

OPERATION & MAINTENANCE MANUAL VACUUM CIRCUIT BREAKER 3.3kV to 36kV



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1.0 - INTRODUCTION

The purpose of this Instruction Manual is to assist the user in developing safe and efficient procedures for the unpacking, storage, installation, maintenance and use of the equipment.

Field Service Operation

E&A can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of E&A equipment, processes and systems. Contact sales offices or the factory for details.

Qualified Person

For the purpose of this manual a Qualified Person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

- Training and authorization to energize, de-energize, clear, group and tag circuits and equipment in accordance with established safety practices.
- Training in the proper care and use of protective equipment

such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.

- Training in rendering first aid.

Safety Precautions

In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work on de-energized equipment. Always de-energize a circuit breaker and remove it from the switchgear before performing any tests, maintenance or repair.
2. Always perform maintenance on the circuit breaker after the spring-charged mechanisms are discharged.
3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

2.0 RECEIVING, HANDING AND STORAGE

2.1 - Safety Aspects

- The Vacuum Circuit Breaker are designed for Indoor Application with all required safety features.
- Before carrying out any installation, operation and maintenance, the service person should be fully acquainted with the relevant safety regulations covering this equipment as well as inside of the substation.
- Check that the personnel operating the apparatus have this instruction manual with them.
- We recommend that installation and commissioning should be carried out by qualified and authorized personnel.
- Ensure compliance of local (site) legal and safety norms.

2.2 - Unloading & Transportation

- The breaker is normally installed in breaker compartment of the switchgear panel for shipment. However if shipped as on independent unit, the Vacuum Circuit Breaker are dispatched in appropriate packaging for the prevailing conditions, e.g. seaworthy packaging.



- Unloading of VCB shall be done as per Instruction stickers given on VCB unit.
- VCB shall be unloaded with sufficient capacity of crane or Hydra. If unloading is done with wire ropes, fit lifting ropes of appropriate load capacity with shackles and ensure that lifting hooks are locked properly.
- Transport VCB Unit upright only. Carry out loading operations only when it has been ensured that all precautionary measures to protect personnel and materials have been taken and using a
 - Crane,
 - Fork-lift truck and/or

- Manual trolley jack

- Never tilt the crates over as shown below. Non Compliance with this stipulation may damage the equipment. Always keep it upright.

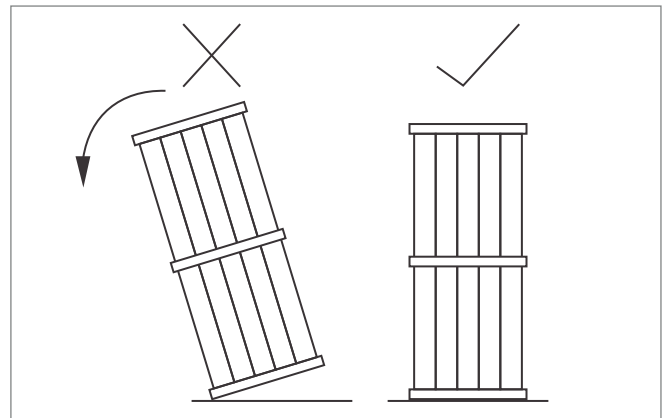


Figure 2.2 –Crate Positioning

2.3 - Unpacking & Inspection

- Generally, each VCB is supplied along with complete Packing List :
 - VCB spring charging handle
 - VCB racking handle
 - Emergency trip rod
- Upon arrival at site, the consignment shall be unpacked within one (1) week and checked against the packing list or the delivery note.
- While unpacking wooden cases, top must be removed first.
- It is advisable to locate the VCB Unit at the sub-station before unpacking. (THE EQUIPMENT SHOULD BE EXAMINED IMMEDIATELY AFTER THE RECEIPT.)
- In case of shortage in supply or damage to the items, report the same within two (2) weeks, accompanied with a full description/ photographs of the missing/damaged parts. Any delay in making the claims will not be entertained.

2.4 - Handling Procedure

- Packaging for air and sea transport: using two slings supporting 500kg each and lifting device.
- Minimum height given on the below diagram shall be respected.

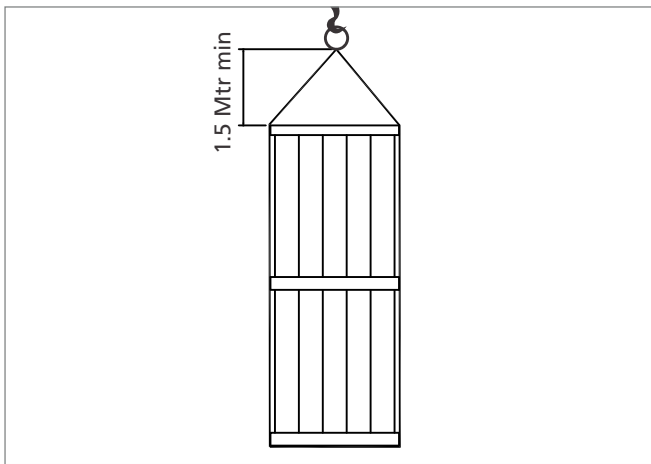


Figure – 2.4.1: Handling of Functional Units

2.5 - Storage Procedure

- The VCB Unit be stored in a clean, dry and well-ventilated environment.
- The storage area must shelter the equipment from deterioration by agents like.
 - Water
 - Water Vapour
 - Salt Laden air
 - Pollution of any type
 - Micro-organisms
- Store VCB Unit standing upright.
- Do not stack VCB Unit.
- VCB Unit are not weather-proof and should not be left outdoor where rain and moisture may cause irreparable damages.
- For temporary storage for less than two (2) weeks, cover the VCB Unit with plastic sheets to protect it against ingress of dust.

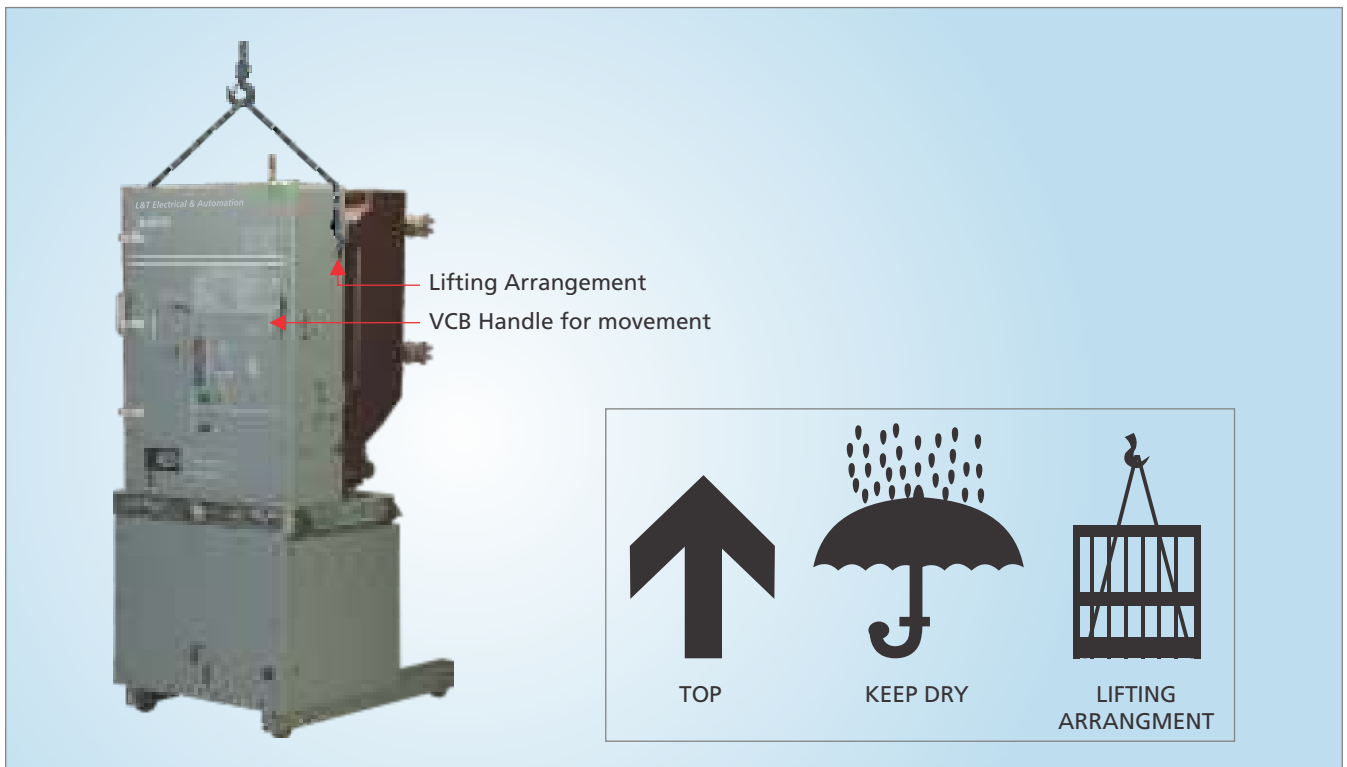
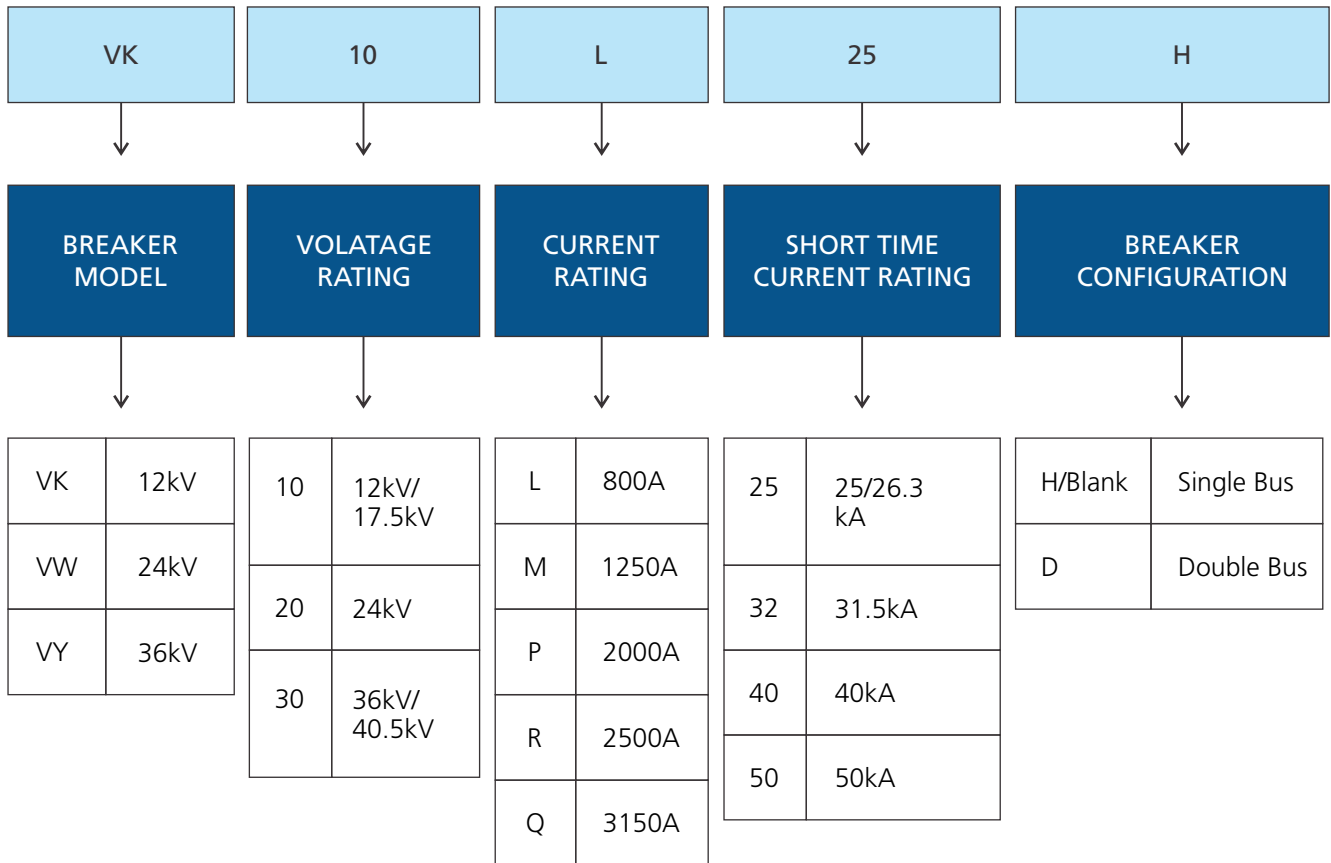


Figure 1: Handling the Vacuum Circuit breaker

3.0 CIRCUIT BREAKER SPECIFICATION



C		VCB DETAILS - 12 kV			
Sr. No.	PARTICULARS	STANDARD FEATURE			
1	Reference standard	IEC-62271-100 / IEC62271-1			
2	No. of Phases & Poles	3			
3	Interrupting medium	Vacuum			
4	Rated frequency	50 / 60 HZ +/- 3%			
5	VCB Model Numbers 40kA		25 / 26.3 kA	31.5 / 40 kA	50kA
		800A VCB	VK10L25H	VK10L40H	VK10L50H
		1250A VCB	VK10M25H	VK10M40H	VK10M50H
		2000A VCB		VK10P40H	VK10P50H
		3150A VCB		VK10Q40H	VK10Q50H
6	Voltage Class	Nominal System Voltage	Upto 11 kV		
		Rated Voltage	12 kV		
		Rated 1 min Power Frequency Withstand Voltage	28 kV / 38 kV		
		Rated 1.2/50 micro-sec Impulse Withstand Voltage	75 kVp / 95 kVP (On Request)		
7	Current	Rated continuous Current at 40 deg C Ambient	800 / 1250 / 2000 / 3150A		
		Rated Short Time Current for 3 sec. (kA rms)	26.3	40	50
		Rated Peak Withstand Current kAp	65.75	100	125
		Rated Making Current kAp	65.75	100	125
		Symmetrical Breaking Current at Rated Voltage (kA rms)	26.3	40	50
8	Duty cycle	Autoreclosing	0-0.3sec -CO-3 min -CO		
		Minimum Dead Time	300 ms		
9	Maximum Make time	lessthan 50 ms			
10	Maximum switching Overvoltages generated	Within 2.5 P.U.			
11	First pole to clear factor	1.5 for Non-Effective Earthed system			
12	Operating mechanism	Fixed trip/ Trip Free	Trip Free		
		Antipumping Device	Inbuilt with mechanism		
		Type of Mechanism	Standard: Motor Operated, Spring Charged Stored Energy		

C		VCB DETAILS - 12 kV			
Sr. No.	PARTICULARS	STANDARD FEATURE			
13	Closing Coil (Only on DC)	Momentary Load	350W		
		Voltage Operating Range	85% -110%		
14	Trip Coil (Only on DC)	Momentary Load	350W		
		Voltage operating range	70% -110%		
15	Spring Charging Operation	Motorised, (Manual Spring charging in case of control supply failure)			
16	Operation Counter	5 Digit, Not resettable			
17	Spring Charging Motor (Available in AC & DC version)	Type of Motor	DC motor		
		Permissible Voltage Variation	+/- 10%		
		Insulation Class	E		
		Time required to Charge spring	Less than 8 Second		
		Operation sequence stored In spring	O – C – O		
18	Auxiliary Contacts	No. of Auxiliary Contacts	6NO+6NC or 12NO+12NC		
19	Net Weight of Breaker	800A VCB kg approx.	105	175	240
		1250A VCB kg approx.	115	175	240
		2000A VCB kg approx.		230	250
		3150A VCB kg approx.		350	360
20	Pole Housing Material	Epoxy			

C VCB DETAILS - 33kV			
Sr. No.	PARTICULARS	STANDARD FEATURE	
1	Reference standard	IEC-62271-100, IEC62271-1	
2	No. of Phases & Poles	3	
3	Interrupting medium	Vacuum	
4	Rated frequency	50/60 HZ +/- 3%	
5	VCB Model Numbers	800A VCB	VY30L32H
		1250A VCB	VY30M32H
		2000A VCB	VY30P32H
6	Voltage Class	Nominal System Voltage	33 kV
		Rated Voltage	36 kV
		Rated 1 min Power Frequency Withstand Voltage	70 kV
		Rated 1.2/50 micro-sec Impulse Withstand Voltage	170 kVp
7	Current	Rated continuous Current at 40 deg C Ambient	800 / 1250 / 2000 A
		Rated Peak Withstand Current kAp	79 kAp
		Rated Making Current kAp	79 kAp
		Symmetrical Breaking Current at Rated Voltage kA	31.5 kA
8	Duty cycle	Autoreclosing	0-0.3sec -CO-3 min -CO
		Minimum Dead Time	0.3 sec
9	Maximum Make time	Less than 50 ms	
10	Maximum switching Overvoltages generated	Within 2.5 P.U.	
11	Closing Coil (Only on DC)	Momentary Load	350W
		Voltage Operating Range	85% -110%
11	First pole to clear factor	1.5 for Non-Effective Earthed system	
12	Operating mechanism	Fixed trip/ Trip Free	Trip Free
		Antipumping Device	Inbuilt with mechanism
		Type of Mechanism	Standard: Motor Operated, Spring Charged Stored Energy

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14	Trip Coil (Only on DC)	Momentary Load	350W
		Voltage operating range	70% -110%
15	Spring Charging Operation	Motorised/ Manual Spring charging in case of control supply failure	
16	Operation Counter	5 Digit, Not resettable	
17	Spring Charging Motor (Available in AC & DC version)	Type of Motor	DC motor
		Permissible Voltage Variation	+/- 10%
		Insulation Class	E
		Time required to Charge spring	Less than 8 Second
		Operation sequence stored In spring	O –C – O
18	Auxiliary Contacts	No. of Auxiliary Contacts	6NO+6NC or 12NO+12NC
19	Net Weight of Breaker	800A VCB	375 kg approx.
		1250A VCB	380 kg approx.
		2000A VCB	390 kg approx.
20	Pole Housing Material	Epoxy	

4.0 CONSTRUCTION

STRUCTURE

The external view of this breaker is shown in Figure 2. The circuit breaker consists of a moulded insulator, housing three (3) vacuum interrupters and an operating mechanism which uses the spring stored energy system.



Figure 2:
External view of the -
12kV upto 1250A CB



Figure 3:
External view of the
- 12kV / 2000A CB

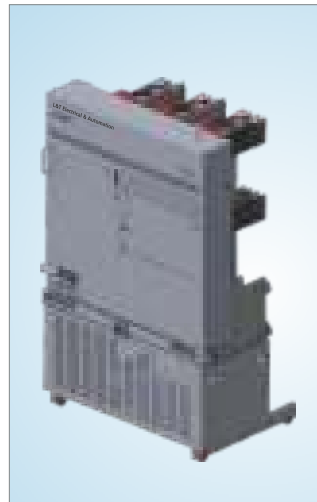


Figure 4:
External view of the
- 12 kV / 3150A CB

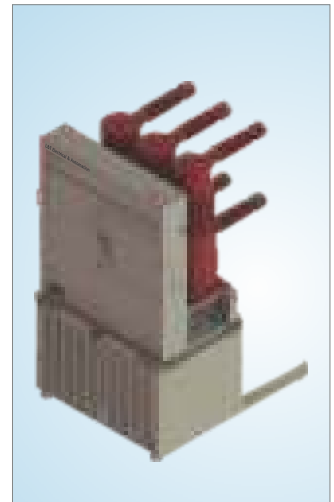


Figure 5:
External view of the -
33kV 2000A CB

VACUUM CIRCUIT BREAKER TYPE: _____

RATED VOLTAGE	12kV	RATED S.C. MAKING CURRENT
RATED INSUL. LEVEL	IMPULSE 75kVp	RATED OPERATING SEQ. O-0.3s -CO- 3MIN- CO
	1 Min p.f. 28kVrms	RATED CLOSING COIL VOLT.
RATED FREQUENCY	50/60HZ	RATED TRIP COIL VOLT.
RATED NORMAL CURRENT		RATED MOTOR SUPPLY VOLT.
RATED SHORT TIME CURRENT		WEIGHT
RATED S.C. DURATION	3 s	SERIAL NO.
RATED S.C. BREAKING CURRENT		MANUFACTURED IN YEAR
		INTERNATIONAL STANDARD - IEC 62271-100

Rating Plate

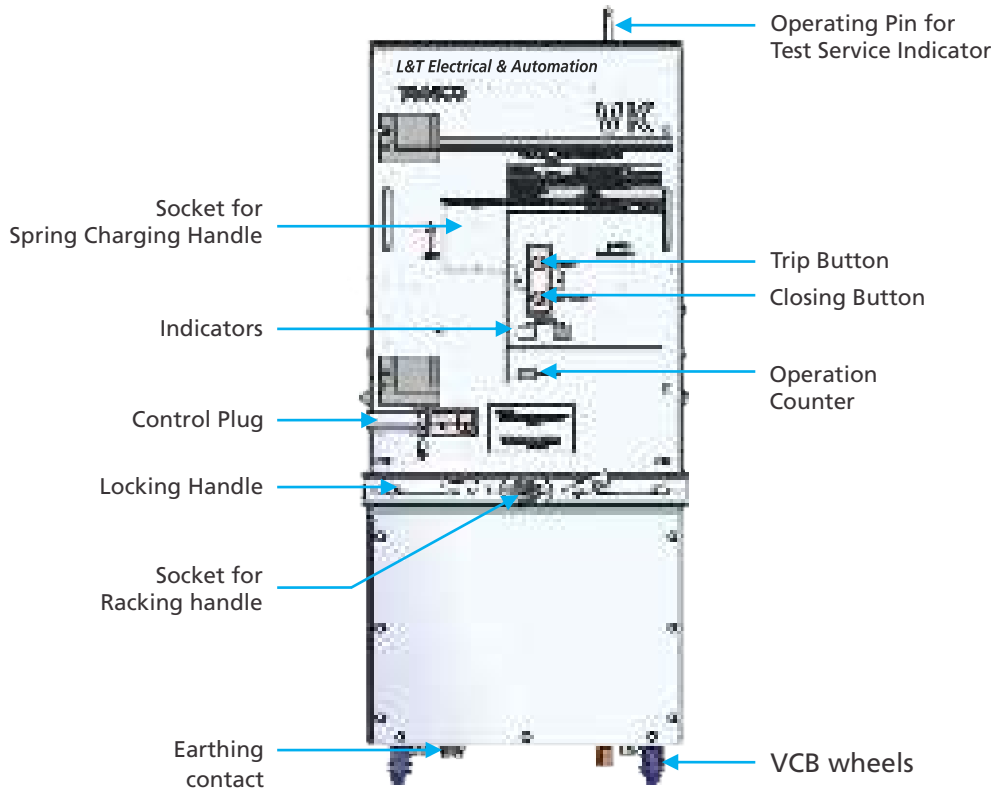


Figure 6 - 12kV 800A VCB - FRONT VIEW

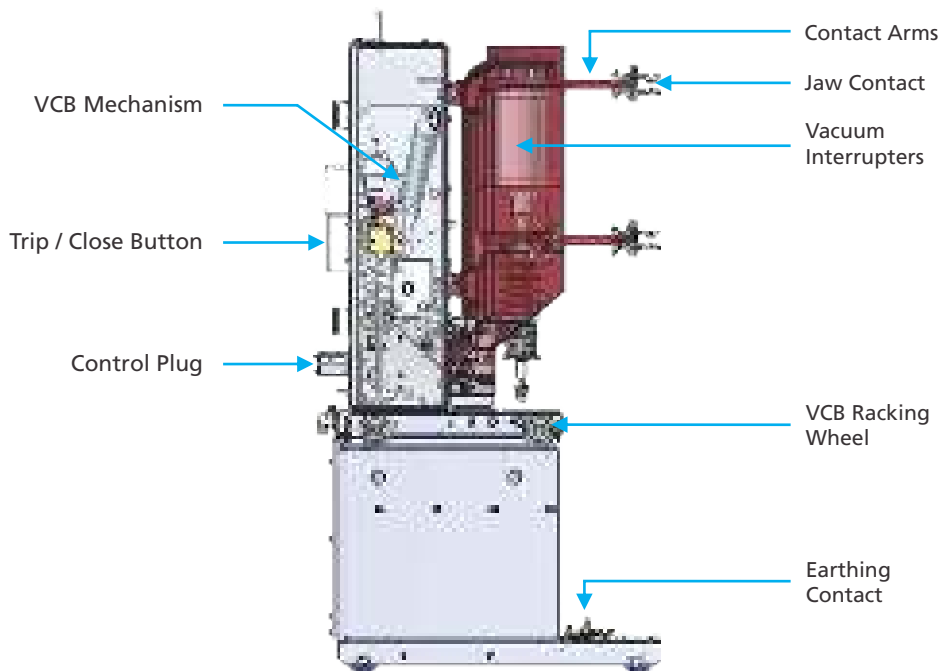


Figure 7 - 12kV 800A VCB - SIDE VIEW

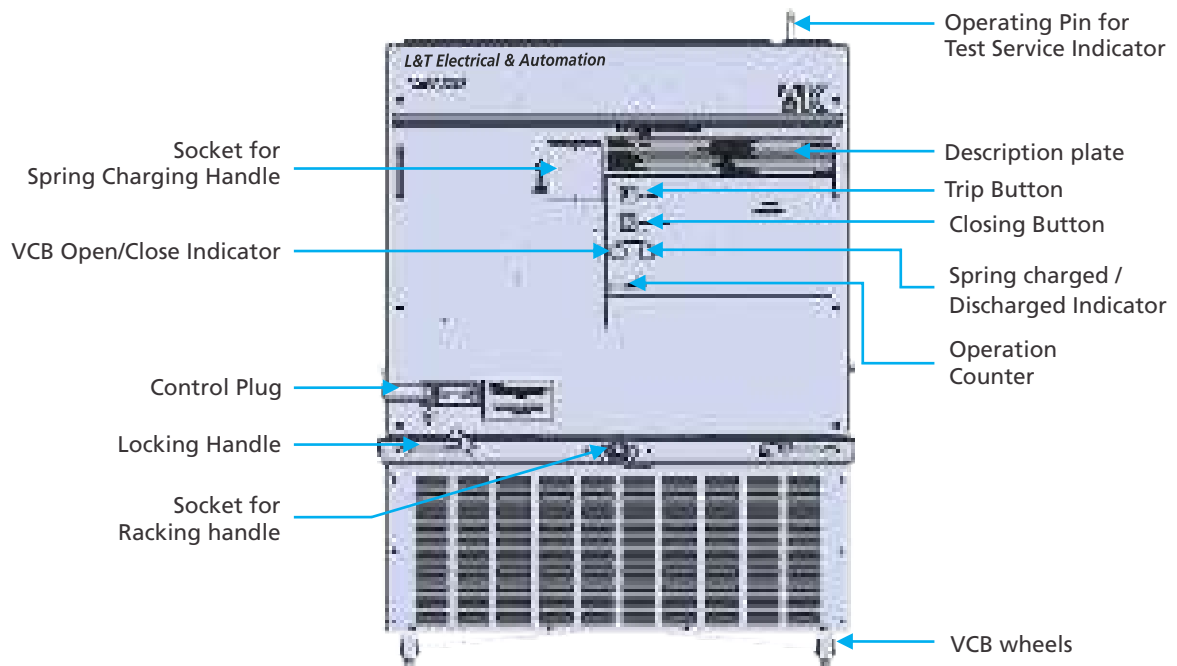


Figure 8 - 12kV / 3150A VCB - FRONT VIEW

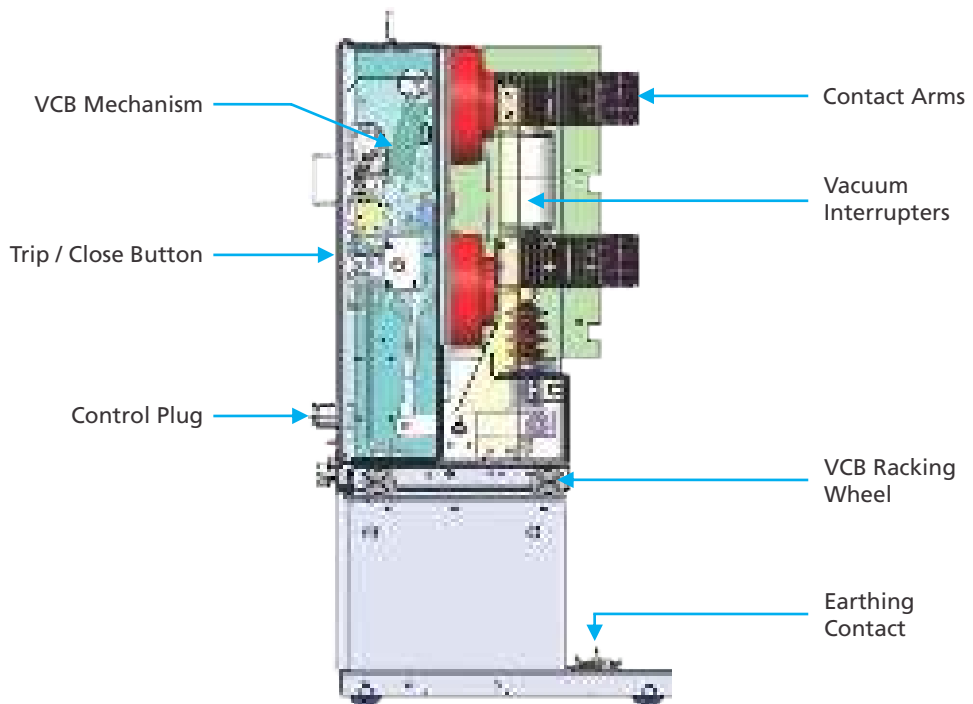


Figure 9- 12kV / 3150A VCB - SIDE VIEW

VCB - 33kV 2000A

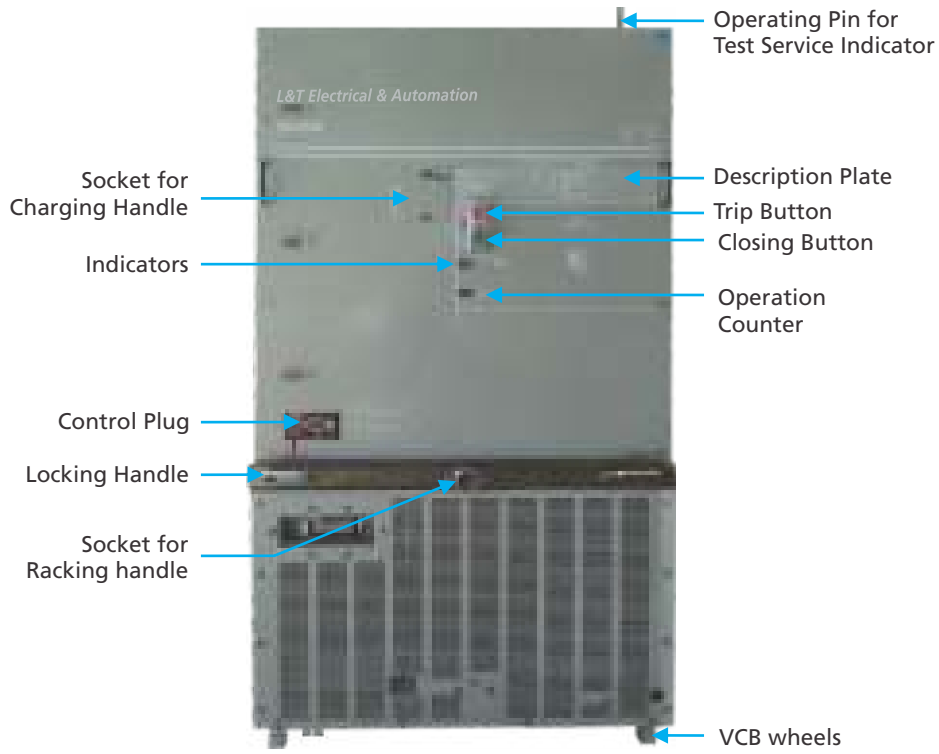


Figure 10 - 33kV VCB - FRONT VIEW

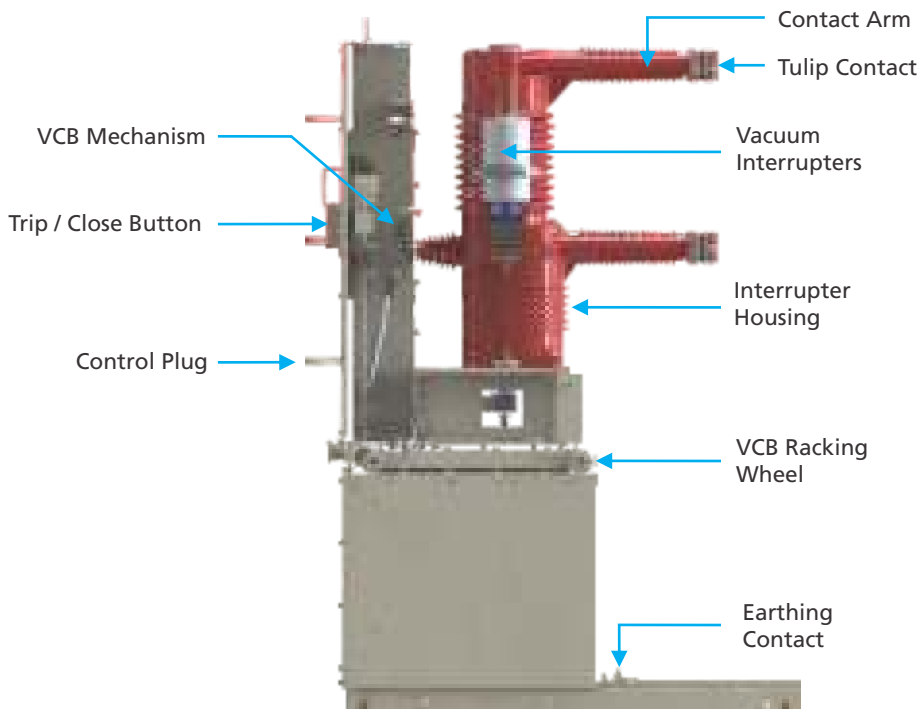


Figure 11 - 33kV VCB - SIDE VIEW

4.1 Operations

The motor energy-storing mechanism of the breaker is shown in Figure 12.

i) Charging of Closing spring

When the power supply is connected to the operation circuit, energy from the motor is stored in the closing spring. When the spring charging is complete, the limit switches cuts motor supply. The indicator turns from white to yellow CHARGED condition, confirming that the spring charging is complete. As the closing spring may be released by a closing signal, the limit switch closes when the closing operation terminates, causing the motor to run.

ii) Closing operation

When the closing coil is excited by a closing signal, the closing catch is released and the closing cam is rotated by the closing spring, which in turn rotates the main shaft. The main shaft

drives the vacuum interrupters through the wipe spring, and the circuit breaker closes.

CAUTION: DO NOT repeat the closing operation once the breaker is closed.

iii) Tripping operation

When the tripping coil is excited by a tripping signal, the tripping catch is released, and the breaker is opened by the opening spring.

iv) Trip-Free Operation

Trip-free operation performed by the energy storage mechanism shown in Figure 13-A shows the open state of the energy storage mechanism. Figure 13-B shows the state immediately after the closing operation. When a tripping signal is delivered with a closing signal, opening operation shall be performed preferentially as shown in Figure 13-C.

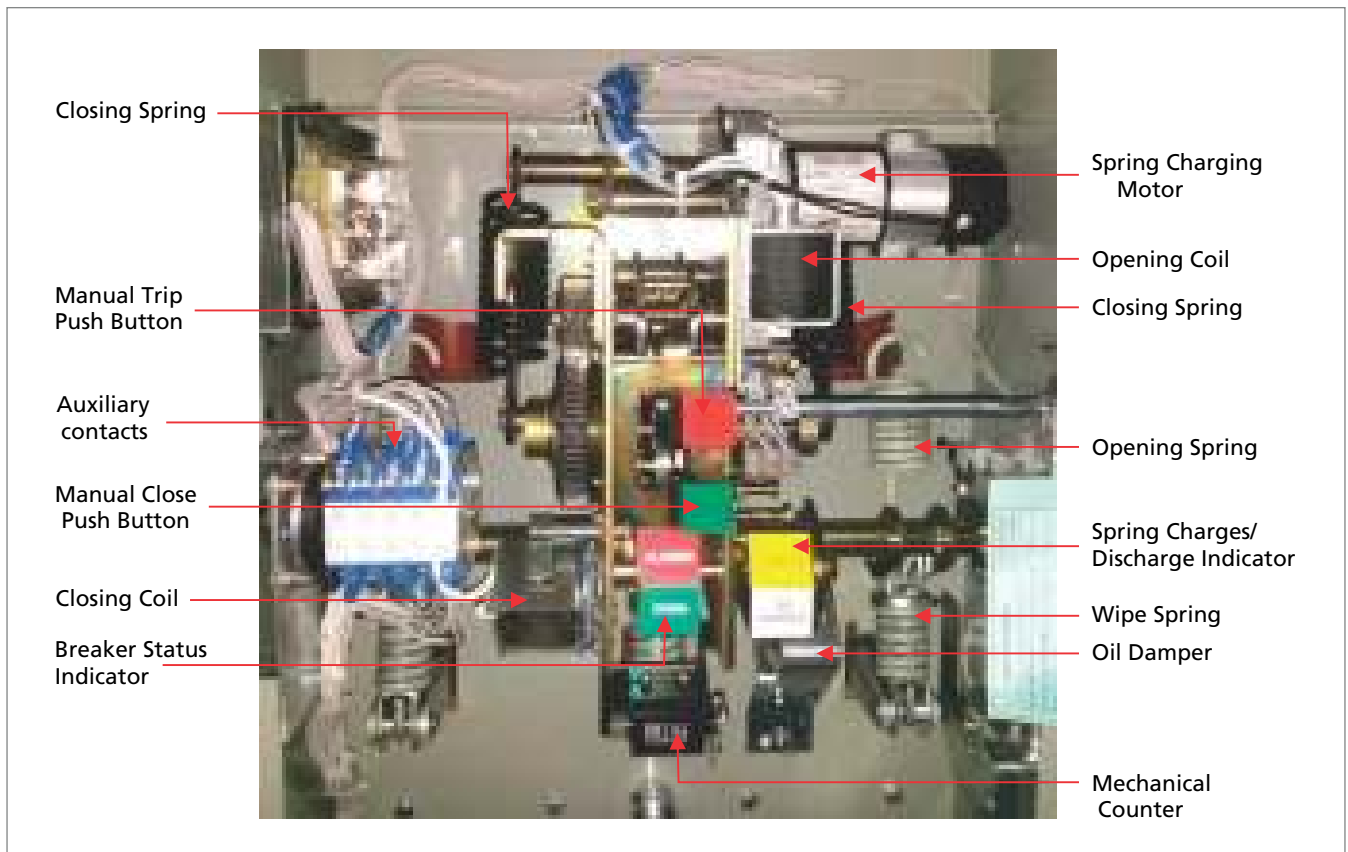


Figure 12 : Mechanism for spring charging breaker



Figure 13 : Motor stored energy mechanism

4.2 Control Circuit

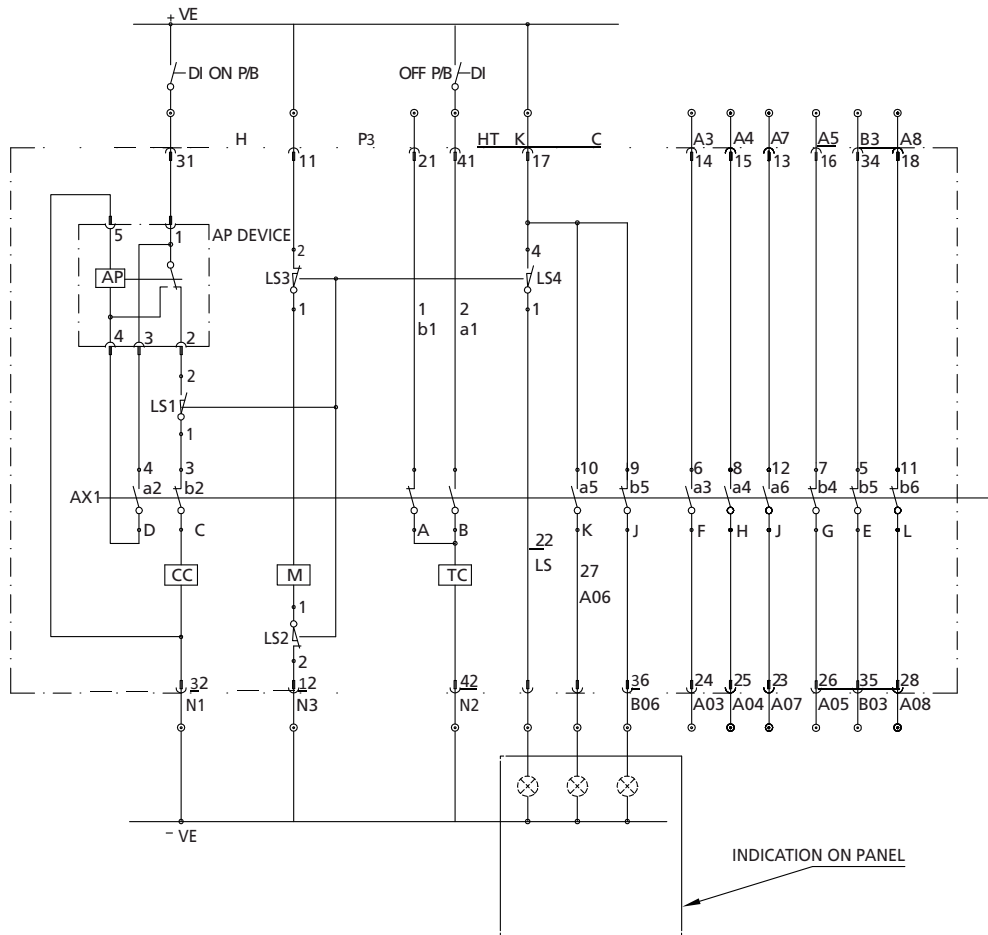
4.2.1 Operations for motorized charged spring.

(a) Closing

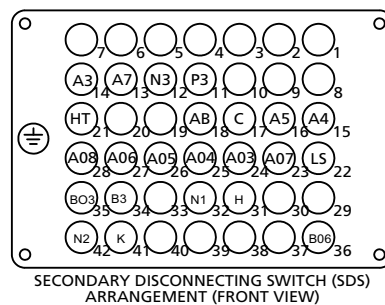
Figure 14 shows the condition in which the charging is

completed. When the external operations switch CS (1) is closed, the circuit IL-b-Yb-Vb-CC energizes the closing coil, thus closing the breaker. Once the breaker is closed, the auxiliary switch (b) changes over, thus de-energizing the closing coil. The auxiliary relay Y energizes to cut off the supply to the closing coil, thus achieving the antipumping feature.

Schematic control wiring diagram



LEGEND	DESCRIPTION
CC	CLOSING COIL
TC	TRIPPING COIL
M	SPRING CHARGING MOTOR
a	BKR. AUX. CONTACT - N/O
b	BKR. AUX. CONTACT - N/C
AP	ANTI-PUMPING DEVICE
LS	SPRING CHARGE LIMIT SWITCH
AX1,	AUX. SWITCH 1



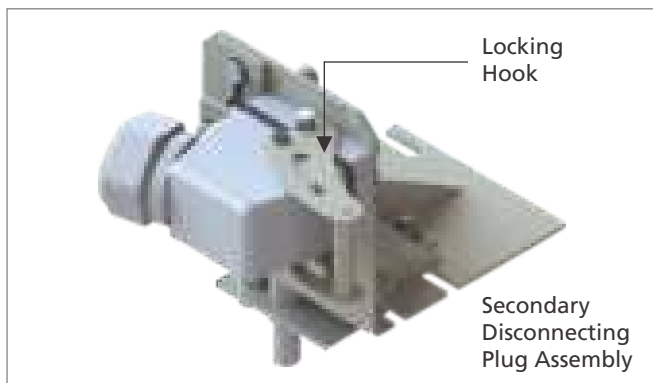
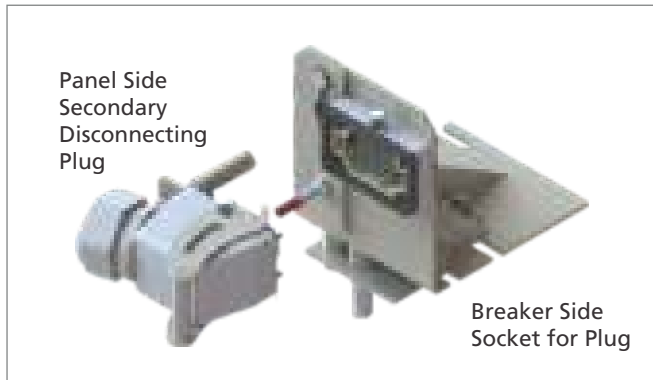
(b) Automatic charging of closing spring.

The microswitch LS will close simultaneously with the breaker, thus energizing the control relay X. With the relay X energized, the circuit LS-LS-Xa-M-Xa-F starts the motor until the charging of the closing spring is completed. Once the spring is fully charged, LS opens, de-energizing the relay X and the motor. Spring charging takes about 3.5 seconds.

(c) Tripping

The tripping of the breaker involves only the a1 contact. Closing the external switch CS (2) will energize the trip coil and trip the breaker. On tripping the breaker, the auxiliary switch (a) changes over, hence de-energizing the trip coil (TC).

4.3 Interlock of Control Circuit Plug



When using the secondary disconnect plug, follow the procedures described in the following page:

a) DISCONNECTED position of panel

- Breaker cannot be moved to service position because the lock

pin 2 is in the lower position (below floor plate) when the plug is not inserted.

- The plug cannot be inserted because the insertion hole is closed by the lock pin 1.

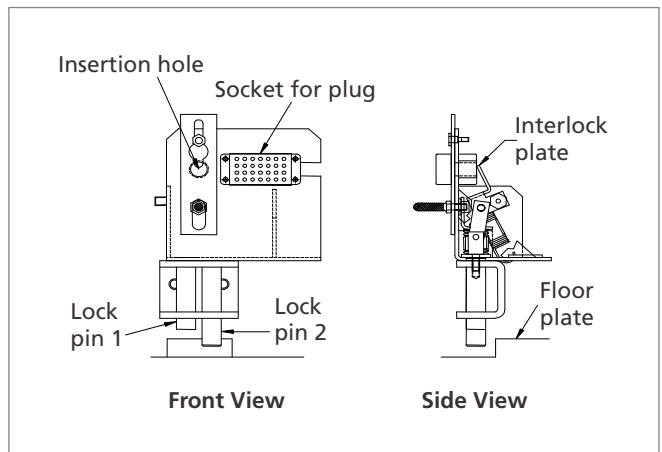


Figure 14 : DISCONNECTED position of panel

b) Preparation for plug connection

- While pressing down the red lever and keeping it held down, insert the plug into the insertion hole.
- During the insertion, the breaker cannot be moved to the service position because lock pin 2 is in the lower position.

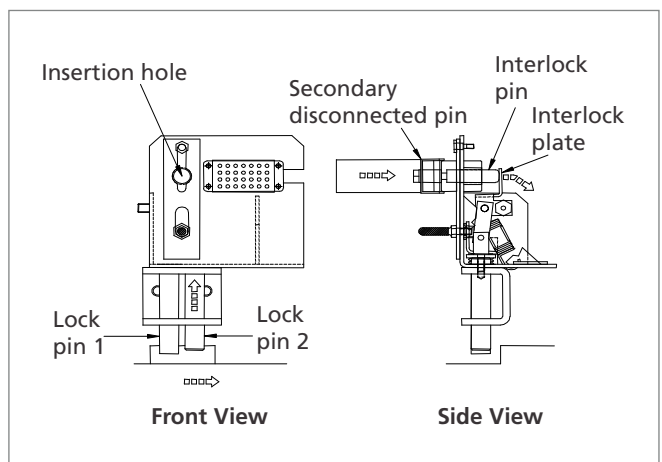


Figure 15 : Preparation for plug connection

c) Incomplete connection of the plug

- Breaker cannot be moved to the connected position because lock pin 2 is not raised by the interlock pin of the secondary disconnect plug.
- During insertion of the plug, the interlock plate is pushed by the interlock pin and the lock pin 2 is raised.
- During removal of the plug from the uncompleted connection, lock pins 1 and 2 return to the position shown in figure 14.

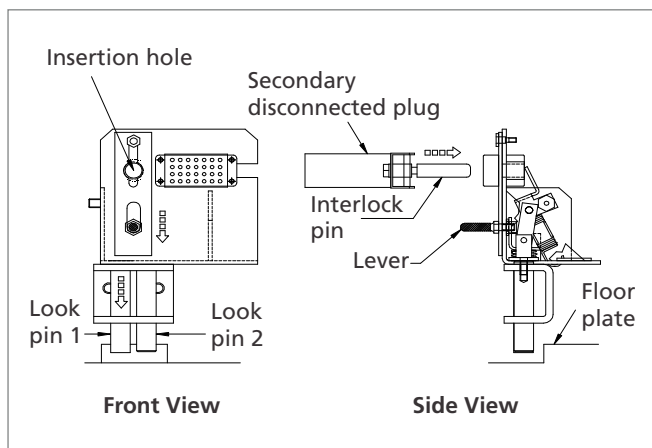


Figure 16 : Incomplete connection of the plug

d) Complete connection of the plug

- Connecting the plug as shown in figure 16 raises the lock pin 1 and breaker can be moved to the connected position.
- In the connected position, coupling of the interlock pin and the lock pin 1 prevents removal of the plug.
- The lever cannot be lowered during removal of the plug in the connected position because lock pin 1 strikes against the floorplate.
- To ensure proper connection of the plug and its contact pins, the plug must be fully home and not tilted to one side. The Locking Hook is provided to ensure this.

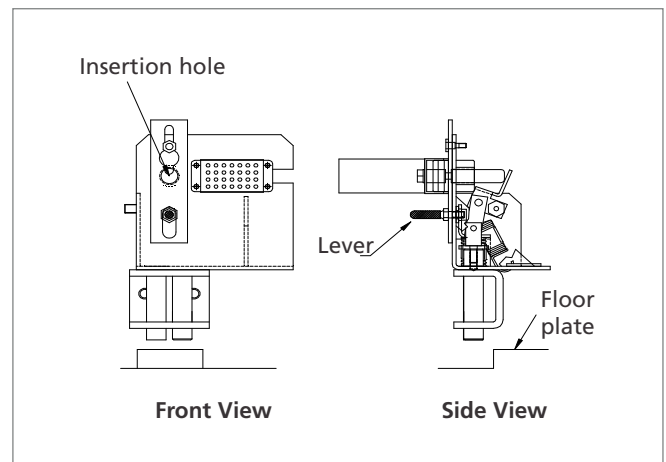


Figure 17 : Complete connection of the plug

5.0 OPERATING INSTRUCTIONS

5.1 - Operating Instructions for VCB rack-in and Rack Out

VCB Operation:

The breaker is of the horizontal withdrawal and horizontal isolation type of truck. It is designed with the interlocks against accidental and dangerous operations.

VCB Rack-IN or Rack-OUT operations to be carried out with VCB compartment door closed only.

It can be inserted in to *CONNECTED/SERVICE* position or withdrawn to *DISCONNECTED / TEST* position with the aid of a racking handle provided. Before starting VCB Operation please ensure that all Panel components are known.



Figure 5.1 A - VCB in Disconnected

Figure 5.1 B - VCB in Test

Figure 5.1 C - VCB in Service

- As shown in Figure 5.1 A VCB is in DISCONNECTED position.
- As shown in Figure 5.1 B VCB is in TEST Position. Indication shown on VCB door will be in Green Colour.
- As shown in Figure 5.1 C VCB is in Service Position. Indication shown on VCB door will be in Red Colour.

Note - For Detail view of Test Service Indicator & VCB Handle with latch please refer Figure No 5.5.

VCB Racking-In to TEST Position Operation Sequence.

- While racking-in VCB to test position, ensure the racking mechanism interlock handle in latched / locked position.
- Hold the Breaker handles & gently push the Breaker into panel.
- Unlatch the racking mechanism interlock handle to lock the Breaker with panel.
- Interlock plate goes into the slots provided at the side of the panel. These handle operate left to right in horizontal plane.
- Breaker is now in TEST Position.

5.2 - Control Plug Arrangement

- A removable plug at the panel connects these control wires to the fixed wiring at the metering compartment.
- Whenever Panels are taken for Maintenance activity, please keep the control plug wire as shown in Figure 5.2 so as to avoid any disturbance & damages to Control plug wire.
- Ensure that the plug makes full connection before fastening the clasp.
- The breaker can only be racked into the SERVICE position when the secondary control plug is inserted.
- Control circuit plug can be inserted by moving the Red lever downwards.

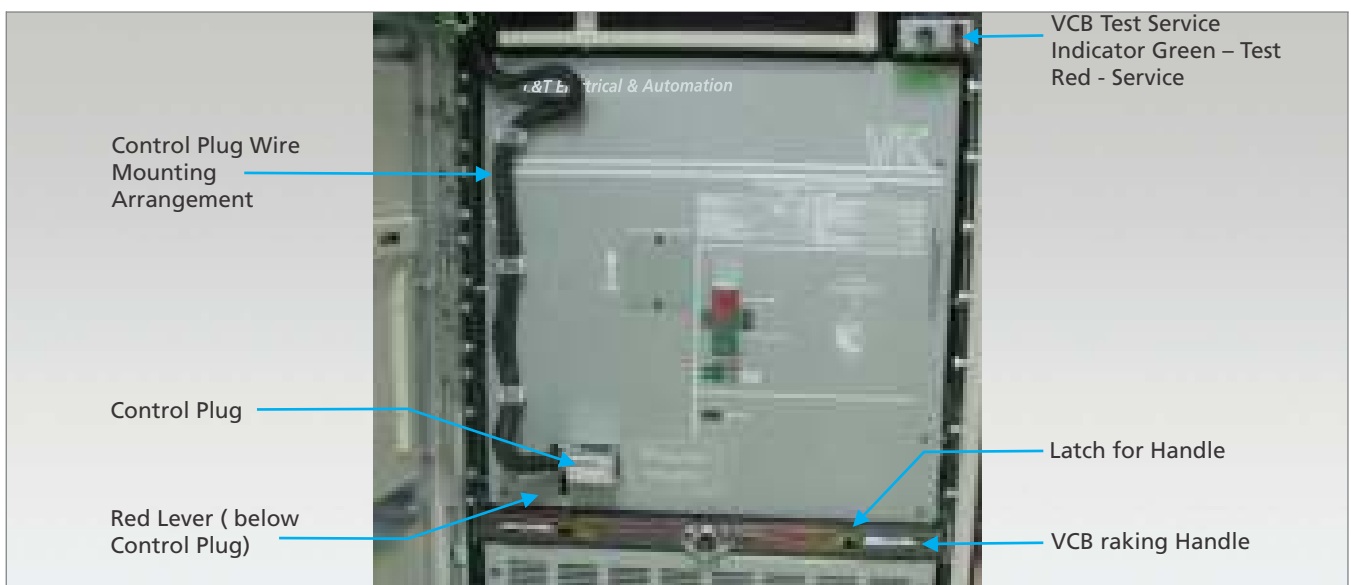


Figure 5.2 - Control Plug Arrangement

VCB Racking Out to Disconnected Position Operation Sequence.

- While racking out VCB to Disconnected position, Pull the Interlock Plates and latch the Handle.
- Hold the Breaker handles & gently pull the Breaker out of panel.
- Now the Breaker is in DISCONNECTED Position.

5.2.1 - VCB Door Operating Instructions are as follows



Figure 5.2.1 A - Door Locked



Figure 5.2.1 B - Door latch Open

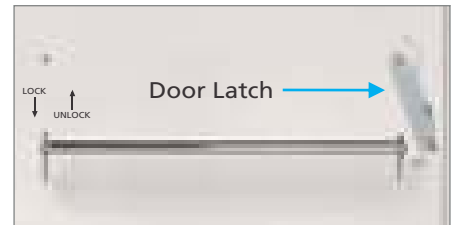


Figure 5.2.1 C - Door Opening

A. Door Opening Sequence

- Before door opening ensure the VCB in in Open condition.
- Door is in closed position with padlocking arrangement as shown in Figure 5.2.1 A.
- For Door Opening Padlocked to be removed, latch to be opened (rotate anticlockwise) as shown in Figure 5.2.1 B.
- Door Handle shall be lifted upwards and door shall be opened as shown in Figure 5.2.1 C.

B. Door Closing Sequence

- Ensure the wheel bracket plates are at closed position.
- Lift the VCB Door handle (if necessary), hold it in same position and swing the door towards panel.
- Once the door flushing with the panel, push the VCB door handles downward and latch the handles (rotate clockwise).
- Padlock the latch.

5.2.2 - VCB Rack-in- & Rack-Out Operation Sequence - Closed Door**CIRCUIT BREAKER RACK-IN OPERATION SEQUENCE :-**

1. ENSURE THE FOLLOWING BEFORE RACK-IN;
 - A VCB IS IN 'TEST' POSITION.
 - B CONTROL PLUG IS PROPERLY CONNECTED TO VCB.
 - C VCB IS IN 'OPEN' CONDITION.
2. SWING THE DOOR FOR CLOSING AND LOCK IT BY MOVING HANDLE DOWN.
3. PAD LOCK DOOR HANDLE.
4. ROTATE THE KNOB OF 'SOCKET FOR VCB RACKING HANDLE' ANTICLOCKWISE AND INSERT THE VCB RACKING HANDLE.
5. ROTATE THE RACKING HANDLE CLOCKWISE UNTIL;
 - A VCB POSITION INDICATOR SHOWS 'SERVICE' AND
 - B MECHANICAL RESISTANCE IS FELT TO ROTATE THE HANDLE.
6. REMOVE THE RACKING HANDLE.
7. ROTATE THE KNOB OF; SOCKET FOR VCB RACKING HANDLE' CLOCKWISE TO COVER RACKING HOLE.

CIRCUIT BREAKER RACK-OUT OPERATION SEQUENCE :-

1. ENSURE THE FOLLOWING BEFORE RACK-OUT;
 - A VCB IS IN 'OPEN' CONDITION.
 - B VCB POSITION INDICATOR SHOWS 'SERVICE' POSITION.
2. ROTATE THE KNOB OF 'SOCKET FOR VCB RACKING HANDLE' ANTICLOCKWISE AND INSERT THE VCB RACKING HANDLE.
3. ROTATE THE RACKING HANDLE ANTICLOCKWISE UNTIL;
 - A THE VCB POSITION INDICATOR SHOWS 'TEST' AND
 - B THE HANDLE STOPS ROTATING.
4. REMOVE THE RACKING HANDLE.
5. ROTATE THE KNOB OF 'SOCKET FOR VCB RACKING HANDLE' CLOCKWISE TO COVER RACKING HOLE.
6. RELEASE PAD LOCK FROM DOOR HANDLE.
7. UN-LOCK DOOR BY MOVING HANDLE UP & SWING IT FOR OPENING.

- To withdraw the breaker from the panel, first remove the control circuit plug. This is done by first opening the clasp, then pressing down the red interlock lever and holding it down while withdrawing the plug. Exert a pulling pressure on the left-hand side of the plug and ensure that it is in line with the socket. Do not pull the plug on the right hand side as this may distort the holding bracket and cause misalignment of the shaft.

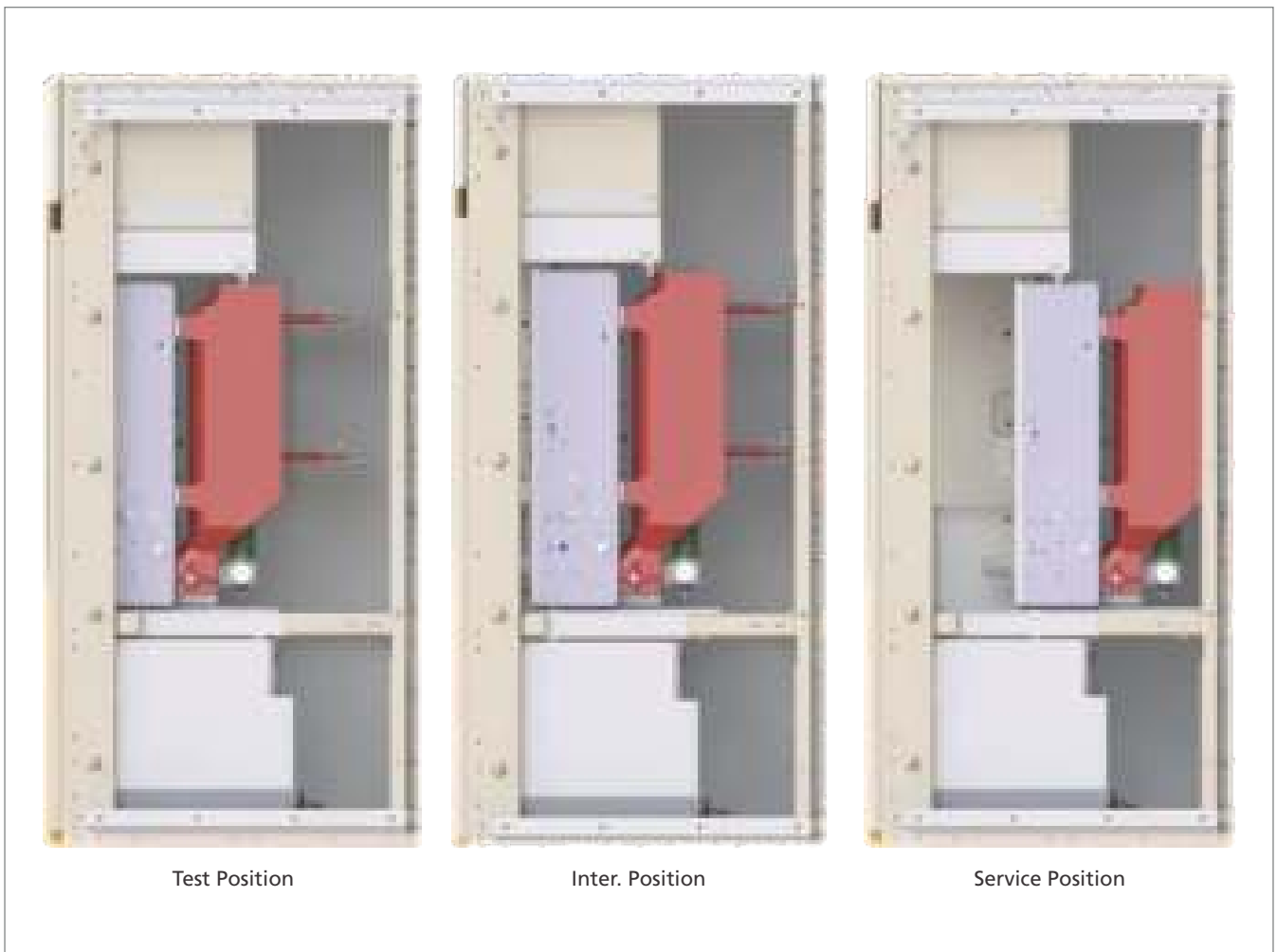


Figure 18 : Procedure for inserting the breaker into the cubicle

5.3 Interlocks

5.3.1 - General Interlocks Provided

- A) The Racking-in & Racking-out of circuit breaker is not possible unless it is OFF.
- B) Circuit breaker can be closed only when it is in the service or test position.
- C) The operation of Circuit breaker is not possible while it is in the intermediate position.
- D) Circuit breaker cannot be racked-in unless the control plug is inserted.
- E) The operation of Circuit breaker is not possible unless control plug is inserted.
- F) It shall not be possible to remove the control plug while the Circuit breaker is in service position.
- G) It shall not be possible to remove the control plug while the Circuit breaker is in the intermediate position.
- H) It shall be possible to remove the control plug if Circuit breaker when in test disconnected position, irrespective of Circuit breaker status.
- I) Circuit breaker can be fully withdrawn out of its compartment only when the control plug is removed.
- J) It is possible to operate Circuit breaker unless earth switch is in 'open' position.
- K) It shall not be possible to move the Circuit breaker from disconnected position/test position into service position while earthing switch is closed.
- L) It is not possible to operate earth switch unless Circuit breaker is in test/disconnected position.
- M) It is not possible to close the earth switch with Circuit breaker in service or intermediate position.
- N) It is not possible for Circuit breaker to operate unless spring is fully charged.
- P) Rating error preventer is provided to prevent rack in with different rating of the Circuit breaker.
- Q) It shall not be possible to open the door while circuit breaker, is in service position.
- R) Door can be opened only if Circuit breaker is in Test position.
- S) Bypassing arrangement is provided to unlock the door in case of emergency.
- T) Safety shutter opens when the VCB is racked-in to service position.
- U) Safety shutter closes automatically once the VCB is withdrawn from the service position
- V) VCB of same rating can be interchanged.

5.3.2 - Padlocking Facility

- A) VCB door key handle
- B) Safety shutter

6.0 MAINTENANCE AND INSPECTION

6.1 Check Points For Periodical Inspection

General checks should be done one year after installation and once every 2 years thereafter, depending on severity of usage &

environmental conditions. This should be done against a well documented schedule of requirements.

NO	CHECK POINT	CHECK ITEM	CHECK METHOD	CRITERIA	WHAT TO DO	FREQUENCY
1	Entire Circuit Breaker	Tightness of bolts and nuts.	By tightening them with screw driver and wrench with torque mark	No loose connections.	Re-tighten loose connections.	Once in 2 years
		Dust and foreign matter.	Visual check	The breaker should be clear of dust and stains.	Clean with a vacuum cleaner. Wipe with a clean, dry cloth and recommended cleaning agent (AS66).	
		Deformation, excessive wear and damage.	Visual check	No deformation, excessive wear or damage.	Replace parts, if necessary.	
		Lost or missing parts.	Visual check	No missing parts	Replace missing parts.	
2	Control circuit (Section 4.2)	Electrical closing and tripping	Check at the "DISCONNECTED" position.	The closing and tripping operations can be done smoothly. Motor can spring charge automatically.	Check circuits and the closing and tripping devices. When the motor cannot spring charge, check the electric connection.	Once in 2 years
3	Auxiliary switch	Terminal	Tighten with screw driver	No loose screws.	Re-tighten.	Once in 2 years
		Moulding and Contacts	Visual check	No damage or deformation.	Replace when damaged.	Once in 2 years
4	Operating mechanism	Dust and foreign matter	Visual check	There should be no dust and foreign matter.	Remove foreign matter with pressurized air.	Once in 2 years
		Smooth operation	Manual operation	Operation should be smooth.	Clean off old lubricant and apply a small amount of fresh lubricant, if necessary.	
		Lubricant of bearing pins.	Check by sight and touch.			
		Shaft of closing and tripping portion.	Visual check	Must rotate smoothly.		

NO	CHECK POINT	CHECK ITEM	CHECK METHOD	CRITERIA	WHAT TO DO	FREQUENCY
5	Vacuum interrupter	Contact wear	Visual check	Red wipe mark must be visible when breaker is in CLOSED position.	If red wipe mark cannot be seen, replace the vacuum interrupter.	After every 30 fault operations (depending on the severity of the fault), 500 mechanical operation or once in 2 years, whichever comes first.
		Vacuum pressure	Refer to section 6-2		Replace the vacuum interrupter when vacuum pressure is insufficient.	Once in 2 years
		Number of OPEN – CLOSED operation.	Counter reading	When the counter reading reaches 10,000 (for the rated current interruption), check the internal pressure. The next check shall be done at the reading of 15,000.	Replace the vacuum interrupter if the internal pressure is insufficient or when the counter reading reaches 20,000.	
6	Main circuit disconnects/ Contact finger	Dis-colouration of contacts	Visual check	There should be a thin film of electrical grease on the contact surface.	Clean the contact surface of old grease and apply a thin film of new grease.	
7	Main barrier	Contamination and discolouration	Visual check	There should be no foreign matter. There should be no tracking marks, cracks or damages.	Clean with pressurized air and then wipe with a clean cloth. Replace when damaged.	Once in 2 years
8	Measurement of insulation resistance	Measuring location	Resistance	Tester	When the insulation resistance between the main circuit terminals is low, clean the surface of the vacuum interrupter with a dry cloth and then take the measurements again.	Once in 2 years
		Main conductor-Ground/ Main conductors		5000V		
		Control circuit Ground		500V		

NO	CHECK POINT	CHECK ITEM	CHECK METHOD	CRITERIA	WHAT TO DO	FREQUENCY
9	Measurement of contact resistance.	Measuring location	Resistance	Tester	Check wipe and Contact gaps.	Once in 2 years
		Across each set of contacts.		Micro-Ohm meter		
10	Timing Test	Across each set of contacts.	Trip test & Close test.		As in Table.1	Carried out when speed of operation is critical.

6.2 Check on Vacuum

The relationship between the dielectric breakdown voltage and the vacuum pressure is shown below.

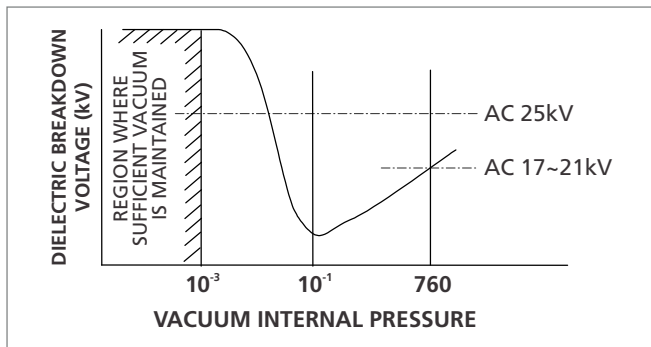


Figure 19 : Dielectric Breakdown Voltage vs. Vacuum Internal Pressure

Breakdown will occur in the vacuum interrupter with vacuum less than 0.1mmHg when applied with a voltage of about 17 – 21kVAC. Therefore, the vacuum interrupter internal vacuum pressure can be checked by applying the voltage of 25 kV AC in this voltage withstand test.

When the internal vacuum pressure is not sufficiently high, breakdown will occur immediately. Hence 10 seconds of voltage application is sufficient.

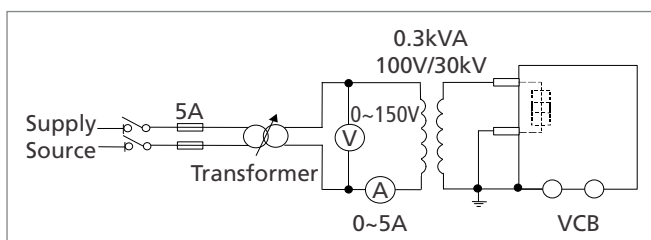


Figure 20 : Set-up for High Voltage Withstand Test for Vacuum Interrupter

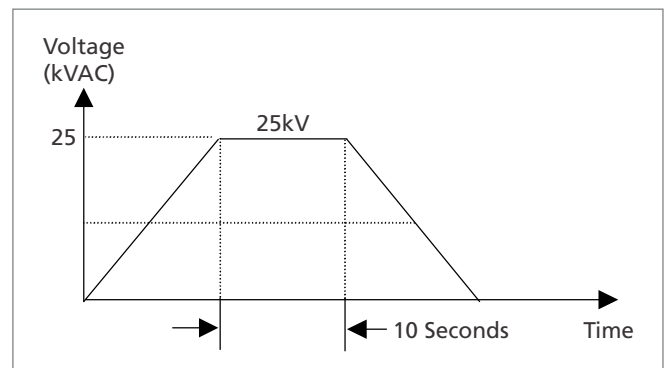


Figure 21 : Application of High Voltage

If the ammeter indicates current flow in the process of increasing voltage, then the voltage must be reduced to zero and gradually increased again. Repeat this process 2 or 3 times. Interrupter is defective if the current increases with the voltage. The leakage current is almost zero for good interrupters.

6.3 Troubleshooting

a) Closing Problem

CANNOT CLOSE	Mechanism	
	Fault	What to do
	Closing spring damaged or dislocated	Replace
	Closing catch seized or galled	Replace
	Closing paddle dislocated.	Replace
	Closing coil burnt.	Replace
	Motor burnt	Replace
CLOSING SOUND BUT BREAKER REMAINS OPEN	Control Circuit	
	Fault	What to do
	Auxiliary switch poor contact or burnt.	Replace switch
	Control relay poor contact or burnt.	Replace PCB
	Auxiliary relay poor contact or burnt.	Replace PCB
	PCB connector poor contact or burnt.	Replace if necessary
	Microswitch poor contact or burnt.	Replace if necessary
CLOSE WITHOUT CLOSING SIGNAL	Mechanism	
	Fault	What to do
	Resetting spring and links fail to reset.	Alignment
	Trip catch/trip shaft fails to reset.	Alignment
	Interlock not properly aligned.	Alignment
	Trip coil armature fails to reset.	Replace if necessary
	Main shaft galled.	Replace
CLOSE WITHOUT CLOSING SIGNAL	Mechanism	
	Fault	What to do
	Closing catch fails to reset.	Realign
Main shaft fails to reset.	Realign	
CLOSE WITHOUT CLOSING SIGNAL	Control Circuit	
	Fault	What to do
Short circuit of the closing circuit.	Repair	

b) Tripping operation

CANNOT TRIP	Mechanism	
	Fault	What to do
	Trip coil burnt or galled.	Replace
	Trip shaft and catch galled.	Replace
	Trip paddle dislocated.	Replace
	Main shaft galled.	Replace
	Control Circuit	
	Fault	What to do
	Auxiliary switch poor contact or burnt	Replace
	Trip coil burnt, armature damaged or galled	Replace
Terminal and connector poor contact or burnt	Replace	

TRIPPING SOUND BUT BREAKER REMAINS CLOSED	Mechanism	
	Fault	What to do
	Link galled.	Replace

TRIP WITHOUT TRIPPING SIGNAL	Mechanism	
	Fault	What to do
	Trip catch damaged	Replace
	Control Circuit	
	Fault	What to do
Short circuit of the trip circuit	Replace	

7.0 MANDATORY SPARES

Sr. No.	Item Description
1	VCB RACKING IN & RACKING OUT HANDLE
2	MANUAL SPRING CHARGING HANDLE ASSY
3	TRIPPING ROD
4	VCB TRIP COIL / CLOSE COIL
5	VCB SPRING CHARGING MOTOR
6	AUXILARY SWITCH - 6NO + 6NC
7	Electrical Contact grease (Preferred - Mosil EC-111)
8	Mechanical Grease (Preferred - Mosil GM-00)
9	Touchup Paint

8.0 DO'S AND DON'TS

IN VCB AND VCB PANEL (CLOSE DOOR OPERATION PANEL)

Read Operation & Maintenance Manual carefully before doing any Operation on the Switchboard.

DO's

- Perform all the operations in CLOSE door condition only. (Rack in, Rack out, Open and Close)
- Ensure following before racking the VCB from TEST to SERVICE position.
 1. VCB is in TEST position.
 2. VCB is in OPEN condition.
 3. Earth switch is in OFF condition if provided.
 4. Control circuit plug is fully engaged. Red lever on control plug mechanism should come upward direction when CONTROL PLUG is fully engaged.
- Ensure VCB compartment door is fully closed and all the bolts on VCB compartment door are fully Tightened.
- Earth switch should be operated when VCB is in DISCONNECTED position.
- Always cross check rating of the VCB before insertion inside the panel.
- Ensure complete switchboard is free from dust and any other foreign particles.
- Ensure all openings including hole provided for earthing connection are properly closed with seal to avoid any vermin/ reptile entry.
- Ensure that the shutter assembly is unlatched before inserting the VCB into the panel.
- Please keep the heater "ON" in all Panels including Dummy panel.

DON'Ts

- Do not apply any flammable lubrication on the busbar joints or VCB finger contacts.
- Do not perform any operations in OPEN door condition. (Rack in, Rack out, Open and Close).
- Do not operate the interlocking lever on VCB.
- Do not try to rack in VCB when control plug is not engaged. By operating the VCB forcefully it may damage the control plug mechanism.
- Do not try to rack in VCB when VCB is in CLOSED condition.
- Do not try to operate Earth switch when VCB is in CONNECTED position if provided.
- Do not operate the VCB when castle lock is in LOCKED condition.
- Do not operate the padlock handles if door bolts are not tightened fully by Allen key.
- Do not try to insert wrong rating VCB inside the panel.
- Do not insert VCB without unlatching the shutter assemblies.
- Do not try to by pass VCB compartment door interlock when the feeder is in Live condition.

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