

PRODUCT MANUAL

SafeRing/SafePlus 36/40.5

SF₆ insulated ring main unit and compact switchgear



- Safe and easy for operators
- Fully sealed for lifetime
- Virtually maintenance-free



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1 General description

SafeRing is a SF₆ insulated ring main unit and SafePlus is a compact switchgear for applications in medium voltage distribution networks. SafeRing can be supplied as 2-, 3- or 4-way standard configurations with additional equipment according to customer specification.

The standard configurations are DeF, CCF, CCCF, CCFF, CCC, CCCC, DeV, CCV, CCCV and CCVV.

SafePlus is more flexible. For SafePlus it is possible with combinations of C, F, V, D and De modules to fully modular and semi-modular configurations.

Available modules are :

- C - Cable switch (switch disconnecter)
- F - Switch fuse combination
- V - Vacuum circuit breaker
- D - Direct cable connection
- De - Direct cable connection with earthing
- M - Metering module (air-insulated)

The maximum number of modules within one SF₆ tank is 4.

SafeRing and SafePlus offers a sealed stainless steel tank which contains all the live components

and switching functions. The transformer is protected by a switch-fuse combination or by a vacuum circuit-breaker with relay.

The units/modules are delivered from the factory ready for installation.

Routine tests are carried out on all units/modules before dispatch.

No special tools are required for the installation of units/modules.

SafeRing/SafePlus with switch fuse combination in compliance with IEC 62271-105

With this unit the transformer will be protected by current-limiting HV fuses in combination with a load break switch. The load break switch is equipped with a stored energy spring mechanism which can be tripped by the fuse striker pin.

SafeRing/SafePlus with vacuum circuit-breaker in compliance with IEC 62271-100

With this unit the transformers will be protected by a vacuum circuit-breaker combined with relay and current transformers. The standard protection relay is based on digital technology and does not require an external power supply.

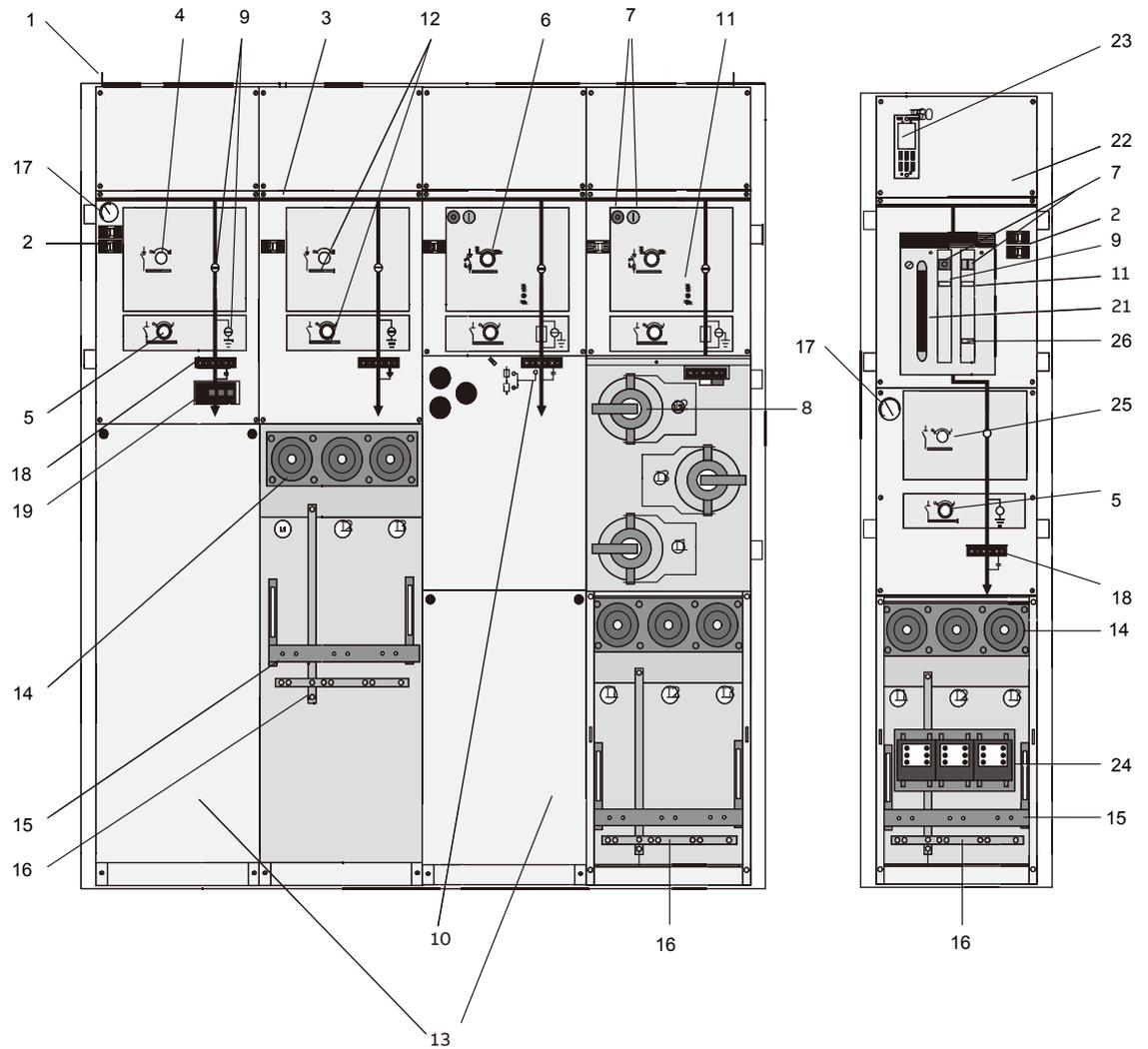


SafeRing CCF



SafePlus CFV

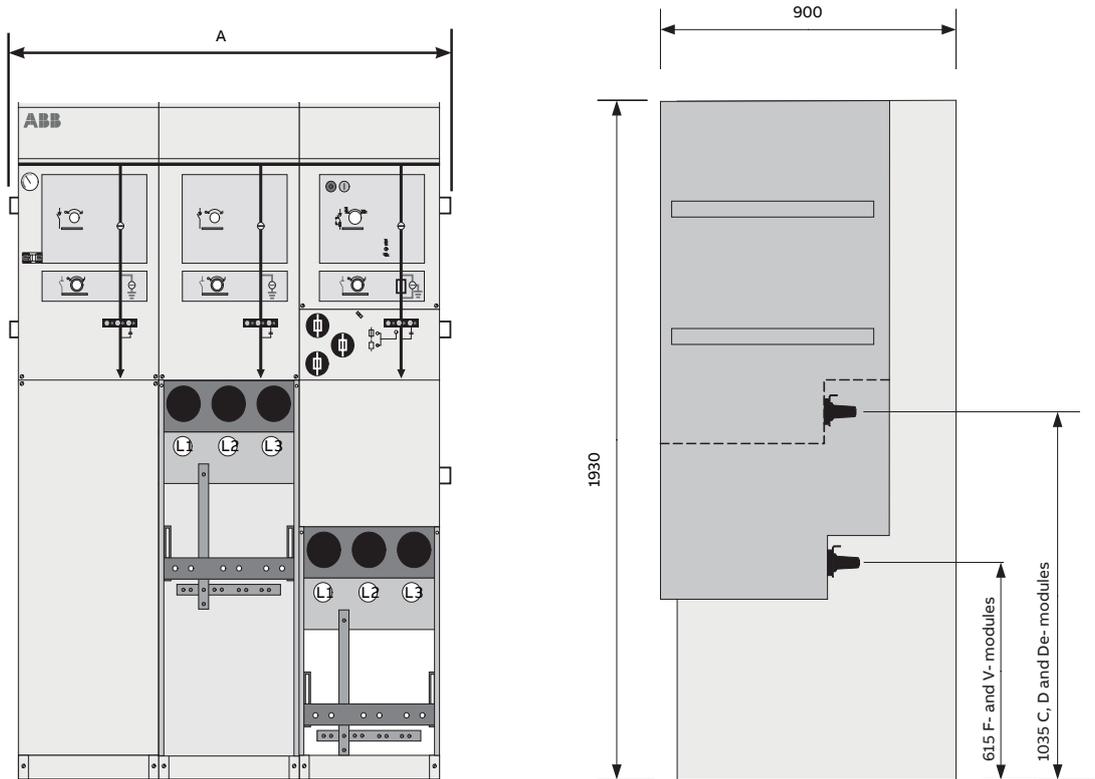
1.1 Description of functions



1. Lifting lugs (hinged)
2. Nameplate with serial number
3. Mimic diagram
4. Load break switch
5. Earthing switch
6. Switch-fuse disconnecter
7. Push buttons close/open
8. Fuse canister
9. Position indicator
10. Blown fuse indicator
11. Charged spring indicator
12. Padlock device
13. Cable compartment cover

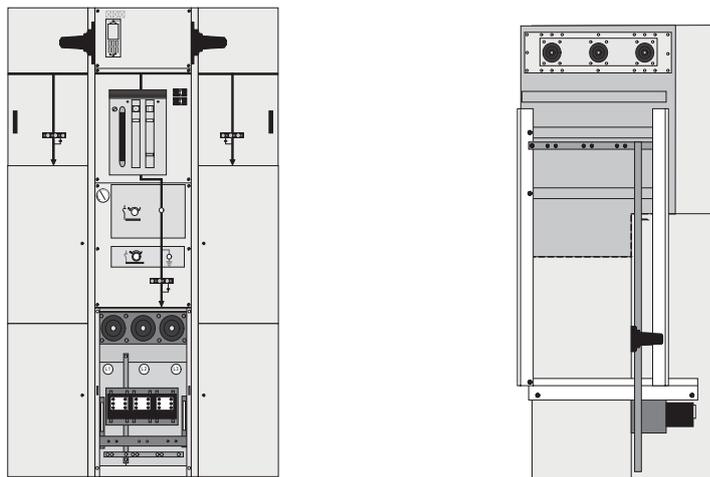
14. Cable bushing
15. Cable support bar
16. Earth bar
17. Pressure indicator
18. Capacitive voltage indication
19. Short circuit indicator (additional equipment)
20. Ronis key interlock (additional equipment)
21. Operating mechanism for vacuum circuit-breaker
22. Low voltage compartment
23. Protection relay
24. Current transformers
25. Disconnecter
26. Counter

1.2 Dimensional drawings

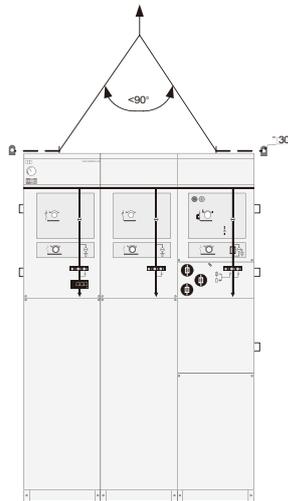


Unit	1-way	2-way	3-way	4-way
A (mm)	490	910	1330	1750

1.3 Side connections



2 Transport and handling



The units are delivered from the factory ready for installation.

Weight table for standard SafeRing:

2-way DeF/DeV	550 kg
3-way CCF/CCV	800 kg
4-way CCCF/CCCW	1050 kg
4-way CCFF/CCVV	1100 kg
3-way CCC	750 kg
4-way CCCC	1000 kg

SafePlus

Standard 1-way	300 kg
Standard 2-way	600 kg
3 and 4-way as for SafeRing	
M module	600 kg

The weights are including additional equipment.

SafeRing/SafePlus is fitted with lifting lugs, but can also be moved on pallets with a forklift truck.

The units are top heavy so please handle with care!

2.1 By receiving inspection

Upon receiving the SafeRing/SafePlus please check that the delivered equipment has not been damaged during transport. If any such damage has occurred, a claim must be submitted to the carrier immediately.

After unpacking, the following must be checked:

1. Operating handle – 1 piece should be included, normally fixed on right hand side.
2. Check that the pointer on the pressure indicator is in the green area.
3. Carry out a function test on the mechanical parts.

Any faults or omissions must be reported immediately to the supplier.

2.2 Storage

SafeRing/SafePlus must be stored under cover in a dry and well ventilated area until it is installed and put into operation.

3 Technical data

3.1 Electrical data

SafeRing/SafePlus 36		C-module		F-module		V-module	
		Switch disconnecter	Earthing switch	Switch-fuse disconnecter	Downstream earthing switch	Vacuum circuit- breaker	Earthing switch/ disconnecter
Rated voltage	kV	36/40.5	36/40.5	36/40.5	36/40.5	36/40.5	36/40.5
Power frequency withstand voltage	kV	70/95	70/95	70/95	70/95	70/95	70/95
- across disconnecter	kV	80/110		80/110			80/110
Lightning impulse withstand voltage	kV	170/185	170/185	170/185	170/185	170/185	170/185
- across disconnecter	kV	195/215		195/215			195/215
Rated normal current	A	630/630		See ²⁾		630/630	
Breaking capacities:							
- active load	A	630/630					
- closed loop	A	630/630					
- off load cable charging	A	20/21				50 (Class C1)	
- earth fault	A	60/63					
- earth fault cable charging	A	35/36					
- transfer current	A						
- short-circuit breaking current	kA			See ²⁾		20/20 (Class E1, S1)	
Making capacity	kA	50/50 (5 times)	50/50 (5 times)	See ²⁾ -/-	2.5/2.5 (5 times)	50/50	50/50
Class (Electrical endurance)		E3/E2	E3/E2		E2/E2	E2/E2	E2/E2
Short time current 3 sec.	kA	20/20	20/20	See ²⁾		20/20	20/20
Short time current 1 sec.	kA	25/25	25/25			25/25	25/25
Internal arc classification IAC AFL, 1 s	kA	20/20		20/20		20/20	

1) Depending on the current rating of the fuse-link.

2) Limited by high voltage fuse-links.

3.2 Fuse table - CEF

SafeRing 36		Rated voltage:		36 kV
SafePlus 36		Operating voltage:		30 kV
F-panel		$I_{transfer}$ at 36 kV		840 A
100% load		T_o:		40 ms
Transformer rating (kVA)	u_k (%)	Tranformer rated current (A)	ABB catalogue no.	Fuse link rated current (A)
100	4	1.9	1YMB744014M5611	6.3
125	4	2.4	1YMB744016M5611	10
160	4	3.1	1YMB744016M5611	10
200	4	3.8	1YMB744018M5611	16
250	4	4.8	1YMB744018M5611	16
315	4	6.1	1YMB744018M5611	16
400	4	7.7	1YMB744018M5611	16
500	4	9.6	1YMB744021M5611	25
630	4	12.1	1YMB744021M5611	25
800	5	15.4	1YMB744021M5611	25
1000	6	19.2	1YMB744025M5611	40
1250	6	24.1	1YMB744025M5611	40

- The table is based on using ABB CEF high-voltage current-limiting back-up fuse links
- Normal operating conditions with no overload of transformer
- Ambient air temperature -25°C to +40°C

SafeRing 36		Rated voltage:		36 kV
SafePlus 36		Operating voltage:		30 kV
F-panel		$I_{transfer}$ at 36 kV		840 A
120% load		T_o:		40 ms
Transformer rating (kVA)	u_k (%)	Tranformer rated current (A)	ABB Catalogue no.	Fuse link rated current (A)
100	4	1.9	1YMB744014M5611	6.3
125	4	2.4	1YMB744016M5611	10
160	4	3.1	1YMB744016M5611	10
200	4	3.8	1YMB744018M5611	16
250	4	4.8	1YMB744018M5611	16
315	4	6.1	1YMB744018M5611	16
400	4	7.7	1YMB744018M5611	16
500	4	9.6	1YMB744021M5611	25
630	4	12.1	1YMB744021M5611	25
800	5	15.4	1YMB744025M5611	40
1000	6	19.2	1YMB744025M5611	40
1250	6	24.1	1YMB744025M5611	40

- The table is based on using ABB CEF high-voltage current-limiting back-up fuse links
- Normal operating conditions with 20% overload of transformer
- Ambient air temperature -25°C to +40°C

4 Installation

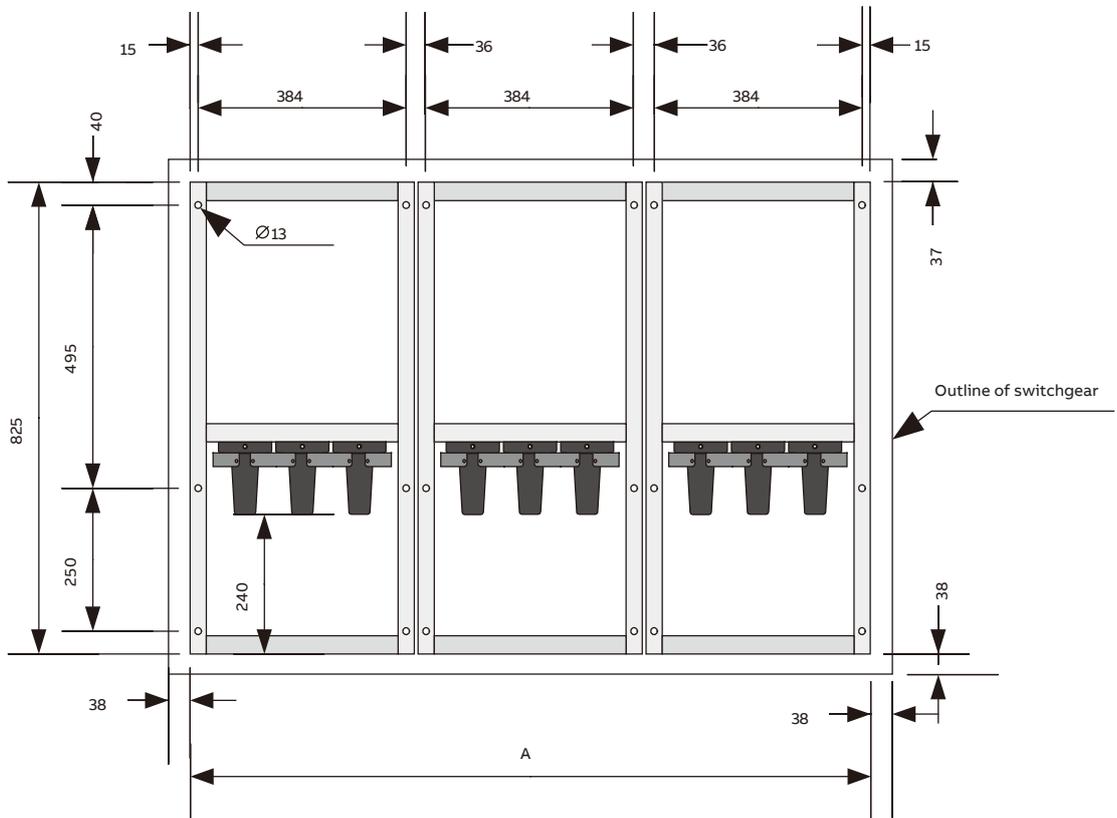
The floor must be well leveled and the unit must be fixed by means of anchor bolts in accordance with the dimensional drawing for the number of modules or units as appropriate.

The unit should have a minimum distance of 100 mm to the wall behind the unit and 20 mm to the wall on any side of the unit.

When installing ring main unit or compact switchgear with Internal arc classification AFL,

the following must be considered:

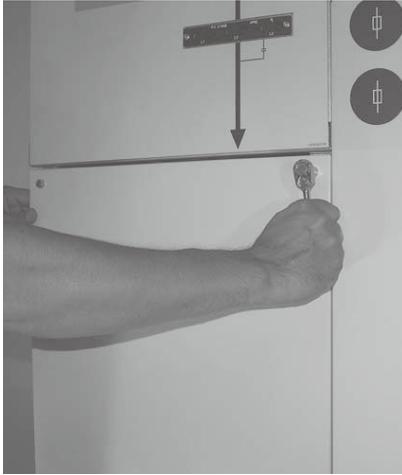
- Unit must be equipped with arc proof cable covers
- Distance from floor to roof must be minimum 2600 mm
- Distance from back of unit to wall must be 100 mm
- Distance from side wall of unit to wall must be minimum 20 mm
- If unit is freestanding (i. e. distance from back of unit to wall exceeds 100 mm), the area behind the unit must be restricted and not accessible
- Minimum dimensions of cable trench are 230x355 mm



Unit	1-way	2-way	3-way	4-way
A (mm)	414	834	1254	1674

4.1 Cable compartment

Removal of cable cover



1. Loosen the two screws on the cable cover.



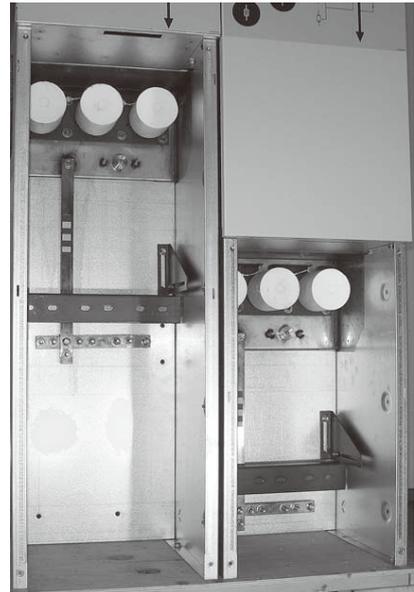
2. Pull out and lift the cover off.

Note!

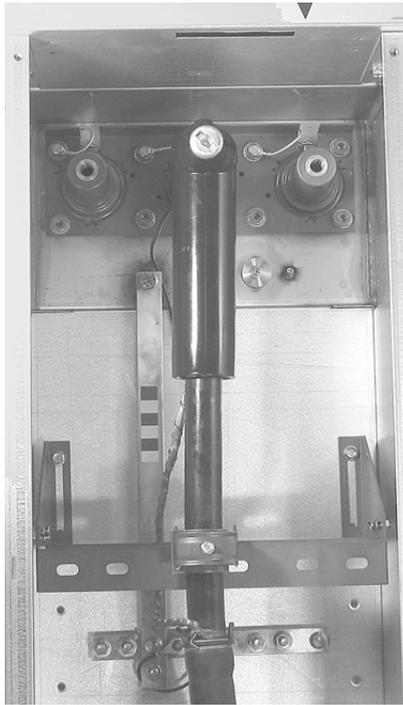
The cable cover can be supplied with interlocking to earthing switches (additional equipment). When interlocking is fitted, the cable compartment can only be accessed when the earthing switch is in the closed position.



3. Removal of front section.



4. Front sections removed.



Prefabricated cable termination
Cable compartment for C, D and De-modules

4.2 Cable connection

SafeRing/SafePlus is equipped with cable bushings outside cone type which comply with CENELEC EN 50181 interface B (400 series plug-in) or interface C (400 series bolted).

All bushings are protected by the cable cover.

Cable terminations

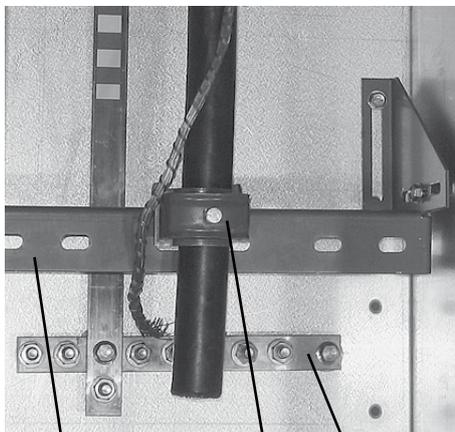
The following types are recommended:

- ABB
- Euromold/Elastimold
- Raychem/Tyco Electronics
- F&G/nkt-cables
- Prysmian
- Südkabel

Please see supplier documentation for details. The manufacturer's installation instructions must be followed. Be sure to lubricate the bushings thoroughly with the silicone supplied.

Note!

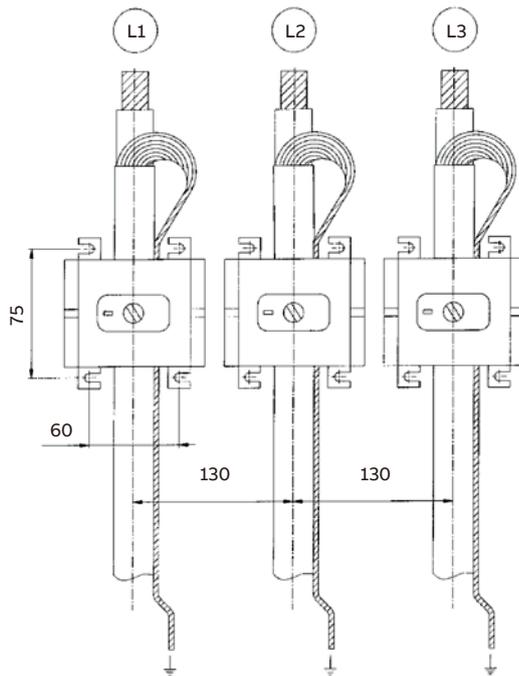
Where cables are not connected, the earthing switch must be locked in closed position or the bushings must be fitted with dead end receptacles before the unit is put into operation.



Adjustable cable support bar
Earthing bar
Cable clamp (additional equipment)



Cable compartment V-module with mounting plate for current transformers and fixed cable support bar



Installing current transformers. The cable shielding is led back through the centre hole and earthed.



V-module with protection relay type REF610 in integrated LV-compartment with hinged door

4.3 Relay and current transformers

A protection relay is installed in each vacuum circuit-breaker module. The cables from the protection relay to the current transformers are installed from the factory, and end up in the cable compartment, ready for connection to the three current transformers supplied.

Before installation:

- Check that the three current transformers have been delivered and that they are all of the same type
- Check that the current transformers are of the correct type, with the correctly rated transformer ratio, for the distribution transformer's rated current and for the adjustment range on the protection relay (see protection relay manual)

Each current transformer must be mounted onto its high voltage cable before the cable termination is fitted.

The earth shield on the cable must be led back through the centre hole in the current transformer (see figure on left) and earthed on the earthing bar in the cable compartment.

A mounting plate for the current transformers is fitted in the cable compartment.

After the current transformers have been installed in the unit, the cables from the protection relay are connected. Consult the manual supplied with the protection relay for a description of the connections.

SafeRing/SafePlus with vacuum circuit-breakers are prepared for self-powered OCEF protection relay ABB type REJ 603.

Relays with auxiliary voltage:

SafePlus can be delivered with advanced protection relays.

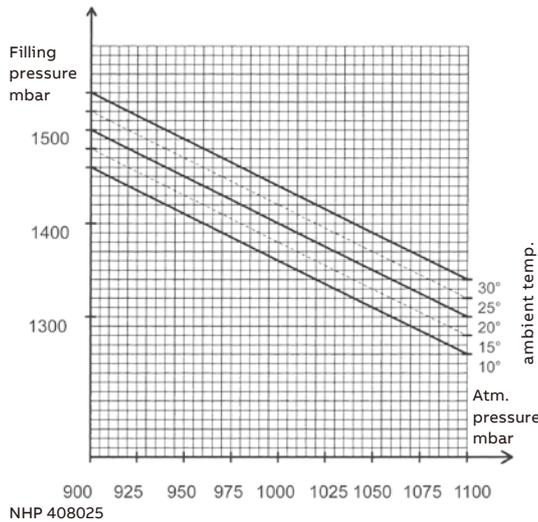
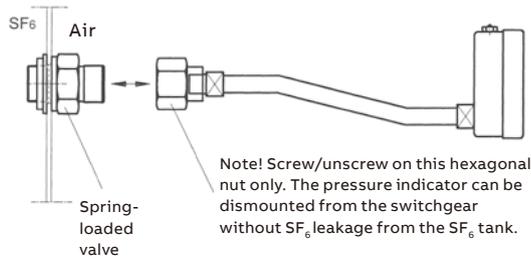
REF610 (integrated LV-compartment with hinged door)

REF615 (integrated LV-compartment with hinged door)

REF541 (high LV-compartment with hinged door)

REF542+ (high LV-compartment with hinged door)

Separate manuals with examples of settings have been prepared for each of these protection relays.



Topping up of SF₆ gas in SafeRing/SafePlus

Potential risk!
 Operators must be trained and qualified for SF₆ gas handling.
 Following equipment is needed: SF₆ gas bottle with manometer and reduction valve, bottle for recovery of SF₆/air mixture, adapter and pressure measuring device.

1. Remove the front cover and unscrew the pressure indicator by unscrewing the hexagonal nut as shown above.
2. Screw the adapter to the valve. The tightening torque is max 45 Nm.
3. Before connecting the hose from the gas bottle to the adapter, the air in the hose must be removed by running SF₆ gas through the hose. The SF₆ gas must be recovered.
4. When gas is flowing into the RMU/switchgear, the manometer on the gas bottle has to be observed. When it shows 0,4 bar at ambient temperature 20° Celsius, (1,4 bar absolute) the gas filling must be stopped. See table for filling pressure above.

5. Remove the filling hose and connect the pressure device to check the pressure inside the RMU/switchgear.
6. When the correct pressure of 0,4 bar (1,4 bar absolute) is obtained, remove the adapter, check that the sealing between the pressure indicator and the valve is smooth and clean, and screw the pressure indicator to the RMU/switchgear with tightening torque max 45 Nm as shown above.

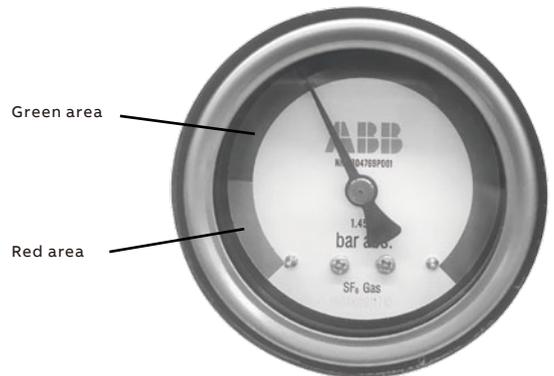
4.4 Gas pressure

SafeRing/SafePlus contain SF₆ gas with a nominal pressure of 1,4 bar at 20°C.

SafeRing/SafePlus are «sealed for life» and is fitted with a temperature-compensated pressure indicator.

Pointer in green area - unit has correct pressure.

Pointer in red area - pressure is too low.



A temperature-compensated device that emits an electrical signal to indicate low gas pressure can be supplied on request.

5 Operation

5.1 Operating conditions

Normal ambient conditions

SafeRing/SafePlus is generally equipped for operation/service in normal indoor conditions in accordance with IEC 62271-1.

The following limitations apply:

Ambient temperature	
Max. temperature	+40°C
Max. temperature (24-hour average)	+35°C
Min. temperature	-25°C

Humidity

Max. average relative humidity measured over 24 hours	95%
Max. average relative humidity measured over 1 month	90%

Max height above sea level for installation without reducing gas pressure
1500 metres

Special conditions

In accordance with IEC 62271-1, the manufacturer and enduser must agree about special operating conditions which deviate from operation under normal conditions.

The manufacturer/supplier must be consulted in advance if especially difficult operating conditions are involved. When SafeRing/SafePlus is installed more than 1500 metres above sea level, the atmospheric pressure will be lower and the overpressure inside the tank will have to be reduced.

Airfreight

Units/modules transported by airfreight are delivered with reduced overpressure. For topping up, please see procedure for topping up of SF₆ gas.

5.2 Operation

Before any operation of mechanisms, make sure that front covers are mounted.

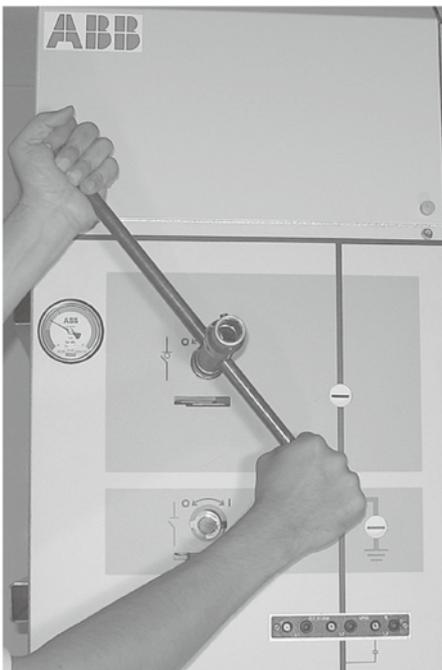
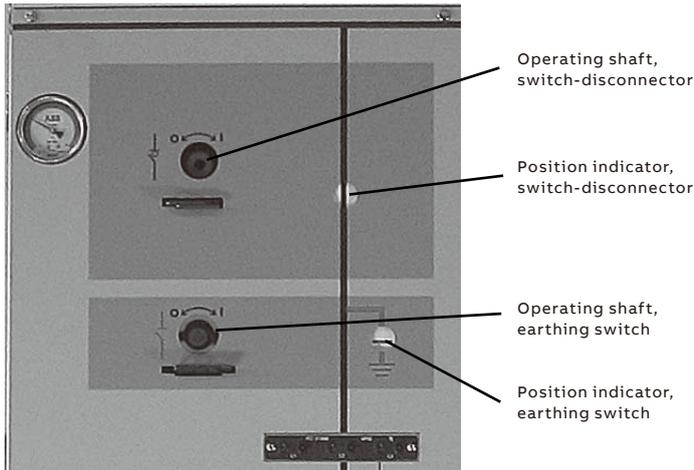
All switch-disconnector and earthing switches can be operated with the included operating handle.

All mechanisms are designed and manufactured in such a way that all three phases are operated simultaneously. The speed of operation is independent of the operator action. An anti-reflexsystem, standard on all operating handles, prevents an immediate operation of switches.

The vacuum circuit-breaker has an integrated lever for the charging of the springs and push buttons for operation.

Internal mechanical interlocking between the switch disconnector/isolator and the associated earthing switches prevents incorrect operation. The operation of the switch disconnector and earthing switches can be further interlocked by means of a padlock.

5.2.1 Switch disconnector



Switch disconnector:

Close: Turn the operating handle clockwise.
 Open: Turn the operating handle anti-clockwise.

5.2.2 Earthing switch



Earthing switch:

Before entering handle, press interlocking bracket towards left. If the earthing switch is open, enter the handle with its pin on the left side. If the earthing switch is closed, enter the handle with its pin on the right side.

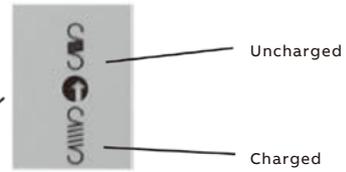
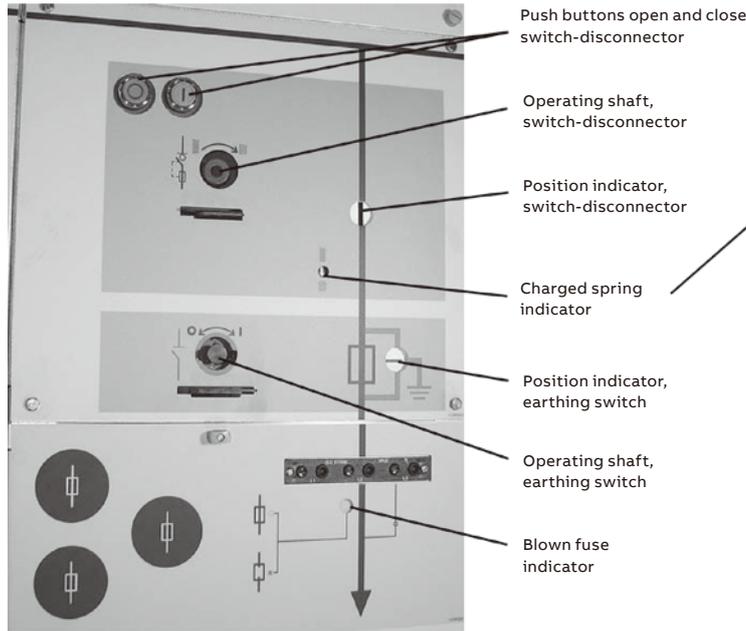


Earthing switch:

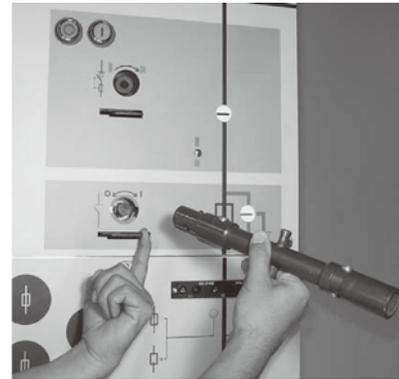
Close: Turn the operating handle clockwise.
 Open: Turn the operating handle anti-clockwise.

It may happen that the spring for the earthing switch is discharged during the opening operation, but the earthing switch does not open. If this happens, just continue the anti-clockwise operation of the handle, until the earthing switch is fully open. (Check the position indicator of the earthing switch.)

5.2.3 Switch-fuse combination



5.2.5 Earthing switch



Switch-disconnector:

Close: Turn the operating handle clockwise. Then both closing and opening springs are charged. Charged spring indicator shall now show charged springs (arrow pointing downwards). Push green (I) button.

Open: Push red (O) button. Charged spring indicator shall now show uncharged springs (arrow pointing upwards).

Earthing switch:

Before entering handle, press interlocking bracket towards left. If the earthing switch is open, enter the handle with its pin on the left side. If the earthing switch is closed, enter the handle with its pin on the right side.

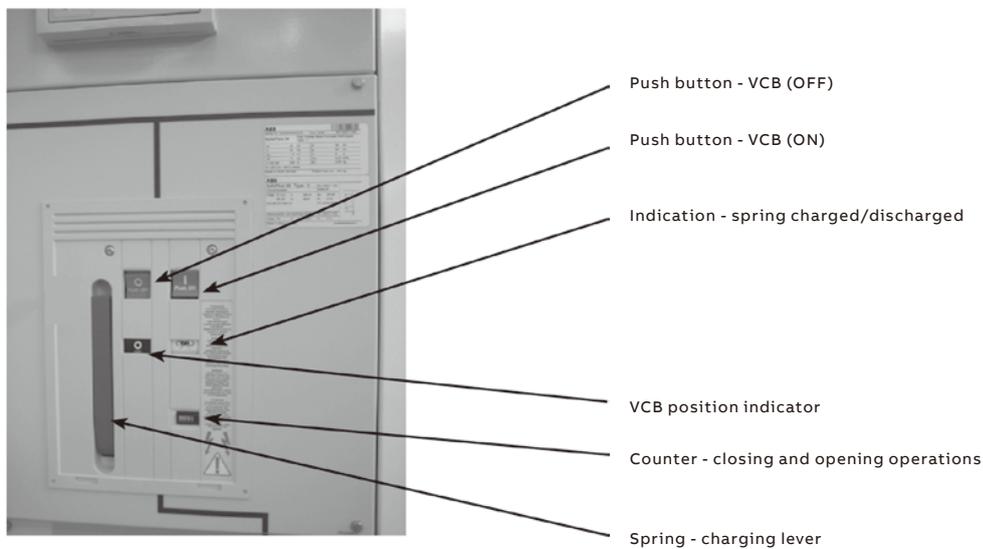


Earthing switch:

Close: Turn the operating handle clockwise.
Open: Turn the operating handle anti-clockwise.

It will normally happen that the spring for the earthing switch is discharged during the opening operation, but the earthing switch does not open. If this happens, just continue the anticlockwise operation of the handle, until the earthing switch is fully open. (Check the position indicator of the earthing switch.)

5.2.6 Vacuum circuit-breaker - VCB



Before operating of the VCB, check that the spring is charged. If the spring is not charged, it can be charged by means of the charging lever. The spring is fully charged when the indicator turns to charged spring (yellow symbol, about 10 operations needed to fully charge the spring).

Note: If the VCB is equipped with motor operation (optional) it is not necessary to charge the spring by hand. The motor starts charging the spring automatically as soon as the auxiliary voltage is switched on.



Close: Push green (ON) button
Open: Push red (OFF) button

Note: The downstream disconnecter is mechanically interlocked with the VCB.

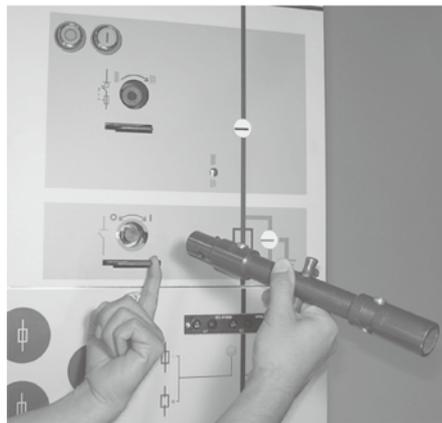
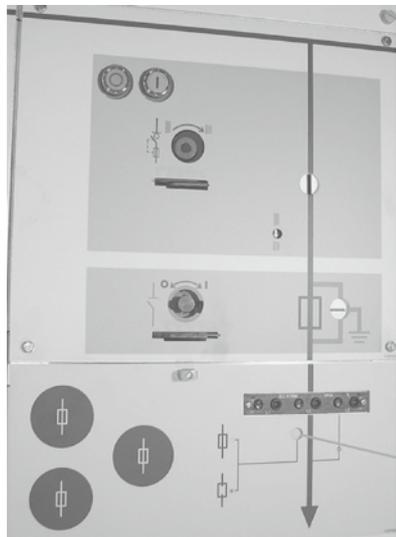
Operation of the downstream disconnecter and earthing switch, see pos. 5.2.1 and 5.2.2.

5.3 Installation and replacement of fuse links

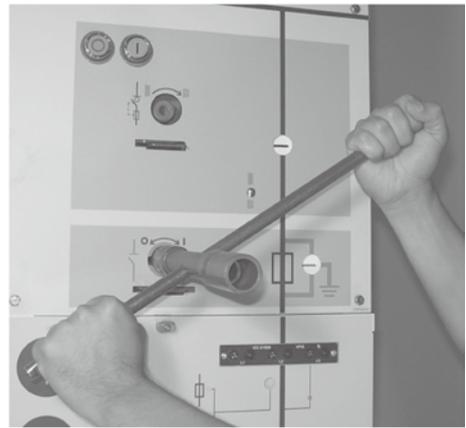
The F-module is equipped with a blown fuse indicator. If this indicator changes colour from white to red, this means that at least 1 fuse-link has blown. This will also automatically trip all three phases of the switch-fuse disconnecter. It also makes operation of the switch-disconnector impossible before the blown fuse-link(s) has been replaced.

Acc. to IEC 60282-1 it is advisable to replace all 3 fuse-links even if only 1 or 2 has blown.

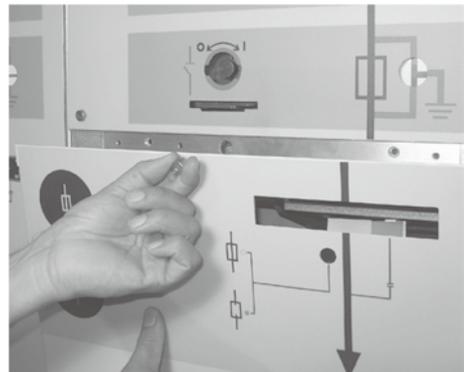
Fuse-links are replaced as shown in the sequence of illustrations. Switch-fuse combinations are supplied without fuse-links installed. When installing fuse-links, follow the sequence of illustrations 1-9.



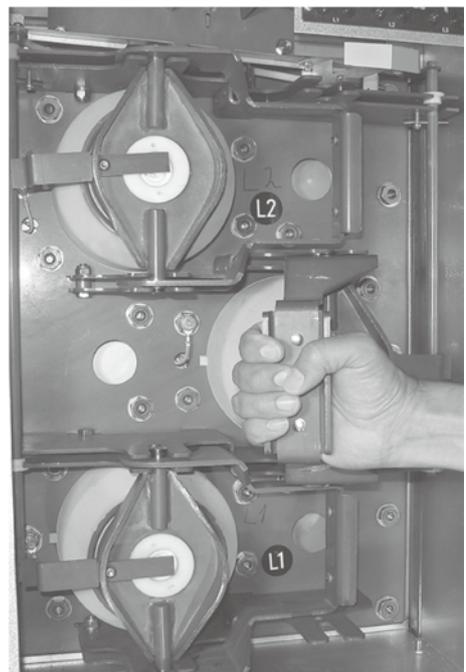
1. Before entering handle on to earthing switch, press interlocking bracket towards left.



2. Close earthing switch by turning operating handle clockwise.



3. Turn knob anticlockwise and tilt out front cover to gain access to fuse canisters.



4. Pull handle and open the fuse canister.



5. If a fuse-link is already installed but has to be replaced, pull it out.



6. Fix the new fuse-link to the fuse cover by means of the contact screw.

Note!

The striker must point towards the fuse cover.



7. Insert the fuse-link into fuse canister.

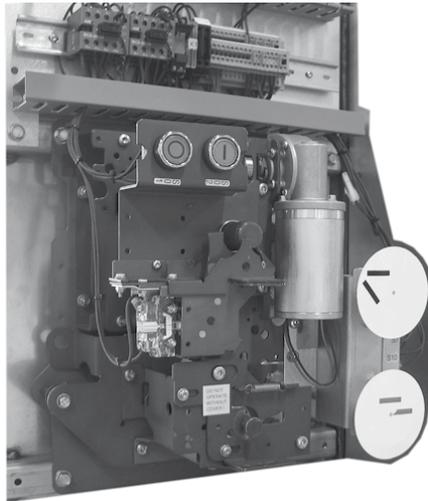


8. Press the handle and close the fuse canister.



9. Fix the front cover. The switch-fuse combination is ready for operation.

6 Additional equipment



VPIS



HR-module



VIM-1

VIM-3



Ammeter



Selector switch



6.1 Motor operation and auxiliary switches

Circuit-breakers, switch-fuse disconnectors and load break switches can be equipped with motor operation. Available control voltages are 24, 48, 60, 110, 230 VDC and 110, 230 VAC. F- and V-modules can also be equipped with closing and opening coils. Motor operated F- and V-modules will always have closing and opening coils.

Auxiliary switches (2NO+2NC) can be supplied to indicate switch positions on all switches. Blown fuse-link can also be indicated by means of an auxiliary switch (1NO).

Motor operation, coils and auxiliary switches can easily be retrofitted.

When ordered, switchgear can also be supplied with an auxiliary switch (1NO) for monitoring of SF₆ pressure.

Access to the low-voltage connections is gained by removing the top front panel.

6.2 Capacitive voltage indication

All modules can be equipped with capacitive voltage indication type HR-module (VDS) or VPIS (Voltage Present Indicating System) acc. to IEC 61958.

This system has integrated LEDs.

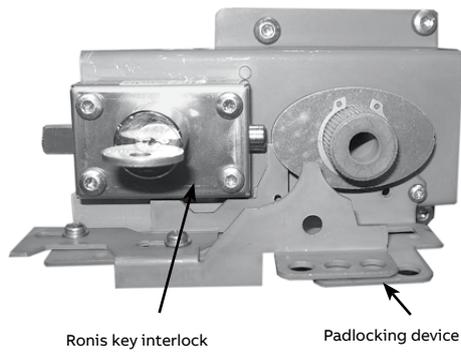
By means of the sockets in VPIS and HR it is possible to carry out phase balance check using suitable phase comparators.

6.3 Current measurement

Ammeter (72x72 mm) and selector switch can be installed in each module. Current transformers have to be installed inside the cable compartment.

6.4 Side extension

When ordered, switchgear can be manufactured with side extension on both sides. This makes the switchgear more flexible and it can then be prepared for future extension.



Ronis key interlock

Padlocking device



6.5 Ronis key interlock

To prevent unintended operations, all switches (except switchdisconnectors on switch-fuse combination) have the possibility to be equipped with Ronis key interlock type EL11AP.

6.6 Padlocking device

All switches except circuit-breakers are equipped with padlocking device as standard. For circuit-breakers, padlocking device can be ordered as option.

6.7 Short circuit indication

C, V, D and De-modules can be supplied with different types of short circuit and earth fault indicators.

7 Maintenance

All components in the SF₆ tank are maintenance-free for the declared life expectancy of the product. The tank is made of stainless steel.

If the panels get any scratches or damage, these must be repaired with paint to prevent corrosion.

Mechanical parts are positioned outside the tank and behind the front panel. This enables easy access and replacement if required.

Mechanical parts are surface-treated to prevent corrosion. Moving parts are lubricated at the factory for the product's life expectancy. In extreme conditions (dust, sand and pollution), inspection and maintenance will be imperative, and in some cases replacements will be necessary.



Check that the lubricants are not washed or wiped away from the mechanical moving parts.

7.1 Control and monitoring the gas

SafeRing/SafePlus is a pressure-sealed system that normally does not require special inspections. However the gas pressure on the pressure indicator should always be checked prior to operation.

7.2 Environmental certification

1. Life expectancy of product

The product is developed in compliance with the requirements denoted by IEC 62271-200. The design incorporates a life span under indoor service conditions exceeding 30 years.

The switchgear is gas-tight with an expected diffusion rate of less than 0.1 % per annum. Referring to the reference-pressure of 1.4 bar, the switchgear will maintain gas-tightness and a gas-pressure better than 1.3 bar at 20°C throughout its designed life span.

2. Recycling capability

Raw material	Weight (kg)	% of total weight	Recycle	Environmental effects & recycle/reuse processes
Iron	139.9	31.1	Yes	Separate, utilise in favour of new source (ore)
Stainless steel	130.8	29.1	Yes	Separate, utilise in favour of new source (ore)
Copper	71.9	16.0	Yes	Separate, utilise in favour of new source (ore)
Brass	3.0	0.7	Yes	Separate, utilise in favour of new source (ore)
Aluminium	1.0	0.2	Yes	Separate, utilise in favour of new source (ore)
Zinc	5.1	1.2	Yes	Separate, utilise in favour of new source (ore)
Silver	0.075	0.014	Yes	Electrolysis, utilise in favour of new source
PBT	2.3	0.5	Yes	Make granulate, re-use or apply as energy
PA6-6	5.3	1.2	Yes	
PC	0.8	0.2	Yes	
Other thermoplastic	0.1	0	Yes	
Packing foil	0.3	0.1	Yes	High-grade energy additive in refuse incineration
SF ₆ gas	5.4	1.2	Yes	Reclaim
Dielectric oil Wooden pallet	0.3	0.1	Yes	Collect/reclaim/regenerate
	27.8	6.2	Yes	Re-use
Total recycleables	394.075	89.0		
Rubber	1.9	0.4	No	Incinerate energy in rubber
Epoxy compounds	46.5	10.3	No	Contains 60% quartz sand, incinerate energy in epoxy
Unspecified	1.5	0.3	No	Stickers, film foils, powder coating, lubricates
Total non-recycleables	49.8	10.8		
Total weight **	443.875	100%		

***) All figures are collected from CCF 3-way unit with fuse canisters.

3. Lifecycle concept for transport, installation, repair, service and disposal at end of life

ABB is committed to the protection of the environment and adhere to ISO 14001 standards. The unit contains no substances listed on the hazardous substances list. The unit contains SF₆ with 0,4 bar overpressure in a maintenance free and sealed unit. The unit is a sealed pressure system and restrictions for air transport exist. Units damaged during transport are returned to the manufacturer for inspection and possible repair.

SF₆ is a fluorinated greenhouse gas covered by the Kyoto Protocol and care must be taken not to cause emission of SF₆ and at end-of-life the greenhouse gas must be recovered.

It is ABB's obligation to facilitate end-of-life recycling for our products. In the EU and EEA, the F-Gas Regulation must be followed. ABB's recycling service is according to IEC 61634 edition 1995 section 6: «End of life of SF₆ filled equipment» and in particular 6.5.2.a: «Low decomposition»: «No special action is required; non-recoverable parts can be disposed of normally according to local regulations.» We also advise customer always to consult ABB's website: <http://www.abb.com/sf6> .

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ABB Connect helps you to find product information and stay connected to the latest news and tools. It's a digital assistant that enables customers to connect to the broadest range of electrification solutions in one place.

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- Saving documents locally, updating automatically
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Scanning QR code
to enter ABB Connect

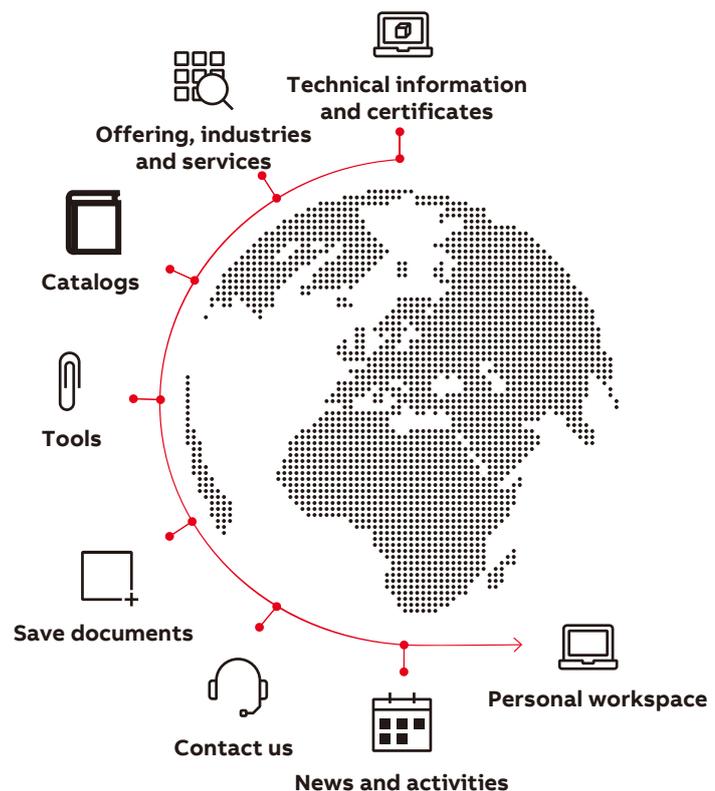


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