DISTRIBUTION SOLUTIONS

VD4

Installation and service instructions
12, 17.5 kV - 1250...4000 A - 63 kA

Index

I. For your safety!

- **Make sure that the installation room (spaces, divisions and ambient) is suitable for the electrical apparatus.**
- **Check that all the installation, putting into service and maintenance operations are carried out by qualified personnel with suitable knowledge of the apparatus.**
- **Make sure that the standard and legal prescriptions are complied with during installation, putting into service and maintenance, so that installations according to the rules of good working practice and safety in the work place are constructed.**
- **Strictly follow the information given in this instruction manual.**
- **Check that the rated performance of the apparatus is not exceeded during service.**
- **Check that the personnel operating the apparatus have this instruction manual to hand as well as the necessary information for correct intervention.**
- **Pay special attention to the danger notes indicated in the manual by the following symbol:**

Responsible behaviour safeguards your own and others' safety!
For any requests, please contact the ABB Assistance Service.

II. Introduction

This publication contains the information needed to install medium voltage VD4 circuit breakers and put them into service.
For correct use of the product, please read it carefully.
Like all the apparatus we manufacture, the VD4 circuit breakers are designed for different installation configurations.
However, this apparatus allows further technical-construction modifications (at the customer's request) to adapt to special installation requirements.
Consequently, the information given below may sometimes not contain instructions concerning special configurations.

Apart from this manual, it is therefore always necessary to consult the latest technical documentation (electric circuit and wiring diagrams, assembly and installation drawings, any protection coordination studies, etc.), especially regarding any variants requested in relation to the standardised configurations.
Only use original spare parts for maintenance operations.
For further information, please also see the technical catalogue of the circuit breaker and the spare parts catalogue.

All the installation, putting into service, running and maintenance operations must be carried out by skilled personnel with in-depth knowledge of the apparatus.

III. Environmental protection programme

The VD4 circuit breakers are manufactured in accordance with the ISO 14000 Standards (Guidelines for environmental management).
The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials. All this is thanks to the medium voltage apparatus manufacturing facility environmental management system.

1. Packing, transport and storage

1.1 Condition on delivery

The factory-assembled switching devices are checked at the works for completeness of the equipment installed and simultaneously subjected to a routine test in accordance with VDE 0670, part 1000, or IEC publication 62271-1, thus verifying their correct structure and function.

1.2 Packaging

The switching devices are mounted individually on a wooden pallet and sealed in film and/or packed in cardboard for delivery.

Packaging for overseas shipment:

- Drying agent bags inserted in the film-sealed packaging
- Drying agent bags in accordance with DIN 55 473.

1.3 Transport

Loading of the package units must only be carried out with a

- crane,
- fork-lift truck and/or
- trolley jack.

Note:

- Avoid impact during handling.
- Do not subject to other damaging mechanical stresses.
- Lifting gear must not be attached to the breaker poles or parts of the operating mechanism. Use the lifting lugs 1.3 for hoists (Figure 8).

1.4 Delivery

The duties of the consignee on receipt of the switching devices at site include the following:

- Checking the delivery for completeness and freedom from damage (e.g. moisture and its adverse effects).
- Any short quantities, defects or damage in transit:
  - Must be precisely documented on the consignment note.
  - The shipper/carrier is to be notified immediately in accordance with the liability provisions of the German general conditions for forwarders (ADSp/KVO).

Note:
Always take photographs to document any major damage.

1.5 Intermediate storage

Intermediate storage of the switching device in the switch position OFF and the stored-energy spring mechanisms discharged

Indicator DISCHARGED: 

Conditions for optimum intermediate storage:

1. Devices with basic packaging or unpacked:

- A dry and well ventilated storeroom with climate in accordance with VDE 0670, part 1000 / IEC 60694 / IEC62271-1.
- Room temperature which does not fall below -5 °C.
- Do not remove or damage the packaging.
- Unpackaged devices:
  - Are to be loosely covered with protective sheeting.
  - Sufficient air circulation must be maintained.
- Check regularly for any condensation.

2. Devices with seaworthy or similar packaging with internal protective sheeting:

- Store the transport units:
  - protected from the weather,
  - dry,
  - safe from damage.
- Check the packaging for damage.
- If the maximum storage period starting from the date of packaging has been exceeded:
  - The protective function of the packaging is no longer guaranteed.
  - Suitable action must be taken if inter-mediate storage is to continue.

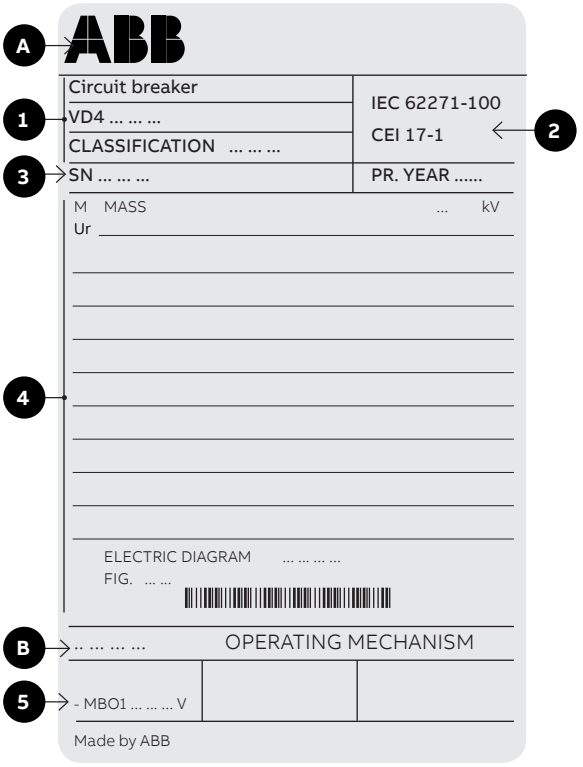
2. Checking on receipt

Before carrying out any operation, always make sure that the operating mechanism spring is discharged and that the apparatus is in the open position.

On receipt, check the state of the apparatus, integrity of the packing and correspondence with the nameplate data (see fig. 1) with what is specified in the order confirmation and in the accompanying shipping note.
Also make sure that all the materials described in the shipping note are included in the supply.
Should any damage or irregularity be noted in the supply on unpacking, notify ABB (directly or through the agent or supplier) as soon as possible and in any case within five days of receipt.
The apparatus is only supplied with the accessories specified at the time of ordering and validated in the order confirmation sent by ABB.

The accompanying documents inserted in the shipping packing are:
- instruction manual (this document)
- test certification
- identification label
- copy of the shipping documents
- electric wiring diagram.

Other documents which are sent prior to shipment of the apparatus are:
- order confirmation
- original shipping advice note
- any drawings or documents referring to special configurations/conditions.



Caption
A Circuit breaker rating plate
B Operating mechanism rating plate
1 Type of apparatus
2 Symbols of compliance with Standards
3 Serial number
4 Circuit breaker characteristics
5 Characteristics of the operating mechanism auxiliaries

Fig. 1

3. Handling

Before carrying out any operations, always make sure that the operating mechanism spring is discharged and that the apparatus is in the open position.
To lift and handle the circuit breaker, proceed as follows (fig. 2):

- use a special lifting tool (1) (not supplied) fitted with ropes with safety hooks (2);
- insert the hooks (2) in the supports (3) fixed to the frame of the circuit breaker and lift. Put the hooks (2) into the support holes (3) according to the type of apparatus (see table);
- on completion of the operation (and in any case before putting into service) unhook the lifting tool (1) and dismantle the supports (3) from the frame.

During handling, take great care not to stress the insulating parts and the terminals of the circuit breaker.

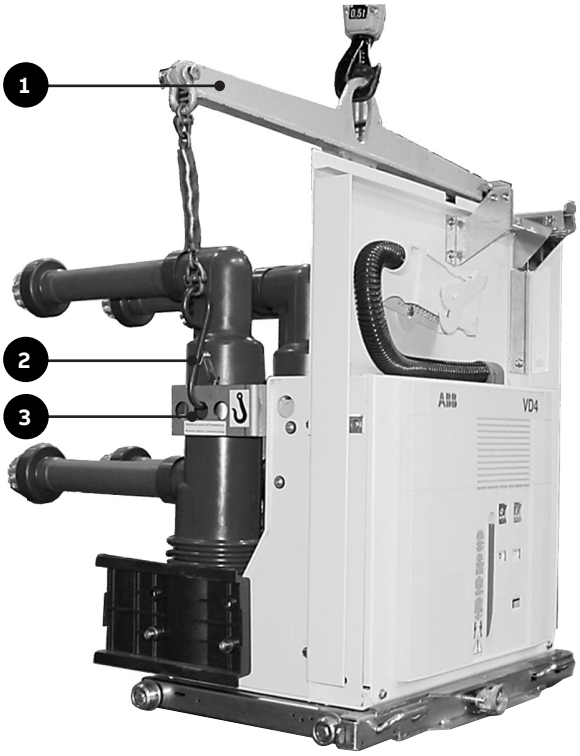


Fig. 2

The apparatus must not be handled by putting lifting devices directly under the apparatus itself.
Should it be necessary to use this technique, put the circuit breaker onto a pallet or a sturdy supporting surface (see fig. 3).
In any case, it is always advisable to carry out lifting using the supports (3).

Version	Pole centre distance	Rated current	Hole
Fixed	275 mm	from 1250 to 4000 A	B
Withdrawable	275 mm	from 1250 to 4000 A	C

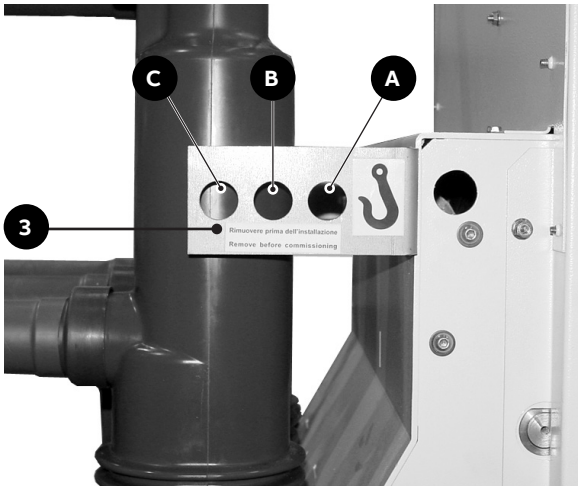


Fig. 2a Lifting support

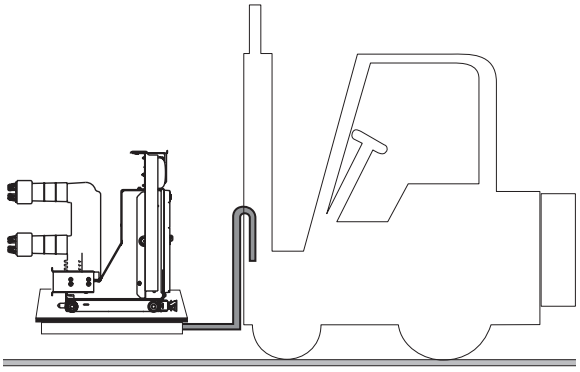


Fig. 3

4. Description

4.1 General

The VD4 are vacuum circuit breaker for indoor installation.
For the electrical performances, please refer to the corresponding technical catalogue code 1VCP000001.
For special installation requirements, please contact ABB.
The following versions are available:
- fixed
- withdrawable for UniGear ZS1 switchgear

4.2 Reference Standards

The VD4 circuit breakers conform to the IEC 62271-100, CEI - VDE - BS Standards are equivalent to IEC Standards due to harmonization with IEC.

4.3 CLASSIC operating mechanism

VD4 circuit breakers are equipped with modular CLASSIC spring operating mechanisms. The operating mechanism is designed to cover the specific range of 63 kA

4.4 Structure and function

4.4.1 Structure of the breaker poles (Figures 4/2, 4/3 and 4/4)

The basic structure of a vacuum circuit breaker and a vacuum interrupter is explained in figures 4/2 and 4/3.
The poles, which are constructed in column form, are mounted on the bracket-shaped rear part of mechanism enclosure 1. The live parts of the breaker poles are located in the insulating material pole tubes 12 and protected from impacts and other external influences.
With the breaker closed, the current path leads from the upper breaker terminal 13 and a chamber holder fixed in the pole tube to the fixed contact 15.2 in the vacuum interrupter 15, then via the moving contact 15.3 and the roller contact 16.2, to the lower breaker terminal 14. The switching motion is effected by means of the insulated coupling rod 18 with internal contact force springs 17.

4.4.2 Structure of the breaker operating mechanism (Figures 4/1, 4/4 and 4/5)

The operating mechanism is of the stored-energy spring type and acts on the three breaker poles. The necessary operating energy is stored ready for activation by charging the spring energy store.
The stored-energy spring mechanism essentially consists of drum 33 containing the spiral spring, the charging system, the latching and operating mechanism and the linkages which transmit the force to the breaker poles. In addition, there are supplementary components such as the charging motor, releases, auxiliary switches and the controls and instruments located on the front of the mechanism enclosure 1.
The basic structure of a stored-energy spring mechanism is explained in figure 4/4.
The operating mechanism is fundamentally suitable for auto-reclosing and, due to the short charging times, also for multi-shot auto-reclosing.
In the basic version of the circuit breaker, the spring energy store is charged manually. The operating mechanism can optionally be fitted with a charging motor.
There is one rating plate with the main data of the switch equipment on front plate 1.1, and another at the lower front right in mechanism enclosure 1.
The basic version of the stored-energy spring mechanism is fitted with the following auxiliary equipment:
- Shunt release OFF -MBO1
- Five-pole auxiliary switch -BGB2 for annunciation purposes 38
- Auxiliary switch -BGB4 for fault annunciation
- Mechanical ON push-button 2
- Mechanical OFF push-button 3
- Mechanical position indicator 4
- Charging condition indicator 8 for the spring energy store
- Mechanical operating cycle counter 5

The following additional equipment can be installed:
- Blocking magnet -RLE1 with auxiliary switch -BGL1
- Shunt release ON -MBC
- Second shunt release OFF -MBO2
- Indirect overcurrent release -MBO3
- Undervoltage release -MBU
- Five-pole auxiliary switches -BGB1 and -BGB3
- Charging motor -MAS 36
- Five-pole auxiliary switch -BGS1 to switch the charging motor.

4.4.3 Releases, blocking magnet and auxiliary switches (Figures 4/1, 4/5, 9/1, 9/2, 9/3)

- The releases and the blocking magnet are mounted at the top left on the spring operating mechanism.

- The allocation of the auxiliary switches can be seen in the wiring diagram.
- The five-pole auxiliary switch -BGS1 is operated by the charging condition indicator 8. It controls the charging motor -MAS, serves as an electrical interlock for shunt release ON -MBC when the spring mechanism is not sufficiently charged, and also provides an electrical switching readiness signal.
- Operation of the five-pole auxiliary switches -BGB1, -BGB2 and -BGB3 is dependent on the switching position of the circuit breaker.

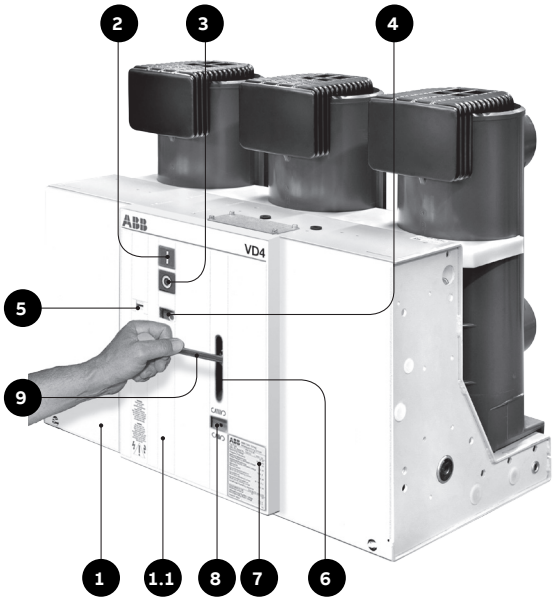


Figure 4/1: Circuit breaker front with controls and annunciations
1 Mechanism enclosure
1.1 Front plate
2 ON push-button
3 OFF push-button
4 Position indicator
5 Operating cycle counter
6 Recess for charging lever 9
7 Rating plate
8 Charging condition indicator
9 Charging lever

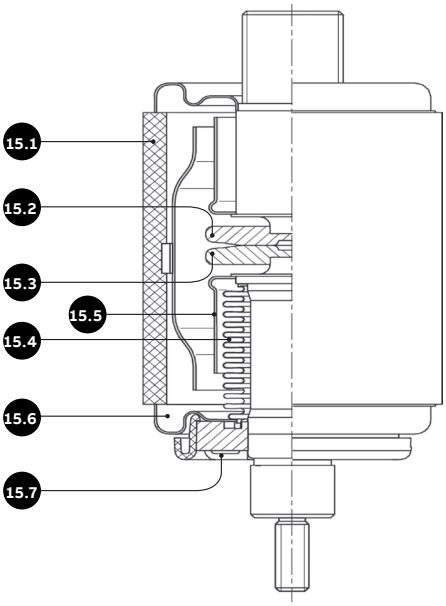


Figure 4/3: Partial section of a vacuum interrupter, simplified schematic diagram (Details vary according to the specified switching duties)
15.1 Insulator
15.2 Fixed contact
15.3 Movable contact
15.4 Metal bellows
15.5 Screen
15.6 Guide
15.7 Interrupter lid

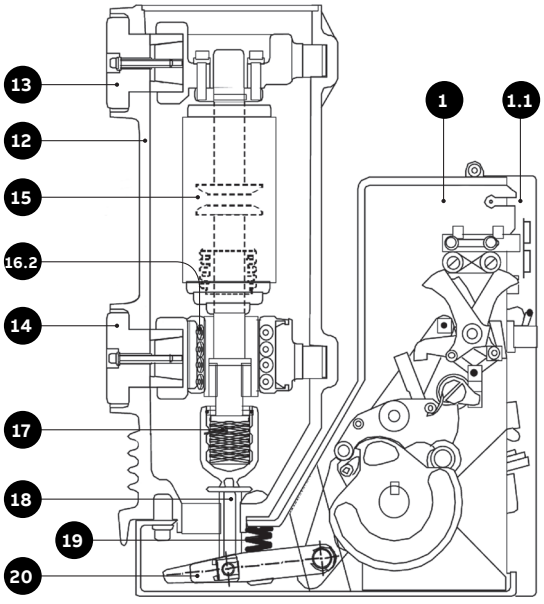


Figure 4/2: Sectional view of a vacuum circuit breaker, type VD4, schematic diagram
1 Mechanism enclosure
1.1 Front plate, removable
12 Insulating material pole tube
13 Upper breaker terminal
14 Lower breaker terminal
15 Vacuum interrupter
16.2 Roller contact
17 Contact force spring
18 Insulated coupling rod
19 Opening spring
20 Shift lever pair

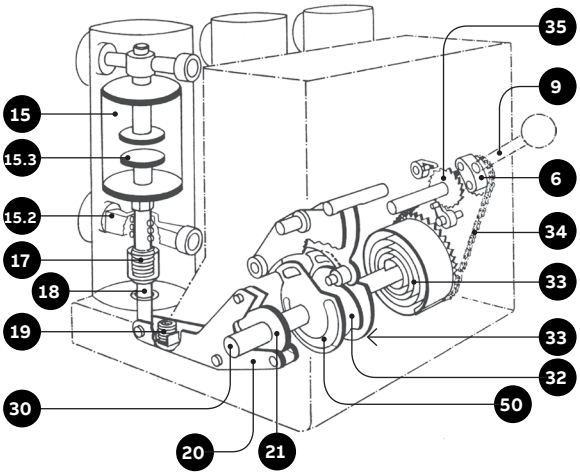


Figure 4/4: Basic structure of the stored-energy spring mechanism
6 Recess
9 Charging lever
15 Vacuum interrupter
15.3 Movable contact
16.2 Roller contact
17 Contact force spring
18 Insulated coupling rod
19 Opening spring
20 Shift lever pair
21 Cam disk
30 Drive shaft
31 Release mechanism
32 Stop disk
33 Drum with spiral spring
34 Chain drive
35 Ratchet wheel
50 Left-hand control cam

4. Description

- Auxiliary switch -BGB1 interrupts the circuit of the optional additional shunt release OFF -MBO2 with the circuit breaker in the open position, and the circuits of shunt release ON -MBC and the optional blocking magnet -RLE1 with the circuit breaker in the closed position. There is one further NOC for other purposes.
- On failure or absence of the control voltage, blocking magnet -RLE1 mechanically locks the ON half shaft and simultaneously acts on the corresponding auxiliary switch -BGL1 to interrupt the circuit of shunt release ON -MBC.
- Blocking magnet -RLE1 is accessible when front plate 1.1 is removed.
- Auxiliary switch -BGB2 interrupts the circuit of shunt release OFF -MBO2 with the circuit breaker in the open position. One further NOC and three NCCs are available for annunciation, control and interlock purposes.
- Auxiliary switch -BGB3 can be optionally designed with any possible combination of contacts from five NOCs to five NCCs. Its contacts are available for any required control, annunciation or interlock functions. The auxiliary switch is normally configured as shown in electrical diagrams.
- The single pole auxiliary switch -BGB4 (fleeting contact time ≥ 30 ms) serves to provide a fault signal (“breaker released”).

With remote control, the auxiliary switch is necessarily operated by:

- Shunt release OFF -MBO1 or
- Shunt release OFF -MBO2 or
- Undervoltage release -MBU or
- Indirect overcurrent release -MBO3.

Note:

1. Shunt releases OFF (-MBO1) and ON (-MBC) are exclusively provided for opening and closing in normal operation. For safety breaking operations, the second shunt release OFF (-MBO2) must be used, in most cases with a separate control voltage supply.
   These three releases are of the solenoid type and suitable for a large number of operating cycles.
2. The undervoltage release (-MBU) and/or indirect overcurrent release (-MBO3) are pure safety and protection releases and must not be used for switching in normal operation.

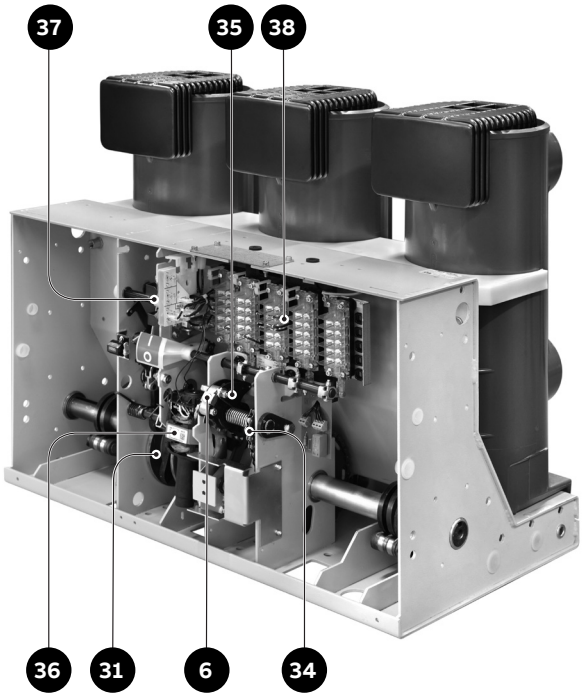


Figure 4/5: View of the stored-energy spring mechanism and auxiliary equipment with the front plate removed

6	Recess for charging lever 9
31	Release and control mechanism on the drive shaft
34	Chain drive
35	Ratchet wheel
36	Charging motor
37	Release and control mechanism area
38	Auxiliary switch block

4.4.4 Mounting of the VD4 -63 kA on trucks from other manufacturers

VD4 -63 kA generator circuit breakers which are not installed on ABB withdrawable parts must be fitted with one or two additional auxiliary switches which are dependent on the mechanical lock and release device. These must interrupt the circuit of shunt release ON -MBC.
Similary to auxiliary switches -BGT2 and -BGT1 in ABB withdrawable parts, no electrial pulse may arrive during and before mechanical blocking of the spindle mechanism, and may only be applied again after the end of mechanical blocking.
This ensures that the shunt release ON cannot be loaded with an electrical ON pulse when the withdrawable part is in an intermediate position, which could burn out the coil.

4.5 Function

4.5.1 Charging of the spring energy store (Figures 4/1 and 4/4)

To provide the necessary motive energy, the spring energy store, either charged automatically by a charging motor or manually in a vertical pumping action with charging lever 9, depending on the equipment fitted to the circuit breaker. The current charging condition is shown at charging condition indicator 8.
As a precondition for an auto-reclosing sequence, the operating mechanism is either (re-)charged after a closing operation automatically by the charging motor, or it requires (re-)charging by hand if the operating mechanism is of the manual type.

4.5.2 Closing procedure (Figures 4/1, 4/3, 4/4 and 4/5)

The closing process is started by the mechanical ON push-button 2, or by activation of shunt release ON -MBC. The release mechanism 31 then permits drive shaft 30 to be rotated by the (previously) charged spiral spring. The moving contact 15.3 in vacuum interrupter 15 is moved until the contacts touch by cam disk 21 and further kinematic links. In the further sequence of motion, spring arrangement 17 is tensioned and the appropriate amount of contact force thus applied. The available overtravel is higher than the maximum value of contact erosion during lifetime of the interrupter. During the closing process, opening springs 19 are simultaneously tensioned.

4.5.3 Opening procedure (Figures 4/1, 4/3, 4/4 and 4/5)

The opening procedure is initiated by mechanical OFF push-button 3 or by activation of one of releases -MBO1, -MBU, -MBO3 or -MBO2. Observe the notes in section 3.2.1 on control of the releases. Release mechanism 31 then permits drive shaft 30 to be turned further by the spring energy store, which is still sufficiently charged. Opening spring 19, which is thus released, moves contact 15.3 into the open position at a defined speed.

4.5.4 Auto-reclosing sequence

An OFF-ON or OFF-ON-OFF auto-reclosing sequence is activated and checked by the protection system. It is necessary for the spiral spring in the operating mechanism to be in the (re-)charged condition, with the circuit breaker in the closed position. The (re-)charging process is carried out automatically after closing of the breaker on breakers with motor charging mechanisms, but must be carried out manually on breakers without charging motors (or when the charging motor has broken down). Opening of the breaker is also possible during the (re-)charging process, but subsequent closing of the breaker is however blocked until the charging process has been completed.

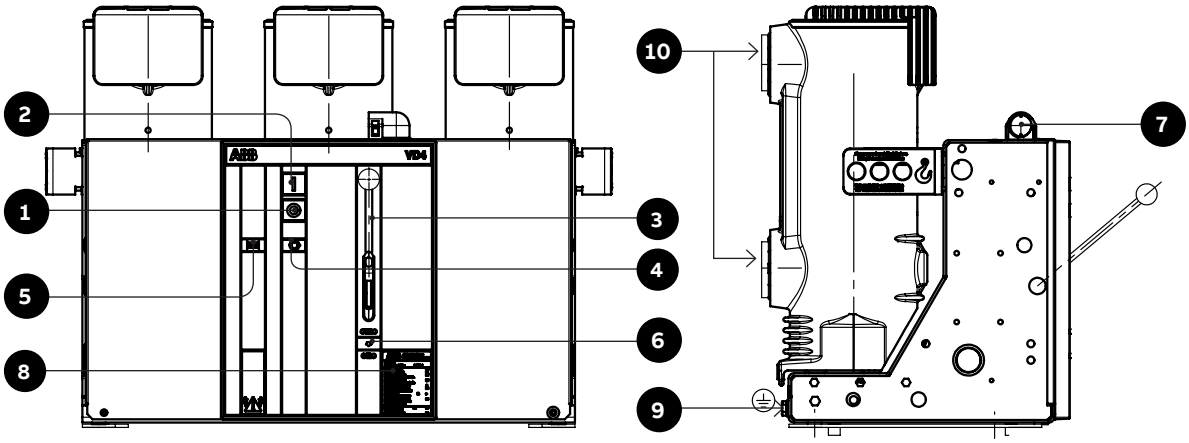
4.5.5 Quenching principle of the vacuum interrupter

Due to the extremely low static interrupter chamber pressure of 10^{-2} to 10^{-6} Pa, only a relatively small contact gap is required to achieve a high dielectric strength. The arc is extinguished on one of the first natural current zeros.
Due to the small contact gap and the high conductivity of the metal vapour plasma, the arc drop voltage, and additionally, due to the short arcing time, the associated arc energy, are extremely low, which has advantageous effects on the life of the contacts and thus on that of the vacuum interrupters.

4. Description

4.6 Fixed circuit breakers

The fixed circuit breaker (fig. 5) is the basic version complete with structure and front protection screen. The fixing holes are made in the lower part of the structure.
The earthing screw is placed in the rear part of the circuit breaker. For further details please see the caption to figure 5.



Caption
1 Opening pushbutton
2 Closing pushbutton
3 Lever for manual closing spring charging
4 Indicator for circuit breaker open “O” and closed “I”
5 Operation counter
6 Charging condition indicator
7 Cable bushing
8 Rating plate
9 Earthing screw
10 Terminals

Fig. 5

4.7 Standard fittings for fixed circuit breakers

The basic versions of the fixed circuit breakers are three-pole and fitted with:

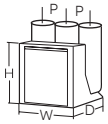
- CLASSIC type manual operating mechanism
- mechanical signalling device for closing spring charged/ discharged
- mechanical signalling device for circuit breaker open/closed
- closing pushbutton, opening pushbutton and operation counter
- set of ten circuit breaker open/closed auxiliary contacts
  Note: with the set of ten auxiliary contacts supplied as standard and the maximum number of electrical applications possible, three make contacts (signalling circuit breaker open) and five break contacts (signalling circuit breaker closed) are available.
- lever for manual closing spring charging

VD4 - 63 kA

4. Description

4.7.1 General characteristics of fixed circuit breakers

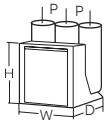
General characteristics of fixed circuit breakers (12 kV)

Circuit breaker		**VD4 12**					
Standards	IEC 62271-100	•					
Rated voltage	Ur [kV]	12					
Rated insulation voltage	Us [kV]	12					
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28					
Impulse withstand voltage	Up [kV]	75					
Rated frequency	fr [Hz]	50-60					
Rated normal current (40 °C)	Ir [A]	1250	1600	2000	2500	3150	4000 (1)
Rated breaking capacity (rated short-circuit breaking current symmetrical)	Isc [kA]	63	63	63	63	63	63
Rated short-time withstand current (3s)	Ik [kA]	63	63	63	63	63	63
Making capacity	Ip [kA]	164	164	164	164	164	164
Operation sequence	[O - 0.3 s - CO - 3 min - CO]	•	•	•	•	•	•
Opening time	[ms]	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55
Closing time	[ms]	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55
Maximum overall dimensions 	H [mm]	615	615	615	615	637	637
	W [mm]	750	750	750	750	750	750
	D [mm]	459	459	459	459	459	459
	Pole distance P [mm]	275	275	275	150	210	275
Weight	[kg]	201	201	201	201	210	210
Standardised table of dimensions	1VCD	003945					
Operating temperature	[°C]	- 5 ... + 40					
Tropicalization	IEC: 60068-2-30, 60721-2-1	•					
Electromagnetic compatibility	IEC: 62271-1	•					

(1) 4000 A rated currentwth guaranted with forced ventilation according to ABB design

4.7.2 General characteristics of fixed circuit breakers

General characteristics of fixed circuit breakers (17.5 kV)

Circuit breaker		VD4 17.5					
Standards	IEC 62271-100	•					
Rated voltage	Ur [kV]	17.5					
Rated insulation voltage	Us [kV]	17.5					
Withstand voltage at 50 Hz	Ud (1 min) [kV]	38					
Impulse withstand voltage	Up [kV]	95					
Rated frequency	fr [Hz]	50-60					
Rated normal current (40 °C)	Ir [A]	1250	1600	2000	2500	3150	4000 (1)
Rated breaking capacity (rated short-circuit breaking current symmetrical)	Isc [kA]	63	63	63	63	63	63
Rated short-time withstand current (3s)	Ik [kA]	63	63	63	63	63	63
Making capacity	Ip [kA]	164	164	164	164	164	164
Operation sequence	[O - 0.3 s - CO - 3 min - CO]	•	•	•	•	•	•
Opening time	[ms]	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55
Closing time	[ms]	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55
Maximum overall dimensions 	H [mm]	615	615	615	615	637	637
	W [mm]	750	750	750	750	750	750
	D [mm]	459	459	459	459	459	459
	Pole distance P [mm]	275	275	275	150	210	275
Weight	[kg]	201	201	201	201	210	210
Standardised table of dimensions	1VCD	003945					
Operating temperature	[°C]	- 5 ... + 40					
Tropicalization	IEC: 60068-2-30, 60721-2-1	•					
Electromagnetic compatibility	IEC: 62271-1	•					

(1) 4000 A rated currentwth guaranted with forced ventilation according to ABB design

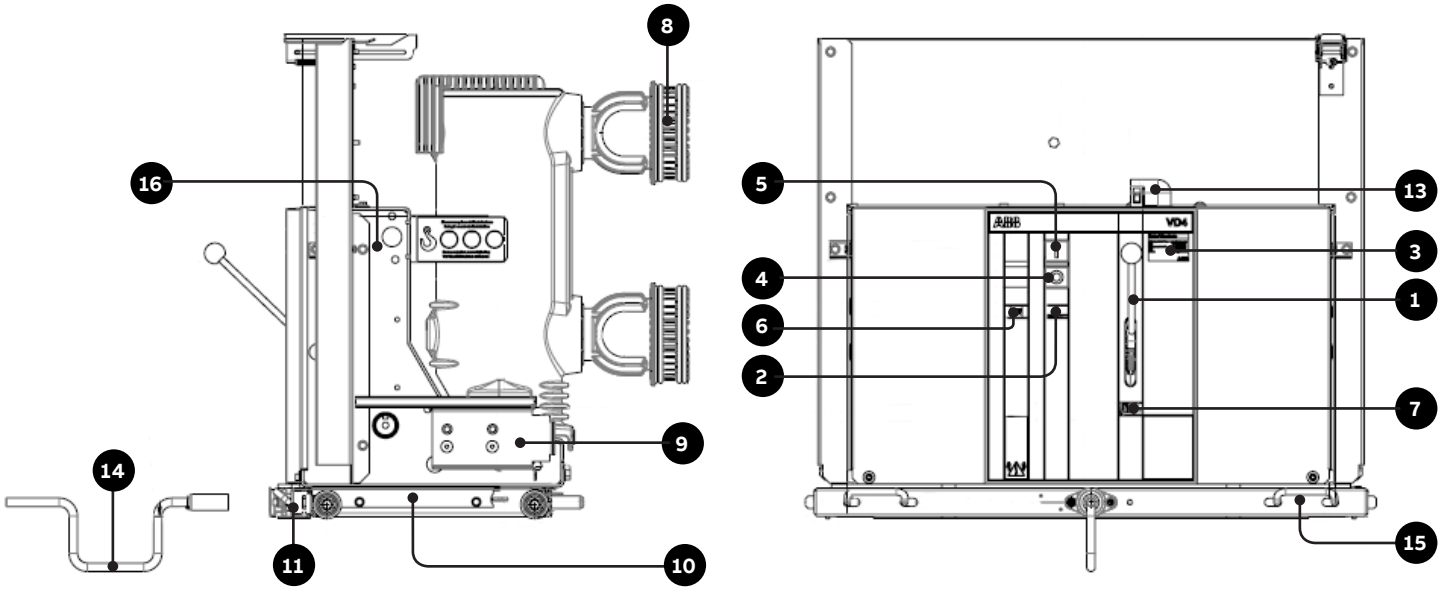
4. Description

4.8 Withdrawable circuit breakers

The 63 kV circuit breakers are available for ZS1 switchgear (see fig. 6).
They consist of a truck on which the supporting structure of the circuit breaker is fixed.

Circuit breakers for UniGear ZS1 (fig. 6)
The cord with the connector (plug) for connection of the operating mechanism electrical accessories comes out of the connection (15).
The strikers for operating the contacts (connected/isolated) placed in the switchgear are fixed in the top part of the circuit breaker.
The shutter actuator (9) and roller (18) are provided for operating the segregation shutters of the medium voltage contacts of the enclosure or of the switchgear are fixed on the sides of the circuit breaker.
The crosspiece with the handles (17) for hooking up the circuit breaker for the racking-in/out operations by means of the special operating lever (16) is mounted on the front part of the circuit breaker truck.
The circuit breaker is completed with the isolating contacts (8).

The withdrawable circuit breaker is fitted with special locks on the front crosspiece, which allow hooking up into the corresponding couplings of the switchgear.
The locks can only be activated by the handles with the truck fully resting against the crosspiece.
The operating lever (16) must be fully inserted. A lock prevents the truck from advancing into the enclosure or fixed part when the earthing switch is closed.
Another lock prevents racking-in and racking-out with the circuit breaker closed. With the truck in an intermediate position between isolated and connected, a further lock prevents circuit breaker closing (either mechanical or electrical).
A locking magnet is also mounted on the truck which, when de-energised, prevents the truck racking-in operation.
On request, an interlock is available which prevents racking-in of the circuit breaker with the door open, and door opening with the circuit breaker closed.
The lever for loading the closing spring (1) in the manual mode is built into the operating mechanism. The spring is loaded by repeatedly lowering the lever with linear movements until the yellow indicator (6) appears to show that loading is complete.
The spring can only be loaded with the switchgear door open.



Caption
1 Lever for manually charging the closing spring
2 Signalling device for circuit breaker open/closed
3 Rating plate
4 Opening pushbutton
5 Closing pushbutton
6 Signalling device for closing spring charged/discharged
7 Operation counter
8 Isolating contacts
9 Slide for operating the switchgear shutters (UniGear ZS1, PowerCube, ZS8.4)
10 Truck
11 Locks for hooking into the fixed part
12 Mechanical override of the undervoltage release (on request)
13 Cabling connection
14 Operating lever for circuit breaker racking-in/out
15 Handles for activating the locks (11)
16 Shutters actuator (for UniSec version only)

Fig. 6

Comply with the instructions in the UniGear switchgear manual for the operations that can be performed with the door open.

Note: on request, the closing spring loading device for withdrawable circuit breakers for UniGear switchgear can be supplied with the lever outside the operating mechanism and a rotary loading movement. This device is part of the standard equipment for VD4/ZS8 withdrawable circuit breakers only. This rotary loading device allows the closing spring to be loaded with the switchgear door closed.

4.9 Standard fittings of withdrawable circuit breakers for UniGear ZS1 switchgear

The basic versions of the withdrawable circuit breakers are three-pole and fitted with:

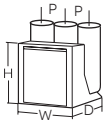
- CLASSIC type manual operating mechanism
- mechanical signalling device for closing spring charged/discharged
- mechanical signalling device for circuit breaker open/closed
- closing pushbutton
- opening pushbutton
- operation counter
- set of ten auxiliary circuit breaker open/closed contacts
  Note: with the set of ten auxiliary contacts supplied as standard and the maximum number of electrical applications possible, three make contacts (signalling circuit breaker open) and four break contacts (signalling circuit breaker closed) are available.
- lever for manually charging the closing spring
- isolating contacts
- cord with connector (plug only) for auxiliary circuits, withstriker pin which does not allow connection of the plugin the socket if the rated current of the circuit breaker isdifferent from the rated current of the panel
- racking-in/out lever (the quantity must be defined according to the number of pieces of apparatus ordered)
- locking electromagnet in the truck. This prevents the circuit breaker from being racked into the panel with auxiliary circuits not connected (plug not inserted in the socket).

VD4/P 63 kA

4. Description

4.9.1 General characteristics of withdrawable circuit breakers for UniGear ZS1 switchgear

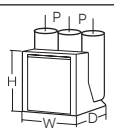
General characteristics of withdrawable circuit breakers for UniGear ZS1 switchgear (12 kV)

Circuit breaker		**VD4/P 12**					
Standards	IEC 62271-100	•					
Rated voltage	Ur [kV]	12					
Rated insulation voltage	Us [kV]	12					
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28					
Impulse withstand voltage	Up [kV]	75					
Rated frequency	fr [Hz]	50-60					
Rated normal current (40 °C) (1)	Ir [A]	1250	1600	2000	2500	3150	4000 (1)
Rated breaking capacity (rated short-circuit breaking current symmetrical)	Isc [kA]	63	63	63	63	63	63
Rated short-time withstand current (1 s)	Ik [kA]	63	63	63	63	63	63
Making capacity	Ip [kA]	164	164	164	164	164	164
Operation sequence	[O - 0.3 s - CO - 3 min - CO]	•	•	•	•	•	•
Opening time	[ms]	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55
Closing time	[ms]	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55
Maximum overall dimensions 	H [mm]	736	736	736	736	736	736
	W [mm]	750	750	750	750	750	750
	D [mm]	646	646	646	646	646	646
	Pole distance P [mm]	275	275	275	275	275	275
Weight	[kg]	261	261	261	261	270	270
Standardised table of dimensions	1VCD	003943					
Operating temperature	[°C]	- 5 ... + 40					
Tropicalization	IEC: 60068-2-30, 60721-2-1	•					
Electromagnetic compatibility	IEC: 62271-1	•					

(1) 4000 A rated currentwth guaranted with forced ventilation according to ABB design

4.9.2 General characteristics of withdrawable circuit breakers for UniGear ZS1 switchgear

General characteristics of withdrawable circuit breakers for UniGear ZS1 switchgear (17.5 kV)

Circuit breaker		VD4 17.5					
Standards	IEC 62271-100	•					
Rated voltage	Ur [kV]	17.5					
Rated insulation voltage	Us [kV]	17.5					
Withstand voltage at 50 Hz	Ud (1 min) [kV]	38					
Impulse withstand voltage	Up [kV]	95					
Rated frequency	fr [Hz]	50-60					
Rated normal current (40 °C) (1)	Ir [A]	1250	1600	2000	2500	3150	4000 (1)
Rated breaking capacity (rated short-circuit breaking current symmetrical)	Isc [kA]	63	63	63	63	63	63
Rated short-time withstand current (1 s)	Ik [kA]	63	63	63	63	63	63
Making capacity	Ip [kA]	164	164	164	164	164	164
Operation sequence	[O - 0.3 s - CO - 3 min - CO]	•	•	•	•	•	•
Opening time	[ms]	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40	28 ... 40
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55	38 ... 55
Closing time	[ms]	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55	≤ 55
Maximum overall dimensions 	H [mm]	736	736	736	736	736	736
	W [mm]	750	750	750	750	750	750
	D [mm]	646	646	646	646	646	646
	Pole distance P [mm]	275	275	275	275	275	275
Weight	[kg]	261	261	261	261	270	270
Standardised table of dimensions	1VCD	003943					
Operating temperature	[°C]	- 5 ... + 40					
Tropicalization	IEC: 60068-2-30, 60721-2-1	•					
Electromagnetic compatibility	IEC: 62271-1	•					

(1) 4000 A rated currentwth guaranted with forced ventilation according to ABB design

4. Description

4.10 Permissible number of vacuum interrupter switching operations in relation to breaking current

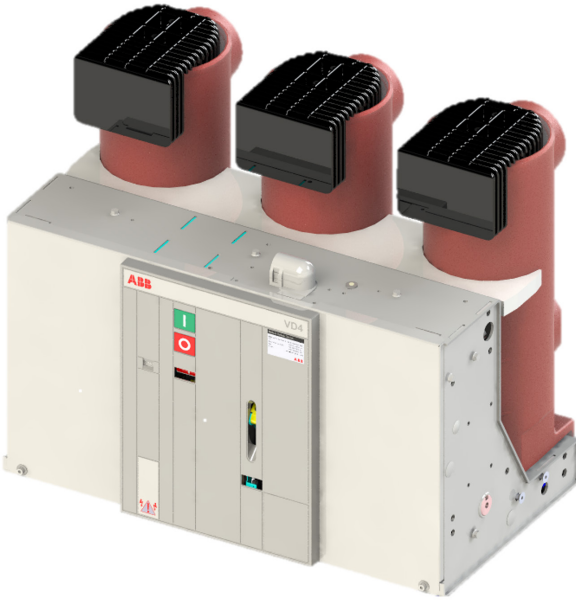


Fig. 7: VD4 63kA for 17.5kV, 275mm pole centers, mechaism side

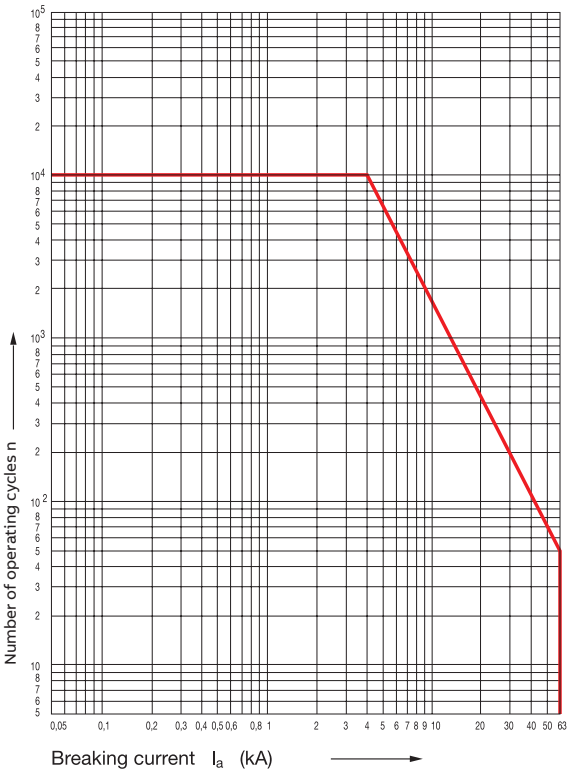


Diagram A

Fig. 7a: Permissible number of vacuum interrupter operating cycles n as a function of the breaking current Ia

5. Installation

5.1 General

Correct installation is of primary importance. The manufacturer's instructions must be carefully studied and followed. It is good practice to use gloves for handling the pieces during installation.

5.2 Installation and operating conditions

The following Standards must be taken into particular consideration during installation and service:

- IEC 62271-1/DIN VDE 0101
- VDE 0105: Electrical installation service
- DIN VDE 0141: Earthing systems for installations with rated voltage above 1 kV
- All the accident prevention regulations in force in the relative countries.

5.2.1 Normal conditions

Follow the recommendations in the IEC 62271-1 and 62271- 100 Standards. In more detail:

Ambient temperature	
Maximum	+ 40 °C
Average maximum over 24 hours	+ 35 °C
Minimum (according to class – 5), apparatus for indoor installation	– 5°

Humidity
The average value of the relative humidity, measured for a period longer than 24 hours, must not exceed the 95%.
The average value of the pressure of the water vapour, measured for a period longer than 24 hours, must not exceed 2.2 kPa.
The average value of the relative humidity, measured for a period longer than 1 month, must not exceed the 90%.
The average value of the pressure of the water vapour, measured for a period longer than 1 month, must not exceed 1.8 kPa.

Altitude
≤ 1000 m above sea level.

5.2.2 Special conditions

Installations over 1000 m a.s.l.
Possible within the limits permitted by reduction of the dielectric resistance of the air.

Increase in the ambient temperature
Reduction in the rated current.
Encourage heat dissipation with appropriate additional ventilation.

Climate
To avoid the risk of corrosion or other damage in areas:
• with a high level of humidity, and/or
• with rapid and big temperature variations, take appropriate steps (for example, by using suitable electric heaters) to prevent condensation phenomena.

For special installation requirements or other operating conditions, please contact ABB.

The areas involved by the passage of power conductors or auxiliary circuit conductors must be protected against access of any animals which might cause damage or disservices.

5. Installation

5.3 Preliminary operations

- Clean the insulating parts with clean dry cloths.
- Check that the top and bottom terminals are clean and free of any deformation caused by shocks received during transport or storage.

5.4 Installation of fixed circuit breakers

The circuit breaker can be mounted directly on supporting frames to be provided by the customer, or on a special supporting truck (available on request).
The circuit breaker, with supporting truck, must be suitably fixed to the floor of its own compartment by the customer.
The floor surface in correspondence with the truck wheels must be carefully levelled.
A minimum degree of protection (IP2X) must be guaranteed from the front towards live parts.

5.4.1 Mounting the circuit breaker on a truck made by other manufacturers

The VD4 circuit breakers which are not installed on ABB trucks, but on trucks made by the customer, must be fitted with one or two additional auxiliary contacts (activated by the mechanical lock and by the circuit breaker release device) to carry out the function of interrupting the shunt closing release circuit (-MBC) during traverse from isolated and vice versa.
In ABB trucks, this function is carried out by the -BGT1 and -BGT2 auxiliary contacts which cut of the release power supply during and before activation of the mechanical lock of the screw truck racking-in device. This means that the shunt closing release power supply can only by applied at the end of activation of the mechanical lock. In this way it is certain that no electrical impulse can activate the shunt closing release with the circuit breaker in an intermediate position.

5.5 Installation of withdrawable circuit breaker

The withdrawable circuit breakers are preset for use in UniGear ZS1.
For racking-in/racking-out of the switchgear, fully insert the lever in the appropriate seat and work it clockwise for racking-in, and anti-clockwise for racking-out, until the limit switch positions are reached.
Circuit breaker racking-in/-out must be carried out gradually to avoid shocks which may deform the mechanical interlocks and the limit switches.
The torque normally required to carry out racking-in and racking-out is <25 Nm.
This value must not be exceeded. If operations are prevented or difficult, do not force them and check that the operating sequence is correct.

Note
To complete the racking-in/out operation, about 20 rotations of the lever are required for circuit breakers up to 17.5 kV, and about 30 rotations for 24 kV circuit breakers.

When the circuit breaker has reached the isolated for test/ isolated position, it can be considered racked into the switchgear and, at the same time, earthed by means of the truck wheels.
Withdrawable circuit breakers of the same version, and therefore with the same dimensions, are interchangeable.
However, when, for example, different electrical accessory fittings are provided, a different code for the plug of the auxiliary circuits does not allow incorrect combinations between panels and circuit breakers.
For the circuit breaker installation operations, also refer to the technical documentation of the abovementioned switchgear.

- **The racking-in/-out operations must always be carried out with the circuit breaker open.**
- **When putting into service for the first time, it is advisable to charge the circuit breaker operating mechanisms manually so as not to overload the auxiliary power supply circuit.**

5.5.1 Circuit breakers with withdrawable motorized truck

Carry out the racking-in/racking-out test of the motorized truck in the same way as for a manual truck, following the instructions below:

- Rack the circuit breaker into the switchgear in the open and isolated position, with the power supply to the motor circuit cut off and with the enclosure door closed.
- Insert the manual racking-in lever in the special coupling and take the motorized truck to about half its run between the isolated for test and the connected position. The torque needed to carry out truck handling is < 25 Nm.
- In the case of accidental inversion of the truck motor power supply polarity, this operation allows a possible error in direction to be dealt with without any damage. Verification checks:
  a) Motor rotation clockwise during circuit breaker racking-in.
  b) Motor rotation anticlockwise during circuit breaker racking-out.
- Remove the manual lever from the coupling
- Supply the truck motor circuit
- Activate the control for the electrical racking-in operation. When racking-in has taken place, check correct changeover of the relative auxiliary contact.
- On completion, activate the control for the electrical racking-out operation. When racking-out has taken place, check correct changeover of the relative auxiliary contact.
- In the case of a motor fault during a racking-in or racking out operation, in an emergency the truck can be taken to the end of its run manually, after first cutting off the power supply to the motor power supply circuit and then, using the manual lever, work in the same way as with the manual truck.

Note
By means of the chain transmission, truck handling carried out using the manual lever makes the truck motor armature rotate which, behaving like a generator, can cause inverse voltage at the connection terminals.
This may damage the permanent magnet of the motor, therefore all the truck racking-in and racking-out operations carried out using the manual lever must be done without power supply in the motor circuit.

5.6 Power circuit connections of fixed circuit breakers

5.6.1 General recommendations

- Select the cross-section of the conductors according to the service current and the short-circuit current of the installation.
- Prepare special pole insulators, near the terminals of the fixed circuit breaker or of the enclosure, sized according to the electrodynamic forces deriving from the short-circuit current of the installation.

5.6.2 Assembly of the connections

- Check that the contact surfaces of the connections are flat, and are free of any burrs, traces of oxidation or deformation caused by drilling or impacts received.
- According to the conductor material and the surface treatment used, carry out the operations indicated in table T1 on the contact surface of the conductor.

Assembly procedure

- Put the connections in contact with the circuit breaker terminals, taking care to avoid mechanical stresses (traction / compression) on, for example, the conducting busbars on the terminals.
- Interpose a spring washer and a flat washer between the head of the bolt and the connection.
- It is advisable to use bolts according to DIN class 8.8 Standards, also referring to what is indicated in table T2.
- In the case of cable connections, strictly follow the manufacturer’s instructions to make the terminals.

5. Installation

T1

Bare copper
• Clean with a fine file or emery cloth.
• Tighten fully and cover the contact surfaces with 5RX Moly type grease

Copper or silver-plated aluminium
• Clean with a rough dry cloth.
• Only in the case of obstinate traces of oxidation, clean with a very fine grain emery cloth taking care not to remove the surface layer.
• If necessary, restore the surface treatment.

Bare aluminium
• Clean with a metal brush or emery cloth.
• Cover the contact surfaces again immediately with neutral grease
• Insert the copper-aluminium bimetal with surfaces shined (copper side in contact with the terminal; aluminium side in contact with the connection) between the aluminium connection and the copper terminal.

T2

Bolt	**Recommended tightening torque (1)**	
	Without lubricant	With lubricant (2)
M6	10.5 Nm	4.5 Nm
M8	26 Nm	10 Nm
M10	50 Nm	20 Nm
M12	86 Nm	40 Nm
M16	200 Nm	80 Nm

(1) The nominal tightening torque is based on a friction coefficient of the thread of 0.14 (distributed value the thread is subjected to which, in some cases, is not negligible). The nominal tightening torque with lubricant is according to the DIN 43673 Standards.

(2) Oil or grease. The thread and surfaces in contact with the lubricated heads. Take into account the deviations from the general Standards table (for example, for systems in contact or terminals) as foreseen in the specific technical documentation. The thread and surfaces in contact with the heads of bolts must be slightly oiled or greased, so as to obtain a correct nominal tightening torque.

5.7 Earthing

For the fixed version circuit breaker, carry out earthing by means of the special screw marked with the relative symbol.
Clean and degrease the area around the screw to a diameter of about 30 mm and, on completion of assembly, cover the joint again with Vaseline grease.
Use a conductor (busbar or braid) with a cross-section conforming to the Standards in force.

5.8 Connection of the auxiliary circuits

Note: the minimum cross-section of the wires used for the auxiliary circuits must not be less than the one used for the internal cabling. Furthermore, they must be insulated for 3 kV of test.

5.8.1 Fixed circuit breaker

The customer can choose between two types of auxiliary circuit connections in the circuit breaker. The first type is supplied as the standard version. In this case, the auxiliary contacts must be disassembled from the structure of the circuit breaker, since their terminals cannot be directly accessed (consult the installation manual). Part of the wiring is made during the production phase for the second type. This means that the customer can wire up by directly accessing the terminal boxes in the front part of the circuit breaker. In this case, the wiring operation is much faster and immediate.
To prevent the cabling wires outside the circuit breaker (carried out by the customer) from accidentally coming into contact with moving parts and therefore undergoing damage to the insulation, it is recommended to fix the wires.
In both types of connection, the wires must pass through connection while outside the circuit breaker, the cables must be screened by an appropriate sort of metallic protection (tube, duct, ...), which must be earthed.

5.8.2 Withdrawable circuit breakers

The auxiliary circuits of withdrawable circuit breakers are fully cabled in the factory as far as the connector. For the external connections, refer to the electric wiring diagram of the switchgear.

6. Commissioning / Operation

6.1 Note on safety at work

- This switching device may only be operated by specially trained personnel who are familiar with the characteristics of the particular device.
- Due to safety reasons, the circuit breaker has to be treated as “switched on” if the switching position can not clearly determined.
  In this case all high voltage connections to the breaker have to be de-energized and zero potential on the primary side of the breaker has to be confirmed prior to commissioning, operation, maintenance or repair work.

6.2 Preparatory activities

(Prior to application of primary voltage)

- Check the circuit breaker for any kind of damage or other injurious environmental influence, and restore to the proper condition where necessary.
- Remove any contamination, particularly on insulating parts, which has occurred during transit, storage or installation.
- Check the primary and secondary connections and the protective conductor terminal.
- Charge the spring energy store by hand (see section 4.5).
- Perform a trial opening or closing operation of the circuit breaker using push-button 2 or 3 (taking into account any required supply voltage and any relevant interlocks).
- Check the charging motor on circuit breakers with motor-operated mechanisms by applying supply voltage.
- Ensure that the Instruction Manual is available to the operators at all times.
- Remove the lifting lugs 1.3 for hoists (Figure 8).

6.3 Operation of the circuit breaker

6.3.1 Charging the spring energy store

Circuit breakers with charging motors:

- Charging takes place automatically.
- If the charging motor breaks down, the charging process can be carried out completed manually.

Circuit breakers with manual charging mechanisms:

- Insert charging lever 9 into recess 6 and pump up and down for approx. 25 strokes until the charged condition is displayed.
- When the charged condition is reached, the charging mechanism automatically disengages, and further strokes of the charging lever have no effect.

Key to the charging condition indications:

Discharged 

Charged 

As a precondition for an auto-reclosing sequence, the operating mechanism is either (re-)charged after a closing operation automatically by the charging motor, or it requires (re-)charging by hand if the operating mechanism is of the manual type.

6.3.2 Closing and opening

- Closing:
  Press mechanical ON push-button 2, or operate the electrical control unit.
- Opening:
  Press mechanical OFF push-button 3, or operate the electrical control unit.

The operating cycle counter 5 is automatically incremented by one complete figure with each switching cycle. On completion of a switching operation the position indicator 4 in the window of front plate 1.1 shows the appropriate position of the circuit breaker.

- Anti-pumping relay:
  The anti-pumping relay -KFN (wiring diagram) prevents repeated ON-OFF switching operations if, for example, the breaker is tripped by a protection relay in response to a primary side fault while a permanent electrical closing command is simultaneously applied. The circuit breaker can then only be closed after the closing command has been interrupted.

- Closing on failure of supply voltage:
  - With standard equipment:
    On failure of the control voltage, mechanical closing by means of ON push-button 2 is possible at any time.
  - With blocking magnet -RLE1 fitted:
    On failure of the control voltage, blocking magnet -RLE1 mechanically locks the ON haflshaft and simultaneously interrupts the circuit shunt release ON -MBC via the corresponding auxiliary switch -BGL1.
- Closing with the blocking magnet de-energised requires manipulation of the circuit breaker operating mechanism:
  - Remove front plate 1.1.
  - Take care to avoid rotating parts!

6. Commissioning / Operation

- Opening on failure of supply voltage:
  On failure of the supply voltage, mechanical opening by means of OFF push-button 3 is possible at any time.

6.3.3 Run-on block

When any irregularities occur in the internal control mechanism or with the charging function of the spring energy store, the run-on stop blocks the next closing operation.
This is a protective function to prevent damage to the circuit breaker.

Release of the run-on block may only be performed by servicing personnel from ABB or adequately trained specialist stuff.

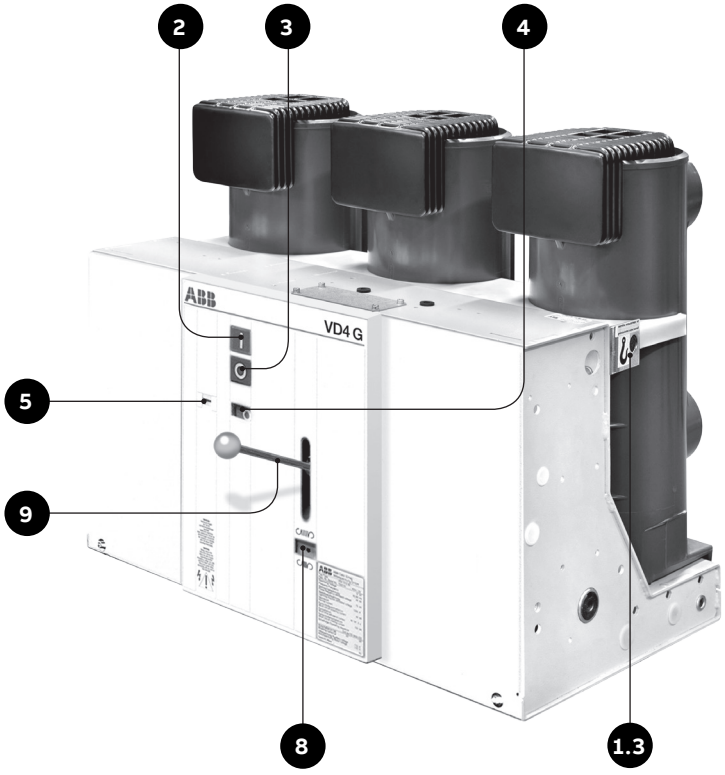


Fig. 8: Operation
1.3 Lifting lug (remove prior to commissioning)
2 Mechanical ON push-button
3 Mechanical OFF push-button
4 Mechanical position indicator
5 Mechanical operating cycle counter
8 Charging condition indicator
9 Charging lever

7. Maintenance

Maintenance serves to ensure trouble-free operation and achieve the longest possible working life of the switchgear.
In accordance with DIN 31051 / IEC 61208 / IEC 62271-1 it comprises the following closely related activities:

Inspection: Determination of the actual condition

Servicing: Preservation of a functional condition

Repair: Measures to restore the functional condition.

7.1 General

Vacuum circuit breakers are characterized by their simple and robust construction. They have a long life expectancy. Their operating mechanisms have a low maintenance requirement, and the interrupters are maintenance-free during their working life.
There is no adverse effect on the vacuum, even from frequent switching of operating and short-circuit currents.
The servicing intervals and scope are determined by environmental influences, the switching sequences and number of short-circuit breaking operations.

Note:
The following must be observed for all maintenance work:
- The relevant specifications in section 1.2.2
- Notes on safety at work in section 6.1
- Standards and specifications in the country of installation.

Maintenance work may only be performed by fully trained personnel, observing all the relevant safety regulations. It is recommended that ABB after-sales service personnel should be called in, at least during the performance of servicing and repair work.
While the work is in progress, all supply voltage sources must also be disconnected and secured to prevent reconnection.

Note:
In order to prevent accidents (particularly injury to hands!) extreme care should be taken during all repair work on the operating mechanism, especially with front plate removed.

The spiral spring in the spring energy store, for instance, retains a basic tension which is independent of the charging and discharging processes during switching, so as to ensure correct function. This spring energy can be inadvertently released if work is performed incorrectly on the spring mechanism!

7.1.1 Service life

Typical life expectancies for VD4 fixed/P 63kA circuit breakers:
- The maintenance-free vacuum interrupters up to 10,000 operating cycles
- The breaker itself, depending on presupposing carefully performed inspection and servicing work and normal operating conditions, up to 2000 operating cycles.

The service life data fundamentally apply to all components which are not directly influenced by the operator.
Components operated manually (movement of the withdrawable part, etc.) may deviate.

7.2 Inspection and functional testing

7.2.1 Switching devices in general

- The proper condition of the switching device is to be verified by regular inspection.
- The checks are to be performed in accordance with BGV A3 standard. If further standards exist in the country of installation they shall be considered in the checks.
- Inspection at fixed intervals may be waived if the switchgear is permanently monitored by a qualified personnel.
- The checks first and foremost comprise visual examination for contamination, corrosion, moisture and discharge phenomena.
- In unusual operating conditions (including adverse climatic conditions) and/or special environmental pollutions (e.g. heavy contamination and aggressive atmosphere), inspection may also be necessary at shorter intervals.
- If an incorrect condition is found, appropriate servicing measures are to be initiated.

7.2.2 Stored-energy spring mechanism

Functional testing of the operating mechanism is to be performed:
- after 2000 operating cycles or 5 years or
- during servicing work.

Prior to functional testing, switch the breaker off and isolate the outgoing feeder.

Note:
Isolate and secure the working area in accordance with the safety regulations specified by DIN VDE/ IEC.

7. Maintenance

Scope of functional testing:
- Perform several switching operations under no load, above all with circuit breakers seldom operated in normal service.
- Switch off the charging motor (if fitted) and discharge the spring energy store by ON/OFF switching operations.
- Examine visual the condition of the lubrication on rotary bearings, sliding surfaces, etc.
- Check the proper mechanical/electrical sequence of the individual functions.

7.2.3 Breaker pole

No inspection of the breaker pole above and beyond the stipulations of section 7.2.1 is necessary.

7.3 Servicing

7.3.1 Switching devices in general

If cleaning is found to be necessary during inspections as set out in 7.2.1, the following procedure is to be adopted:
- Prior to cleaning, the working area is to be isolated and secured against reclosing where necessary in accordance with the safety regulations of DIN VDE/IEC.
- Cleaning of surfaces in general:
  - Dry, lightly adhering dust deposits with a soft, dry cloth.
  - More strongly adhering contamination with slightly alkaline household cleanser or Isopropanol.
- Cleaning of the insulating material surfaces and conductive components:
  - Light contamination: with Isopropanol.

Wipe down after cleaning, using clean water, and dry properly.

Note:
Use only halogen free cleansers, and in no case 1.1.1-trichloroethane, trichloroethylene or carbon tetrachloride!

7.3.2 Stored-energy spring mechanism (Figures 9/1 to 9/4)

Servicing of the operating mechanism is to be performed after the following number of operating cycles:
- Breakers with rated short-circuit breaking currents up to 50 kA and 63 kA after 2000 operating cycles. Prior to servicing, switch the breaker off, and move it out of the panel (with withdrawable breakers) or
- isolate the outgoing feeder (with stationary mounted breakers).

Observe the safety regulations.

Details of the servicing:
- Switch off the charging motor (if fitted), and discharge the spring energy store by closing and opening the breaker once.
- Replace parts subject to high climatic and mechanical stresses as a precaution.
- For replacing highly stressed parts neutralize basic tension of the spiral spring, state the rate. Be careful when carrying out!
- Relubricate pawls, support shafts, sliding and rotating bearing surfaces. Lubricant: Isoflex Topas NB 52.
- Check the fit of fasteners (e.g. locking pins) in cranks, pins, bolts etc. Check the tightness of fastening bolts.
- Always replace any spring lock washers, split pins and other fasteners removed during the work with new parts when reassembling the equipment.
- Check the general condition of the operating mechanism and recharge the spring energy store.
- Perform comprehensive mechanical and electrical functional tests.
- Observe the instructions on setting.
- Ensure that the bolted joints at the contact locations of the conductor bar system and the earthing connections are tight.

Note:
Above mentioned work may only be performed by the after-sales service personnel of ABB or adequately qualified personnel.

7.3.3 Breaker pole

The breaker pole with the vacuum interrupter is maintenance-free up to reaching the permissible number of vacuum interrupter operating cycles in accordance with section 2.4.
Checking of the vacuum is only necessary when there is good cause to suspect that force applied externally to a pole tube has caused damage to the vacuum interrupter inside.
If the pole tube is damaged or destroyed, it may be necessary to replace the complete breaker pole.
The working life of the vacuum interrupter is defined by the sum current limit corresponding to the equipment data in individual cases in accordance with section 4.9:
- When the sum current limit is reached, the complete breaker poles are to be replaced.

Note:
Dismantling and Replacement of the complete breaker poles should only be carried out by ABB after-sales service personnel or by specially trained personnel, particularly as proper adjustment is necessary.

For testing the vacuum without dismantling the circuit breaker you may use:
- Vakuumtester VIDAR, der Firma Programma Electric GmbH Bad Homburg v. d. H.

The following test values have to be set for checking of the internal interrupter chamber pressure with the VIDAR vacuum tester:

Rated voltage of the circuit breaker	DC test voltage
12-17.5 kV	40 kV

Testing is to be performed at the rated contact distance in the OFF condition.

Procedure for vacuum interrupter testing for stationary mounted switching devices:
- Isolate and secure the working area in accordance with the Safety Regulations to DIN VDE / IEC.
- Open the circuit breaker.
- Earth all poles of the circuit breaker on one side.
- Connect the earthed test lead of the the VIDAR vacuum checker conductively to the station earth.
- Connect the high voltage test lead of the VIDAR vacuum checker with phase L1 of the unearthed pole side and test the vacuum interrupter chamber with the circuit breaker contact gap open. Repeat for phases L2 and L3.

Note:
Connected cables may lead to a “detective” indication on the vacuum checker as a result of their cable capacitance.
In such cases, the cables are not be removed.

7.4 Repair

7.4.1 Replacement of circuit breaker parts and accessories

Only remove and reassemble circuit breaker parts and accessories when the breaker has been switched off and the working area is to be isolated and secured against reclosing. The spring energy store must be discharged.

All supply voltage sources must be disconnected and secured against reclosing during the removal and installation work.

7.4.2 Touch up of surfaces

- Sheet steel parts, painted:
  - Remove rust, e.g. with a wire brush.
  - Grind off paint coat and grease.
  - Apply anti-rust primer and top coat.
  - Use top coat paint in the standard colour RAL 7035.
- Sheet steel parts, with zinc surface and passivated functional parts:
  - Remove white rust with a wire brush or cleaning pad (e.g. Scotch-Brite white).
  - Remove loosely adhering particles with a dry cloth.
  - Apply zinc spray or zinc dust primer.
- Functional parts, phosphated:
  - Remove rust with a wire brush or cleaning pad (e.g. Scotch-Brite white).
  - Clean with a dry cloth.
  - Grease with Isoflex Topas NB 52.

7. Maintenance

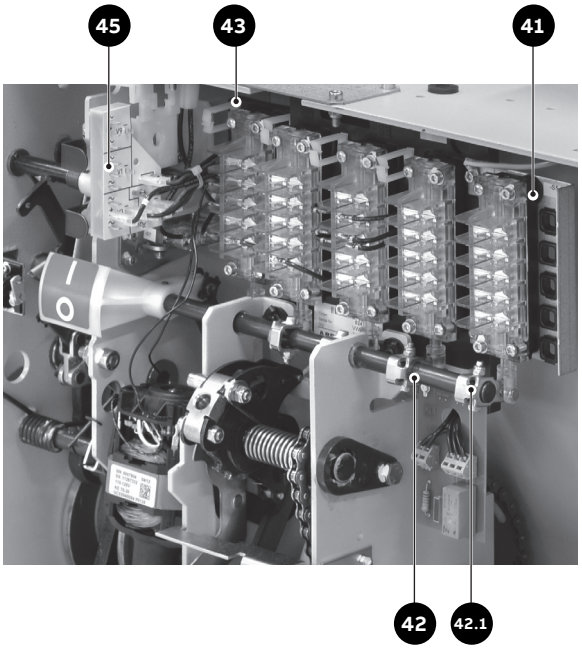


Figure 9/1: Auxiliary switch block, equipment example
41 Mounting plate
42 Auxiliary shaft
42.1 Crank
43 Fastening screw
45 Magnet holder, complete

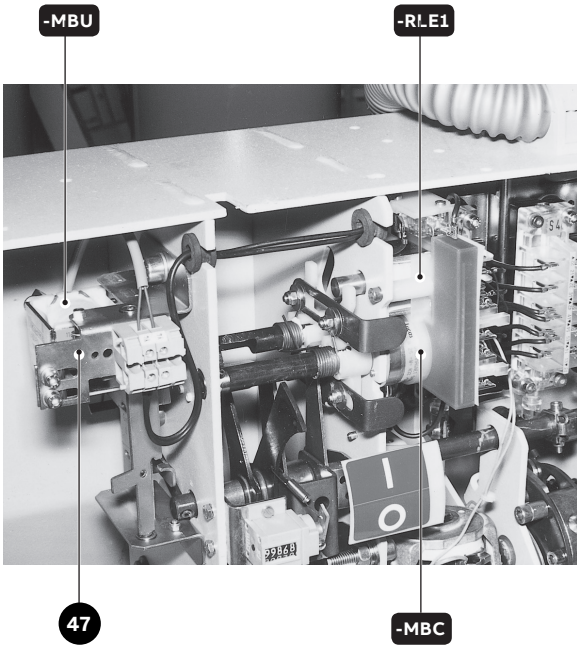


Figure 9/2: Undervoltage release and operation area, equipment example
47 Interlock plate for -MBU
-RLE1 Blocking magnet
-MBC Shunt release ON
-MBU Undervoltage release

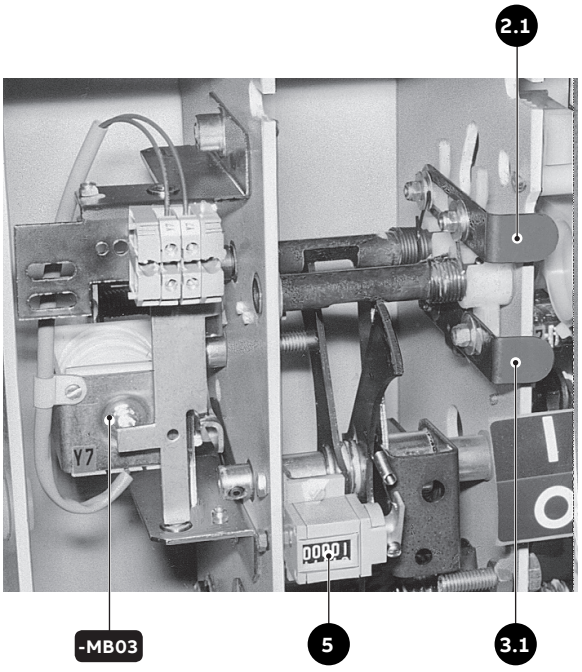


Figure 9/3: Indirect overcurrent release and operation area, equipment example
2.1 ON push-rod
3.1 OFF push-rod
5 Operating cycle counter
-MBO3 Indirect overcurrent release

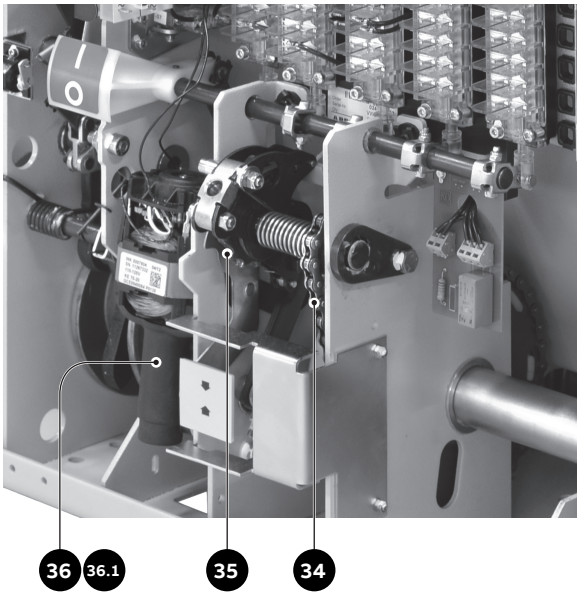


Figure 9/4: Charging motor, charging system and spring energy store
34 Chain
35 Ratchet wheel
36 Charging motor with gearing
36.1 Fastening screw (gearbox)

8. Application of the X-ray regulations

One of the physical properties of vacuum insulation is the possibility of X-ray emissions when the contact gap is open. The specified test performed by the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig demonstrates that the local dosage output of 1 µSv/h at a distance of 10 cm from the touchable surface is not exceeded when the rated voltage is applied.

The results are as follows:

- Testing of the switching device or the vacuum interrupter to VDE 0671 part 100 or IEC 62271-100 at the relevant rated power frequency withstand voltage may only be performed by trained personnel observing the stipulations of the EU basic standard [Directive 96/29/Euratom of the Council of 13 May 1996 (ABI.L 159 of 29 June 1996)].
- Application of the rated voltage specified for the switching device by VDE 0671 part 100 or IEC 62271-100 is completely safe.
- Higher voltages than the rated voltage or DC test voltage specified in VDE or IEC standards must not be applied!
- The containment of the above mentioned local dosage output with the vacuum interrupter in the open position is dependent on maintenance of the specified distance between the contacts (which is automatically ensured with correct mechanism function and force transmission).
- Safety clearances must be maintained.

9. Spare parts and auxiliary materials

9.1 Spare parts

Designation	Item no.	Rated supply voltage	Ident no. (order code)
Auxiliary switch (with clamp-type terminal)	-BGS1 -BGB1 -BGB2 -BGB3		GCE7002397R01... [1] [3]
Auxiliary switch on blocking magnet	-BGL1		GCE7003022P0... [1]
Auxiliary switch for fault annunciation	-BGB4		GCE0905121P0... [1]
1st shunt releas OFF	-MBO1	24 V ... 240 V DC	GCE7004590P011... [1]
2nd shunt release OFF	-MBO2	110V ... 240 V AC	GCE7004590P012... [1]
Shunt release ON	-MBC	24 V ... 240 V DC	GCE7004590P010... [1]
Blocking magnet	-RLE1	110V ... 240 V AC	GCE9478103P011... [1]
Undervoltage release with spring mechanism	-MBU	24 V ... 240 V DC	GCE9371466R0... [1]
Delayed undervoltage release with spring mechanism	-MBU	see RN3U for supply voltage	GCE9371466R0... [1]
Indirect overcurrent release with intermediate current transformer and spring mechanism	-MBO3	24 V ... 240 V DC	GCE9371466R0212
Intermediate current transformer for indirect overcurrent release		24 V ... 220 V DC	GCE9371466R0248
Magnet holder, complete (with integrated rectifiers -TB4, -TB1, - TB3, -TB2)		24 V ... 220 V DC	GCE7000880R0121
Series rectifier	-TB6/-TB7		GCE7004050R0129
Charging motor (with gearing)	-MAS	24 V ... 240 V DC 110V ... 240 V AC	GCE0940084P013... [2]
Push-on sleeve 4.8-2.5 for push-on blade 0.8 thick (for additional external connections)			DIN 46247 Page 2

1) State the type of release and voltage
2) State rated sypply voltage, serial no. of switch (on identification sign) as well as thwe manufacturer of the motor
3) Quote contact arrangement

9.2 Auxiliary materials

Auxiliary materials	Ident no. (order code)
Lubricants: Isoflex Topas NB 52	 GCE0007249P0100
Cleaning agents for general cleaning: Isopropanol	 1VB0000463P0100
Touch-up paint: Standard colour RAL 7035 - 1 kg-box - Spray tin	 GCE9014060R0103 GCE0007895P0100

10. Electric circuit diagrams

The standard VD4 circuit breaker electric circuit diagrams are as follows:

Free standing version:
- 1VCD400230: Fixed circuit breakers without plug
- 1VCD400232: Fixed circuit breakers with 58-pole connector

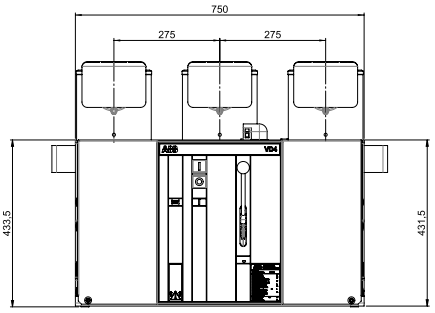
Withdrawable version
- 1VCD400231: Withdrawable circuit breakers for Unigear ZS1 with 58-pole connector

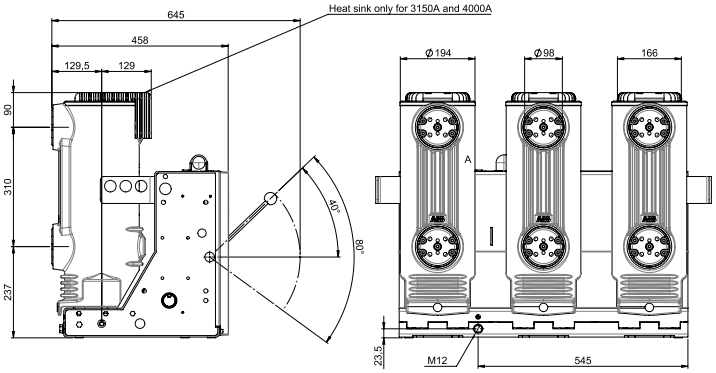
Each circuit breaker is always provided with the standard electric diagram or with a specific diagram in the case of a circuit breaker with non-standard cabling.

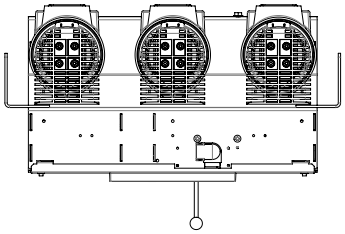
11. Overall dimensions

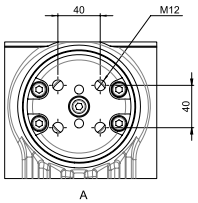
Fixed circuit breakers

VD4		
TN	1VCD003945	
Ur	12	kV
	17.5	kV
Ir	1250	A
	1600	A
	2000	A
	2500	A
	3150	A
	4000	A
Isc	63	kA





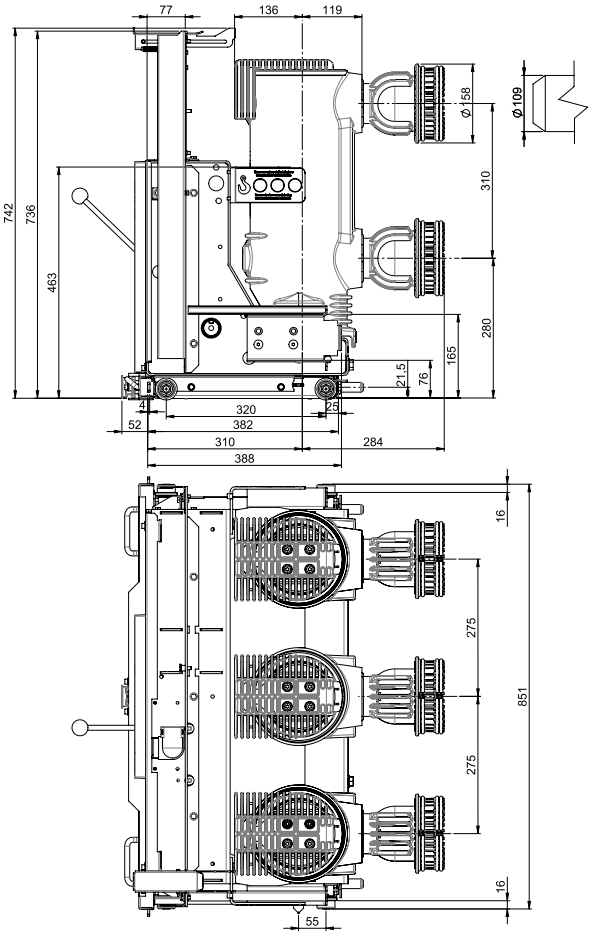


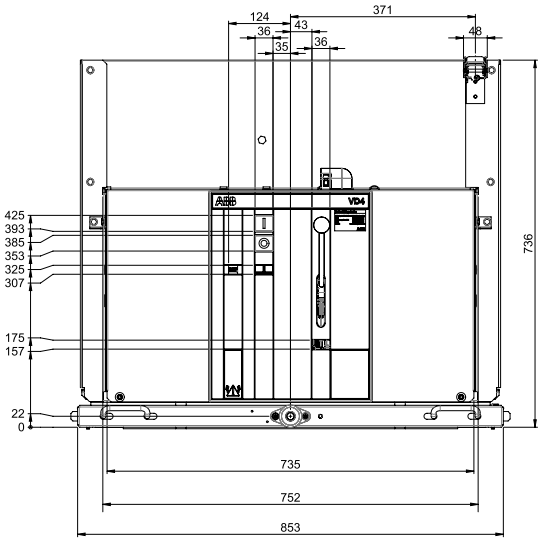


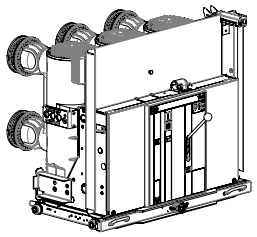
(*) Fixing interchangeability with previous series (345 x 650).

Withdrawable circuit breakers for UniGear ZS1 switchgear

VD4/P		
TN	1VCD003943	
Ur	12	kV
	17.5	kV
Ir	1250	A
	1600	A
	2000	A
	2500	A
	3150	A
	4000	A
Isc	63	kA







12. Product quality and environmental protection

The apparatus are produced in compliance with the requirements of international standards for the quality management system and environmental management system. In these fields, the excellent level is proved by quality certificates according to ISO 9001 and by the EMS according to ISO 14 001.

End of life of product

The ABB company is committed to complying with the relevant legal and other requirements for environment protection according to the ISO 14 001 standard.
The duty of company is to facilitate subsequent recycling or disposal at the end of product life. During disposal of the product, it is always necessary to act in accordance with local legal requirements in force.

Methods of disposal

Disposal can either be carried out thermally in an incineration plant or by storing on a waste site.

Raw material	Recommended method of disposal
Metal material (Fe, Cu, Al, Ag, Zn, W, others)	Separation and recycling
Thermoplasts	Recycling or disposal
Epoxy resin	Separation of metal material and the disposal of rest
Rubber	Disposal
Oil as dielectric (transformer oil)	Draining from equipment and further recycling or disposal
Packing material – wood	Recycling or disposal

Notes

For more information please contact:

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More product information:
abb.com/mediumvoltage
Your contact center:
abb.com/contactcenters
More service information:
abb.com/service

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The data and illustrations are not binding. We reserve the right to make changes without notice in the course of technical development of the product.

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1VCD601410 - Rev A en - EDO-D0003080 - Instruction Manual -2022.04 (VD4 12 and 17.5 kV, 63kA) (gs)