Instruction Leaflet **IL0102002E** Effective July 2021

Ring Main Unit Operation Instruction

Product Type	Product Name
RVAC	Indoor, Fixed, AC Metal-Enclosed Switchgear (SF6 RMU)

Powering Business Worldwide

Dear Customers:

Thank you for your purchase of the indoor fixed AC metal enclosed switchgear (thereafter as SF6 RMU). For correct and safe operation of this equipment, make sure to read this manual carefully prior to the installation of the equipment. Please keep the manual properly after reading, for future reference when necessary.

The manual is aimed to assist technicians to install, commission, operate, run and maintain SF6 ring main units (RMU). Users shall observe proper operating procedures in running the equipment.

The manual has considered the issues as specific as possible during the installation and usage, but can not cover all the possible changes concerning the equipment itself and the operating conditions. In case of any special occurrence, contact the After Sales Department of Cooper Power System.

The information within the manual is subject to changes without further notice.

⚠ WARNING

THIS IS A SIGN TO INDICATE THAT FAILURE TO FOLLOW THE OPERATING INSTRUCTIONS MAY CAUSE PERSONAL INJURIES OR LIFE DANGERS.

△ CAUTION

THIS IS A SIGN TO INDICATE THAT FAILURE TO FOLLOW THE INSTRUCTIONS MAY CAUSE DAMAGES TO THE EQUIPMENT.

Add optional mark.

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Chapter 1 Product introduction

1. General description

The RVAC indoor fixed AC metal enclosed switchgear (hereafter as RMU) is a new generation of SF6 gas insulated switchgear developed by Cooper Power Systems, relying on the Edison R&D center of powerful technical advantages, adopting the computer simulation technology, aimed to provide high quality products for electric network. This product is mainly used for the secondary electrical distribution system of 3-phase AC 50Hz, with the rated voltage of 12kV and 24kV, especially applicable for capturing and distributing electric power in power systems such as small-sized secondary distribution substations, switching stations, industrial and mining enterprises, urban residential areas, airports, railways, tunnels, and high rise buildings, greatly improving the reliability and utilization rate of the power supply.

This product adopts a three-phase common enclosure structure, using SF6 gas of excellent insulation and arc extinguishing performance as medium, and achieving the goal of miniaturization and light weight with optimized design; the product also uses interface insulation structure, allowing flexible plug-in and expansion of high voltage components. The product offers a range of advantages such as simple structure, compact size, low price, small floor space, high power supply quality and high power supply safety. The basic module is a one-circuit load switch cabinet and a one-circuit load switch plus current limiting fuse combination cabinet module. In addition, several additional modules are offered, including 3-circuit common enclosure RMU (two incomings and one outgoing), one incoming and one outgoing, bus tie cabinet, metering cabinet, voltage transforming cabinet. The circuit breaker cabinet is also developed and equipped, to expand the usage scope of the RMU. On the basis of the indoor cases, the corresponding outdoor cases are supplied to expand the use in outdoor environments.

The RUM has been equipped separately with primary circuit devices inside the sealed enclosure, including the load switch or load switch plus current limiting fuse. The load switch is used to control the circuits to open and close load current and overload current, while the load switch plus current limiting fuse is used to control, open and close, and isolate the transformer and its distribution circuit, as well as to offer protections against short circuit current and overload current at the medium voltage side of the medium voltage transformer, the transformer and low voltage distribution circuits.

2. Operating conditions

2.1. Ambient air temperature:
Upper limit: +40°C, and the average temperature measured within 24 hours ≤35°C;
Lower limit: -40°C;

2.2. Humidity
Relative humidity: daily average ≤95%,
monthly average ≤90%.
Vapor pressure: daily average ≤2.2kPa,
monthly average ≤1.8kPa.

2.3. Altitude: ≤1000m.

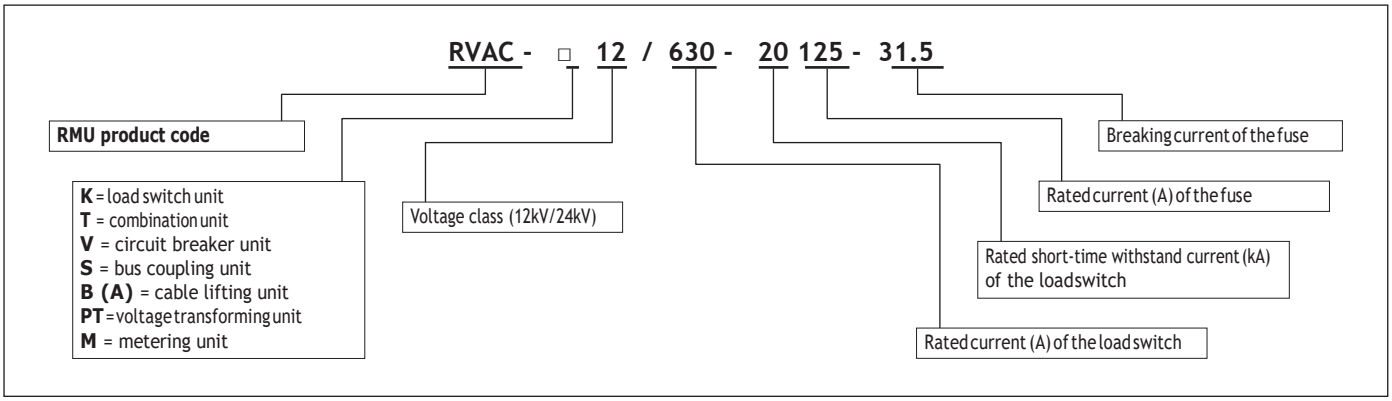
2.4. The ambient air is not apparently affected by dust, smoke, corrosive or flammable gas, vapor or salt mist pollutions.

2.5. The vibration or quake external to the switchgear and controlgear is negligible.

2.6. The amplitude of the electromagnetic interference induced in the secondary system does not exceed 1.6kV.

3. Catalogue numbering system

The structure and meaning of the catalogue numbering system are shown below.



4. Technical data

4.1. Rated technical data:

No.	Item		Unit	Data	Data
1	Rated voltage		kV	12	24
2	Rated frequency		Hz	50	50
3	Rated current	Load break switch	A	630	630
		LBS+FUSE Combination unit	A	125	100
4	1min power frequency withstand voltage	Phase to earth, phase to phase	kV	42	50 (65)
		Isolating distance	kV	48	60 (79)
5	Lighting impulse withstand voltage	Phase to earth, phase to phase	kV	95	125
		Isolating distance	kV	110	145
6	Short-time withstand current (rms)	Main circuit 4s	kA	20	20
		Earthing switch 2s	kA	20	20
		Earthing connection circuit 2s	kA	17.4	17.4
7	Short-time withstand current (peak)	Main circuit	kA	50	50
		Ground switch	kA	50	50
		Earthing connection circuit	kA	43.5	43.5
8	Rated short circuit making current (peak)	Load break switch	kA	50	50
		Earthing switch	kA	50	50
9	Load break switch's rated active load breaking current		A	630	630
10	Load break switch's rated closed-loop breaking current		A	630	630
11	Load break switch's 5% rated active load breaking current		A	31.5	31.5
12	Load break switch's rated cable charging breaking current		A	10	25
13	Fuse's rated short circuit breaking current		kA	31.5	31.5
14	Fuse's rated short circuit making current		kA	80	80
15	Load break switch's rated transfer current		A	1850	1400
16	Load break switch's rated active load breaking operations		operation	200	200
17	Ground fault current switching		A	5 (10 operations)	5 (10 operations)
18	Line and cable charging current switching under the ground fault conditions		A	20 (10 operations)	20 (10 operations)
19	Mechanical Endurance	Load break switch	operation	5000	5000
		Earthing switch	operation	2000	3000
20	Rated pressure of SF6 gas (20°C, meter pressure)		MPa	0.03	0.03
21	SF6 gas leakage rate		yearly	≤ 0.1%	≤ 0.1%

4.2. Rated current of the fuse:

Based on the capacity of the transformer, the rated current of the fuse is selected, as shown below.

(no overload, -25°C<0<40°C)

Transformer capacity kVA	Rated current A	Transformer capacity kVA	Rated current A
50	10	315	31.5
75	10	400	40
100	16	500	50
125	16	630	63
160	16	800	80
200	20	1000	100
250	25	1250	125

5. Standards

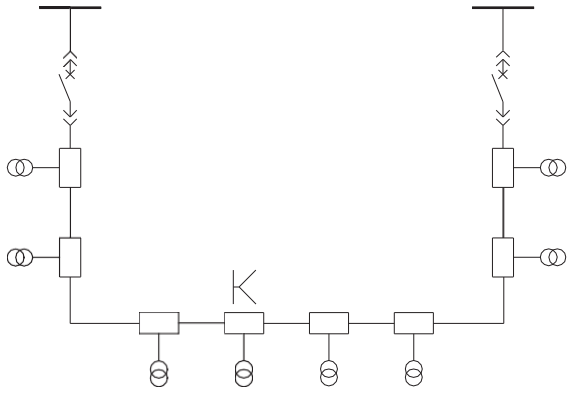
GB3906-2006	3.6kV~40.5kV AC Metal Enclosed Switchgear and Controlgear
GB/T11022-1999	Common Technical Requirements of High Voltage Switchgear and Controlgear Standard
GB3804-2004	3.6kV~40.5kV High Voltage AC Load Switch
GB16926-1997	AC High Voltage Load Switch – Fuse Combination Unit
GB1984-2003	High Voltage AC Circuit Breaker
GB1985-2004	AC High Voltage Isolating Switch and Ground Switch
GB3309-1989	Mechanical Testing under Normal Temperature of High Voltage Switchgear
GB/T16927.1-1997	High Voltage Testing Technique Part 1: General Testing Requirements
GB/T7354-2003	Partial Discharge Measurement
GB8905-1996	Gas Management and Inspection Guideline of SF6 Electrical Equipment
GB11023-1989	SF6 Gas Sealing Test Guideline of High Voltage Switchgear
GB12022-1989	Industrial SF6
GB4208-1993	Housing Protection Degree (IP Code)
IEC 62271-100	High-voltage switchgear and controlgear - Part 100: Alternating-current circuit-breaker
IEC 62271-102	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches (2003)
IEC 62271-105	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
IEC 62271-200	High-voltage switchgear and controlgear - Part 105: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV up to and including 52 kV
IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
IEC 60265-1	High-voltage switches - Part 1: Switches for rated voltages above 1 kV and less than 52 kV
IEC 60529	Degrees of protection provided by enclosures(IP Code)DL/T 592-2006 common specifications for high-voltage switchgear and controlgear standard

6. Typical functions

A RMU of 12kV typical scheme is composed of three circuits - one cable incoming circuit, one cable feeding circuit and one combination unit outgoing circuit. The load switches on the cable incoming circuit and the cable feeding circuit can reset the circuits in time to resume power supply when isolating fault line segments. The load switch and fuse of the combination unit protect the downstream loads, while its load switch also conducts opening-closing and isolation on the fuse and the downstream loads.

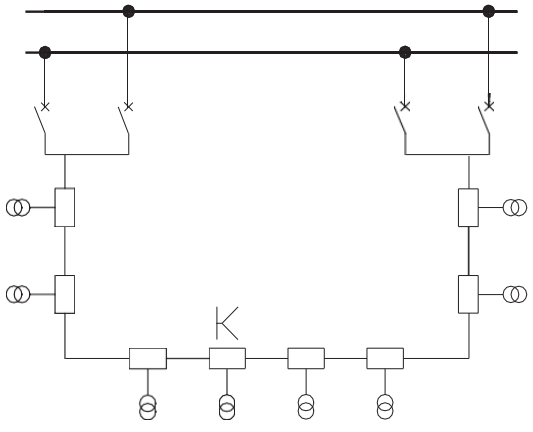
The supply circuit of the RMU is operated in open loop.

The RUM is usually energized in the forms shown in **Figure 1, 2** and **3**.



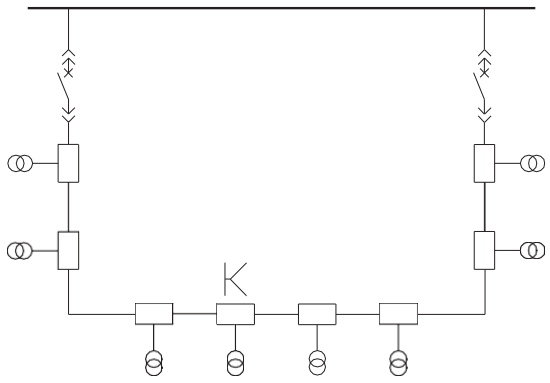
Dual-power supplied ring network power supply system

Figure 1



Two-independent-power supplied ring network power supply system

Figure 2



The ring network power supply system with only one power supply

Figure 3

Note: a) "⊣□⊢" RMU b) "K" open loop point

7. Typical schemes and structures (see Figure 4, 5 and 6)

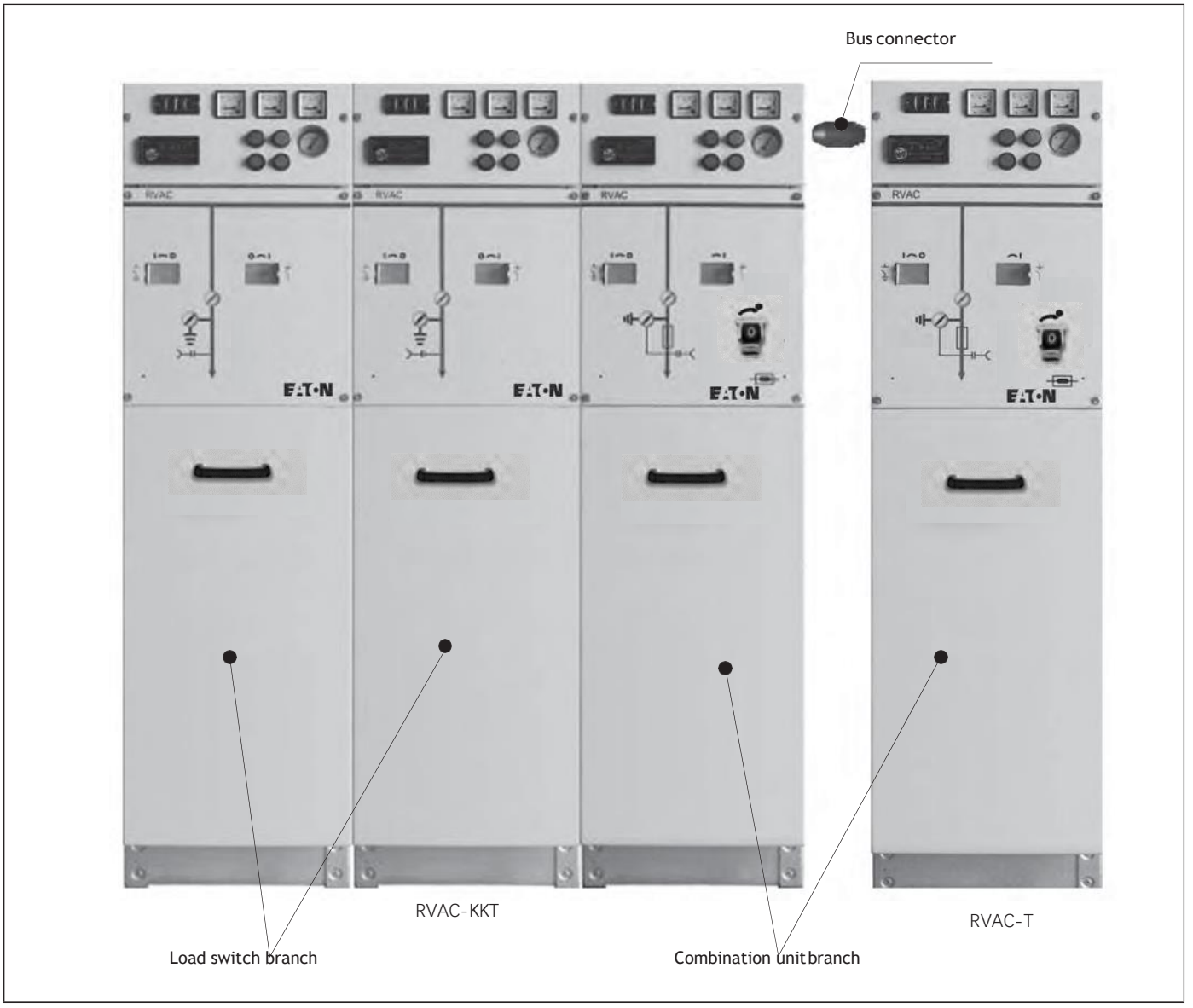
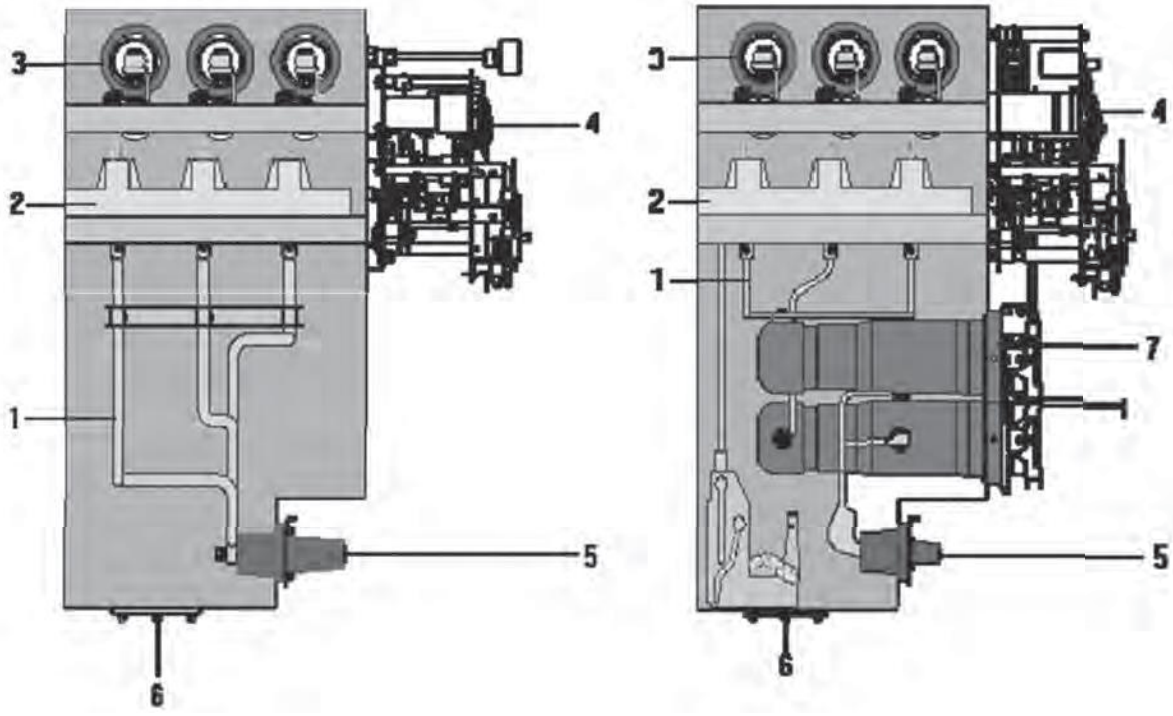


Figure 4 RMU structure diagram



1. Busbar
2. Load break switch
3. Bus connector, Extension bushing
4. Spring operating mechanism
5. Incoming/outgoing cable bushing
6. Pressure relief device
7. Fuse tube

Figure 5 Sealed enclosure housing cross-section drawing

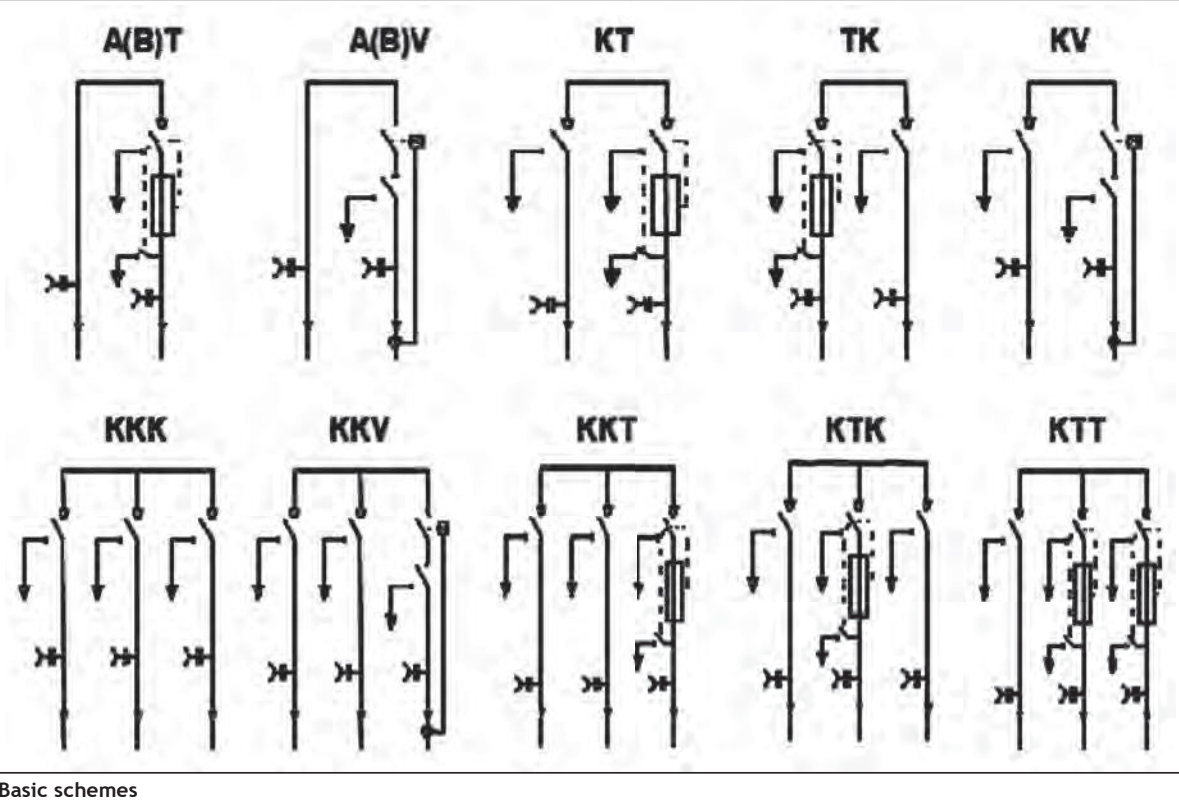


Figure 6-1 Basic schemes

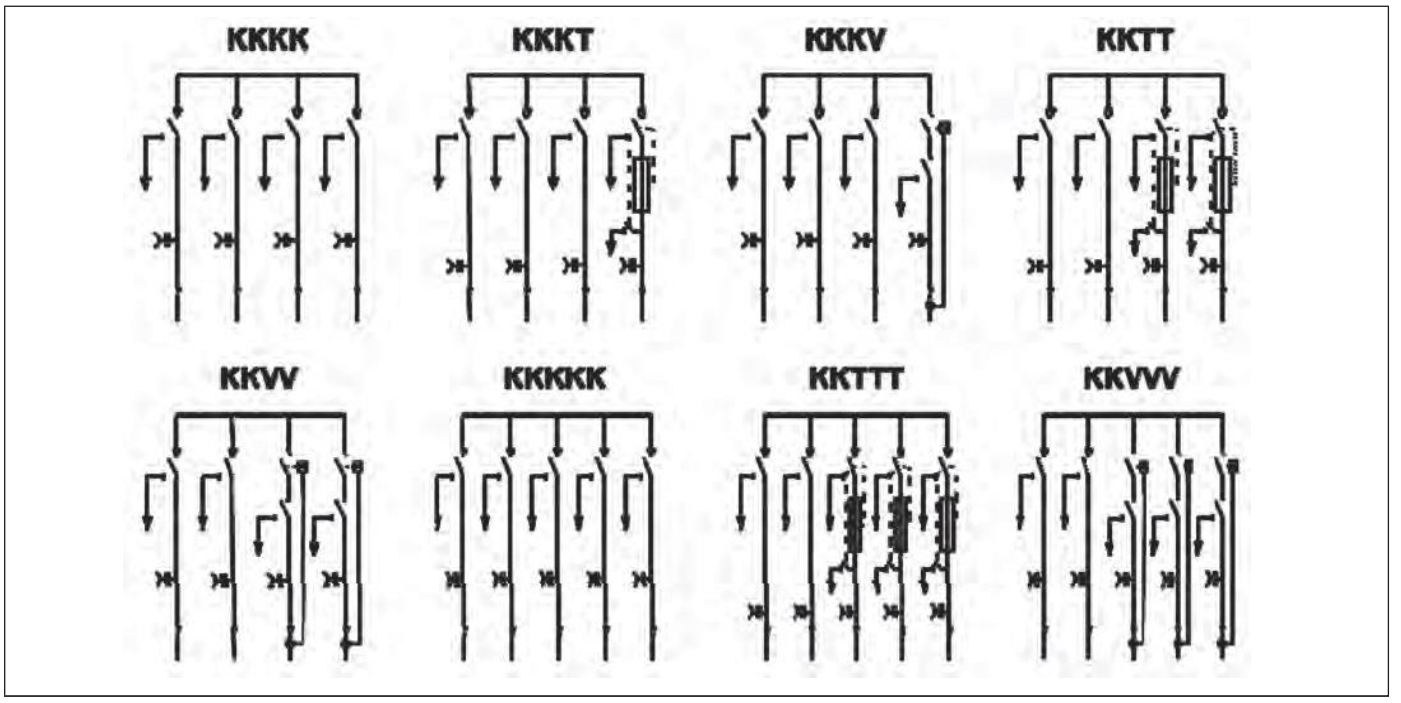


Figure 6-2 Basic schemes

7.1. Overall structure

The typical scheme is a one/in-two/out three-section common enclosure RMU, including one incoming, one ring feeder and one ring outgoing.

The layout of the typical scheme is shown in **Figure 4** (RVAC-KKT).

The overall structure is composed of two major parts, the gas-filled sealed housing part and the non-gas-filled part such as the control compartment, cable compartment, frame, and pressure relief channel. The high voltage circuit is within the gas-filled sealed housing, and the mechanism compartment is on the top front, while the pressure relief channel is on the bottom front. Fully shielding cable terminals are used for incoming and outgoing lines.

7.2. Component structure

7.2.1. Sealed housing

The sealed enclosure housing is made of high-quality stainless steel plates, using fully enclosed welding method and SF6 gas, with the rated pressure of 0.03 MPa. During the whole running life, safe operations can be maintained without the need to refill the gas. After assembling, the gas-filled housing can not be drilled nor welded.

7.2.2. Three-position Load switch

The three-position load switch is installed inside the gas-filled housing, with its operating mechanism installed inside the control compartment. The three-position load switch offers closing, opening and grounding positions. The three-position load switch is in the opening position when the knife is in the middle position. The three-position load switch is in the closing position and ground position separately when the knife is in the two-limit positions. The load switch side and the ground switch side of the three-position load switch are equipped with clear and reliable mechanical opening/closing indicator (see **Figure 7**).

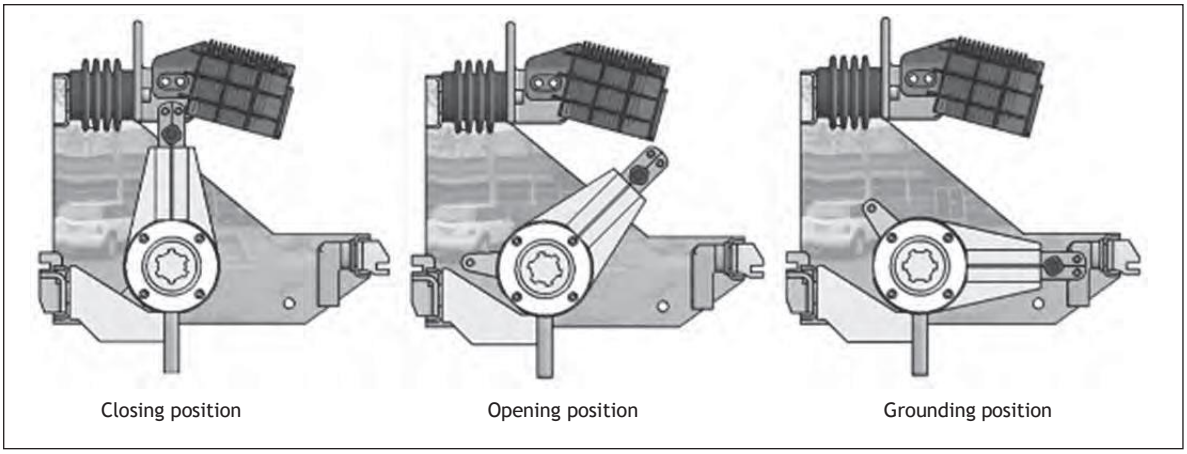


Figure 7 3-position opening/closing position indication

7.2.3. Fuse ground switch

The combination unit branch circuit (load switch + current limiting fuse) is equipped with a fuse ground switch for linkage operations with the three-position load switch, offering reliable grounding to the fuse outgoing side. When the load switch is in closing/opening operation, the fuse ground switch basically remains non-operating. When the three-position load switch is in ground position, the fuse ground switch makes reliable contact with the fixed contact base at the fuse outgoing side, to ensure the fuse outgoing side is reliably grounded.

7.2.4. Fuse

The fuse and the load switch constitute the transformer protection circuit. Highly quickbreak current-limiting fuse is installed inside the epoxy casting insulation housing. In the case of a short circuit, after the fuse is blown out, the striker will be ejected to open the load switch, enabling the fault line to be removed.

7.2.5. Frame

The frame (the housing except the sealing enclosure) is the basic body of all the parts and components, to support and secure the sealing enclosure. The frame uses aluminum- zinc plates formed with multiple bendings, to be connected with high strength bolts, nuts (Level 8.8) and rivets. The frame can be divided into three main compartments: the control compartment, cable compartment and pressure relief channel. There are a mechanism, a fuse holder and a secondary circuit inside the control compartment. The cable compartment contains a cable, its holder, and the ground bus bar, with optional current transformer as needed. The pressure relief channel is located behind the cable compartment. On the front is located a pressure meter, a main wiring mimic diagram, a voltage presence display, an operating hole and operation buttons, a nameplate, a mechanism compartment door, and a cable compartment door.

7.2.6. Mechanisms and their mechanical interlock

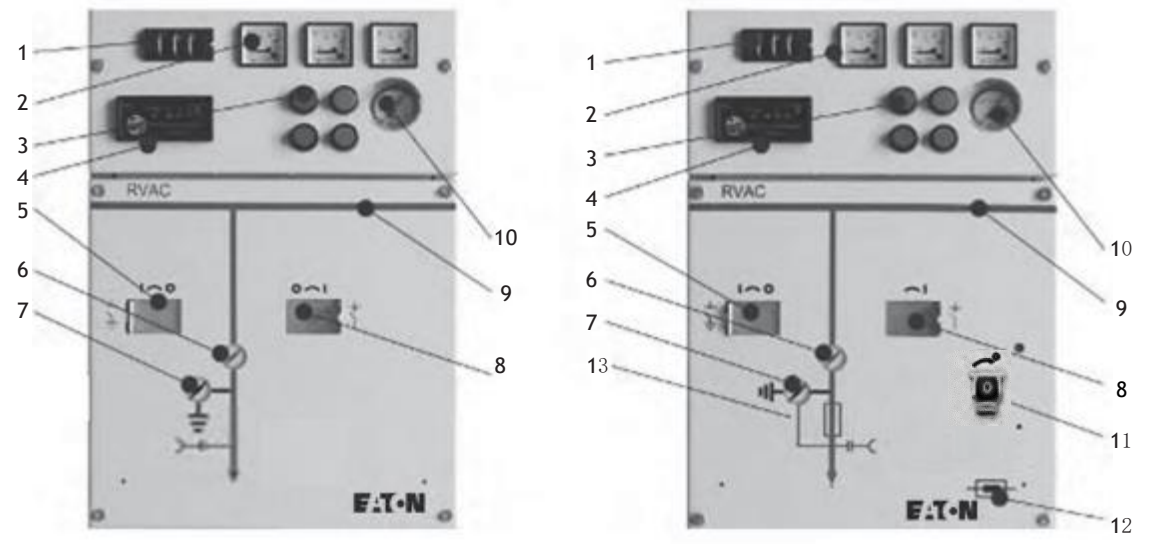
The three-position load switch is equipped with a spring operating mechanism, offering reliable mechanical interlocking. The load switch must be operated on according to specified operating procedures.

Interlocking conditions are as follows:

a. Only when the load switch is moved to the opening position, the ground switch can be closed;
b. Only when the ground switch is moved to the opening position, the load switch can be closed;
c. Only when the ground switch is moved to the ground position, the cable compartment door can be opened;
d. Only after the cable compartment door is closed, the ground switch can be opened.

7.2.7. Simple and reliable operating interface

The operating mechanism has position indicator and mechanical interlocking devices, with optional auxiliary contact, opening coil, and electrical operating device, as shown in **Figure 8**.



1. Voltage presence indicator;
2. Meters;
3. Electric operating button and status indicating light;
4. Fault indicator;
5. Ground switch operating hole;
6. Loads switch status indication;
7. Ground switch status indication;
8. Load switch operating hole;
9. Main circuit mimic line;
10. SF6 gas pressure meter;
11. Combination unit manual release button;
12. Fuse status indication;
13. Fuse mimic line;

Figure 8

7.2.8. Fuse Tube

The fuse tube mainly includes two parts: epoxy insulating tube and locking plug, both of which are used to install and secure the fuse. The epoxy insulating tube is installed on the sealed housing, itself offering gas sealing feature to ensure the sealing performance of the gas-filled housing. The fuse is secured on the locking plug with screws, offering reliable insulation with close cooperation of the silicone rubber locking plug and the epoxy insulating tube.

7.2.9. Pressure relief device

An explosion-proof sheet is equipped at the bottom of the sealed enclosure housing. In the case of internal arcing fault, the high pressure gas inside the housing can explode this sheet away to release the pressure. Meanwhile, SF 6 gas will be released into the ditch through the pressure relief channel to ensure the safety of the operators. The pressure relief device is shown in **Figure 9**.

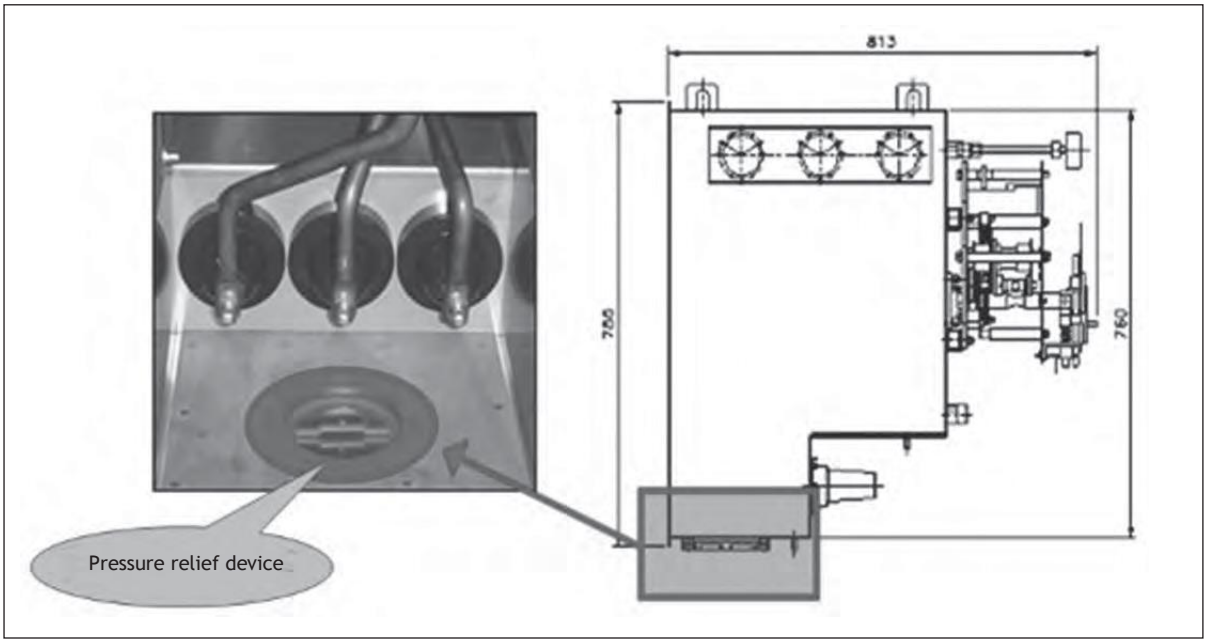


Figure 9

7.2.10. Ground circuit

The main grounding copper bar is supplied individually inside the cable compartment, throughout the whole arrangement, for use by directly grounded assemblies. The ground contact base of the three-position load switch is connected with the main ground copper bar with a copper bar, to constitute a ground circuit to make the whole cabinet in a well grounding status, and ensure the safety of the operators.

Chapter 2 Transport, handling, inspection and storage

1. Transport and handling

1.1. The switchgear must be transported under the conditions that the load switch is in “OFF” position, with its charging device in “energy-releasing” state and the ground switch in “closed” state.

1.2. The outer packing of the switchgear shall have anti-shock, moisture-proof and dust-proof performance, and be adaptable to railway and highway transportation.

1.3. In the case of handling by hand-push type forklift or by freight forklift, the switchgear should be put onto the transportation pallet (see **Figure 10.1**). In the case of crane handling, the lifting hook of the crane should be hooked into the two lugs on the top of the switchgear. The angle between the lifting rope and the top of the cabinet shall exceed 45° (the angle between the lifting rope and the plumb line shall not exceed 45 °), so as to avoid any deformation to the cabinet or the lug (see **Figure 10.2**).

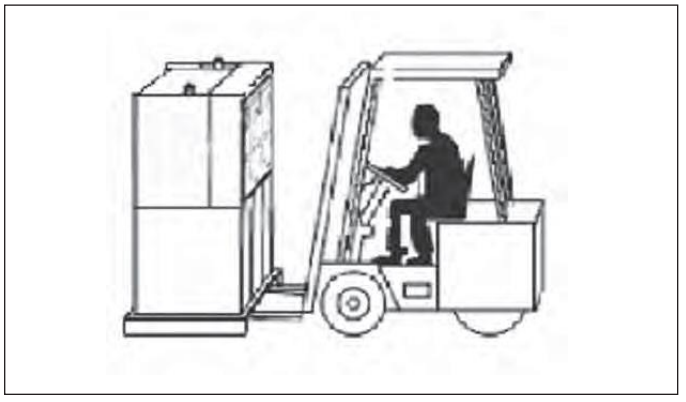


Figure 10.1 Forklift handling example

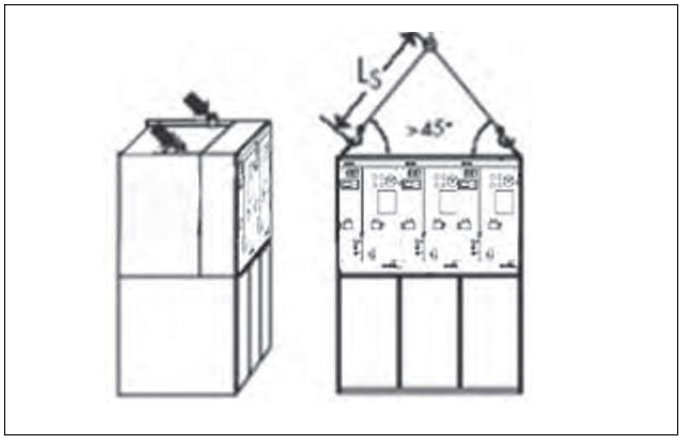


Figure 10.2 Crane handling example

⚠CAUTION

CHECK THE WEIGHT OF THE SWITCHGEAR. DO NOT USE WORN OUT AND DAMAGED STEEL ROPES OR LIFTING RINGS. DO NOT USE THE LIFTING EQUIPMENT WITH THE LIFTING CAPACITY LESS THAN THE WEIGHT SHOWN ON THE NAMEPLATE OF THE SWITCHGEAR.

1.4. During loading and unloading, the switchgear shall be handled according to the storage and transport indication mark on the package, to avoid equipment damages. In general, the switchgear should be moved vertically, to prevent from tilting or turning over.

1.5. In the case of any damages found on the switchgear after long-distance transportation, notify the cargo division immediately to have the damage accidents identified.

2. Inspection and storage

2.1. Visual inspection
Users shall make open-box inspections in a timely manner after receiving the goods, to check the equipment for any damages or deformation during transportation.

2.2. SF6 gas pressure inspection
When the product is delivered from the factory, SF6 gas has been filled, with the gas relative pressure of 0.03 MPa. During on-site inspection, the gas density meter will indicate whether the pressure of the gas is normal (normal when the pointer points to the green area, and abnormal when pointing to the red areas).

⚠CAUTION

IN THE CASE OF ABNORMAL GAS PRESSURE, NOTIFY THE AFTER-SALES SERVICE OF COOPER ELECTRIC IN A TIMELY MANNER FOR DULY AND PROPER HANDLING.

2.3. Accessory inspection
After unpacking the package, please check whether the equipment’s primary scheme conforms to the requirements of the order, and whether the accessories are complete, such as the equipment’s factory data, special opening tools, and spare parts. In the case of any errors, please contact the After-sales Service of Cooper Electric in a timely manner.

2.4. Storage
If the equipment can not be installed in time and has to be stored for a period of time, use the original packaging materials to properly pack the equipment after open-case inspections, and store the equipment in a dry and clean place, to avoid any mechanical damages to the equipment.

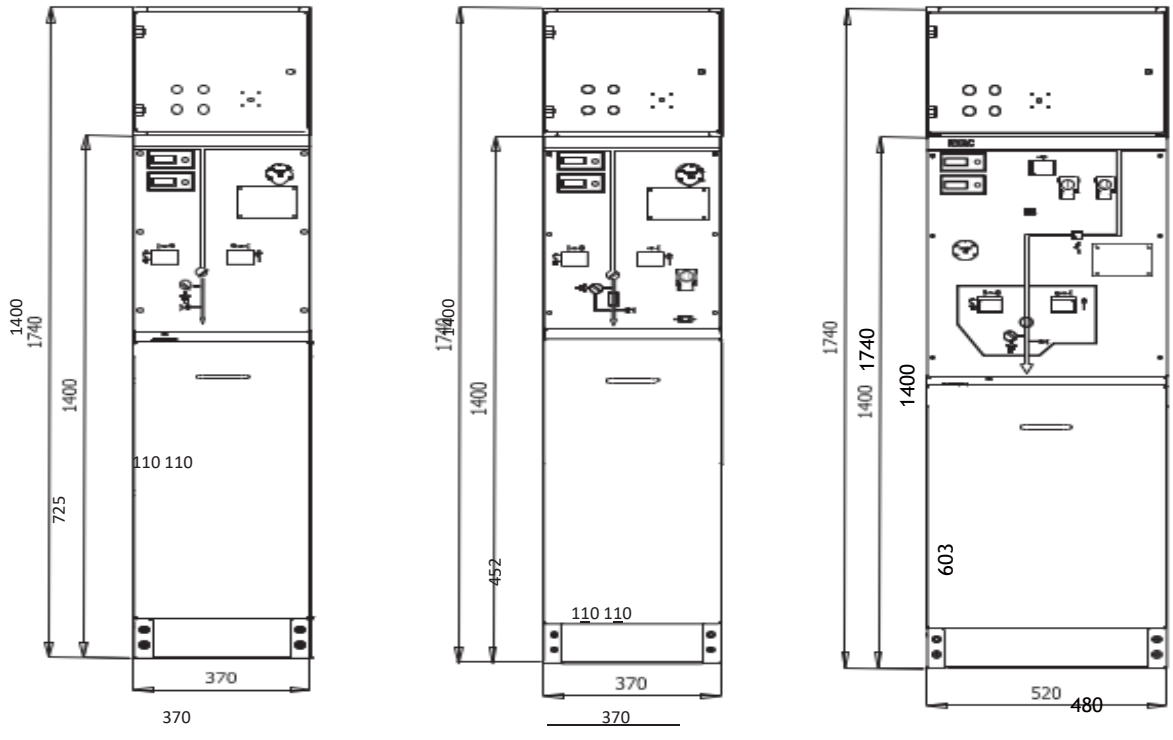
Chapter 3 Installation

△ CAUTION

THE PRODUCT SHALL BE INSTALLED BY PROPERLY TRAINED PROFESSIONALS OR UNDER THE INSTRUCTION OF PROFESSIONALS.

1. RMU dimensions

RAVC-K, RVAC-T and RVAC-V are taken as examples for RMU dimensions. See **Figure 11**.



		K	T	V
12kV	Width	370	370	480
	Depth	800	800	800
	Height	1400	1400	1400
24kV	Width	370	370	520
	Depth	870	870	870
	Height	1400	1400	1400

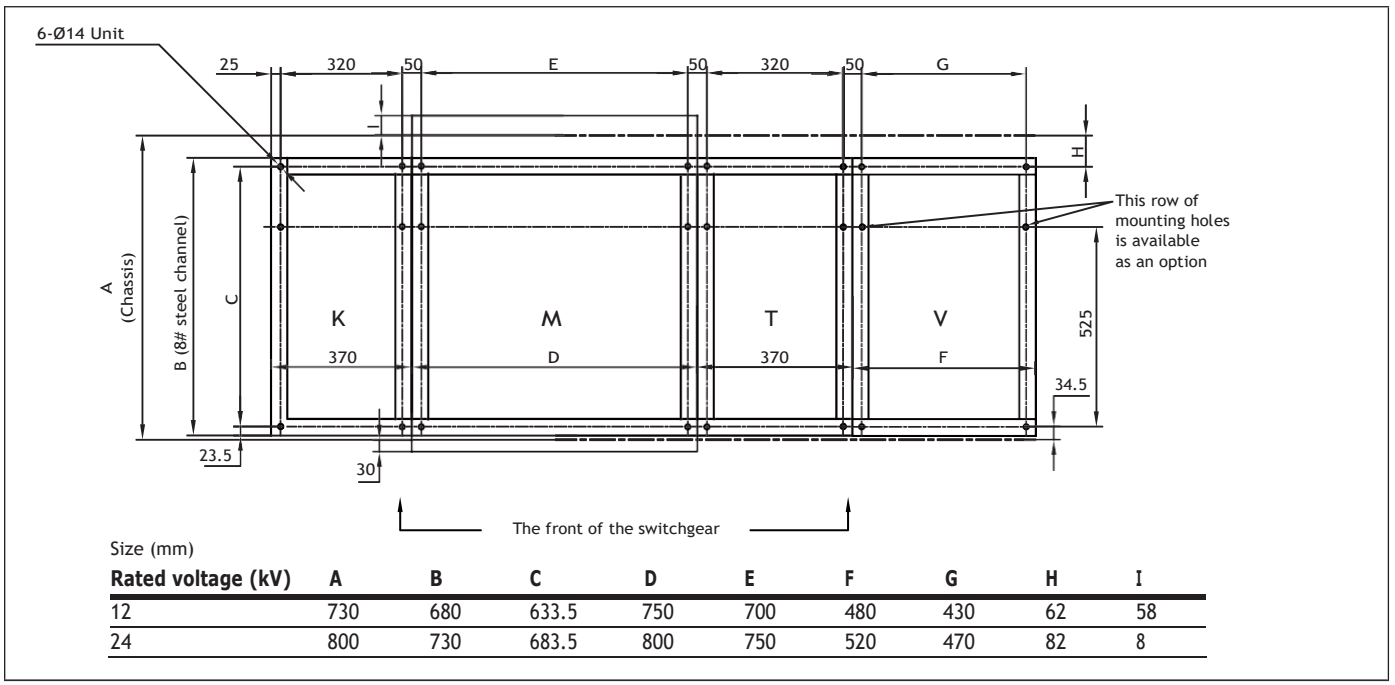
Figure 11

2. Base form

2.1. The RMU installation base shall be constructed in accordance with relevant regulations in Technical Specifications for Electric Power Construction and Acceptance Inspection.

2.2. The RMU's installation base is generally poured with concrete twice. For the first time, concrete the installation base of the RMU's installation elements including the angle steel, square steel and channel steel. For the second time, concrete the ground supplement layer, with a common thickness of 60 mm. When pouring concrete to the supplement layer, the height of the concrete should be 1 ~ 3 mm lower than the element surface.

2.3. For the dimensions of the RMU installation bases, see **Figure 12.1** and **Figure 12.2** (12kV cabinet depth 800mm, 24kV cabinet depth is 870mm).



Size (mm)

Rated voltage (kV)	A	B	C	D	E	F	G	H	I
12	730	680	633.5	750	700	480	430	62	58
24	800	730	683.5	800	750	520	470	82	8

Figure 12.1 RMU indoor installation base dimension

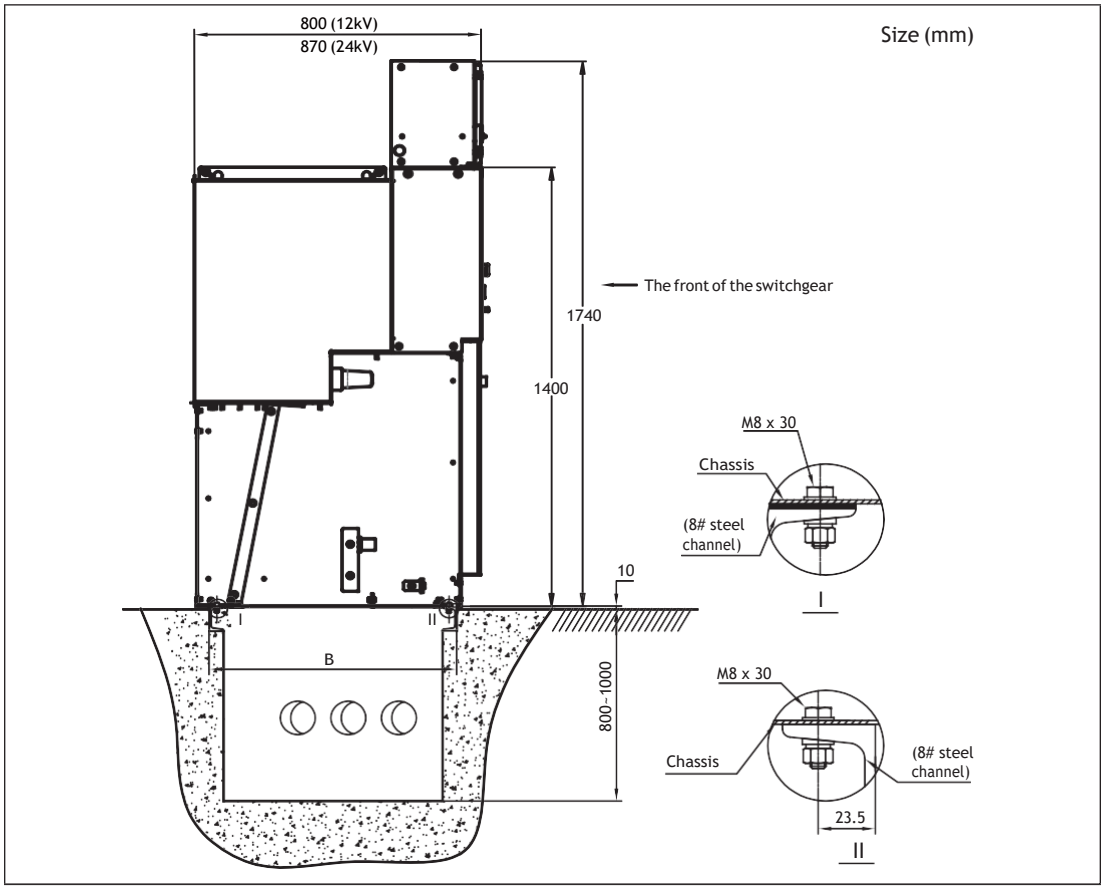


Figure 12.2 The frame installation base at the RMU side

2.4. To ensure the installation quality of the basic elements, the levelness of the framework installation requires the tolerance of 1 square meter shall be less than 3 mm.

3. RMU fixation

3.1. The bottom of the switchgear is linked to the metal base frame with bolts, enabling the switchgear to be fixed on the frame (the cabinet shall have 4 connection joint surfaces with the frame). Use M20 connecting screws and bolts, with the torque of 40 + 4 Nm.

⚠WARNING

THE CHARGING DEVICE SHALL NOT BE IN CHARGING STATE DURING THE INSTALLATION AND CONNECTION OF THE RMU. OTHERWISE, THIS MAY CAUSE PERSONAL INJURY.

3.2. Check all the fastening bolts for looseness, and all the wirings for reliability.

3.3. Check whether the 3-position load switch mechanism can be operated flexibly, whether the load switch can open and close freely; check for any abnormity. Check whether the interlocks are reliable.

4. RMU grounding

The grounding bar of the RMU must be connected to the grounding grid of the site. The grounding position of the RMU is inside the right side frame of the cabinet chassis. See **Figure 13**. Use M12 connecting screws or bolts, with the torque of 70 ±7Nm. The grounding wire is not included in the supply scope.

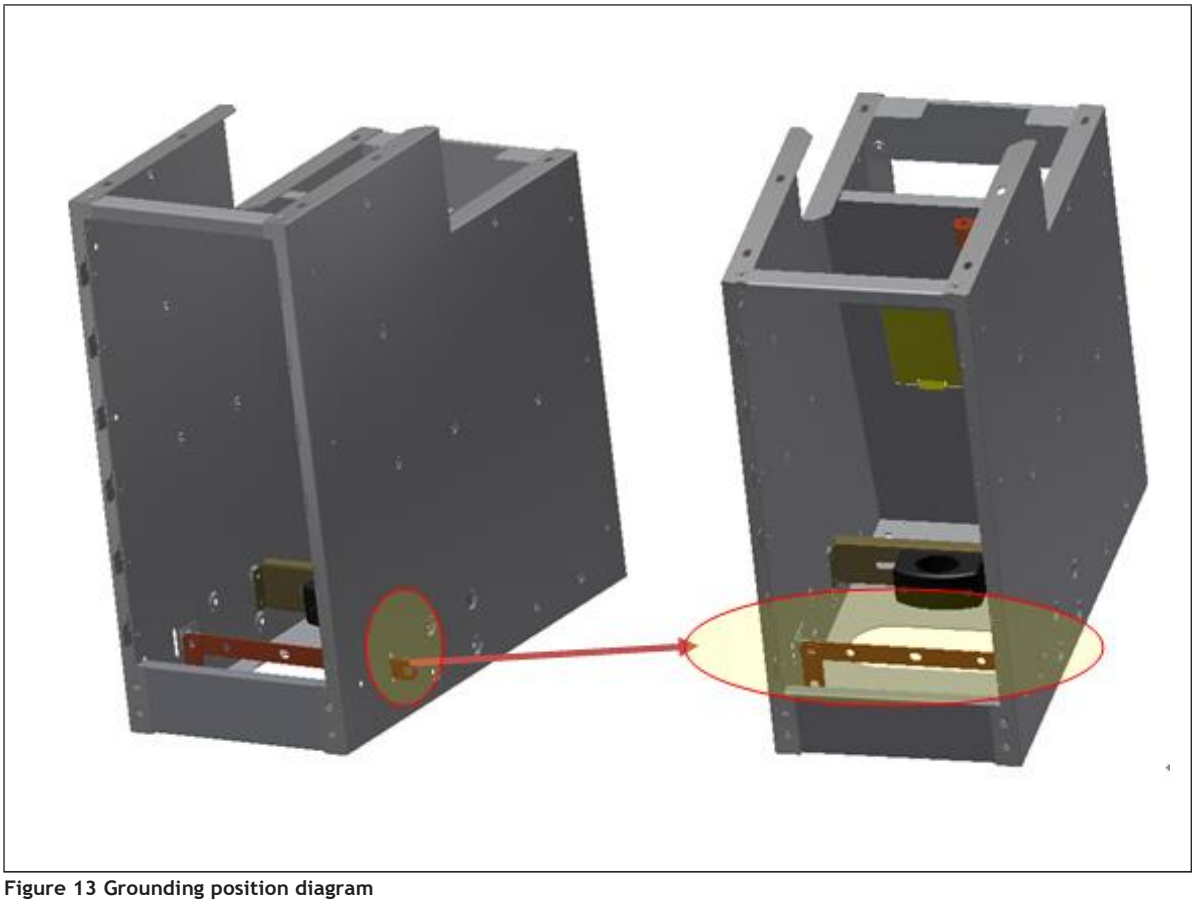


Figure 13 Grounding position diagram

5. Cable installation

5.1. Preparation prior to cable placing

Remove the cable compartment door in the procedures shown below (for the operating method of the switch, see Chapter 4)

a. Operate and confirm the ground switch is in the closed state (see **Figure 14.1**);

b. Remove the cable compartment door, and open the cable compartment (see **Figure 14.2**);

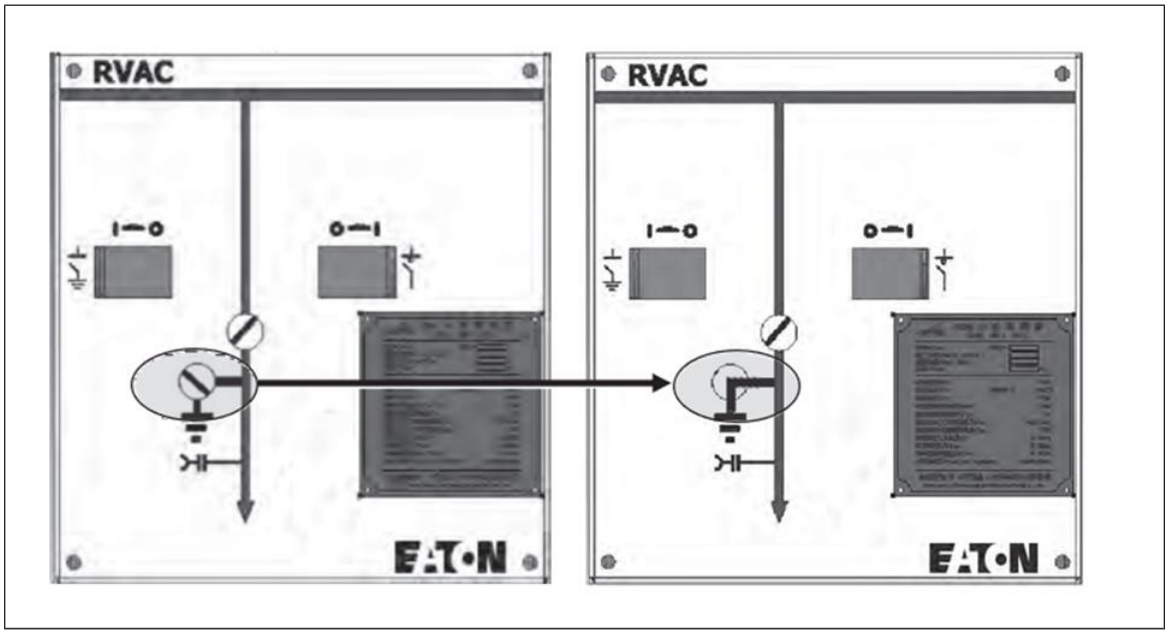


Figure 14.1 Ground switch status indication

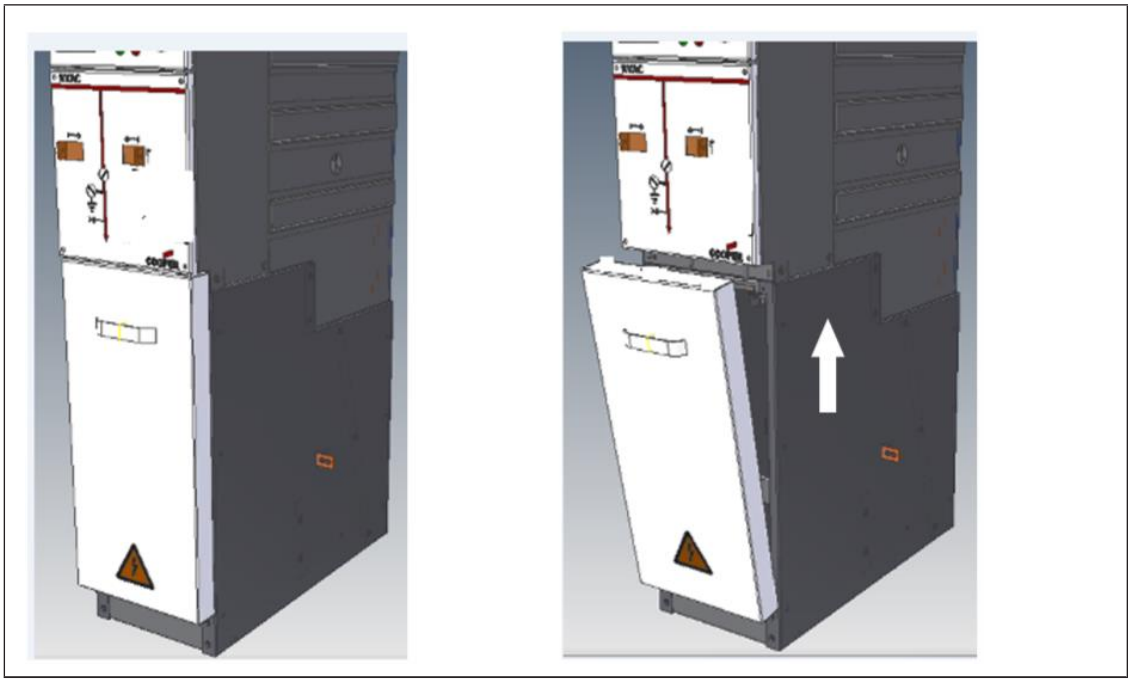


Figure 14.2 Removal of the cable compartment door

5.2. Cable connection

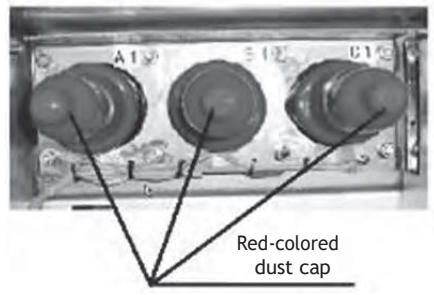
The cable terminal head adopts prefabricated silicone rubber, with well-designed internal stress cone and shielding, properly solving electric field concentration issues at the cutting place of the outer screen and at the high voltage end. There is a semi-conductive layer outside the product, allowing the live parts to be fully sealed, fully insulated and completely screened, thus ensuring reliable operations of the ring main unit. The load switch casing is 725 mm away from the ground, while the combination unit cabinet casing is 452 mm away from the ground, well protected by the cable compartment door. Passing through the cable trench into the cabinet, the cable are cut off after the length is measured. The connections of relevant parts and the making of cable heads shall be considered as far as the length is concerned.

⚠ WARNING

PLEASE READ CAREFULLY THE INSTALLATION INSTRUCTION MANUAL OF THE CABLE ACCESSORIES. ONLY PROFESSIONAL INSTALLATION PERSONNEL ARE ALLOWED TO MAKE THE ACCESSORY STRICTLY ACCORDING TO ITS REQUIREMENTS. FAILURE TO DO SO WILL SEVERELY AFFECT THE NORMAL OPERATION OF THE EQUIPMENT.

⚠ WARNING

THE INSTALLATION OF THE CABLE BRACKETS AND THE FIXATION OF THE CABLE SHALL NOT BRING ADDITIONAL FORCES TO THE INSULATING CASING.



⚠ WARNING

RED-COLORED PROTECTIVE DUST CAP IS FORBIDDEN TO BE PUT INTO OPERATION, AND CAN NOT REPLACE THE INSULATION COVER FOR USE.

6. Fuse installation (equipped with the fuse's transformer feeder unit)

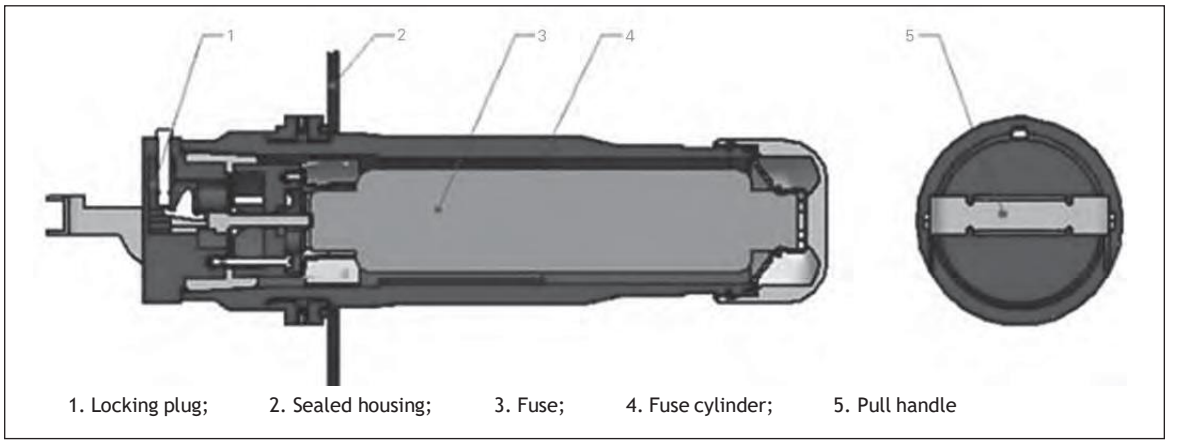


Figure 15 Fuse cylinder structure drawing

The fuse shall be installed and replaced by properly trained professionals.

Before the RMU is put into operation, properly install the chosen fuse as described in the following procedures:

a. Open the combination unit branch load switch;

b. Move the 3-position load switch to the ground position, to ensure that both ends of the fuse are grounded;

c. As shown in **Figure 16**, move the handle from the vertical place to horizontal place, maintain and withdraw the locking plug horizontally. Handle with care, to avoid any damage to the fuse cylinder;

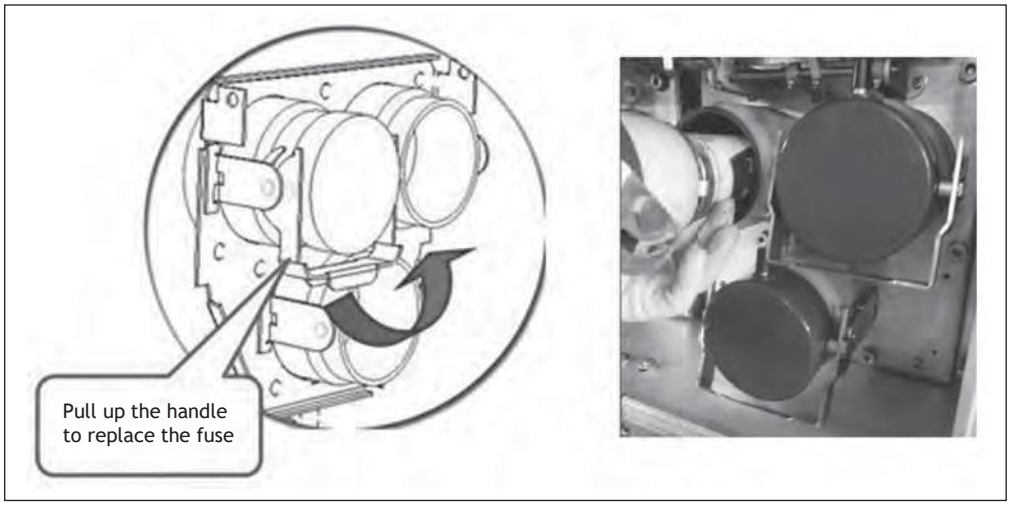


Figure 16 Fuse cylinder operation example

d. Check the silicone rubber sleeves for any damage, and the contact button on the locking plug for any permanent deformation;

e. Install a new fuse, ensuring a dimension of 2 to 4mm as shown in **Figure 17**. Check whether the installation direction is correct, because the fuse's striker pushes the load switch to open after the fuse is blown. Therefore, the striking end of the fuse (small end) must be outward;

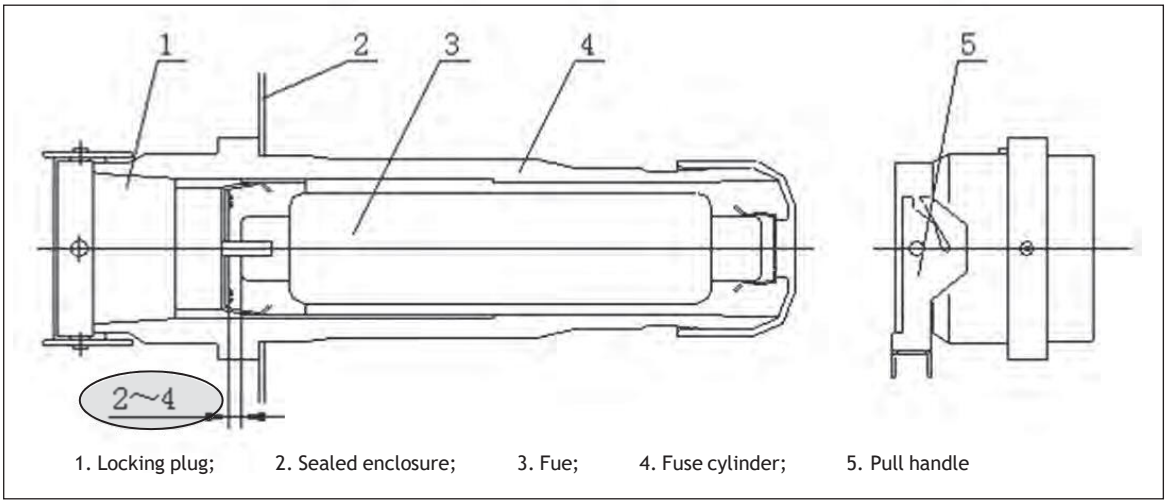


Figure 17 Fuse cylinder structure diagram

f. Before inserting the fuse into the insulation cylinder, clear and clean the silicon rubber surface with alcohol cotton paper. Then apply silicon grease evenly on the surface of the silicon rubber special grease smearing

g. As shown in **Figure 18**, insert the fuse into the insulation cylinder horizontally, ensuring the inner side of the fuse has good contact with the contact button inside the insulation cylinder. Push the locking plug slightly to make the handle's notch clutch onto the pin of the cabinet. Then press the handle from the horizontal position to vertical position, to complete the installation of the fuse.

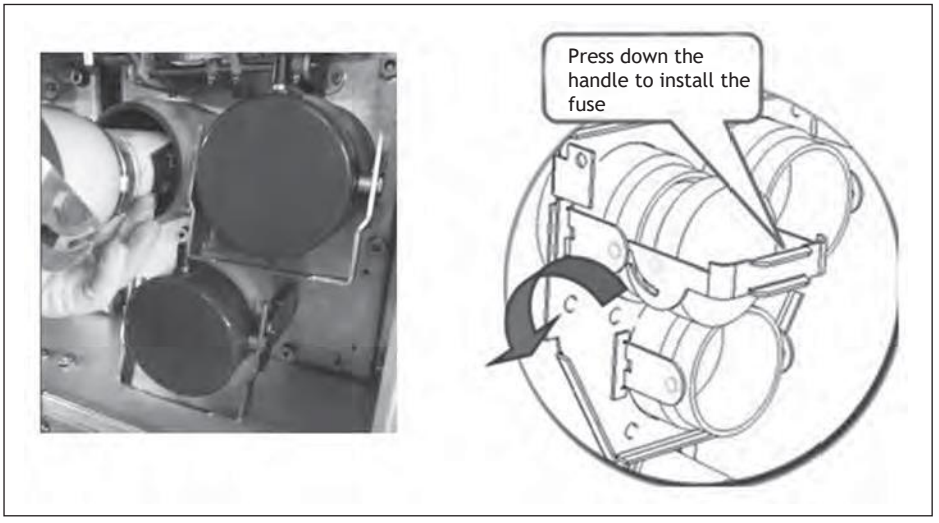


Figure 18 Fuse cylinder operation example

During operation, the fuse must be replaced after blown out. Be careful and cautious during the replacement of the fuse. For the consideration of safety, wait at least for 10 minutes after the action of the fuse, the circuit is isolated by the load switch, the ground switch is closed, and both ends of the fuse are grounded. Then replace the fuse as follows:

a. Make sure that the fuse has blown out, and the load switch has opened;

b. Move the 3-posiition load switch to the ground position, ensuring that both ends of the fuse are grounded;

c. As shown in **Figure 16**, move the handle from the vertical position to horizontal position, and maintain and withdraw the locking plug and the fuse horizontally. Handle with care, to avoid any damage to the fuse cylinder;
d. Check the silicone rubber sleeves for any damage, and the contact button on the locking plug for any permanent deformation;
e. Remove the blown fuse;
f. Insert the fuse into the insulation cylinder, clear and clean the silicon rubber surface with alcohol cotton paper. Then apply silicon grease evenly on the surface of the silicon rubber, and press down the top pin of the locking plug;
g. Insert the fuse into the insulation cylinder horizontally, ensuring the inner side of the fuse has good contact with the contact button inside the insulation cylinder. Push the locking plug slightly to make the handle's notch clutch onto the pin of the cabinet. Then press the handle from the horizontal position to vertical position (see **Figure 18**), to complete the installation of the fuse.

⚠WARNING

THE FUSE SHALL BE SELECTED ACCORDING TO THE FUSE SELECTION TABLE. IN THE THREEPHASE POWER GRID, EVEN IF ONLY ONE-PHASE FUSE TAKES ACTION, ALSO REPLACE THE OTHER TWO-PHASE FUSES. WHEN REPLACING, MAKE SURE THAT THE FUSE IS COOLED!

7. Cabinet connection and installation

Cooper series ring main units can make two different switchgears connected together with a bus connector. The process does not involve the process of SF6 gas. This connector consists of silicone rubber plug-ins and contact buttons, installed between the two bus insulators (bus exit) on the side of the switchgear, with electric field distribution controlled by the semiconductor layer, with contact buttons to carry current, to make adjacent switchgear buses to connect in the electric circuit and have the joints insulated. First, insert three bus connectors into the corresponding bus insulators of one switchgear, and draw the adjacent switchgear closer to it. During closing up, the bus connector shall be aligned towards the center of the bus insulator, connect and tighten these two switchgear cabinets with bolts.

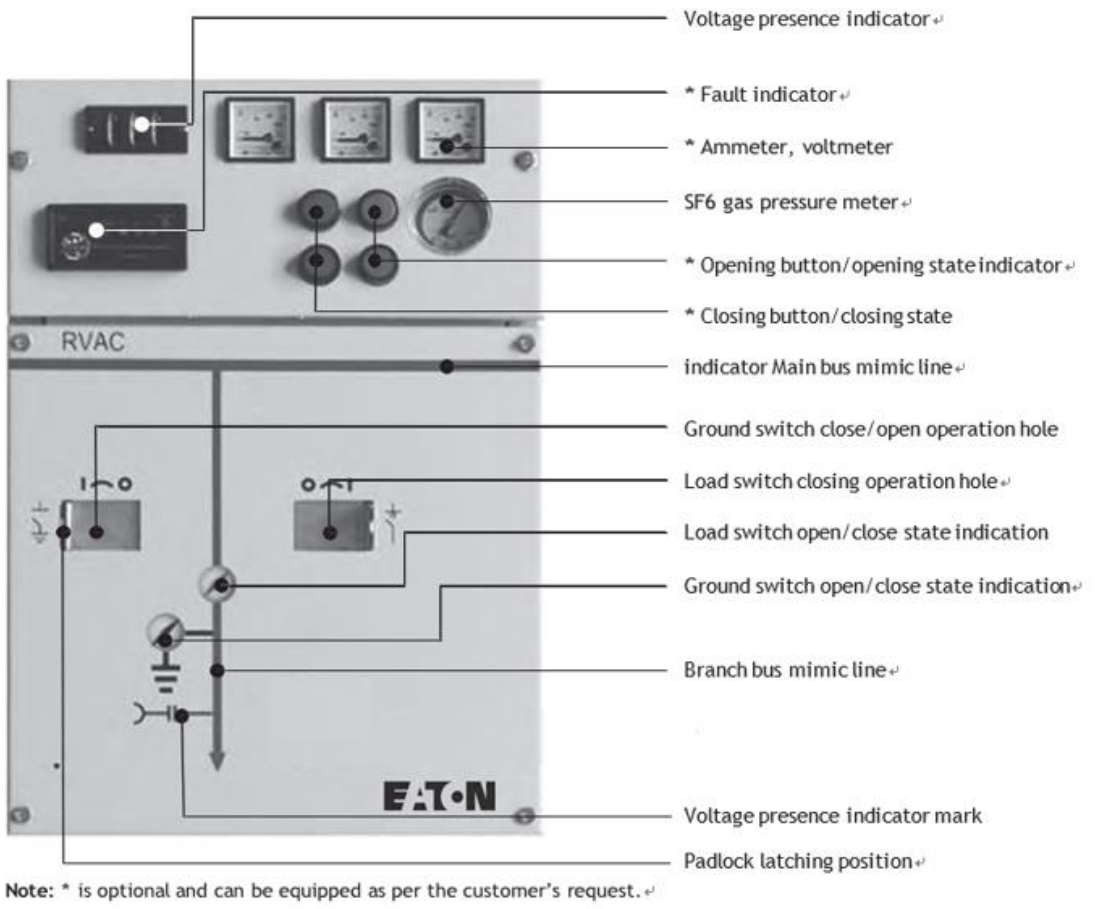
8. Inspection and cleaning after installation

- To check the data on the nameplate;
- To check the control circuit line and voltage;
- Gas pressure indication (red/green);
- To remove the dust on the equipment due to installation;
- To remove instructions, leaflets and data no longer needed;
- To check all the fastening pieces for looseness, and remove the tools and parts no longer needed on the installation site;
- To check the wirings on the installation site;
- To check the effectiveness of the interlocks.

Chapter 4 Operation

1. Load switch cabinet

1.1. Operating interface description



Note: * is optional and can be equipped as per the customer's request.

1.2. Interlock description

The load switch cabinet offers the following question-and-answer mechanical interlock.

Load switch	Ground switch	Cable compartment door
Closed	Locked	Locked
Opened	Not locked	Locked
Locked	**Closed**	Not locked
Not locked	**Opened**	Locked
Locked	Locked	**Open**
Locked	Not locked	**Close**

1.3. Operation instruction

a). Close the cable compartment door, and unlock the operation of the ground switch;

b). Push open the ground switch operating hole latching panel to the right, open the ground switch operating hole, insert the handle into the ground switch operating hole, rotate the handle clockwise to open the ground switch, and pull out the operating handling after operation;

c). Push open the load switch operating hole latching panel to the left, open the load switch operating hole, insert the handle into the load switch operating hole, rotate the handle clockwise to close the switch, and pull out the operating handling after operation;

d). Push open the load switch operating hole latching panel to the left, open the load switch operating hole, insert the handle into the load switch operating hole, rotate the handle counter clockwise to open the switch, and pull out the operating handling after operation;

e). Push open the ground switch operating hole latching panel to the right, open the ground switch operating hole, insert the handle into the ground switch operating hole, rotate the handle counterclockwise to close the ground switch, and pull out the operating handling after operation;

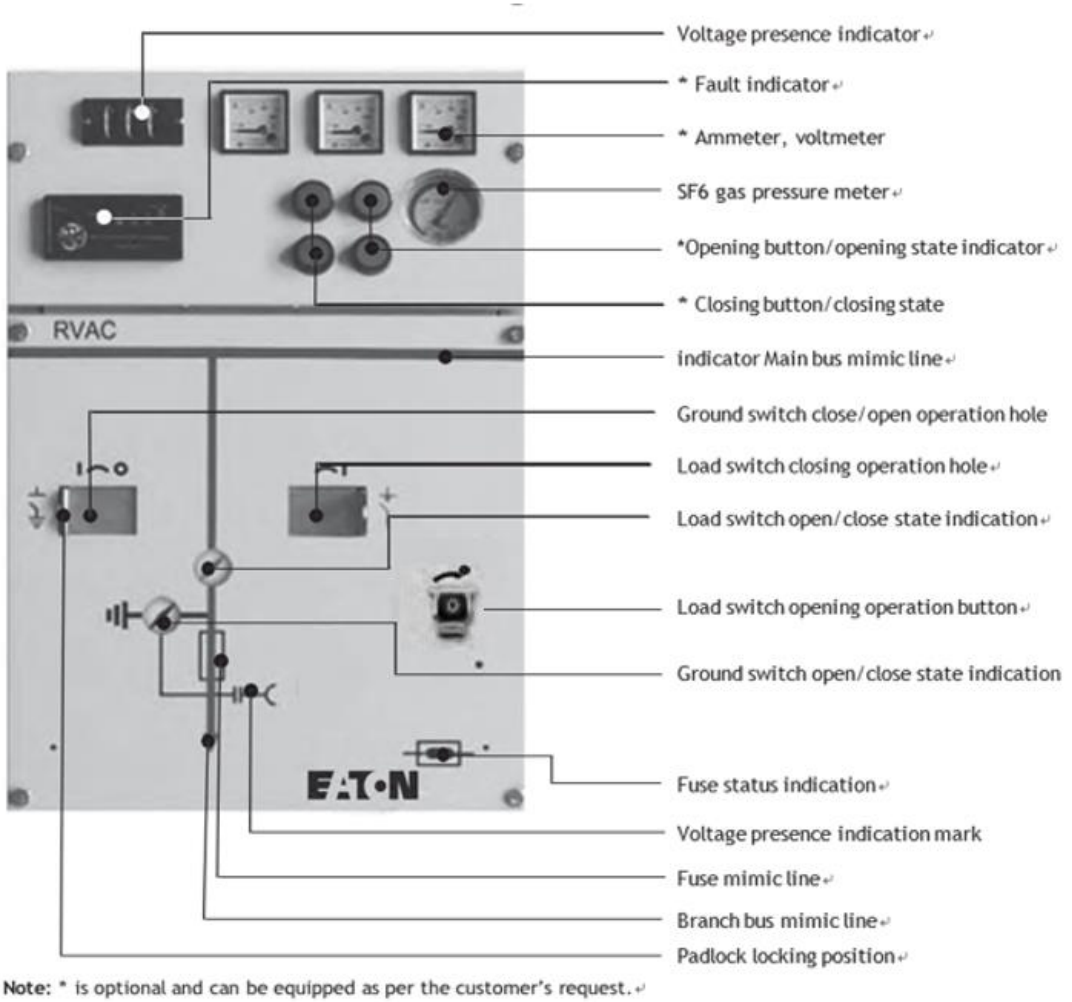
f). Lift up the lock catch of the interlocking device to lock the operation of the ground switch, and open the cable compartment door;

⚠ WARNING

IT IS STRICTLY PROHIBITED TO CLOSE THE GROUND SWITCH AND OPEN THE CABLE COMPARTMENT DOOR WHEN THE CABLE HEAD IS ENERGIZED.

2. Combination unit cabinet

2.1. Operating interface description



Note: * is optional and can be equipped as per the customer's request.

2.2. Interlock description

The combination unit offers question-and-answer mechanical interlock.

Load switch	Ground switch	Fuse compartment and cable compartment door
Closed	Locked	Locked
Opened	Not locked	Locked
Locked	**Closed**	Not locked
Not locked	**Opened**	Locked
Locked	Locked	**Open**
Locked	Not locked	**Close**

2.3. Operation instruction

a). Close the cable compartment door, and unlock the operation of the ground switch;

b). Push open the ground switch operating hole latching panel to the right, open the ground switch operating hole, insert the handle into the ground switch operating hole, rotate the handle clockwise to open the ground switch, and pull out the operating handling after operation;

c). Push open the load switch operating hole latching panel to the left, open the load switch operating hole, insert the handle into the load switch operating hole, rotate the handle clockwise to close the switch, and pull out the operating handling after operation;

d). Rotate the load switch opening button clockwise to open the load switch;

e). Push open the ground switch operating hole latching panel to the right, open the ground switch operating hole, insert the handle into the ground switch operating hole, rotate the handle counterclockwise to close the ground switch, and pull out the operating handling after operation;

f). Lift up the lock catch of the interlocking device to lock the operation of the ground switch, and open the cable compartment door;

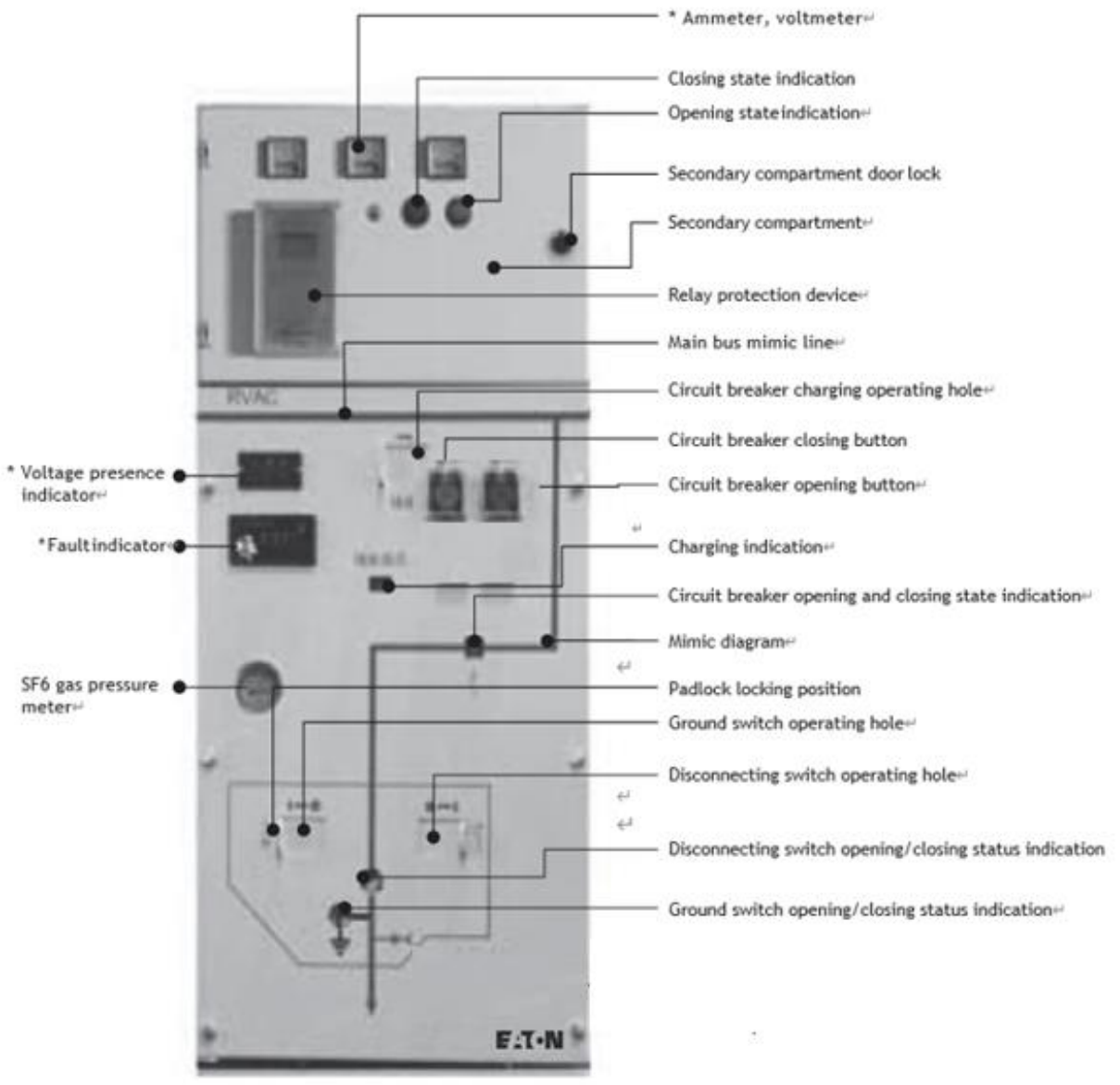
g). Only after opening the cable compartment door, the fuse compartment can be operated. For operational details, see Chapter 3 Section 6 Fuse Installation

⚠WARNING

THE FUSE STATUS INDICATION SHALL BE CONFIRMED FIRST DURING OPERATION. IF THE FUSE IS IN DISCONNECTED STATE, REPLACE THE FUSE AS SOON AS POSSIBLE. IT IS FORBIDDEN TO CONDUCT CLOSING OPERATION ON THE LOAD SWITCH.

3. Circuit breaker cabinet

3.1. Operating interface description



Note: * is optional and can be equipped as per the customer's request.

3.2. Interlock description

Circuit breaker	Disconnecting switch	Ground switch	Cable compartment door
Closing	Locked	Locked	Locked
Opening	Not locked	Locked	Locked
Not locked	**Opening**	Not locked	Locked
Not locked	Locked	**Closing**	Not locked
Not locked	Not locked	**Closed**	Locked
Not locked	Locked	Locked	**Open**
Not locked	Locked	Not locked	**Close**

3.3. Operating instruction

a). Close the cable compartment door, and unlock the operation of the ground switch;

b). Push open the ground switch operating hole latching panel to the right, open the ground switch operating hole, insert the handle into the ground switch operating hole, rotate the handle clockwise to open the ground switch, and pull out the operating handling after operation;

c). Push open the disconnecting switch operating hole latching panel to the left, open the disconnecting switch operating hole, insert the handle into the disconnecting switch operating hole, rotate the handle clockwise to close the switch, and pull out the operating handling after operation;

d). Push open the circuit breaker charging operation hole latching panel to the left, open the circuit breaker charging operation hole, insert the handle into the circuit breaker charging operation hole, rotate the handle clockwise to charge the circuit breaker;

e). Open the circuit breaker closing operation button cover, press down the closing operation button to close the circuit breaker, and put back the operation button cover after operation;

f). Open the circuit breaker opening operation button cover, press down the opening operation button to open the circuit breaker, and put back the operation button cover after operation;

g). Push open the disconnecting switch operating hole latching panel to the left, open the disconnecting switch operating hole, insert the handle into the disconnecting switch operating hole, rotate the handle counter-clockwise to open the switch, and pull out the operating handling after operation;

h). Push open the ground switch operating hole latching panel to the right, open the ground switch operating hole, insert the handle into the ground switch operating hole, rotate the handle counterclockwise to close the ground switch, and pull out the operating handling after operation;

i). Lift up the lock catch of the interlocking device to lock the operation of the ground switch, and open the cable compartment door;

⚠ WARNING

IT IS FORBIDDEN TO CONDUCT OPENING AND CLOSING OPERATIONS ON THE DISCONNECTING SWITCH WHEN LOADED! MAKE SURE TO CONFIRM THE STATUS OF THE CIRCUIT BREAKER FIRST PRIOR TO ANY OPERATION DURING RUNNING. ONLY WHEN THE CIRCUIT BREAKER IS IN OPENING STATE, THE DISCONNECTING SWITCH CAN BE OPERATED ON.

⚠ WARNING

IT IS STRICTLY PROHIBITED TO CLOSE THE GROUND SWITCH AND OPEN THE CABLE COMPARTMENT DOOR WHEN THE CABLE HEAD IS ENERGIZED.

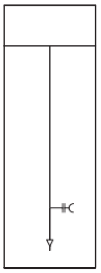
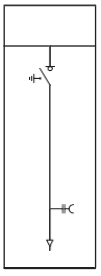
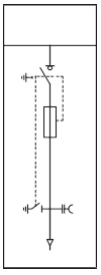
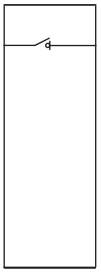
⚠ WARNING

FOR THE OPERATION OF ANY CABINET TYPE, MAKE SURE TO CONFIRM THE CURRENT STATUS INDICATION OF THE SWITCH PRIOR TO AND AFTER THE OPERATION, TO AVOID UNNECESSARY MAL-OPERATION.

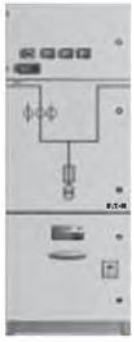
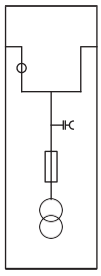
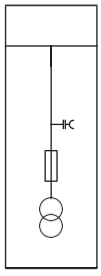
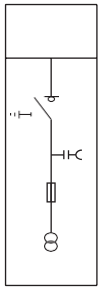
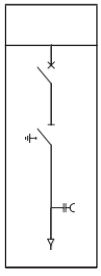
⚠ WARNING

THE RUM OFFERS MECHANICAL INTERLOCKING FUNCTION, FOR SATISFACTION OF THE REQUIREMENTS OF THE INTERLOCKING CONDITIONS, WITH MECHANICAL FORCED LATCHING. NO OPERATION SHALL BE FORCED WHEN IT IS DIFFICULT TO CONDUCT. OTHERWISE, THIS CAN EASILY CAUSE EQUIPMENT DAMAGE AND EVEN ACCIDENTS.

4. RVAC cabinet types

RVAC series	Primary scheme	Type No.	Name	Function	Others
		RVAC-B(A)	Cable incoming cabinet	The incoming/outgoing cable is connected directly to the bus, with a metal stainless steel protection case. The voltage display is offered, for the connection of incoming/outgoing cable.	1. The HV part is inside the SF6 gas. 2. Expandable to the left and right or bushings can be added 3. Termination head (for end cabinet) 4. Equipped with voltage presence display 5. Cabinet A is air insulated, while Cabinet B is SF6 gas insulated
		RVAC-K	Cable outgoing cabinet	Equipped with a three-position load switch, to connect or break the connection of incoming/outgoing cable with the bus, enabling simultaneous grounding of the three phases of the incoming/outgoing cable, offering short circuit making capacity, for the control of the incoming/outgoing cable	1. Expandable on both sides 2. Cable incoming/outgoing is available on the side 3. Manual/electric operating mechanism 4. Equipped with voltage presence display and fault indicator 5. Ground switch interlocking device
		RVAC-T	Combination unit cabinet	Equipped with the same load switch as the incoming/outgoing cabinet, and connected in series with the fuse of high breaking capacity to constitute a combination unit, to control, open and close, and isolate the transformer and its distribution circuit, and protect against short circuit current and overload current at the high voltage side of the transformer, the transformer and the low voltage distribution circuit.	1. For transformer protection (fuse protection) to the use of 1250 kVA transformer 2. Transfer current 1500A 3. Expandable on both sides 4. Both ends of the fuse are grounded during side incoming maintenance 5. Manual/electric operating mechanism 6. Equipped with voltage presence display and ground interlocking device 7. Optional relay protection and trip unit, for improving the performance of the fuse when breaking at small currents. 8. Optional thermal switch start tripping device to provide the transformer with
		RVAC-L	Bus coupling cabinet	Equipped with a two-position load switch, with load connecting or breaking main bus option for bus coupling.	1. Main bus is not grounded 2. Rising cabinet is not needed 3. Incoming cabinet can be interlocked with 4. Key locks can be supplied

4. RVAC cabinet types (Continued)

RVAC series	Primary scheme	Type No.	Name	Function	Others
		RVAC-M	Metering cabinet	Equipped with normal current transformer and voltage transformer, for the convenience of inspection by power sectors, easy to be used with any other cabinet, for the metering of electrical power	1. Air insulation 2. Bus connection 3. Equipped with electromagnetic lock, to prevent from entrance into live sections by mistake 4. Optional ammeter, voltmeter, watt hour meter, PT fuse and lightening arrestor 5. As per the requirements of power companies 6. Several different schemes
		RVAC-PT-I	Voltage transforming cabinet-I	Type I is equipped with a voltage transformer and connected directly to the bus, to monitor the system voltage and provide operating power supply (the cabinet is gas insulated).	1. Unexpandable on the left and right, nor adding bushings 2. Termination head (for end cabinet) 3. Equipped with voltage presence display and voltage transformer
		RVAC-PT-II	Voltage transforming cabinet-II	Type II is equipped with a three-position load switch, with optional load connecting or breaking voltage transformer and grounding, to monitor the system voltage and provide operating power supply	
		RVAC-V	Circuit breaker cabinet	Equipped with a vacuum circuit breaker, connected in series with a three-position disconnecting switch, the circuit breaker placed at the bus side, the disconnecting switch at the incoming/outgoing cable side, with optional regular relay protection device.	1. Vacuum circuit breaker 2. Three-position disconnecting switch / ground switch 3. Rated short circuit breaking current 20kA 4. Operating life: circuit breaker: 10,000 operations, disconnecting switch: 5,000 operations, ground switch: 2,000 operations 5. Voltage presence indication 6. Short circuit and ground fault indicator 7. Current transformer 8. Relay protection device 9. Optional forced latching device at the incoming side

Chapter 5 Operation, maintenance and repair

⚠ WARNING

THE OPERATION, MAINTENANCE AND REPAIR OF THE PRODUCT SHALL BE CONDUCTED ONLY BY PROPERLY TRAINED PROFESSIONAL STAFF.

1. Notice for operations

1.1. Inspection prior to operation

The RMU can be put into operation right after the completion of installation and commissioning. Check the mechanisms completely before running to see whether each functional circuit switch is in open position, whether the voltage presence display is normal, whether the indications are indicating correctly, whether the interlocking mechanism is operating properly, whether the pressure meter indication is at the rated pressure, whether the fuse is installed in the combination unit circuit. Properly lubricate the drive parts, and tighten the loose nuts and screws.

1.2. SF6 gas control and supervision

Pure SF6 gas is colorless, tasteless, non-toxic, and not easy to be noticed. However, SF6 gas will deposit in the lower part of the area, because SF6 gas has bigger density than the air. When the density of SF6 in the air exceeds a certain amount, SF6 can make people suffocate. Therefore, before the staff goes into the installation site, especially into low-lying places such as the basement and the cable trench, the place must be ventilated, and the oxygen concentration in the air shall be detected. Only when the oxygen concentration is greater than 18%, the work shall be started. From the perspective of environmental protection and safety, the concentration of SF6 in the air should not exceed 1000 PPM.

The SF6 gas should maintain a certain density within the enclosure. A certain amount of gas shall be released when the density of use exceeds the upper limit. A certain amount of gas shall be filled when the density of use is lower than the lower limit. The RMU uses a pressure meter to check the SF6 gas inside the enclosure, while the SF6 gases of same density offer different pressures at different temperatures, the curve as shown in **Figure 19**.

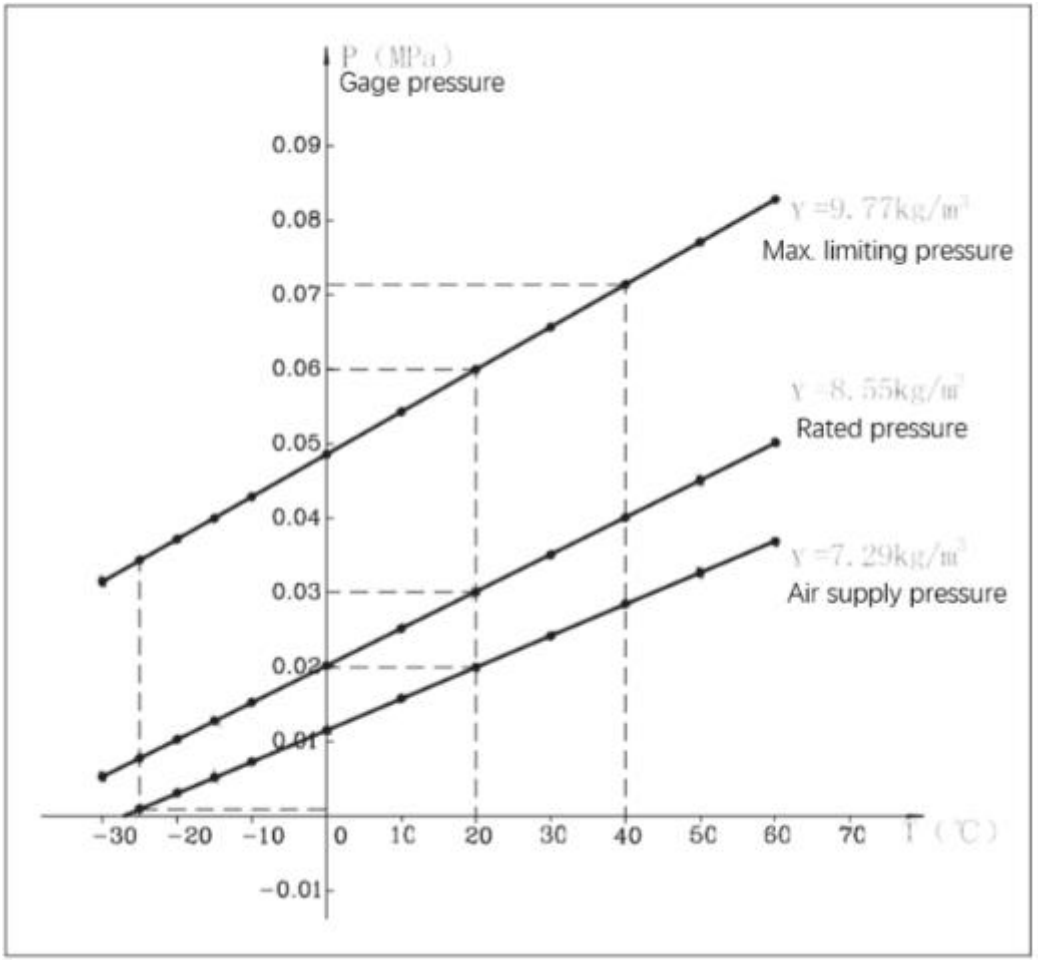


Figure 19 Pressure curve according to gas density and temperature change

2. Maintenance and repair

The RMU shall be maintained and repaired as specified in relevant regulations. Generally, there are four different inspections, including patrol inspection, general inspection, regular inspection and temporary maintenance.

2.1. Patrol inspection

This mainly refers to appearance inspection on the equipment during operation. Make a visual check for any abnormal conditions, on a daily or weekly basis, or according to the enterprise standard of the using unit.

Item	Inspection content	Remark
External conditions of the equipment	1. The indication status of the breaking-closing indicator; 2. Whether there is abnormal sound or odor; 3. Whether the HV presence display is normal 4. Whether the external surface of the cable is damaged 5. The indication status of SF6 pressure meter	
Spring operating mechanism	1. Whether the breaking-closing indication is correct	

2.2. General inspection

This refers to the general inspection and maintenance from the outside when the RMU is stopped for running.

Item	Inspection content	Period	Remark
Mechanical operation test	1. Opening and closing indication status 2. Opening/closing time measurement to check for any exceptions 3. To confirm whether the indication meter is working properly 4. To check whether the secondary circuit wiring is loose 5. Lubrication and cleaning	Once every 3 years.	Conduct manual opening-closing operation once every year, if the switch is not operated frequently
Fuse	To measure the changes of internal resistance of the fuse	Once every 3 years	The change of the inner resistance variations shall be within ±10%
External connections	To check the fastening status of the sealing parts	Once every 3 years	Mechanical inspection
Testing	To measure circuit resistance and see whether there are any abnormal changes.	Once every 3 years	Electrical inspection

2.3. Regular inspection

This refers to detailed inspection and maintenance from the outside when the RMU is stopped for running.

Item	Inspection content	Period	Remark
Mechanical operation test	1. Opening and closing indication status 2. To check whether the mechanisms and the pins and shafts of each part are normal 3. To replace or repair the corrosive, deformed and damaged parts in the operating mechanism 4. To confirm whether the indication meter is working properly 5. To check whether the secondary circuit wiring is loose 6. Lubrication and cleaning	Once every 12 years	
Fuse	To measure the changes of the internal resistance of the fuse	Once every 12 years	The change of the inner resistance variations shall be within±10%
External connections	To check the fastening status of the sealing parts	Once every 12 years	Mechanical inspection
Testing	To measure the circuit resistance and see whether there are any abnormal changes; Opening/closing operation characteristics test	Once every 12 years	Electrical inspection

2.4. Temporary maintenance

This refers to temporary maintenance on the parts necessary for maintenance in the following cases:

When exceptional situation occurs;

When the high voltage switchgear has reached the specified number of operations or the electrical life reaches relevant rules shown in below table.

No.	High voltage switch component name	Operating conditions	Specified number of operations
1	Load switch	No-load operation	5,000 operations
		Breaking rated active load current	2,00 operations
		Breaking rated cable charging current	10 operations
		Closing short circuit fault	5 operations
2	Ground switch	No-load operation	2,000 operations
		Closing short circuit fault	2 operations

⚠WARNING

WHEN ANY INDICATOR ON THE NUMBER OF OPERATIONS OF THE ELECTRICAL LIFE SPECIFIED IN THE ABOVE TABLE HAS BEEN REACHED, THE DEVICE SHALL BE WITHDREW AND QUIT OPERATION.

2.5. Testing after repair

Usually, inspections shall be conducted after the repair of the RMU, including main circuit resistance measurement, seal tightness test, and main circuit power frequency withstand voltage test.

Chapter 6 Supplied documents and accessories

The following documents and accessories are supplied when the product is delivered from factory:

- Product certificate (one copy)
- Product packing list (one copy)
- Product factory test report (one copy)
- Secondary schematic diagram and wiring diagram (one set)
- Installation operation instruction (one copy)

Chapter 7 Ordering information

The users shall submit the following technical information upon ordering:

- Secondary wiring plan, arrangement diagram, and floor layout plan of the main circuit;
- Secondary line schematic diagram;
- Types, specifications and quantities of all designated electrical components;
- Electric equipment summary table;
- Please make it clear when the switchgear is to be used under special environment conditions
- Please specify category and quantity when other or a large number of accessories and spare parts are needed.

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Eaton Corporation
Asia Pacific Headquarter No.3,
Lane 280, Linhong Road,
Changning District,
Shanghai 200335
Tel: 86-21-52000099
Fax: 86-21-52000200

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