ii) At rated short circuit breaking current (iii) At 60% of short circuit breaking current (iv) At 30% of short circuit breaking current (v) At 10% of short circuit breaking current	ms ms ms ms ms	
37.	Total break time from the instant of trip coil energisation to the final extinction of arc (i) At rated normal current (ii) At short circuit breaking current	ms ms	
38.	Rated restriking voltage (i) Amplitude factor (ii) Rate of rise at natural frequency (iii) Type and device used to limit rate of rise of restriking voltage	kV	

39.	Minimum time interval (t) permissible between successive "CO" operation after first auto reclosure	s	
40.	Number of operations (close and open) the Vacuum Circuit Breaker can perform with the available stored energy	No	
41.	Number of operations permissible without change of Vacuum Bottle (i) At 50% of rated current (ii) At 100% of rated current (iii) At 50% of rated short circuit breaking current (iv) At 100% of short circuit breaking current	No No No No	
42.	Number of operations permissible without replacement/ inspection of contacts(min )  (i)At 50% of rated current  (ii)At 100% of rated current  (iii)At 50% of short circuit breaking current (iv)At 100% of short circuit breaking current ( A graph establishing the above two parameters at SN 41 and 42 should be enclosed )	No No No No	
43.	First pole to clear factor (In case of Double Pole Vacuum Circuit Breaker/ Interruptor		
D	OTHER TECHNICAL PARTICULARS		
44.	Maximum rise at temperature over an ambient of 50°C when carrying its normal rated current continuously (i) Main contacts of Vacuum Bottle (ii) Terminal when connected with external connectors (iii) Metal parts arcing as springs (iv) Metal parts in contact with insulators (v) Auxiliary contacts (vi) Operating coils	°C °C °C °C °C	
45.	Power required for tripping / closing (max)	W	

46.	Control circuit voltage with permissible voltage variation (i) Closing coil (ii) Tripping coil (iii) Contactors ( if any) (iv) any other item ( for which the Tenderer feels that the voltage is to be maintained within certain limits)	V dc + % / - % V dc + % / - % V dc + % / - % V dc + % / - %	
47.	Type of tripping / closing mechanism		
48.	Manual tripping / closing mechanism (lever push button or any other device)		
49.	Spring charging motor (i) Make and type designation (ii) Rating (iii) Voltage with permissible variation (iv) Power frequency withstand voltage (v) Class of insulation (vi) Time required by the motor to charge the spring(s) fully (vii) Power required at normal controlled voltage to charge the spring (viii) Mode of protection (ix) Specification of design and testing	kW V kV (rms) s W IS/ IEC	
50.	Springs- Closing / Opening (i) No. of springs (ii) Type (Compression/tension) (iii) Specification of testing and design	IS/IEC	
51.	Porcelain Insulators (i) Makers name and type designation (ii) Minimum creepage distance	Support Insulator Interrupting Chamber Insulator	
52.	Insulation grade of PVC control wiring cable	V	
53.	Approximate height of close/trip switch and socket for spring charging from ground level.		
54.	Details of Operation counter: (i) Make and type		

	(ii) No. OF digits		
55.	Auxiliary Switch (contacts) (i) Make and type (ii) Normally open contacts (iii) Normally close contacts (iv) Continuous ratings of contacts (v) Breaking capacity of contacts at 220V dc with inductive load (vi) Life (No. of operations)	Total Spare Total Spare A A No.	
56.	Limit switch ( for spring charging motors) (i) Make and type (ii) Continuous ratings of contacts (iii) Breaking capacity of contacts at 220V dc with inductive load (iv) Life (No. of operations)	A A No	
E	OTHER DETAILS		
57.	Is the Vacuum Circuit Breaker/Interruptor having a common drive (For DP Vacuum Circuit Breaker and Interrupter)?	Yes/No	
58.	Is a device for tripping the Vacuum Circuit Breaker, in the event of 85 V / 110V dc supply failure, provided? The Vacuum Circuit Breaker should TRIP automatically below 85 + / - 3 volts (Indicate the type of the device)?	CTD/No volt relay	
59.	Does provision of trip circuit supervision exist?	Yes/No	
60.	Is electrical anti-pumping device provided?	Yes/No	
61.	Is mechanical closing device provided?	Yes/No	
62.	Is local electrical closing & tripping device provided?	Yes/No	
63.	Is manual closing & tripping device provided?	Yes/No	
64.	Is terminal connector of VCB/BM provided?	Yes/No	
65.	Is mechanical tripping device provided?	Yes/No	
66.	Is handle/crank for manual charging of the closing spring provided?	Yes/No	
67.	Is operating counter visible without opening the mechanism door?	Yes/No	
68.	Are the mechanical close and open	Yes/No	

	indicator provided?		
69.	Are two positions LOCAL/REMOTE switch provided? Indicate type- (spring loaded)	Yes/No	
70.	Are electrical and mechanical interlocks with keys provided?	Yes/No	
71.	Is the operating mechanism housed in a dust weather vermin proof cabinet of 2mm thick sheet steel construction? (indicate the protection)	Yes/No	
72.	Is a heater provided for prevention of condensation of moisture in the operating mechanism box?	Yes/No	
73.	Is three pin socket and inspection lamp provided?	Yes/No	
74.	The size and number of cable glands provided.	Dia No Dia No	
75.	What is the insulation grade of PVC cable used?	V	
76.	Are the cables terminated with crimped lugs?	Yes/No	
77.	Is ac and dc +ve & -ve wiring completely segregated?	Yes/No	
78.	Are the terminal blocks for wiring dust proof and provided with unbreakable transparent shrouds?	Yes/No	
79.	Are the two distinct earthing terminals provided with indication for earth? (i) Support structure (ii) Operating mechanism cubicle	Yes/No Yes/No	
80.	Are fasteners of 12mm dia and less exposed to atmosphere of stainless steel?	Yes/No	
81.	Are fasteners of more than 12mm dia of stainless steel or mild steel hot dip galvanized?	Yes/No	
82.	If supervision for erection testing and commissioning is provided?	Yes/No	
83.	If training of two IR engineers be arranged for a total period of two weeks?	Yes/No	
84.	Has list of spares been furnished?	Yes/No	
85.	Has list of special maintenance tools furnished?	Yes/No	
86.	Has erection operation and maintenance manual furnished?	Yes/No	
87.	Does provision of slow opening and slow closing exists?	Yes/No	
88.	Have closing/tripping springs properly	Yes/No	



	fixed to prevent their misalignment?		
89.	If any deviations asked? Give number of clauses where deviation has been asked for.	Clause No.	
90.	Is any external indicator for contact wire provided?	Yes/No	
91.	If painting of steel surfaces exposed to weather done to RDSO's Specifications?	Yes/No	
92.	If the support structure and operating mechanism cubicle hot dip galvanized?	Yes/No	
93.	Quantity of zinc or galvanization	Kg/m2	

Annexure- 'B'

The following information shall be furnished by the manufacturer/ supplier.

Sl. No.	Description	Unit of measurement
1.	Details of Permanent Magnet a) Make b) Type and its Material c) Governing Specification d) Maximum service temperature ie, the max. temperature to which the magnet may be exposed with no significant long range Instability or structural changes. e) Curie Temperature ie, the transition temperature above which material loses its Magnetic properties.	
2.	Capacitors used for opening and closing a) Make b) Description and Type c) Type designation d) Identification Mark e) Governing Specification. f) Rating i) Capacity in Farad ii) Operating voltage with permissible variation	
3.	Electronic controller Unit a) Description and Type b) Type Designation c) Identification Mark d) Governing Specification	
4.	Proximity Switches a) Make b) Description and Type c) Type designation d) Rating	
5.	Vacuum Bottle  (i) Description and type Designation (ii) Make (iii) Rating (iv) Identification mark. (v) Item drawing No	

	<ul style="list-style-type: none"> <li>(vi) Geometry of contact</li> <li>(vii) Governing Specification No.</li> <li>(viii) Weight</li> <li>(ix) Level of vacuum adopted</li> <li>(x) Level of current chopping</li> <li>(xi) Shelf life</li> </ul>	
6.	<p>Auxiliary contact</p> <ul style="list-style-type: none"> <li>(i) Description and type Designation</li> <li>(ii) Make</li> <li>(iii) Identification mark</li> <li>(iv) Item drawing No.</li> <li>(v) Governing Specification No.</li> <li>(vi) Rating <ul style="list-style-type: none"> <li>(a) Voltage</li> <li>(b) Continuous Current</li> <li>(c) Breaking and making Current</li> <li>(d) Electrical &amp; Mechanical life( No. of operations)</li> </ul> </li> </ul>	
7.	<p>Motor limit switch</p> <ul style="list-style-type: none"> <li>(i) Description and type</li> <li>(ii) Type designation</li> <li>(iii) Make</li> <li>(iv) Identification mark</li> <li>(v) Governing Specification No.</li> <li>(vi) Rating <ul style="list-style-type: none"> <li>(a) Voltage</li> <li>(b) Continuous Current</li> <li>(c) Breaking and making Current</li> <li>(d) Electrical &amp; Mechanical life( No. of operations)</li> </ul> </li> </ul>	
8.	<p>MCIRCUIT BREAKER's</p> <ul style="list-style-type: none"> <li>(i) Description and type</li> <li>(ii) Type designation</li> <li>(iii) Make</li> <li>(iv) Identification mark</li> <li>(v) Governing Specification No.</li> <li>(vi) Rating <ul style="list-style-type: none"> <li>(a) Voltage</li> <li>(b) Continuous Current</li> <li>(c) Breaking and making Current</li> <li>(d) Electrical &amp; Mechanical life( No. of operations)</li> </ul> </li> </ul>	
9.	<p>Spring charging motor</p> <ul style="list-style-type: none"> <li>(i) Description and type</li> <li>(ii) Type designation</li> </ul>	

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	<ul style="list-style-type: none"> <li>(iii) Make</li> <li>(iv) Identification mark</li> <li>(v) Governing Specification No.</li> <li>(v) Rating <ul style="list-style-type: none"> <li>(a) Voltage(with permissible variation)</li> <li>(b) Wattage</li> <li>(c) Power frequency voltage withstand</li> <li>(d) Class of insulation</li> <li>(e) Time required by the motor to charge the spring fully(max)</li> <li>(f) Power required at normal control voltage to charge the spring</li> <li>(g) Mode of operation</li> </ul> </li> </ul>	
10.	Spring- Closing/ Tripping /Other <ul style="list-style-type: none"> <li>(i) Description and type</li> <li>(ii) Type designation</li> <li>(iii) Make</li> <li>(iv) Identification mark</li> <li>(v) Governing Specification No.</li> <li>(vi) Drawing No.</li> <li>(vii) Rating <ul style="list-style-type: none"> <li>(a) No. of springs</li> <li>(b) Type(compression/ tension/spiral)</li> <li>(c) No. of turns</li> <li>(d) Gauge</li> <li>(e) External diameter</li> <li>(f) Stiffness</li> <li>(g) Material</li> <li>(f) Force developed in fully charged position</li> </ul> </li> </ul>	
11.	Operating coil Closing    Tripping <ul style="list-style-type: none"> <li>(i)Description and type</li> <li>(ii)Type designation</li> <li>(iii)Make</li> <li>(iv)Identification mark</li> <li>(v)Governing Specification No.</li> <li>(vi)Rating <ul style="list-style-type: none"> <li>(a) Operating voltage (with permissible variation)</li> <li>(b) Power</li> <li>(c) Resistance at 20° C</li> <li>(d) Class of insulation</li> </ul> </li> </ul>	
12.	Operation counter	

	(i)Description and type (ii)Type designation (iii)Make (iv)Identification mark (v)Governing Specification No. (vi) No. of digits	
13.	Heater  (i)Description and type (ii)Type designation (iii)Make (iv)Identification mark (v)Governing Specification No (vi)Rating (a) Voltage (b) Power (vii) Make and type designation of thermostat (if used)	V - ac W
14.	Interlock  (i)Description and type (ii)Type designation (iii)Make (iv)Identification mark (v)Governing Specification No (vi)Electrical rating of switch used	V dc A
15.	"O" Ring and Gasket(Please furnish details for all the varieties) (i) Description and make (ii) Dimension/Drawing No. (iii) Material and Specification	
16.	Terminal connector  (i)Description and type (ii)Type designation (iii)Make (iv)Identification mark (v)Governing Specification No (vi)Rating (a) Voltage (b) Current	V ac A
17.	Relays and contactors( please furnish details for all the types of relays/ contactors used)  (i)Description and type (ii)Type designation	

	<ul style="list-style-type: none"> <li>(iii) Make</li> <li>(iv) Identification mark</li> <li>(v) Governing Specification No</li> <li>(vi) Rating <ul style="list-style-type: none"> <li>(a) Operating voltage range</li> <li>(b) Pick up voltage</li> <li>(c) Drop out voltage</li> <li>(d) Burden</li> <li>(e) Auxilliary contact rating</li> <li>(f) Guaranteed life <ul style="list-style-type: none"> <li>1. Electrical</li> <li>2. Mechanical</li> </ul> </li> <li>(g) Wiring details (drawing No.)</li> </ul> </li> </ul>	<p style="text-align: center;">V ± V V V</p> <p style="text-align: center;">No. of operations No. of operations</p>
18.	<ul style="list-style-type: none"> <li>Shock Absorber <ul style="list-style-type: none"> <li>(i) Description and Type</li> <li>(ii) Type Designation</li> <li>(iii) Identification Mark</li> <li>(iv) Governing Specification</li> <li>(v) Type Brand and Specification of fluid used (if any)</li> </ul> </li> </ul>	

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