

24kV ET1 Removable AC Metal-enclosed Switchgear With VE24 Encapsulated Pole Vacuum Circuit Breaker



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MV switchgear technology is in our DNA

Eaton Corporation is a worldwide leader in the design, manufacture, and sale of safe, reliable and high-performance medium voltage power distribution equipment in accordance with GB and ANSI standards.

Complete Global Medium Voltage Switchgear Solutions

Eaton, a premier leader in designing and manufacturing power distribution and protection equipment in the electrical industry, offers a comprehensive range of medium voltage (MV) solutions to meet the needs of virtually every application. From products that feature cutting-edge design that allow for easy access, maintenance and space savings, to arc-resistant products that enhance safety, Eaton's medium voltage solutions provide a variety of products for every need. Additionally, Eaton's global service network provides maximum customer support in all regions of the world.

As one of the few completely vertically integrated and diversified industrial manufacturers in the world, Eaton designs not only MV assemblies, but also the key components that comprise the MV solutions – from steel housing and circuit breaker compartments to vacuum interrupters, circuit breakers, bus systems and fuses.

Eaton's MV heritage, strengthened by acquisitions such as Westinghouse DCBU, Cutler Hammer, MEM and Holec, has resulted in breakthrough MV technologies and numerous international patents over the years.

Part of Eaton's complete electrical PowerChain Solutions – which help businesses minimize risks while realizing greater reliability, cost efficiencies, capital utilization and safety – Eaton's medium voltage equipment meets all applicable standards and certifications such as NEMA / ANSI, GB, UL, IEEE, KEMA and CSA.

When it comes to medium voltage solutions, you can trust the one name with a long history of proven performance: Eaton.



24kV ET1

Removable AC metal-enclosed switchgear

With VE24 Encapsulated pole VCB



24kV ET1 switchgear with advanced technology

Safe and reliable

- Metal-clad and fully enclosed structure
- Adoption of balanced electric field, with main conductors using thermal shrinkage material for insulation, providing higher dielectric performance
- LV compartment is separate from each HV compartment
- Fast closing earthing switch is used for earthing and provides short-circuit current closing capacity
- All operations can be conducted when the door panel is closed, including breaker switching on and off, breaker trolley's drawing in or out, as well as earthing switch's switching on and off.
- Reliable latch device is used to effectively prevent misoperation
- Through the front and rear observation windows in the door panel, breaker's switching status, trolley position, mechanism energy stored status, earthing switch switching position and cable end connection status can be clearly viewed
- In line with GB3906 and China power industry standards

Highly practical

- Enclosure protection degree is IP4X can prevent sewage and little animals from entrance
- VCB trolley is maintenance free and the equipped operating mechanism requires only a little maintenance
- Good interchangeability of trolleys, very easy to replace circuit breakers
- Secondary wire is laid in ample wire casing, neat and convenient for inspection

Wide application

- Can be used for incoming and outgoing of cable and busbar or mixed incoming and outgoing of cable and busbar
- Normal standard cable end can be used
- Can be connected to several cables

ET1-24 switchgear technical data

Main switchgear technical data

| | | | |
|--|----|---|---|
| Rated voltage | kV | 24 | 24 |
| Rated frequency | Hz | 50 | 50 |
| Rated 1min power frequency withstand voltage | kV | 65 | 65 |
| Rated lightning impulse voltage(BIL) | kV | 125 | 125 |
| Power frequency voltage of auxiliary control circuit | V | 2000 | 2000 |
| Rated current | A | 630,1250,1600,2000,2500,3150 | 630,1250,1600,2000,2500,3150 |
| Rated short-time withstand current (4s) | kA | 25 | 31.5 |
| Rated peak withstand current | kA | 63 | 80 |
| Rated short-circuit breaking current | kA | 25 | 31.5 |
| Rated short-circuit making current | kA | 63 | 80 |
| Rated voltage of auxiliary control circuit | V | DC/AC 110/220 | DC/AC 110/220 |
| Protection degree | | IP 4X (compartment: IP2X when breaker door is open) | IP 4X (compartment: IP2X when breaker door is open) |
| Dimension (W*D*H) | | 1000*1800*2400, 1000x2200(2300)x2400 | 1000*1800*2400, 1000x2200(2300)x2400 |
| Weight | kg | 840-1440 | 840-1440 |

Main technical data of VE24 VCB

| | | | |
|--|----|-------------------|------------------------------|
| Rated voltage | kV | 24 | 24 |
| Rated frequency | Hz | 50 | 50 |
| Rated 1min power frequency withstand voltage | kV | 65 | 65 |
| Rated lightning impulse voltage(BIL) | kV | 125 | 125 |
| Rated current | A | 630,1250 | 630,1250,1600,2000,2500,3150 |
| Rated short-time withstand current (4s) | kA | 25 | 31.5 |
| Rated peak withstand current | kA | 63 | 80 |
| Rated short-circuit breaking current | kA | 25 | 31.5 |
| Rated short-circuit making current | kA | 63 | 80 |
| Rated short-circuit operating sequence | | 0-0.3s-CO-180s-CO | 0-0.3s-CO-180s-CO |

24kV ET1 Removable AC Metal-enclosed Switchgear

Structure and operating principles

Structure overview

24kV ET1 switchgear is composed of cubicle and removable parts (so called trolley). The cubicle is separated into several functional compartments by metal sheet, including busbar compartment, circuit breaker compartment, cable compartment and LV compartment.

Switchgear removable parts can be equipped with VCB trolley, voltage transformer trolley, lightning arrester trolley and fuse trolley.

Pressure relief device

Pressure relief devices are installed above trolley compartment, busbar compartment and cable compartment. Special sealing ring on the door seals the panel door. In case of faults inside the compartments resulting in arc, the pressure is going up inside the switchgear and the pressure relief equipped on the top will open automatically, to release pressure and high temperature gas. In this way, it can ensure the safety of operating staff and the switchgear.

Secondary plug and trolley position interlocking

The secondary connection of the switchgear and trolleys are conducted via secondary plug coordination. The secondary plug is connected to trolleys through a nylon bellow. The plug is located on the upper right side of switchgear's trolley compartment. Only when the trolley is on Test position, the secondary plug can be plug in or out. When the trolley is on Operating position, the plug is locked.

Electrical indication device

The switchgear can install electrical indication device in primary circuit. The device includes high voltage sensors and an indicator, and can indicate high voltage circuit electrical status. It can also cooperate with electromagnetic lock to conduct compulsory latching on operating handle, cubicle door and adjacent cubicles. Thus, it can prevent from withdrawing isolation trolley with loads, prevent earthing switch from energized closing, and prevent from entrance of energized compartment. In this way, it can increase prevention performance of the equipped products.

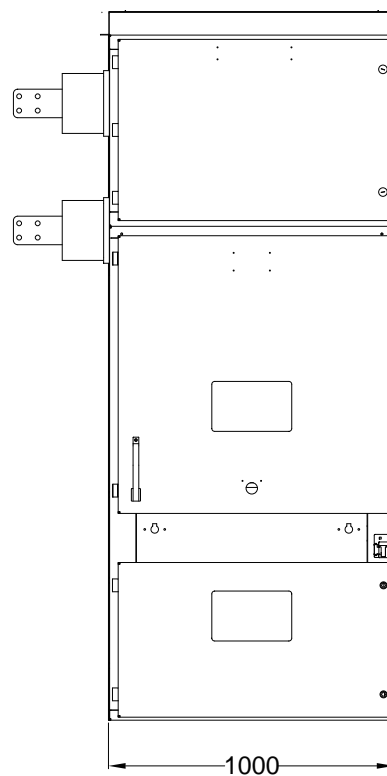
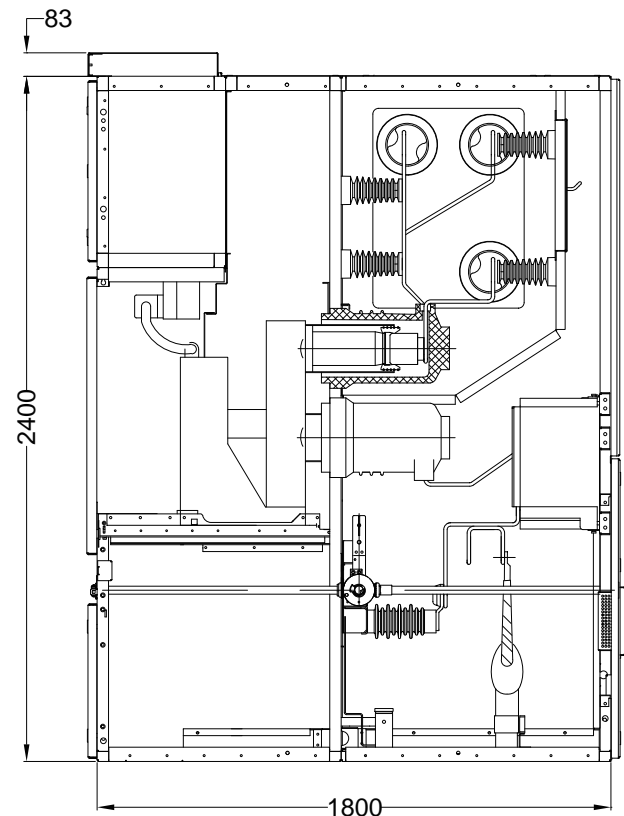
Prevention of condensation

In order to prevent condensation in high humidity or dramatically changed temperature environment, electrical heater is installed separately in circuit breaker compartment and cable compartment, to avoid dielectric accidents in the above conditions.

Earthing device

Cable compartment installs additionally 60*5 mm² earthing copper bus which goes through adjacent cubicles and with good connection to cubicles. The copper bus is used for direct earthing components. Since the whole cubicle is joint by aluminum zinc coated steel plates, the cubicle is in good earthing status, thus ensuring safety of operating staff.

Structural diagram of 24kV ET1 switchgear



24kV ET1 Removable AC Metal-enclosed Switchgear

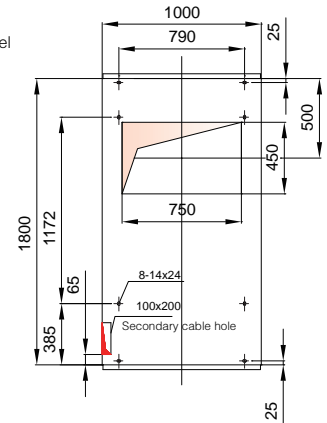
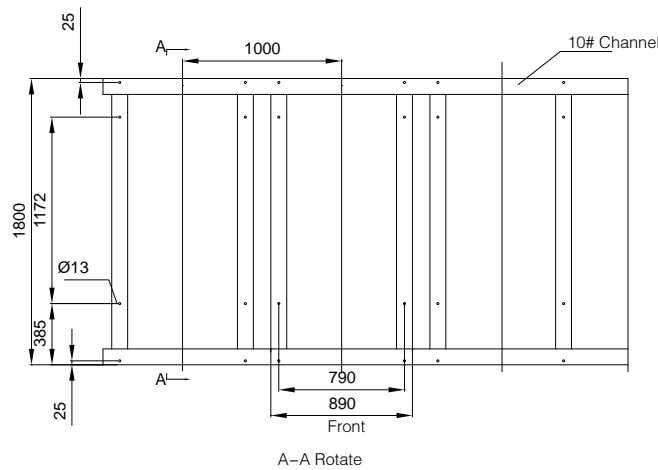
Dimension

Interlock devices to prevent misoperations

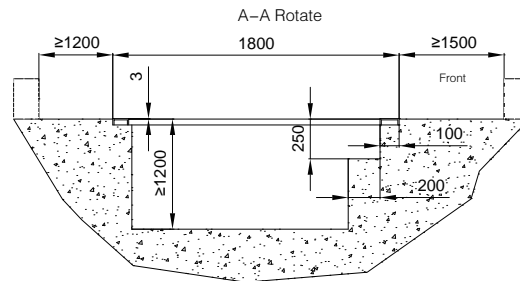
24kV ET1 switchgear has a series of interlock devices to fundamentally prevent dangerous situations and misoperations which may result in serious consequences, and thus effectively ensuring safety of operating staff and the switchgear itself. The detailed interlock includes:

- When circuit breaker and earthing switch are in opening position, the trolley can move from TEST/isolation position to SERVICE position. If the circuit breaker is in closing condition and is racked, the trolley will trip automatically when moving from TEST/isolation position to SERVICE position. Reverse movement has the same result (mechanical interlock)
- Only when the trolley is completely engaged in TEST or SERVICE position, the circuit breaker can close (mechanical interlock)
- If the trolley is in TEST or SERVICE position without control voltage, the circuit breaker can not close. It can only be manually opened (mechanical interlock)
- If the trolley is in SERVICE position, the control plug is locked and can not be pulled out.
- When the earthing switch is closed, the trolley can not move from TEST/isolation position to SERVICE position; when the trolley is in SERVICE position, the earthing switch can not be closed (mechanical interlock)

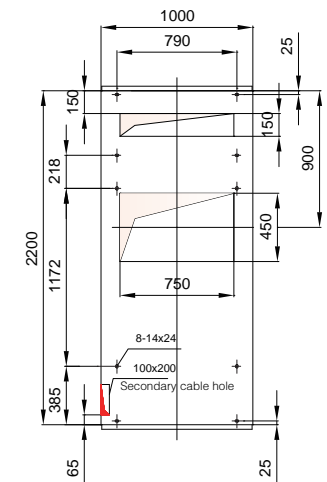
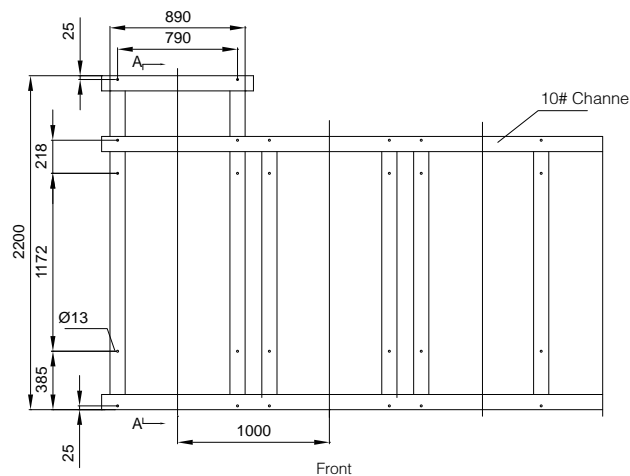
Switchgear's mounting basis and base plate cutout dimension diagram



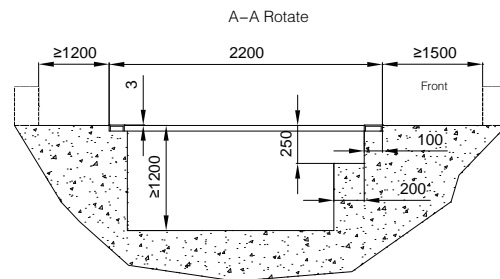
Switchgear bottom carting (1800mm)



Installation basic Schematic(1800mm)

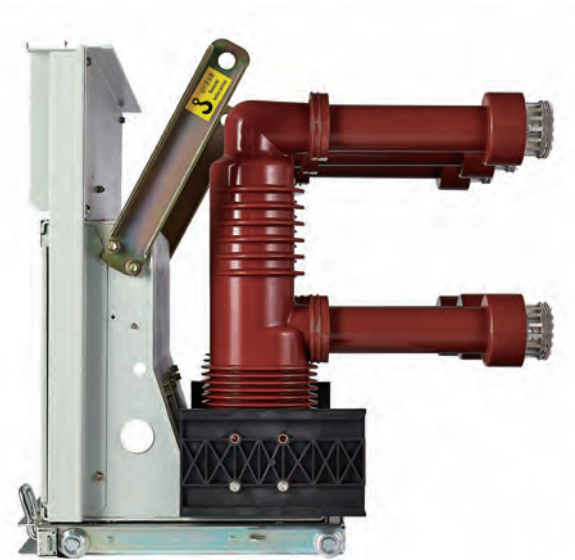


Switchgear bottom carting (2200mm)



Installation basic Schematic(2200mm)

VE24 VCB



Standards

- GB 1984-2003 HV AC Circuit Breaker
- JB 3855-1996 3.6-40.5kV Indoor AC HV Vacuum Circuit Breaker
- DL/T 403-2000 12-40.5kV HV Vacuum Circuit Breaker Ordering Technical Conditions

VE 24 VCB is Eaton's new generation of indoor vacuum circuit breaker with integrated encapsulated pole, with ratings of 24kV, 630A to 3150A / 25kA to 31.5kA.

VE24 VCB is an indoor circuit breaker of 3-phase, 50Hz and 24kV rated voltage. It is applicable for protection and control units of power grid equipment, industrial and mining power equipments. The product is equipped with unique advancing mechanism and thus become a trolley unit. Its primary circuit is encapsulated by epoxy resin using APG technology to prevent vacuum interrupter and other main circuit parts from collision, dust and condensation. VE24 VCB is used in circumstances which require frequent operation of rated operating current or repeatedly switching of short-circuit current. It is also used in harsh environmental applications.

Normal service condition:

- Ambient temperature:
Maximum temperature: +40°C
Minimum temperature: -15°C
- Ambient humidity:
Daily average RH: ≤95%
Monthly average RH: ≤90%
Daily average vapor pressure: ≤2.2*10⁻³Mpa
Monthly average vapor pressure: ≤1.8 *10⁻³Mpa
- Altitude:
Not more than 1000m
- Seismic intensity not over 8 degree
- Surrounding air is not polluted by dust, smoke, corrosive and/or combustible gas, steam or salt fog

Technical features

- VE24 adopts proved APG technology to make vacuum interrupter and main conduction circuit embedded into insulating cylinder. In this way, it solves the problem that the insulation parts are influenced by environment with reduced withstand voltage level, ensuring that the VCB can be applicable in harsh environment.
- VE24 uses China's top-class vacuum interrupter with high breaking capacity and high reliability. It meets actual operation requirements, with primary section of maintenance free.
- Proven spring mechanism provides stable and reliable performance and long service life. It is easy to operate with superior anti-corrosion capacity, requiring only very little maintenance within its lifetime.
- Type tests are conducted, according to GB1984-2003's extended electrical life of E2 level, extended mechanical life of M2 level and capacitive current switching of C2 level with very low re-strike probability.
- Products are assembled to guarantee product consistency. Before products are delivered, push-in tests are conducted for standard panels, ensuring interchangeability and universality.
- All products have passed hundreds of mechanical operation run-in tests before delivered in factories, ensuring product performance at its most stable stage.
- Advance imported testing equipments are used to make records of empty load mechanical features for each product, and to provide users with concerned characteristic curves. In this way, it ensures reliability of product quality.

Spring operating mechanism data

Technical data of stored energy motor

| Item | Data | |
|---|-------------------------------------|-------------------------|
| Rated operating voltage (V) | AC, DC110 | AC, DC220 |
| Motor rated input power (W) | 65(80 when over 2500A) | 65(80 when over 2500A) |
| Normal operating voltage range | 85%-110% of rated operating voltage | |
| Stored energy time at rated operating voltage (s) | ≤ 15 | |

Technical data of opening and closing coils

| Item | Data | |
|---|---|---|
| Rated operating voltage (V) | AC, DC110 | AC, DC220 |
| Rated operating current of closing coil (A) | 2.0 | 1.0 |
| Rated operating current of opening coil (A) | 1.8 | 0.9 |
| Normal operating voltage range | Closing: 80%-110% of rated operating voltage Opening: 65%-120% of rated operating voltage; Not opening when ≤ 30% rated operating voltage | Closing: 80%-110% of rated operating voltage Opening: 65%-120% of rated operating voltage; Not opening when ≤ 30% rated operating voltage |

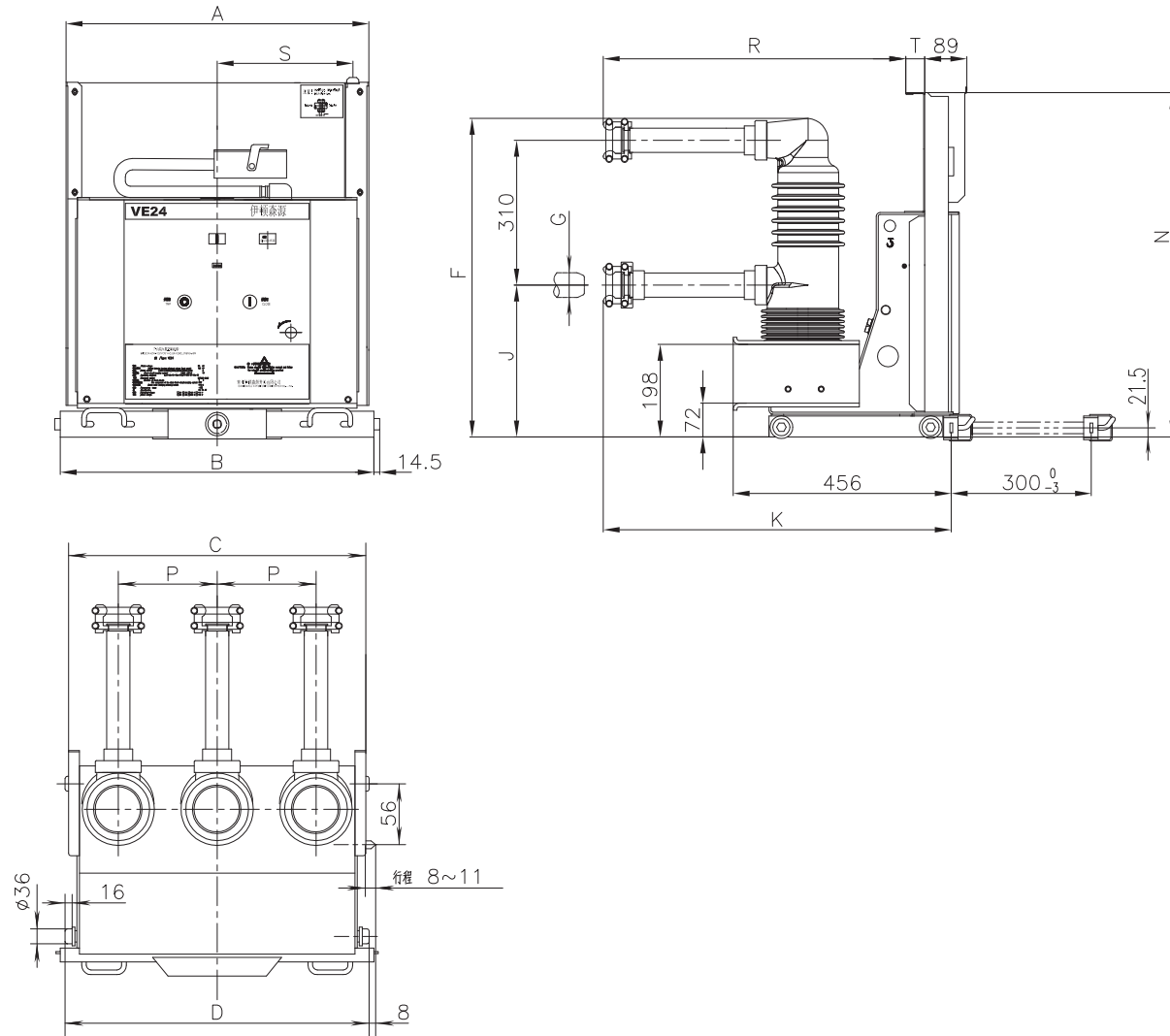
Technical data of VE24 vacuum circuit breaker (phase-to-phase distance at 275mm)

| | | | |
|--|-----|-------------------------------|---------------------------------|
| Rated voltage | kV | 24 | 24 |
| Rated frequency | Hz | 50 | 50 |
| Rated 1min power frequency withstand voltage | kV | 65 | 65 |
| Rated lighten impulse voltage | kV | 125 | 125 |
| Rated current | A | 630/1250 | 630/1250/1600/2000/2500/3150 |
| Rated short-time withstand current (4s) | kA | 25 | 31.5 |
| Rated peak withstand current | kA | 63 | 80 |
| Rated short-circuit breaking current | kA | 25 | 31.5 |
| Rated short-circuit making current | kA | 63 | 80 |
| Rated short-circuit operating sequence | | 0-0.3s-CO-180s-CO | 0-0.3s-CO-180s-CO |
| Conduction circuit resistance per phase | μΩ | ≤ 60(630) ≤ 35(1600-2000A) | ≤ 50(1250) ≤ 25 (over 2500A) |
| Average closing speed | m/s | 0.8-1.2 | 0.8-1.2 |
| Average opening speed | m/s | 1.1-1.7 | 1.1-1.7 |
| Closing time | ms | 35-70 | 35-70 |
| Opening time | ms | 20-50 | 20-50 |
| Bounce time when contact closing | ms | ≤ 2 | ≤ 2 |
| Non-periodicity of 3-phase closing and opening | ms | ≤ 2 | ≤ 2 |
| Phase to phase center distance | mm | 275 | 275 |
| Allowable wearing thickness of moving and fixed contacts | mm | 3 | 3 |

VE24 VCB

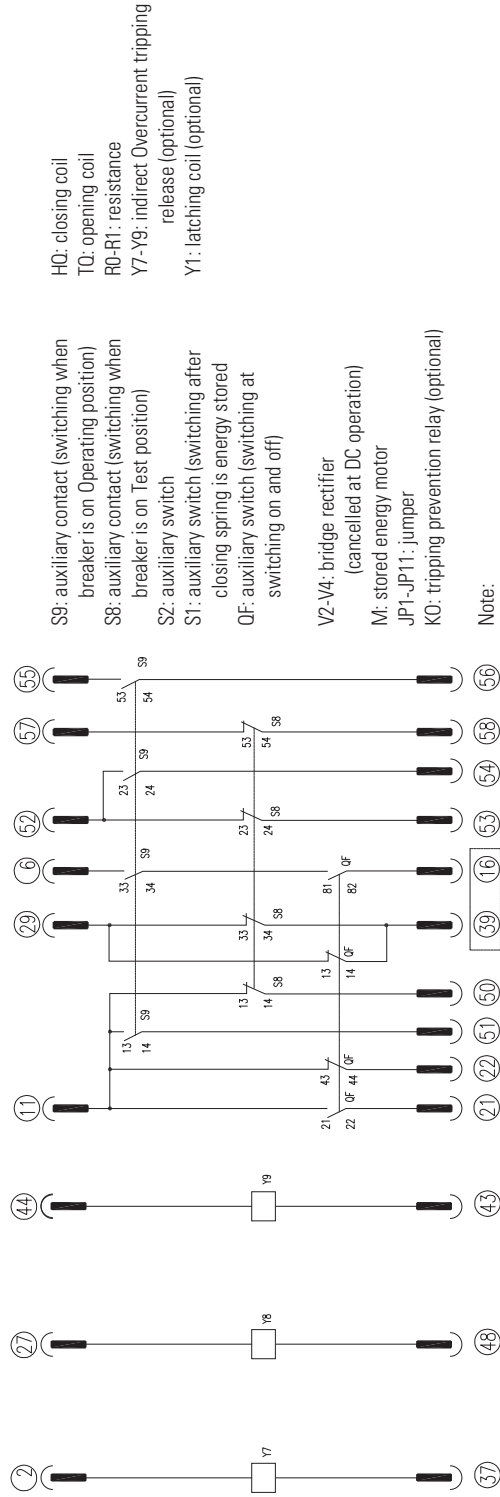
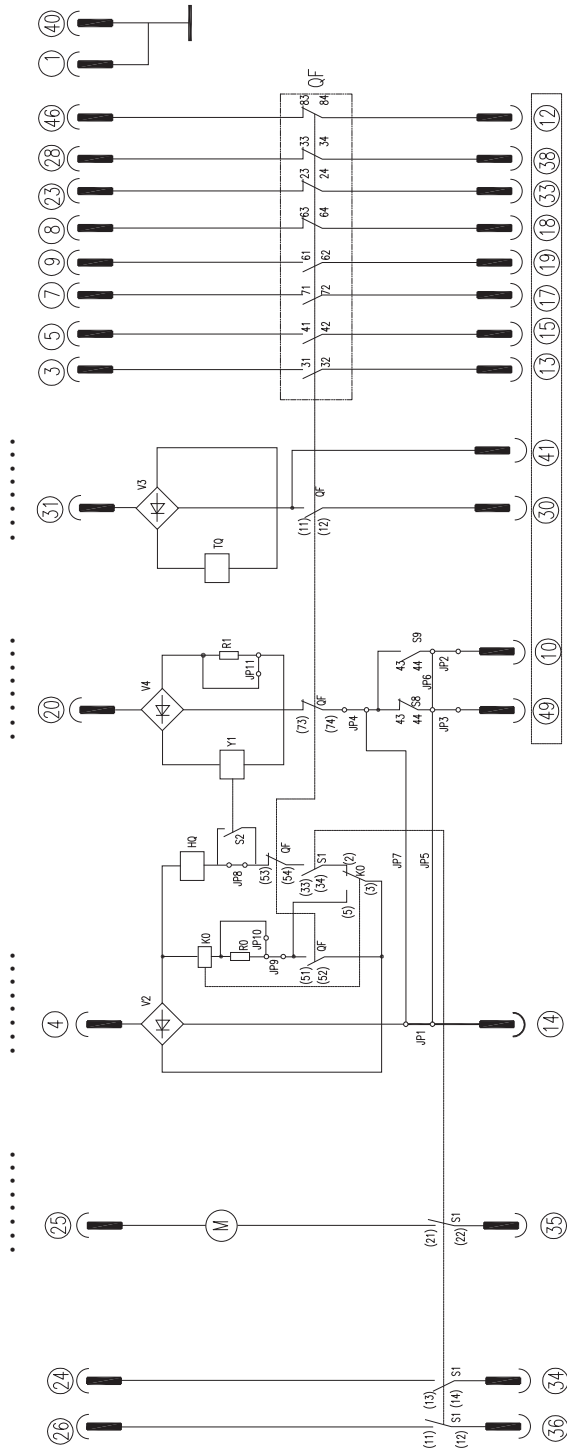
Dimension

Dimension diagram of VE24 vacuum circuit breaker



| Cubicle width | Rated current | Rated short-circuit breaking current (kA) | Rated short-circuit breaking current (kA) | | | | | | | | | | | | |
|---------------|---------------|---|---|-----|-----|-----|-----|-----|------------|-----|-----|-----|-----|-----|----|
| | | | P | A | B | C | D | F | G | J | K | N | R | S | T |
| 800 | 630 | 25 | 210 | 638 | 652 | 640 | 650 | 685 | $\phi 35$ | 325 | 745 | 737 | 655 | 277 | 40 |
| 800 | 630 | 31.5 | 210 | 638 | 652 | 640 | 650 | 705 | $\phi 35$ | 345 | 745 | 757 | 655 | 277 | 40 |
| 800 | 1250 | 25 | 210 | 638 | 652 | 640 | 650 | 685 | $\phi 49$ | 325 | 745 | 737 | 655 | 277 | 40 |
| 800 | 1250 | 31.5 | 210 | 638 | 652 | 640 | 650 | 705 | $\phi 49$ | 345 | 745 | 757 | 655 | 277 | 40 |
| 1000 | 630 | 25 | 275 | 838 | 852 | 840 | 850 | 685 | $\phi 35$ | 325 | 745 | 737 | 655 | 377 | 40 |
| 1000 | 630 | 31.5 | 275 | 838 | 852 | 840 | 850 | 705 | $\phi 35$ | 345 | 745 | 757 | 655 | 377 | 40 |
| 1000 | 1250 | 25 | 275 | 838 | 852 | 840 | 850 | 685 | $\phi 49$ | 325 | 745 | 737 | 655 | 377 | 40 |
| 1000 | 1250 | 31.5 | 275 | 838 | 852 | 840 | 850 | 705 | $\phi 49$ | 345 | 745 | 757 | 655 | 377 | 40 |
| 1000 | 1600-2000 | 31.5 | 275 | 838 | 852 | 840 | 850 | 705 | $\phi 79$ | 345 | 735 | 757 | 685 | 377 | 0 |
| 1000 | 2500-3150 | 31.5 | 275 | 838 | 852 | 840 | 850 | 781 | $\phi 109$ | 345 | 735 | 825 | 685 | 377 | 0 |

Internal electrical wiring principle diagram of VE 24 vacuum circuit breaker



HQ: closing coil
 TO: opening coil
 R0-R1: resistance
 Y7-Y9: indirect Overcurrent tripping release (optional)
 Y1: latching coil (optional)

S9: auxiliary contact (switching when breaker is on Operating position)
 S8: auxiliary contact (switching when breaker is on Test position)
 S2: auxiliary switch
 S1: auxiliary switch (switching after closing spring is energy stored)
 QF: auxiliary switch (switching at switching on and off)

V2-V4: bridge rectifier (cancelled at DC operation)
 M: stored energy motor
 JP1-JP11: jumper
 KO: tripping prevention relay (optional)

Note:
 1. The diagram shows circuit breakers at Test position, energy unsaved, closing status
 2. When operating supply is DC, polarity in the virtual box is the same

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