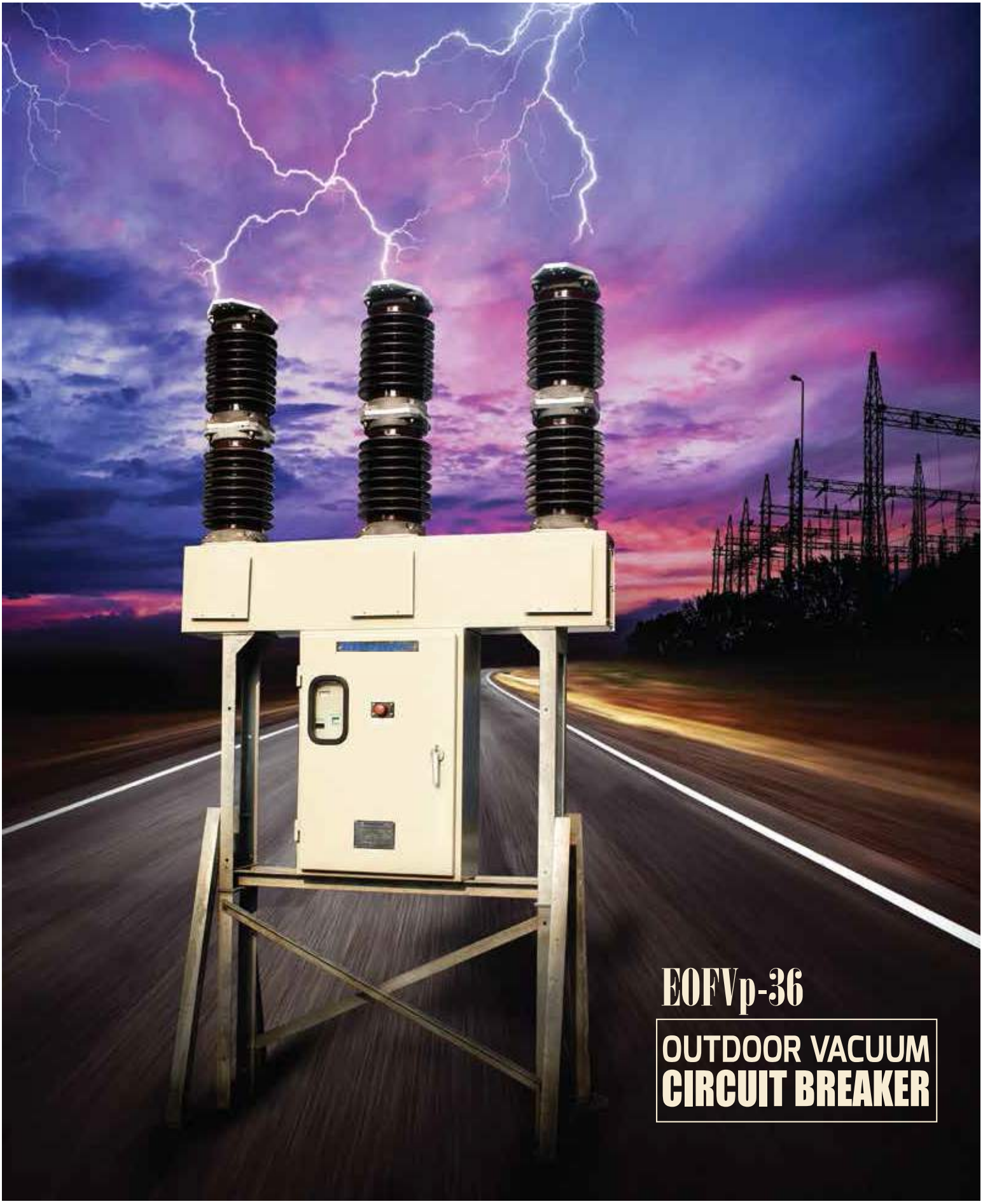

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1.1. General description

The EOFVp-36 is the result of consistent further development for application in modern current interruption technology for medium voltage switchgear. It is characterized by compact dimensions, good operator guidance and a modern functional industrial design.

The EOFVp-36 is porcelain clad outdoor vacuum circuit breaker supported on steel frames and designed for plinth mounting and is for use on earthed systems. It requires minimum maintenance compared to other circuit breaker technologies and it can perform well in harsh conditions. The mechanism of this breaker is designed for operation of very short stroke required in vacuum interrupter.

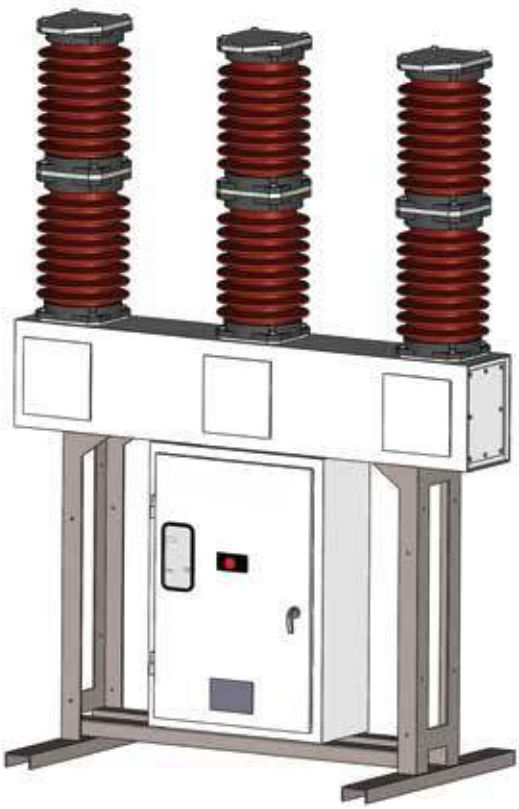


Figure 1: EOFVp-36 vacuum circuit-breaker (without secondary structure)

Main characteristics

- Three pole operation system
- Robust vacuum interrupters
- Operating mechanism motor driven
- Fully spring operated mechanism for all range
- Tested to IEC standard

Key benefits

- Simple to install and to operate
- Long service life that other types of breaker
- Maintenance reduced at the minimum
- Operates in all kinds of extreme climate conditions
- Increased safety High mechanical endurance
- Environment friendly than other type of circuit breaker

1.2. Applied standards

The EOFVp-36 vacuum circuit breakers comply with the provisions of IEC 62271 – 100/ IEC 56

Note: In their basic design and with all standard listed equipment options, EOFVp-36 vacuum circuit breakers are type – tested components in accordance with IEC. If the customer intends to fit the breakers with additional functions, we recommend that he should first consult us as in most cases proven and tested solutions are already available.

1.3. Environment & operating conditions

The EOFVp-36 vacuum circuit breakers are designed for the normal operating conditions laid down in the standards. Operating under conditions deviating from these is only admissible upon consultation with and with the written approval of the manufacturer.

1.3.1. Ambient temperature & relative humidity

Admissible ambient temperature & relative humidity	
Maximum ambient temperature	+45°C
Average ambient temperature over 24 hours	+35°C
Minimum ambient temperature	-10°C
Maximum average relative air humidity over 24 hours	95 %
Maximum average relative air humidity over 1 month	90 %

Table 1: Ambient conditions for EOFVp-36 vacuum circuit breaker

1.3.2. Site altitude

The rated insulating capacity values (rated lightning impulse withstand voltage, rated power frequency withstand voltage) specified for the equipment are, in accordance with the provisions of IEC Publication 71, based on standard atmospheric conditions (101.3 k Pa, 200C and 11 g/m3 water content) i.e. sea level. The insulating capacity of an insulation in air decreases with increasing altitude as a result of changes in the air density. Standards promulgated by IEC and others disregard this decrease in insulating capacity for altitudes of up to 1,000 m, i.e. the decrease in insulating capacity of 9% at an altitude of 1,000 m is still permissible. The standards provide no guideline for altitudes of more than 1,000 m with respect to insulation ratings. Our own recommendation is as follows:

Since this method used for rating insulation up to altitudes of 1,000 m has proved to be satisfactory, it should also be applied to higher altitudes. The altitude correction factor 'a' in Fig. 2 should therefore be based on the insulation capacity at 1,000 m, which is lower by 9% than the capacity at sea level.

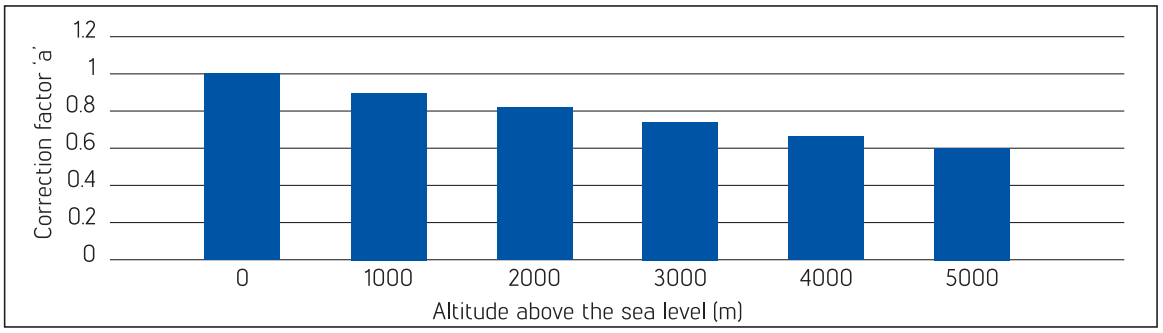


Figure 2: Correction factor 'a' Vs. Altitude above sea level (m)

Rated impulse withstand voltage to be selected ≥ $\frac{\text{(Required rated withstand voltage)}}{\text{(1.1 * a)}}$

For Example:

If the site altitude above sea level = 2000 m
Required rated impulse withstand voltage = 170 kV
Correction factor = 0.82 (according to Figure 1)

$$\text{Rated impulse withstand voltage to be selected} = \frac{\text{(170 kV)}}{\text{(1.1 * 0.82)}} = 188 \text{ kV}$$

When ordering replacement pole assemblies, state the circuit breaker type, design code and serial. This means that equipment designed for a rated voltage of 200 kV, is required for this application. When the permissible maximum has been attained, the complete pole assemblies must be renewed. Detailed instructions are supplied with the replacement pole assemblies.

1.3.3. Other operating conditions

Air pollution	The ambient air may be polluted by dust, smoke, corrosive gas or salt. For higher pollution please contact the Energypac department
Wind speed	The wind speed does not exceed 34 ms^{-1} (corresponding to 700 Pa on cylindrical surface)
Solar radiation	Solar radiation up to a level of 1000 Ws^{-2} (on a clear day at noon) should be considered.

1.4. Characteristic values

Opening time: The interval of time between the initiation of the opening operation and opening of the pole.

Arcing time: The interval of time between the instant of the first initiation of an arc and the instant of final arc extinction in all poles.

Break time: The interval of time between the initiation of the opening operation and the instant of final arc extinction in the last circuit breaker pole (= opening time + arcing time).

Close-open time: The interval of time (in a make-break operating cycle) between the instant when the contacts touch in the first pole in the closing process and the instant when the arcing contacts separate in all poles in the subsequent opening process.

Dead time: The interval of time between final arc extinction in all poles in the opening operation and the first re-establishment of current in any pole in the subsequent closing operation.

Closing time: The interval of time between the initiation of the closing operation and the instant when the last breaker pole closes.

1.5. Service life

Under normal operating conditions, the circuit breakers are designed for 10,000 mechanical operating cycles. Due to the optimization of the service life of all parts, the level of reliability falls if the breakers are used for a greater number of operating cycles. The manufacturer can therefore not recommend continued use of the circuit breakers, even if certain subassemblies are renewed. When the permissible maximum has been attained, the complete poleassemblies must be renewed. Detailed instructions are supplied with the replacement pole assemblies.
When ordering replacement pole assemblies, state the circuit breaker type, design code and serial number (see name plate).

1.6. Selection table

Type	Rated short time current (STC) 3 s kA	Pole center spacing mm	Rated voltage kV	Rated power frequency withstand voltage kV	Rated lightning impulse withstand voltage kV	Rated frequency Hz	Rated (normal) current A	Rated peak withstand current kA	Rated short-circuit current kA	Percentage value of DC component %	Cable charging breaking current A	O-0.3 s-CO-3 min-CO	Number of operating cycles without overhaul – Mechanical: Drive mechanism	Number of operating cycles without overhaul – Mechanical: Interrupter chamber	Number of operating cycles without overhaul – Electrical: Rated (normal) current	Number of operating cycles without overhaul – Electrical: With rated short-circuit current	Breaker operating times: Opening time ms	Breaker operating times: Closing time ms	Breaker operating times: Break time ms	Arc duration ms	Minimum command time for release coils ms	Charging time for motor drive mechanism s	Weight (Approximate) KG
EOFV$_p$ - 36	26.4	725	36	70	170	50	630	66	26.4	33	50	•	10000	30000	10000	100	45±10	65±10	45-67	7-12	20	≤ 20	650
							1250																650
							1600																650
							2000																650
							2500																650
	31.5	725	36	70	170	50	630	80	31.5	33	50	•	10000	30000	10000	100	45±10	65±10	45-67	7-12	20	≤ 20	700
							800																700
							1250																700
							1600																700
							2000																700
							2500																750
	40	725	36	70	170	50	1250	100	40	33	50	•	10000	30000	10000	100	45±10	65±10	45-67	7-12	20	≤ 20	750
							1600																750
							2000																750
							2500																800

Table 2: EOFVp-36 vacuum circuit breaker selection table with necessary drawing unit

2.1. Design & dimensions

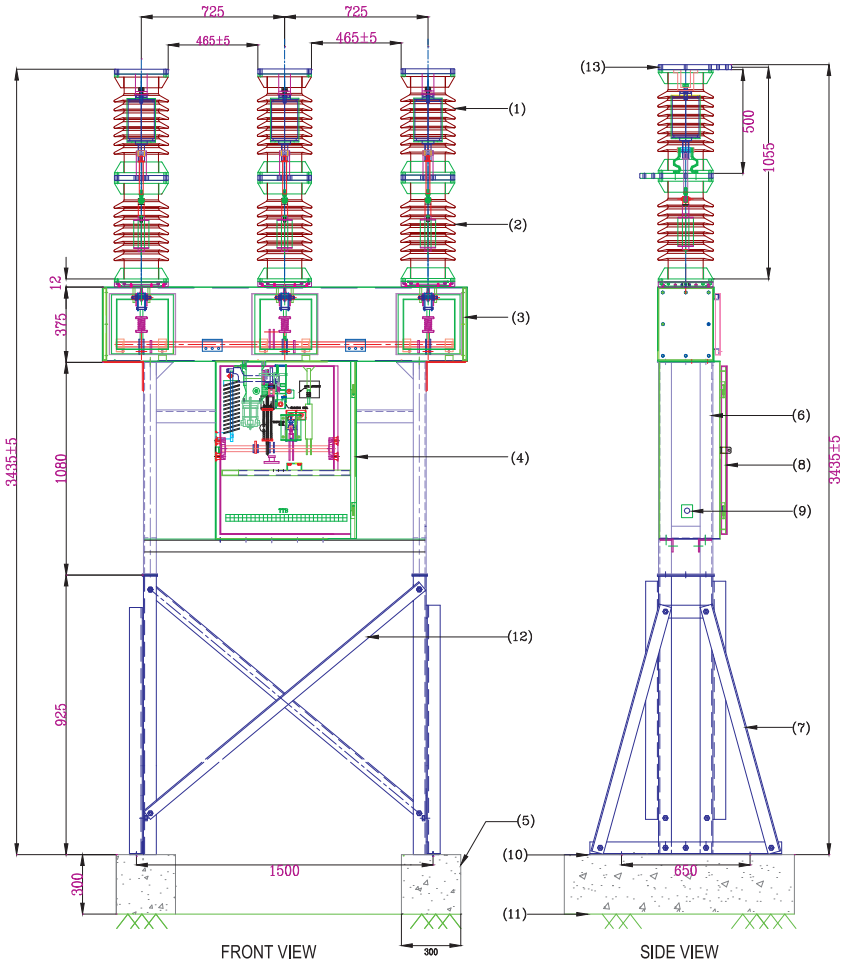


Figure 3: EOFVp-36 outdoor vacuum circuit breaker basic dimensions

List of basic parts	
1. Top insulator	8. Mechanism chamber door
2. Bottom insulator	9. Earth pad
3. Drive chamber	10. Plinth level
4. Mechanism chamber	11. Ground level
5. Foundation	12. Angle
6. Primary structure	13. Terminal
7. Secondary structure	

Table 3: Basic parts of EOFVp-36 outdoor vacuum circuit breaker

2.2. Main Components

EOFVp-36 outdoor vacuum circuit breakers consist of four main components:

- Pole assembly
- Drive chamber
- Mechanism chamber
- Support structure

2.2.1. Pole assembly

The EOFVp-36 outdoor vacuum circuit breaker consists of three pole assemblies each. Each pole assembly has upper and lower part both containing porcelain made insulator bushing. Top insulator bushing contains the vacuum interrupter, also known as the heart of the circuit breaker, which is mounted from the top. The fixed contact stem of the interrupter is connected to the top aluminum terminal pad. The moving contact stem at the bottom of the interrupter is connected to the drive chamber by an epoxy link through the bottom bushing insulator. Three such assemblies are mounted on drive chamber intended to locate the line terminals at a safe distance above the ground.

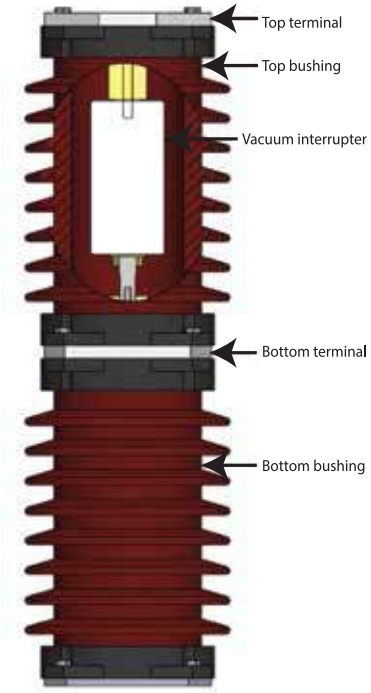


Figure 4: Broken out view of pole assembly of EOFVp-36 vacuum circuit breaker

2.2.1.1. What is a vacuum interrupter?

The vacuum interrupter consists of a steel arc chamber where operation of opening and closing contacts and associated arc interruption takes place. The vacuum pressure inside an interrupter is normally maintained at 10-7 bar. When the contacts separate, the current to be interrupted initiates a metal vapor arc discharge and flows through this plasma until the next current zero. The arc is then extinguished and the conductive metal vapor condenses on the metal surfaces within a matter of microseconds. As a result, the dielectric strength in the break builds up very rapidly.

The contacts are designed so that the self-generated field causes the arc to travel. This prevents their local overheating when interrupting large current. The metal vapor arc discharge can only be maintained if a certain minimum current flows. A current that does not attain this level is chopped prior to current zero. The chopping current must be kept to a minimum in order to prevent unduly high over voltages building up when inductive circuits are switched. The use of a special contact material ensures that current chopping is limited to 4-5 A.

The rapid build-up of the dielectric strength in the break enables the arc to be safely extinguished even if contact separation occurs immediately prior to current zero. The arc drawn in the vacuum interrupter is not cooled. The metal vapor plasma is highly conductive and the resulting arc voltage only attains value between 20 and 200 V. For this reason and because of the short arcing time, the arc energy developed in the break is very small. This also accounts for the long electrical life expectancy of the vacuum interrupter.

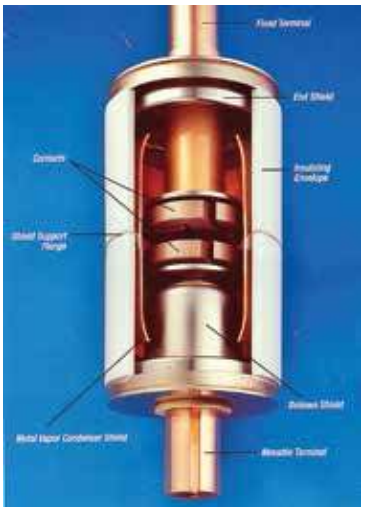


Figure 5: Broken out view of a vacuum interrupter

2.2.2. Drive chamber

The three pole assemblies are mounted on a steel structured box known as the drive chamber. The drive chamber contains a common drive shaft and also a contact pressure spring for each phase. The common linkage assembly is attached to the three vacuum interrupters by respective insulator link called epoxy link Also the common linkage assembly is attached by

a link rod to the operating shaft in mechanism box just beneath the drive chamber. The operating mechanism applies horizontal movement to the drive shaft of the common Linkage assembly and transmitted the energy vertically through bell crank levers, operating shaft, operating link to the sliding contact attached to the interrupter moving contact system. Compressed Hold Open Spring provides opening force during tripping of the breaker.

2.2.3. Mechanism chamber

The operating mechanism, together with the trip spring, stores the necessary energy for the closing and opening operation of the circuit breaker. Located at ground potential, the operating mechanism also includes necessary wiring. The primary structure also encloses the operating mechanism. The breakers can be electrically operated from control room or by hand locally.
On the control panel to the right of the mechanism is mounted when necessary, the Local/ Remote switch, the breaker ON/OFF switch and door lamp switch. Control and signaling cables are connected to terminal blocks on the panel. As per wiring diagram, external connections shall be made on the terminal blocks

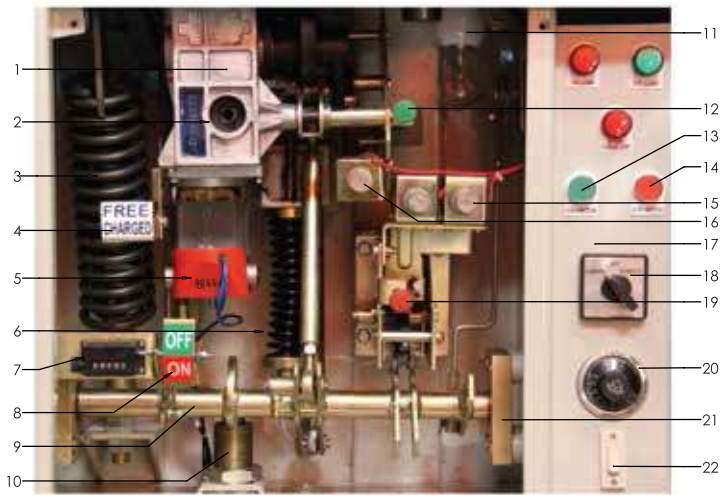


Figure 6: Inside view of upper part of the mechanism chamber

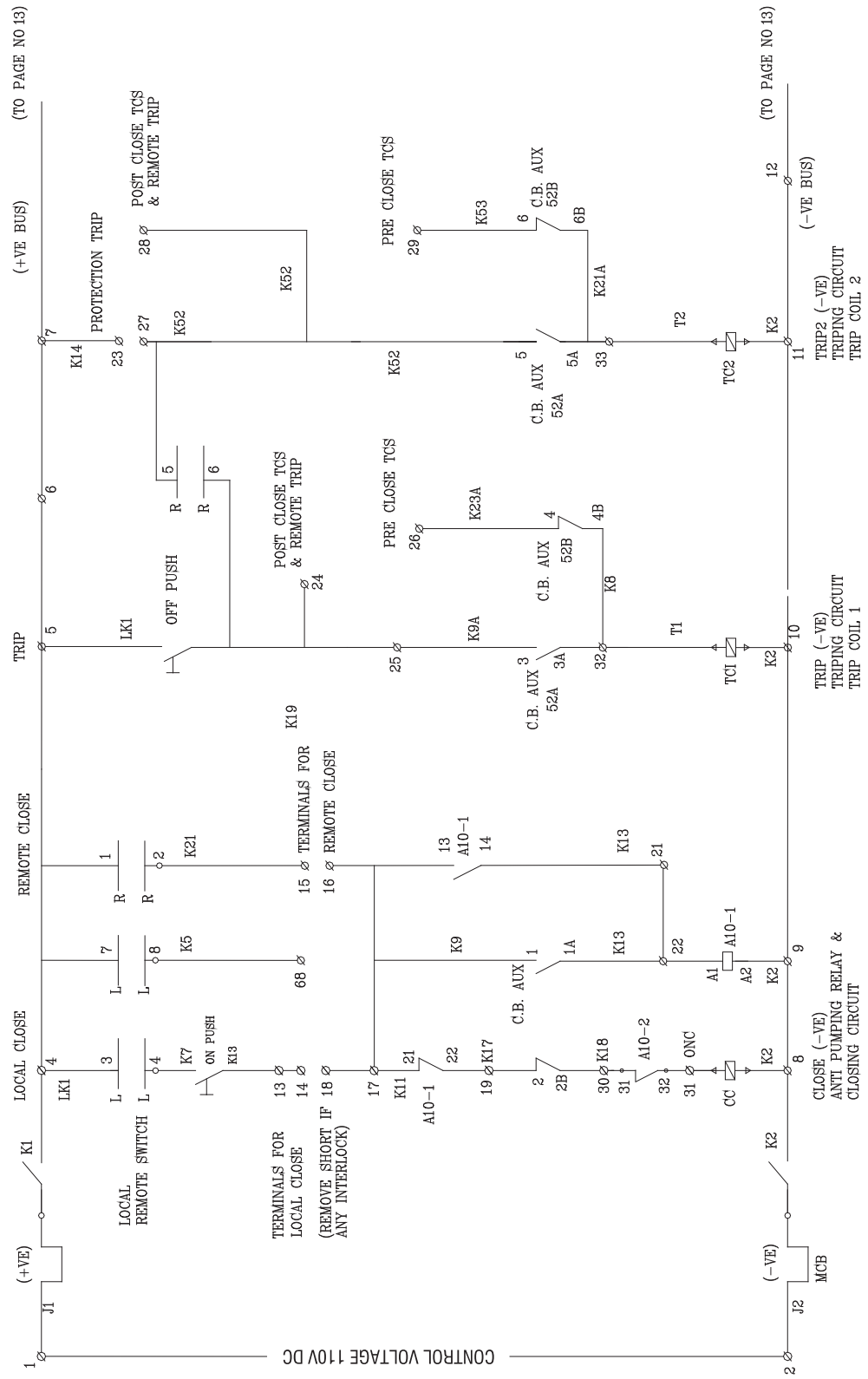
Operating box contains the following basic parts:	
1. Mechanism (Gear box)	12. Mechanical ON push button
2. Opening for hand crank	13. Electrical ON push button
3. Closing spring	14. Electrical OFF push button
4. Mechanical spring CHARGED indicator	15. Tripping coil
5. Charging motor	16. Closing coil
6. Tripping spring	17. Control panel
7. Operation counter	18. Local/Remote switch
8. Mechanical ON/OFF indicator	19. Mechanical OFF push button
9. Operating shaft	20. Thermostat
10. Shock absorber	21. Bearing block
11. Bulb	22. Door lamp switch

Table 4: Basic parts of an mechanism chamber

2.2.4. Support structure

There are two types of support structures – primary and secondary. The main function of the Primary Structure is to support the breaker along with linkage assembly and mechanism. And secondary structure provides necessary line to ground clearance. The supports are usually made of hot-dip galvanized steel.

2.3. Wiring diagram



REF	DESCRIPTION	QTY
ONC	ON COIL	01NO.
TC1	TRIP COIL 1	01NO.
TC2	TRIP COIL 2	01NO
A10-1	ANTI-PUMPING RELAY	01NO
A10-2		01NO

Figure 7: EOFVp-36 vacuum circuit breaker general wiring diagram (control CKT.)

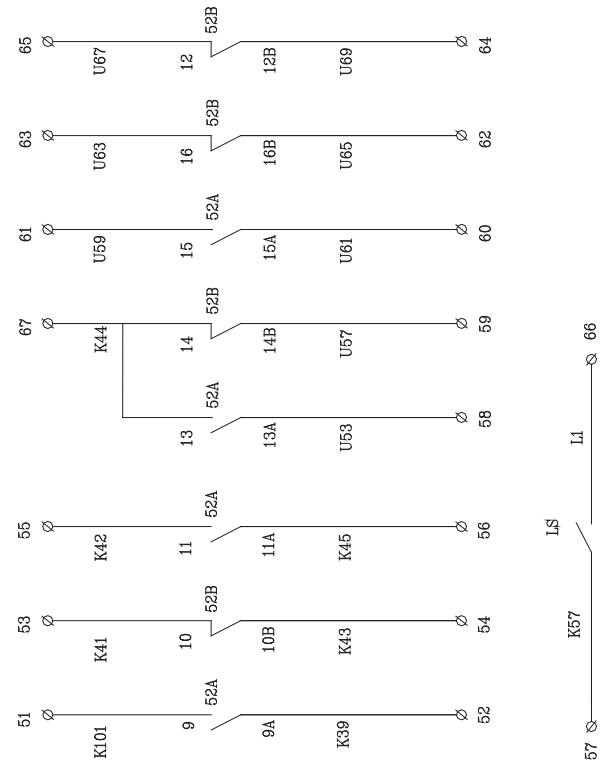


Figure 8: EOFVp-36 vacuum circuit breaker general wiring diagram (Auxiliary CKT.)

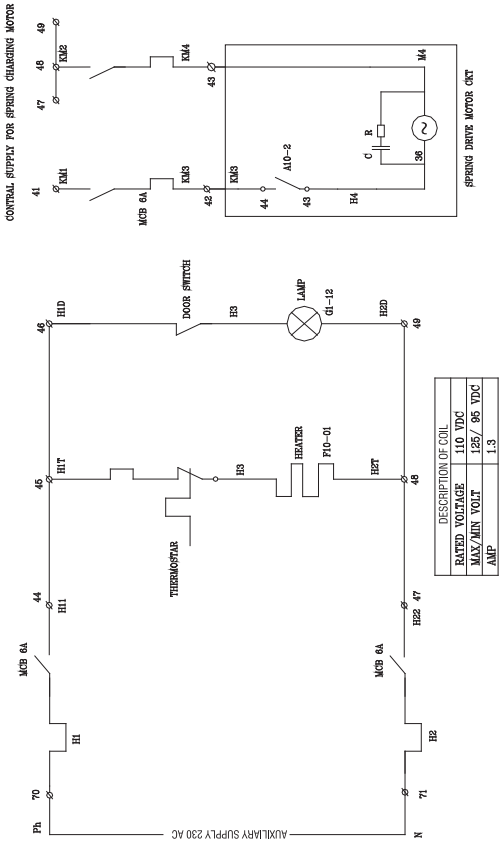
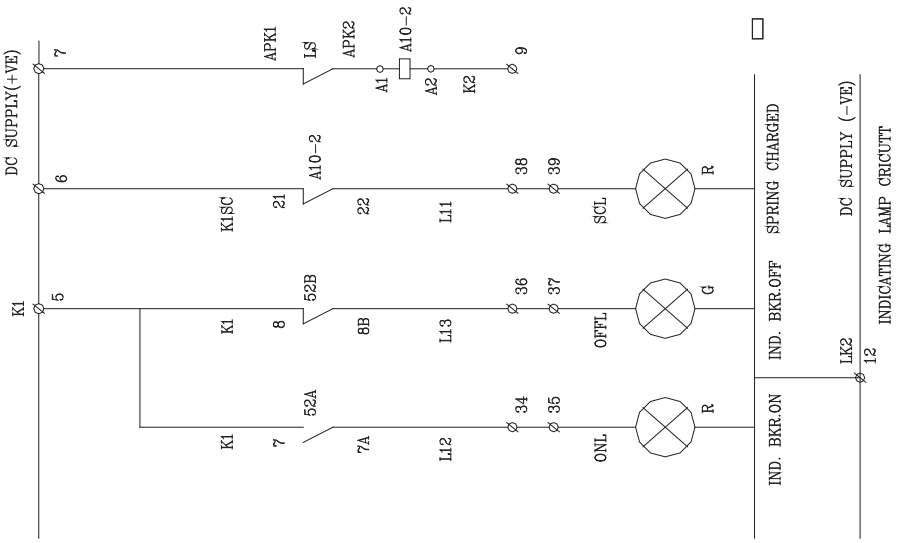


Figure 9: EOFVp-36 vacuum circuit breaker general wiring diagram (AC CKT.)



3.1. Transport

3.1.1. Goods Marking

The circuit-breaker is transported in seaworthy packing in OPEN position in two parts. The pole with primary structure and the secondary structure. Other loose items are packed separately. The case marking include information of case number, gross weight etc. In addition to above, the cases are marked with the symbols in Figure 10. These should be observed when choosing lifting equipment

Figure 10: Legend on package case

3.1.2. Transportation

The EOFVp-36 outdoor vacuum circuit breaker is shipped by road or overseas according to the contract terms.

The vacuum circuit breakers are contained in one wooden box with	
2.1. The complete breaker with primary structure	01 set
2.2. Secondary structure and angle	10 pcs
2.3. Charging handle	01 pc
2.4. Terminal connectors	06 set
2.5. Foundation bolt	04 pcs
2.6. Nut-bolt	26 pcs
2.7. Spring washer	26 pcs
2.8. Flat washer	52 pcs
Total weight of the complete Breaker with accessories (approximate)	650 Kg
Gross weight of the complete box (approximate)	900 Kg

Table 5: List of items included with a complete circuit breaker

3.2. Delivery

The Breaker is kept in a wooden box during transportation. It is also advisable to use some vibration damper inside the wooden box to protect from being damaged during transportation. Safety transportation angles should also be used. Crane or Fork lift should be used during loading and unloading of the Breakers and manual handling should be avoided. Safety transportation channels are provided with the primary structure for safety.

Figure 11: Use forklift for loading, unloading and storing of a circuit breaker

3.3. Reception

Unloading & unpacking the circuit breakers requires a lot of care. Unloading should be done only by expert manpower. Immediately after receipt the breaker must be unpacked & inspected for any damages, which might have occurred during transit. And carry out visual inspection of Porcelain clad pole assembly, count and ascertain structure and hardware materials are in line with Bill of Materials. The manufacturer must be informed in case of deviations. If required the supplier/insurance company must be informed without delay. Please repack if the equipment is going to be stored for a long period.

Note:
The equipment should be carefully examined immediately when received to ensure that no damage has occurred in transit. If the equipment has been damaged, both the transport contractor and the local Schneider Electric representative should be advised as soon as possible.

3.4. Storage

If the equipment is not required for immediate use it should be covered and stored in a clean, dry, well-ventilated place. The Circuit Breaker should be stored in upright position on secured plane ground. The free fall of the Circuit Breaker or storing it in inclined position should be avoided since the center of gravity is confined to the upper portion of the circuit breaker.

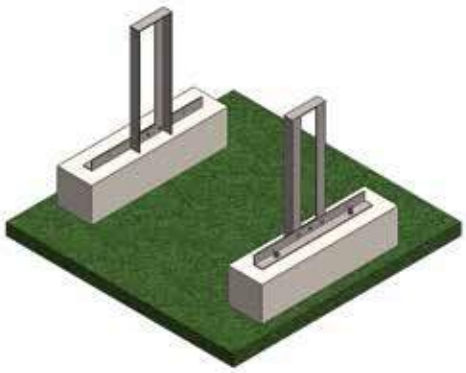
Note:
When the equipment is to be stored for some period it should be preferably kept at a dry place in its original packing.

4.1. General

The breaker and the support structure are packed together. Following things needed for installation and assembly for a complete circuit breaker.

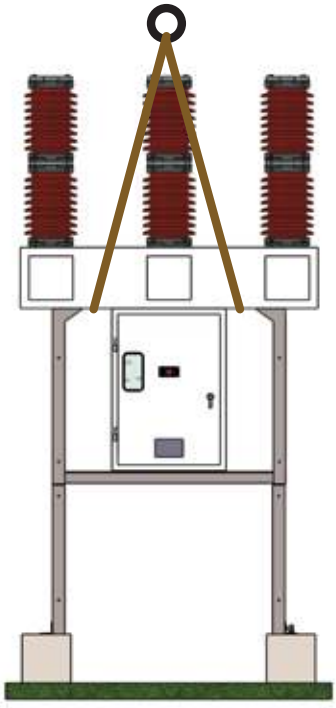
- A complete breaker with primary structure (assembled)
- Secondary structure (not assembled)
- Connectors

4.2. Installation procedure sequence

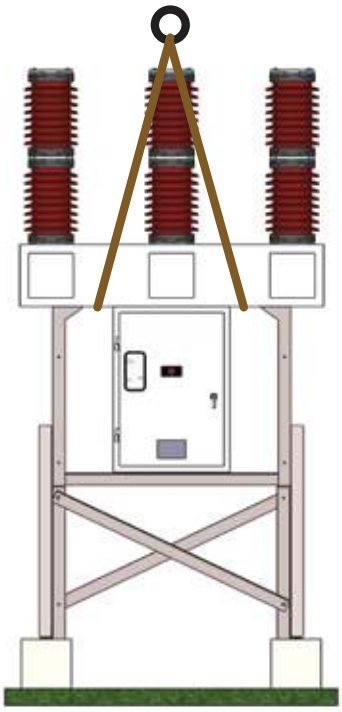


Step 1: Install the basic channels of secondary structure with the concrete foundation

Step 2: Remove the transportation safety channels from the primary structure before installation of VCB



Step 3: Load the breaker on the secondary structure by a crane and bolt the two structures.



Step 4: Install rest of the necessary support channels with the structure and complete tightening all the joints.

Figure 12: Installation sequence of EOFVp-36 outdoor vacuum circuit breaker

The following care should be taken for proper & safe operation of the breaker

- Use only the suitable bolts supplied with breaker.
- Use torque wrench for assembling the circuit breaker. Otherwise inappropriate tightening may result great damage to the breaker.

The necessary torques for screwed joints	
M 6	: 8 Nm ± 1 Nm
M 8	: 20 Nm ± 2 Nm
M 10	: 40 Nm ± 4 Nm
M 12	: 70 Nm ± 7 Nm
M 16	: 100 Nm ± 10 Nm

- Any locking washer or gasket loosened or exposed during assembly must be replaced.
- In line with the foundation plan shown in the G.A. drawing, the foundation pockets are made. Grout the foundation bolts and cure. Ensure the foundation area is leveled for proper seating of the circuit breaker.
- The pull rod length is factory preset. Do not change it.
- The contacts of the vacuum interrupter are in the open position during transport.
- Auxiliary cables should be connected through the opening at the bottom of mechanism chamber.
- Power cables should be connected with the breaker by using supplied Aluminium connectors Figure 14.

Figure 13: A complete assembly of EOFVp-36 vacuum circuit breaker

Aluminium connector set for power cable connection

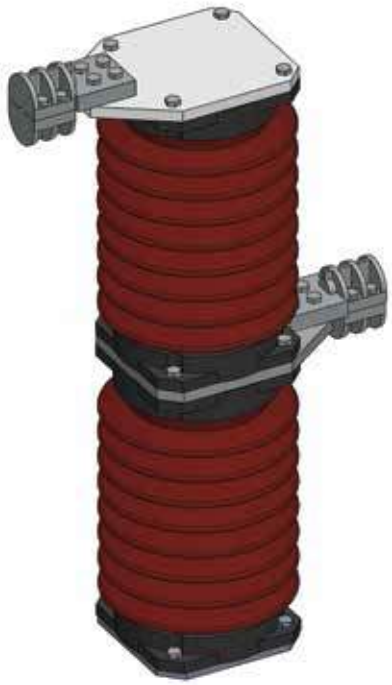


Figure 14: Pole with Aluminium connectors at top and bottom terminals

Operation

5.1. General

The main requirement of the operating mechanism is to open and close the contacts of the circuit breaker within specified time. The operating mechanism shall provide the following consecutive functions:

- Charging and storing of energy
- Release of energy
- Transmission of energy
- Operation of the contacts

In addition, an operating mechanism shall provide control and signaling to a network's control and protection system. Figure 3 shows the location of the mechanism chamber.

A requirement common to most breakers, regardless of the type of operating mechanism, is to carry out an open-close-open (O – 0.3 s – CO) sequence with no external power supply to the operating mechanism. The circuit breaker shall, after a closing operation, always be able to trip immediately without intentional time delay. For circuit breakers intended for rapid auto-reclosing, the operating duty cycle in accordance with IEC 62271-100 is:

O – 0.3 s – CO – 3 min – CO

The time of 3 min is the time needed for the operating mechanism to restore its power after a O-0.3s-CO. Modern spring and hydraulic operating mechanisms do not need 3 minutes to restore their power. The dead time of 0.3sec is based on the recovery time of the air surrounding an external arc in the system (i.e. a short-circuit)

The basic version of the EOFVp-36 vacuum circuit breaker comprises:

- Manually operated stored-energy mechanism for closing
- Electrical operating mechanism with anti-pumping feature
- Shunt closing release
- 1st shunt release
- Auxiliary switch 8 NO / 8 NC or 12 NO / 12 NC
- Operating cycle counter
- ON-OFF & spring charge indicators (Electrical & Mechanical)

Each EOFVp-36vacuum circuit breaker can be equipped with the following supplementary devices:

- Position switch for signaling "Closing spring charged"
- 2nd shunt release
- Current transformer-operated release
- Under-voltage release

The permissible combinations of supplementary equipment and special versions are stated in the relevant catalogue.

5.2. Spring Operated Mechanism

In the spring mechanism the energy for open and close operation is stored in springs. When the mechanism's control system receives an open or close command, the energy stored in the spring will be released and transmitted through a system of levers and links and the contacts will move to the open or closed position.

The closing spring has two tasks:

- To close the contacts
- To charge the opening spring.

Thus the criteria stated above are fulfilled; circuit breaker in closed position is always ready to trip After the O – 0.3 s – CO operation the closing spring will be recharged by an electric

motor, a procedure that lasts 7–12 seconds. The circuit breaker will be then be ready for another CO operation.

Manual operation can also be performed at any time. The closing spring is charged by inserting the hand crank in the opening until the "SPRING CHARGED" indication appears and an audible clicking noise indicates that the closing pawl has latched. It is then possible to close the breaker either manually or electrically. After closing, the spring can be recharged manually. The maximum DC power input is 880W (approx.).The maximum AC power input is 900 VA (approx.). During part of the short spring charging time, the motors operate in the overload range. The supply voltage of the motor-operated mechanism may deviate from the rated value by – 15% to + 10%.

The advantage of spring operated mechanism is that the system is purely mechanical; there is no risk of leakage of oil or gas, which could jeopardize the reliability. A well-balanced latching system provides stable operating times.

Furthermore, the spring system is less sensitive to variations in temperature than pneumatic or hydraulic mechanisms are. This ensures stability even at extreme temperatures. The spring mechanism has fewer components than hydraulic and pneumatic mechanisms, which improves its reliability.

5.3. Shunt releases

5.3.1. Shunt closing release

The closing solenoid unlatches the charged closing spring and thus closes the circuit breaker electrically. It is available for 100 VDC operation. The closing solenoid is not designed for continuous operation and it is de-energized internally. The supply voltage of the closing solenoid may deviate from the rated value by -15% to + 10%. Power consumption: approx. 250 W/VA.

5.3.2. 1st shunt release

The shunt release is used as standard in the basic circuit breaker version. With this shunt release, the electrically supplied tripping pulse is passed to the "Open" latching mechanism by means of a direct-action solenoid armature and the circuit breaker is thus opened. This opening solenoid is not designed for continuous operation and it is de-energized internally. The supply voltage of the shunt release may deviate from the rated value by -30% to + 10% with DC voltage; Power consumption: approx. 250 W/VA.

5.3.3. 2nd shunt release (optional feature)

This shunt release is fitted with the 1st shunt release and works when breaker is at remote operation mode. With this design, the electrical opening command is transferred in boosted form to the "Open" latching mechanism via a solenoid armature through unlatching of an energy store and the circuit breaker is thus opened. This opening solenoid is not designed for continuous operation and it is de-energized internally.

5.4. Auxiliary switch

The breaker is fitted with 8 NO and 8 NC contacts. It is actuated by the breaker shaft, and switches the auxiliary circuits. Optionally, auxiliary switch with 12 NO and 12 NC contacts is also available.

Rated insulation voltage:
AC/DC 250 V Insulation class: C
Current: 10 A
Making capacity: 50 A

Voltage (Volt)	Breaking capacity (Amp)	
	Resistive Load	Inductive load
Up to 230 AC	10	10
24 DC	10	10
48 DC	10	9
60 DC	9	7
110 DC	5	4
220 DC	2.5	2

Table 6: Breaking capacity of auxiliary switch

Commissioning

6.1. Precautions

- The policy to be followed in making the equipment available for commissioning or maintenance shall be that it is isolated, proved dead and earthed.
- Local electricity authority / utility procedures shall also be complied with.
- Precautions should be taken to ensure that the isolated equipment cannot be re- energized from any high voltage or low voltage source of supply.
- Do not open the door of the mechanism housing. Do not put your hand inside the operating mechanism. This equipment contains hazardous mechanical and electrical parts which move at high speed and may be controlled remotely.
- Do not touch pole assemblies and operating rods mounted in the base frame. The circuit breaker closing mechanism is of the motor wound spring type capable of retaining a stored closing spring charge. Before attempting any work, the stored energy must be released, by operating the circuit breaker manually from 'OFF' to 'ON' to 'OFF' with the motor supply disconnected

Danger! High voltage!

- Touching live parts will result in death or severe personal injury.
- This equipment may be operated only by qualified personnel who have become thoroughly familiar with the operating instruction manual and in particular all safety instructions.

Prior to commissioning, check the vacuum circuit breaker in accordance with the following points.

- Clean the circuit breaker as applicable
- Check that all fixing and terminal screws are tightened securely.
- Examine the circuit breaker for any external damage, especially to the terminal pads, porcelain insulators and vent tube.
- Check functioning of space heaters.

6.2. Charging the closing spring by hand

Insert the hand-crank in hole and turn it clockwise until the indicator shows "CHARGED". The hand-crank is coupled with the charging mechanism via a decoupling facility. The operator is thus not exposed to any risk should the control supply recover during charging.

Caution!
The vacuum circuit breaker may be operated manually with the hand crank in order to avoid injuries that may occur if the motor starts up suddenly.

6.3. Closing

Press the "ON" button or initiate a switching command from the control room until the vacuum breaker has closed. The ON-OFF indicator will then display the symbol "ON" and the closing spring indicator will display "FREE" symbol.
The closing spring is automatically recharged by the motor mechanism immediately after the breaker has closed. In hand operated breakers, the closing spring can be recharged by hand.

6.4. Opening

The tripping spring is charged during closing. To open the breaker, press the "OFF" button or initiate a tripping command from the control room unit. The vacuum breaker will open and the "OFF" symbol is displayed by indicator.

6.5. Space heater in the operating mechanism housing

One heater is provided in the mechanism housing. Keep the heater switch in the ON position, so that when the control supply is applied all the heaters are ON.

Caution!

- The heaters must be always "ON" whether the breaker is in service or not, to prevent
- Condensation of moisture particularly on the insulating components.
- Keep all covers closed firmly to prevent entry of dust, moisture, insects etc.

6.6. Anti-pumping device

• Issue a 'CLOSE' command by applying a control voltage to terminal 13 & 14, leave the voltage applied. The breaker will close.

• Issue 'OPEN' command by applying a voltage to terminal 27 & 28 (or 24 & 25). The breaker will open.

• After the interruption by OPEN command the circuit breaker should not re-close in spite of the CLOSE command still being present.

Note: The operating mechanism of circuit breaker is fitted with a mechanical anti-pumping device, which prevents re-closing due to either electrical or mechanical command.

6.7. Electrical testing

The tests (below) are advised: refer to local safety regulations. All the breakers made by Energypac are tested very carefully at factory. It is not so important to test these at site during commissioning. But if customer wants to test the product, this should only be carried out by competent personnel, in accordance with local safety regulations and with appropriate electrical and safety clearances.

6.7.1. Contact resistance test

Test is conducted by injecting DC current through the breaker main contact system when circuit breaker is closed. By measuring the voltage drop the resistance can be calculated. The value of the main contact resistance reflects the condition of the conducting parts.

6.8. Disposal of the product

The product is environmentally compatible. The following materials have been used to make up the device: steel, copper, aluminium, cast-resin, glass-fiber-reinforced thermoplastics, rubber, porcelain, greases etc. PVC is used as an insulation material for control wires. In as-supplied condition, the product does not incorporate any hazardous substances. In operation, the product does not emit hazardous materials or gases. During disposal of the product, care must be taken to dismantle as far as possible in more environmentally accepted way as recyclable & non- recyclable scraps i.e. steel, copper, aluminium, rubber, PVC, cast-resin & glass-fiber-reinforced materials segregated properly.

The recyclable materials like steel, copper, aluminium can be reused. Non – recyclable materials like cast-resins, glass-fiber-reinforced etc. can be broken in to pieces & then used as land filling materials. Local customer support-Energypac office will be able to answer any questions concerning disposal.

7.1. Maintenance interval

The EOFVp-36 Vacuum Circuit Breakers in general require little maintenance. The interval at which the maintenance is to be carried out depends on the application by the client. The parameters to be considered are:

- The number of short circuit operations the circuit breaker
- The switching frequency
- The service duty
- The pollution level at the site

7.2. Maintenance schedule

The maintenance schedule is given as a guideline. However depending upon particular operating & site conditions, the schedule should be fixed up.

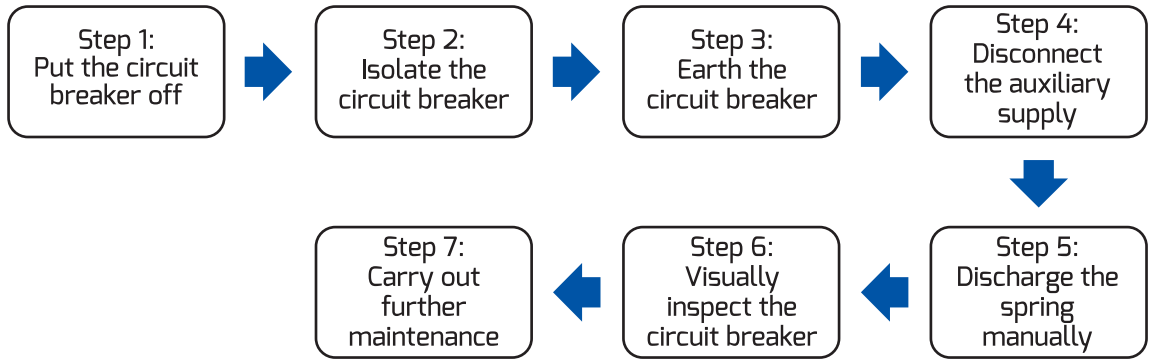
SL. No.	*Description*	*Before Start Up*	*Every 1000 operations*
1.	*Checking of operating mechanism*	✓	✓
2.	*Checking tightness of all nut-bolt*	✓	✓
3.	*Checking oxidation over all nut-bolt*	✓	✓
4.	*Checking tension of springs and oxidation over the springs*	✓	✓
5.	*Bearing items*	–	✓
6.	*Checking of operating box assembly for proper open/close operation*	✓	✓
7.	*Lubrication of charging device and every contact meshing points*	✓	✓
8.	*Connection of electronics circuit*	✓	✓
9.	*Cleaning of electronic circuit*	✓	✓
10.	*Retention of spring circlips and spring washer*	✓	✓
11.	*Measuring insulation resistance*	✓	✓

Table 7: Maintenance schedule guideline

Note:

- Complete overhaul of circuit breaker mechanism chamber to be done after 10000 operations or 10 years, whichever is earlier.
- Contact with Energypac for details of overhaul procedure.

7.3. Typical maintenances sequences



7.4. General inspection of the circuit breaker

Part subjected to	Abnormalities noticed	Remedies
Spring operated mechanism	Presence of dirt or dust on the mechanism	Clean with a dry brush or cloth
	Rusted or distorted spring	Replace the damaged spring
	Loose nuts or screws	Tighten the nuts and screws
	Rusted or damaged nut-bolt	Replace the damaged nut-bolt
Coil and Motor supply	Check the operation of close coil and trip coils for values between 85% and 110% of the corresponding rated voltage. If the coils fail to operate correctly they are needed to be replaced.	Replace the coil with new one.
	Check the supply voltage of the operating mechanism and other electrical accessories like motor. Check any abnormalities in motor operation.	Replace the motor if any abnormality found.
Circuit breaker high voltage pole parts	Presence of dirt or dust on the insulator bushing	Clean with a dry brush or cloth
	Loose nuts or screws	Tighten the nuts and screws
	Rusted or damaged nut-bolt	Replace the damaged nut-bolt
	Crack or distortion of the insulator bushing	Contact with Energypac immediately for replacement of the damaged parts
	Trace of over-heated connection to the circuit breaker terminals	Contact with Energypac for proper consultancy
Earthing connection	Trace of the oxidation or loose nuts	Replace the rusted part and tighten the earthing connection fully and cover it with neutral grease.

Table 8: General inspection of the circuit breaker

7.5. Checking the vacuum

Before putting the breaker in service, or if an interrupter is suspected of leakage as a result of mechanical damage check the vacuum as follows:
Steps 1 to 6 as in clause 7.3
Remove the side covers of the base frame. Remove the circlip from the pin use the handle in the closing direction to facilitate removal of the pin. When the pin is removed, the switching rod will be suddenly pulled up due to the vacuum in the healthy interrupter.
In the case of a loss of vacuum in the interrupter, if the switching rod is pulled down it will not move back on its own. This indicates that the vacuum interrupter has to be replaced.

7.6. Dielectric test

Prior to commissioning the breaker or putting it back into service after a maintenance outage, the circuit breaker should be checked for insulation resistance using a 5 kV Megger kit.

- CB open between phase terminals (3 readings)
- CB open between top terminals and earth (3 readings) and
- CB closed between terminals and earth (3 readings)

In each case the reading should be greater than 1,000 M Ohm.

Summary Of Important Instructions

8.1. Dos

During installation & commissioning stages
1. Brush the contact surfaces properly before bolting overhead terminals on flanges of breaker. Also grease the joints & apply proper torque on the bolts.
2. Check rated voltage of equipment such as motor, closing & tripping releases mounted in the operating mechanism with the available auxiliary supply to be connected to these equipment in the substation.

During service life of the breaker
1. Keep door & covers firmly closed to prevent entry of dust, moisture, insects etc.
2. Ensure spring charging handle & manual handle are kept in the mechanism housing.
3. Decide maintenance schedule based upon a. Number of short circuit operations b. Frequency of breaker ON-OFF operations c. Pollution level etc.
4. Isolate & earth the breaker before carrying out maintenance & ensure it is in OFF position & springs are discharged completely before cleaning.
5. Depending on site conditions, inspect – a. Clean the interior of the mechanism housing b. Clean porcelain insulators c. Clean operating mechanism parts such as plungers of releases, moving joints etc. d. Check functioning of space heaters
6. Lubricate moving parts with lubricants provided for the breaker
7. Check insulation resistance with a Megger before putting the breaker back into service
8. Keep a log-book for each breaker
9. Follow instructions given in the operating manual
10. Ensure breaker operations, maintenance etc. is done by trained and skilled persons

Table 9: Things should be done during installation, commissioning & service life

8.2. Don'ts

During Cleaning And Maintenance
1. Do not leave any equipment or tools in the mechanism housing
2. Do not leave incandescent lamp in ON position when closing the mechanism housing door
3. Do not put hands or tools in operating mechanism when breaker is electrically operated
4. Do not operate the breaker during cleaning & maintenance on going

Table 10: Things should not be done during cleaning & maintenance

8.3. Troubleshooting

Problem	Symptoms/Effect	Possible Causes	Remedial Measures
Breaker fails to close	Closing spring charges, but breaker does not close	1. Electrical power to auxiliary circuit is off, or MCB has tripped.	1. Check electrical power to auxiliary circuit and/or replace blown fuses.
		2. Loose connection, damage to wiring.	2. Check & repair as necessary.
		3. Un-operational closing release.	3. Test closing release separately & then replace, if not operating.
		4. Auxiliary switch contacts are open when the breaker is closed.	4. Check & adjust mechanical linkage with aux. switch.
		5. Un-operational anti-pumping contactor & its contacts.	5. Check & replace, if necessary.
	Closing spring does not charge automatically.	1. Electrical power to auxiliary circuit is off, or MCB has tripped.	1. Check electrical power to auxiliary circuit and/or replace blown fuses.
		2. Loose connection, damage to wiring.	2. Check & repair as necessary.
		3. Un-operational closing release.	3. Check & replace.
		4. Limit switches fail to operate.	4. Check& mechanical linkage with limit switch & correct.
		5. Mechanical failure of operating mechanism.	5. Check & contact authorized service centers.
	Closing release operates, sound of breaker closing is heard, but breaker contacts do not close.	Mechanical failure of operating mechanism.	Check & contact authorized service centers.
Nuisance or false closing of breaker	Electrical problem	Tripping command continues on terminal.	Check & correct logic circuits.
	Mechanical problem	Mechanical failure of operating mechanism.	Check & contact authorized service centers.
Breaker does not trip	Tripping Release does not trip.	Electrical power to auxiliary circuit if off, or MCB has tripped.	Check electrical power to auxiliary circuit and/or replace blown fuses.
	There is no tripping sound	1. Loose connection, damage to wiring.	1. Check & repair as necessary.
		2. Un-operational tripping release.	2. Test tripping release separately & replace, if not operating.

Table 11: Vacuum circuit breaker typical problems, symptoms, causes, solutions

8.4. Recommended accessories and spare parts

All parts of this breaker type have been optimized to last the normal service life. Nevertheless, if you require spare parts, state the following data when ordering them:

Spare parts and accessories		Remarks
1. Closing or tripping coil : 110V DC	EOFVp-36-004	Highly recommended
2. Auxiliary switch • 8 NO + 8 NC • 12 NO + 12 NC	 EOFVp-36-005 EOFVp-36-006	
3. MCB 6A, 2 pole, 230 V AC MCB 6A, 2 pole, 110 V AC	- -	
4. (E11 - E14) Heater, 240V AC, 120W	EOFVp-36-007	
5. Motor (880W) • 220 V AC • 110 V DC	 EOFVp-36-001 EOFVp-36-003	Highly recommended
6. Contactor 2NO + 2NC (Voltage same as closing release) 110 V DC	EOFVp-36-009	
7. Vacuum Interrupter	EOFVp-36-002	
8. 2nd Shunt Release • 110V - 127V DC	 EOFVp-36-011	
9. Local/Remote Selector Switch	EOFVp-36-013	
10. Lubricants & Grease	EOFVp-36-014	Highly recommended
11. Hand Lever for spring charging	EOFVp-36-015	

Table 12: List of spare parts and accessories

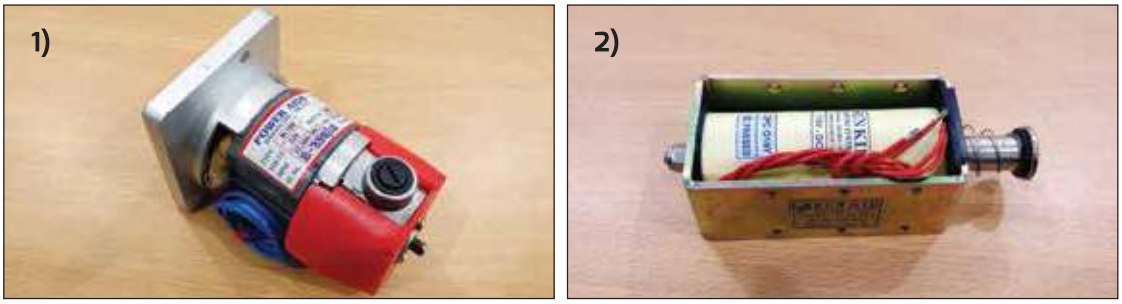


Figure 15: Highly recommended spare parts: (1) Motor; (2) Closing/Tripping Coil

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The information contained in this booklet is necessarily general in nature. For further information regarding sales, services or any general queries contact us at the email addresses below:

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