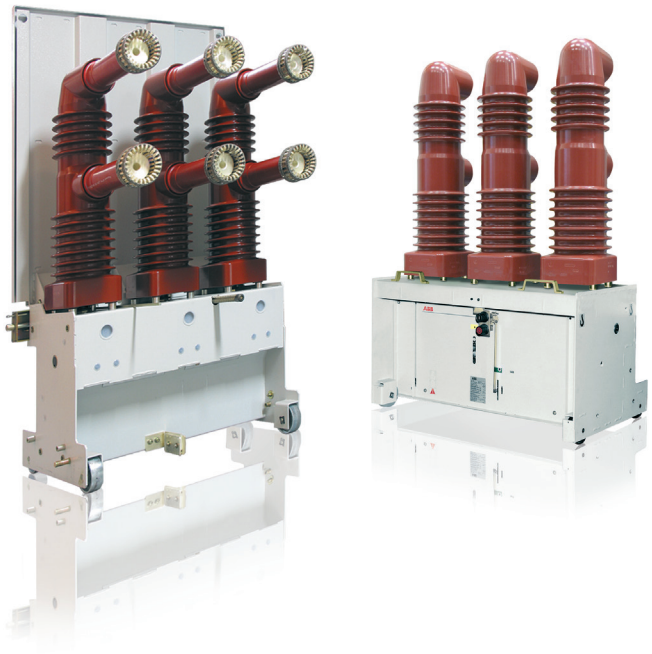
Instruction manual

VD4
Vacuum circuit-breaker – 36/40.5 kV

Contents



Power and productivity
for a better world™

Your safety first – always!

That's why our instruction manual begins with these recommendations:

- Only install switchgear and/or switchboards in enclosed rooms suitable for electrical equipment.
- Ensure that installation, operation and maintenance are carried out by specialist electricians only.
- Comply in full with the legally recognized standards (DIN VDE/IEC), the connection conditions of the local electrical utility and the applicable safety at work regulations.
- Observe the relevant information in the instruction manual for all actions involving switchgear and switchboards.
-  Danger!

  Pay special attention to the hazard notes in the instruction manual marked with this warning symbol.
- Make sure that under operation condition of the switchgear or switchboard the specified data are not exceeded.
- Keep the instruction manual accessible to all persons concerned with installation, operation and maintenance.
- The user's personnel are to act responsibly in all matters affecting safety at work and the correct handling of the switchgear.
- Always observe the five safety rules set out in EN 50110 on establishing and securing the off-circuit condition at the place of work for the duration of work on the switchgear.
  - Isolate
  - Secure to prevent reconnection
  - Check the off-circuit condition
  - Earth and short-circuit
  - Cover the guard off adjacent live parts

If you have any further questions on this instruction manual, the members of our field organization will be pleased to provide the required information.

Contents

1 Summary

1.1 General

Vacuum circuit-breakers of type VD4 are intended for indoor installation in air-insulated switchgear.
The circuit-breakers of column design with a rated voltage of 36 kV and 40.5 kV were developed both for fixed installation and for installation on a withdrawable assembly. The circuit-breakers for fixed installation also have trucks.
Vacuum circuit-breakers have particular advantages for use in networks where there is a high switching frequency in the working current range and/or where a certain number of short-circuit breaking operations are expected. Type VD4 vacuum circuit-breakers are suitable for autoreclosing, and have exceptionally high operating reliability and long life.

1.2 Standards and specifications

1.2.1 Switchgear manufacture

The switchgear complies with the following specifications in accordance with DIN VDE and the relevant IEC publications respectively:

– VDE 0670, Part 1000 and IEC 60694
– VDE 0671, Part 100 and IEC 62271-100

1.2.2 Installation and operation

The relevant specifications are to be taken into account during installation and operation, particularly:

– DIN VDE 0101, Power installations exceeding AC 1 kV
– VDE 0105, operation of electrical installations
– DIN VDE 0141, earthing systems for special power installations with rated voltages over 1 kV

Accident prevention regulations issued by the appropriate professional bodies or comparable organisations.

In Germany, these comprise the following safety regulations:

– Health and Safety at Work standards BGV A1 and BGV A3
– Safety guidelines for auxiliary and operating materials
– Order related details provided by ABB.

1.3 Operating conditions

1.3.1 Normal operating conditions

– Design to VDE 0670 Part 1000, “Common specifications for high-voltage switchgear and controlgear standards” and IEC publication 60694, with the following limit values:
– Ambient temperature:
– Maximum [1]:
  - Rated current 1250 A + 55 °C
  - Rated current 1600 A + 55 °C
  - Rated current 2000 A + 55 °C
  - Rated current 2500 A + 40 °C
  - Rated current 2500 A + 55 °C
    (VD4 with forced ventilation (fan cooling) and assembled pole on withdrawable part)
  - Rated current 3150 A + 40 °C
    (VD4 with forced ventilation fan cooling) and assembled pole on withdrawable part)
– Minimum (in accordance with “minus 5 indoor” class) – 5 °C
– Humidity:
  - Average value of relative humidity, measured over a period of 24 h, max. 95%
  - Average value of water vapour pressure over a period of 24 h, max. 2,2 kPa
  - Average value of relative humidity, measured over a period of one month, max. 90%
  - Average value of water vapour pressure over a period of one month, max. 1,8 kPa
  - Site altitude:
    ≤ 1000 m above sea level

1.3.2 Special operating conditions

Special operating conditions are to be agreed on by the manufacturer and user. The manufacturer must be consulted in advance about each special operating condition:

– Site altitude over 1000 m:
  - Allow for the reduction in the dielectric strength of the air.
– Increased ambient temperature:
  - Current carrying capacity is reduced.
  - Provide additional ventilation for heat dissipation.
– Climate:
  - Avoid the risk of corrosion or other impairments in areas:
    - with high humidity, and/or
    - with major rapid temperature fluctuations.
  - Implement preventive measures (e.g. electrical heaters) to prevent condensation phenomena.

1) All the data on the vacuum circuit-breakers presented below are based on results of tests with standard ABB panels. When used with other panels, corresponding tests are required at the customer’s responsibility.

2 Technical data

2.1 Technical data

Circuit-breakers for fixed installation and on withdrawable part

Rated voltage	kV	36 / 40.5	36 / 40.5
Rated frequency	Hz	50/60	50/60
Rated lightning impulse withstand voltage	kV	190	200 [7]
Rated power frequency withstand voltage	kV	95	95
Rate of rise of transient recovery voltage	kV/µs	0.57 / 0.69	0.57 / 0.69
Peak of ransient recovery voltage	kV	62 / 70	62 / 70
Rated operating sequence		O-3min-CO-3min-CO	
Rated operating sequence with auto-reclosing		O-0.3s-CO-3min-CO	

Breaker type	Rated voltage	Rated current	Rated short-circuit breaking current symm. [1]	Rated short-circuit breaking current asymm. [1]	Rated short-circuit breaking current (peak) [1]	Rated short-circuit duration	Poles centres		Weight		Permissible operating cycles of the vacuum interrupters
							fixed	with-drawable	fixed	with-drawable	
VD4..	kV	A	kA	kA	kA	s	mm		approx. kg		Fig. 2/1 page 9/10
3606-16	36	630 [3]	16	17.4	40	4	360	280	320	290	Diagram A
3612-16	36	1250 [3]							320	290	Diagram A
3606-20	36	630 [3]	20	21.8	50	4	360	280	320	290	Diagram B
3612-20	36	1250 [3]							320	290	Diagram B
3612-25	36	1250 [3]	25	27.3	63	4	360	280	320	290	Diagram C
3616-25	36	1600 [3]							320	290	Diagram C
3620-25	36	2000 [3]							355	340	Diagram C
3625-25	36	2500 [4] [5]							355	340	Diagram C
3631-25	36	3150 [6]				3		280		290	Diagram F
3612-31	36	1250 [3]	31.5	34.3	80	4	360	280	320	290	Diagram D
3616-31	36	1600 [3]							320	290	Diagram D
3620-31	36	2000 [3]							355	340	Diagram D
3625-31	36	2500 [4] [5]							355	340	Diagram D
3631-31	36	3150 [6]				3		280		290	Diagram G
3612-40	36	1250 [3] [7]	40	43.6	100	4	360	280	330	300	Diagram E
3616-40	36	1600 [3] [7]							330	300	Diagram E
3620-40	36	2000 [3] [7]							365	350	Diagram E
3625-40	36	2500 [4] [5] [7]							365	350	Diagram E
4006-16	40.5	630 [3]	16	17.4	40	4	360	280	320	290	Diagram A
4012-16	40.5	1250 [3]							320	290	Diagram A
4006-20	40.5	630 [3]	20	21.8	50	4	360	280	320	290	Diagram B
4012-20	40.5	1250 [3]							320	290	Diagram B
4012-25	40.5	1250 [3]	25	27.3	63	4	360	280	320	290	Diagram C
4016-25	40.5	1600 [3]							320	290	Diagram C
4020-25	40.5	2000 [3]							355	340	Diagram C
4025-25	40.5	2500 [4] [5]							355	340	Diagram C
4031-25	40.5	3150 [6]				3		280		290	Diagram F
4012-31	40.5	1250 [3]	31.5	34.3	80	4	360	280	320	290	Diagram D
4016-31	40.5	1600 [3]							320	290	Diagram D
4020-31	40.5	2000 [3]							355	340	Diagram D
4025-31	40.5	2500 [4] [5]							355	340	Diagram D
4031-31	40.5	3150 [6]				3		280		290	Diagram G
4012-40	40.5	1250 [3] [7]	40	43.6	100	4	360	280	330	300	Diagram E
4016-40	40.5	1600 [3] [7]							330	300	Diagram E
4020-40	40.5	2000 [3] [7]							365	350	Diagram E
4025-40	40.5	2500 [4] [5] [7]							365	350	Diagram E

Guideline values for function times at the rated supply voltage:

Closing time	approx.	60 ms
Opening time	≤	45 ms
Arcing time (at 50 Hz)	≤	15 ms
Total break time	≤	60 ms
Minimum command time on closing	20 ms	(120 ms [2])
Minimum command time on opening	20 ms	(80 ms [2])

[1] When the operating voltage is lower than the rated voltage the same values apply as for rated voltage. Higher values on request.
[2] If the activating relay contact cannot itself interrupt the release coil current
[3] Ambient temperature ≤ 55 °C
[4] Ambient temperature ≤ 40 °C
[5] Rated current 2500 A at 55 °C ambient temperature (VD4 with forced ventilation (fan ccoling) and assembled poles on withdrawable part)
[6] Rated current 3150 A at 40 °C ambient temperature (VD4 with forced ventilation (fan cooling) and assembled poles on withdrawable part)
[7]

Closing time	approx. 60 ms
Opening time	≤ 60 … 90 ms
Arcing time (at 50 Hz)	≤ 15 ms
Total break time	≤ 75 … 105 ms
Minimum command time on closing	20 ms (120 ms [2])
Minimum command time on opening	60 ms
Minimum command time on opening, if the activating relay cannot itself interrupt the release coil current	120 ms

2.2 Technical data
Releases and blocking magnet

Equipment		Power consumption [1]	
		AC VA	DC W
Shunt release OFF	-MO1 [3], -MO2 [3]	250	250
	-MO1 [5], -MO2 [5]	310	310
Shunt release ON	-MC [3],	250	250
	-MC [5]	310	310
Blocking magnet	-RL1 [3]	10	10
Undervoltage release			
- undelayed [3] [5]	-MU [3] [5]	11	10
- delayed [4]		10	–
Indirect overcurrent release with intermediate current transformer			
- two phase	-MO3	3.5 [2] /15	–
- three phase		2.0 [2] /15	–

2.3 Technical data
Motor-operated mechanisms

Groschopp motor

Rated power supply V	Power consumption [1] VA/W	Motor protection (ABB Stotz m.c.b.) A	Charging time (max.) [6] s
AC			
110	260	1.6 S 281UC-K	10
220	260	0.75	10
240	260	0.75	10
DC			
24	230	6.0 S 282 UC-K	12
48	240	4.0 S 282 UC-K	10
60	240	3.0 S 282 UC-K	10
110	230	1.6	10
125	260	1.6	10
220	240	0.75	10
240	260	0.75	10

[1] Approximate values
[2] With short-circuited intermediate current transformer.
[3] Rated supply voltage AC: 110 and 220 V
DC: 24, 48, 60,110 and 220 V
Other voltages on request.
[4] See RN3U for supply voltage
[5] Rated supply voltage AC: 240 V
DC: 125 and 240 V
[6] At rated supply voltage

2.4 Permissible number of vacuum interrupter operating cycles in relation to breaking current

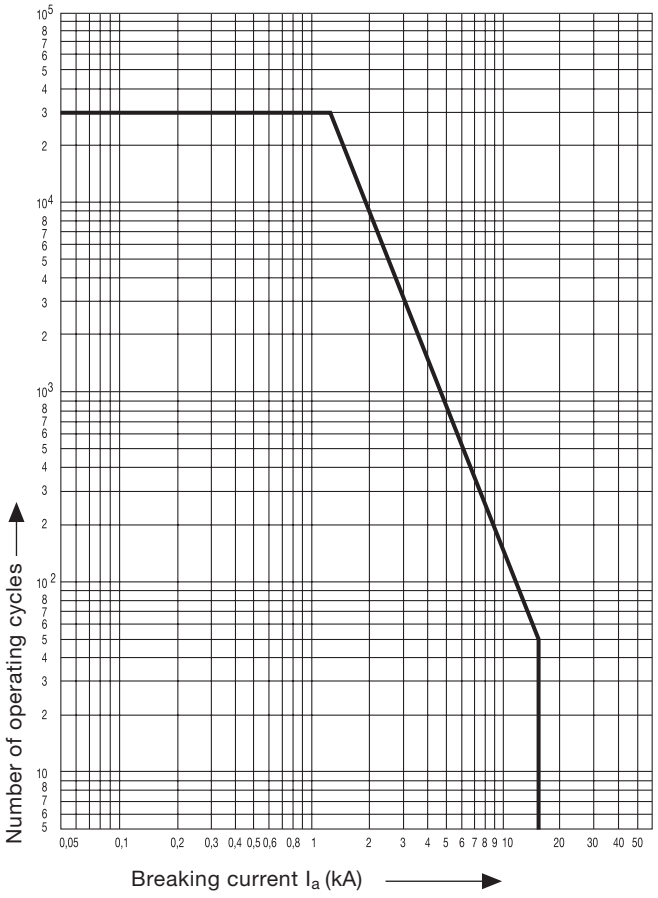


Diagram A)

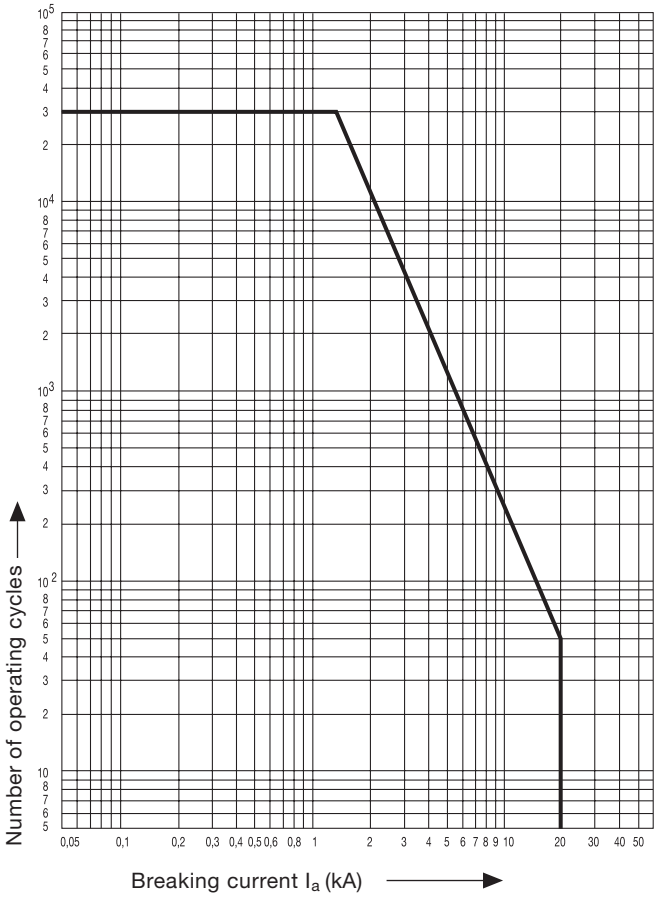


Diagram B)

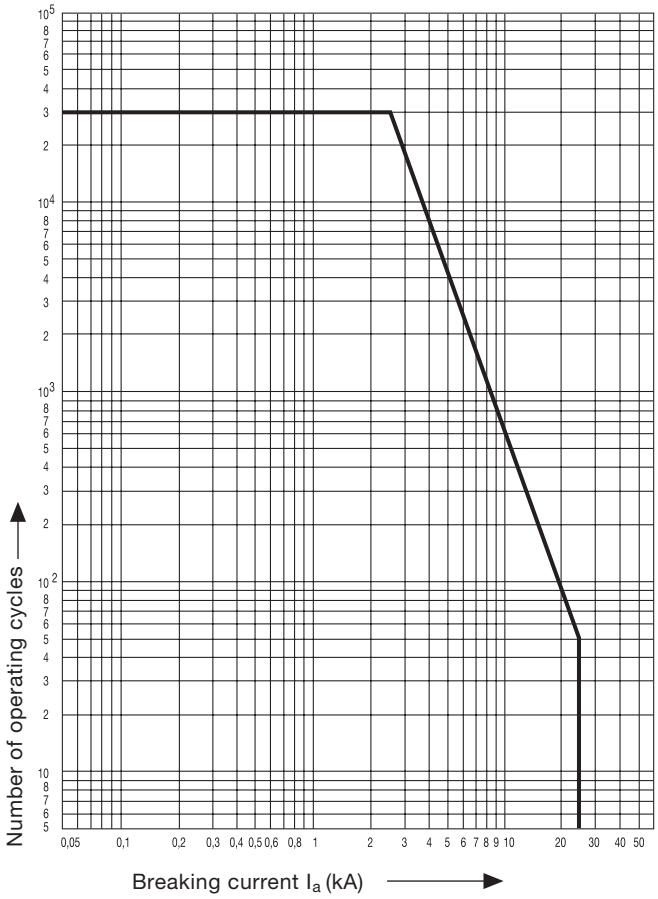


Diagram C)

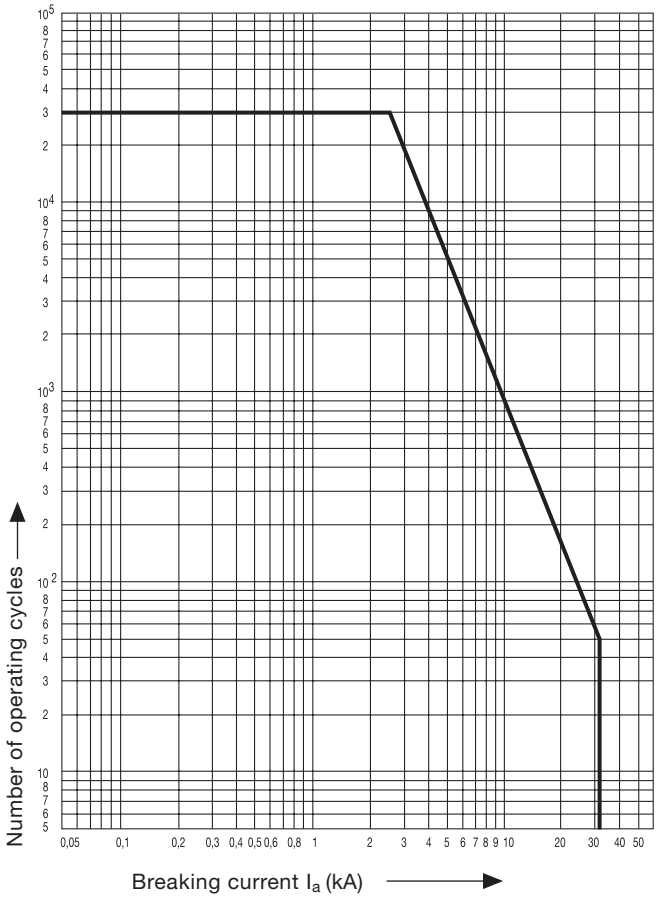


Diagram D)

Figure 2/1: Permissible number of vacuum interrupter operating cycles n as a function of the breaking current I_a.

2.4 Permissible number of vacuum interrupter operating cycles in relation to breaking current

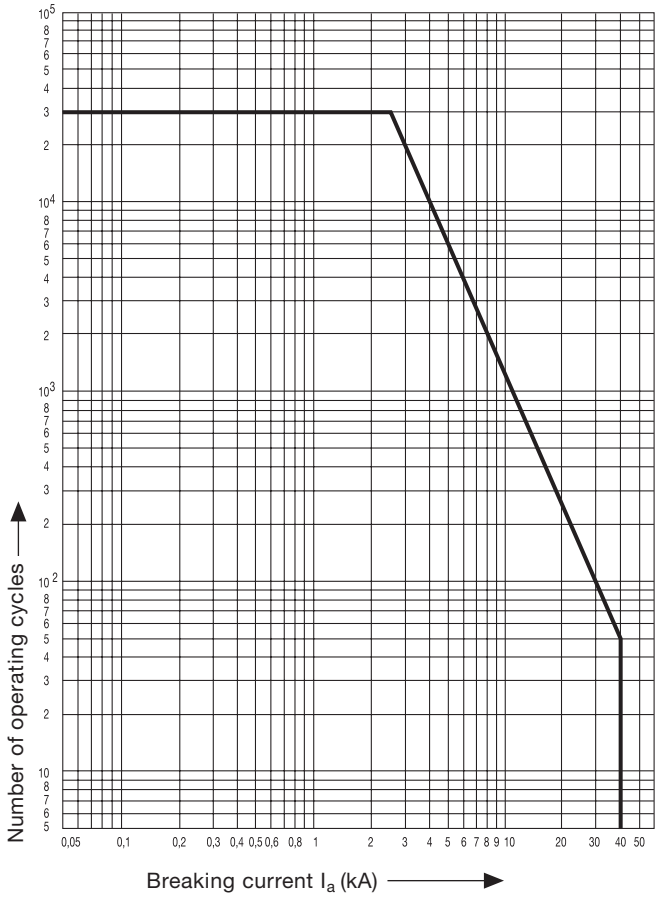


Diagram E)

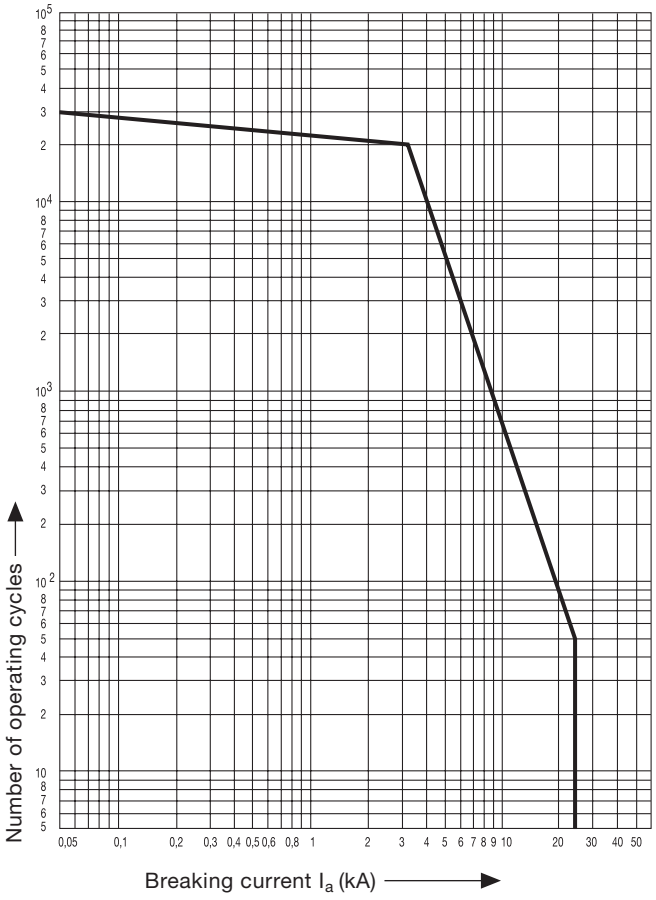


Diagram F)

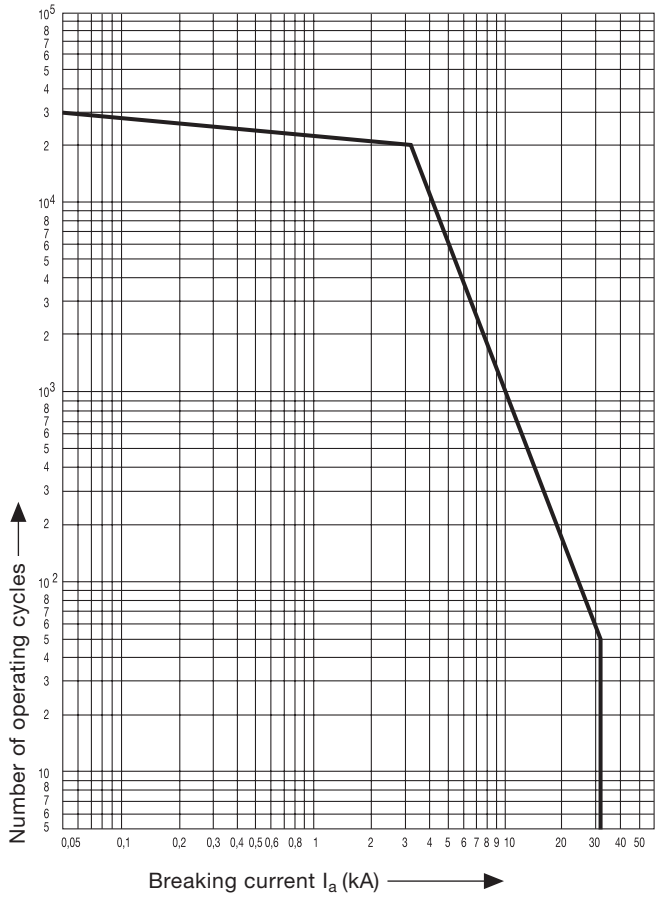


Diagram G)

Figure 2/1: Permissible number of vacuum interrupter operating cycles n as a function of the breaking current Ia. (Assignment see section 2.1 and 2.2 – Technical data page 7 and 8)

2.5 Dimensions

2.5.1 Dimensions – Circuit-breakers for fixed installation

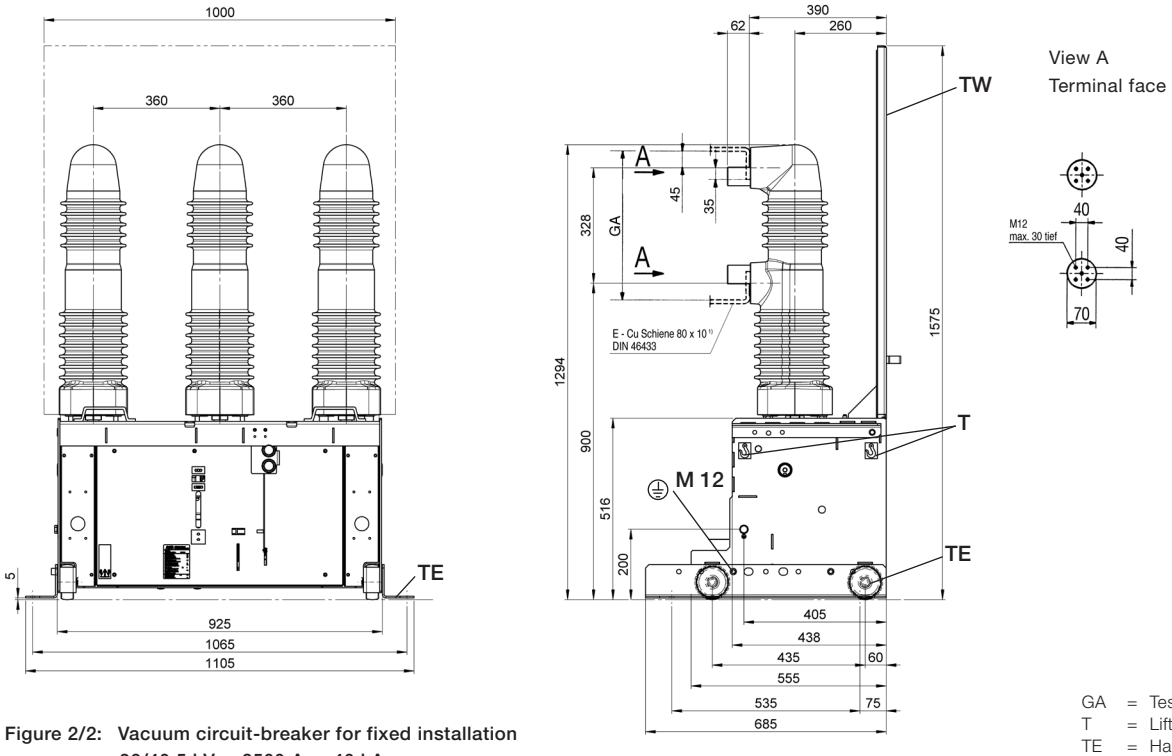
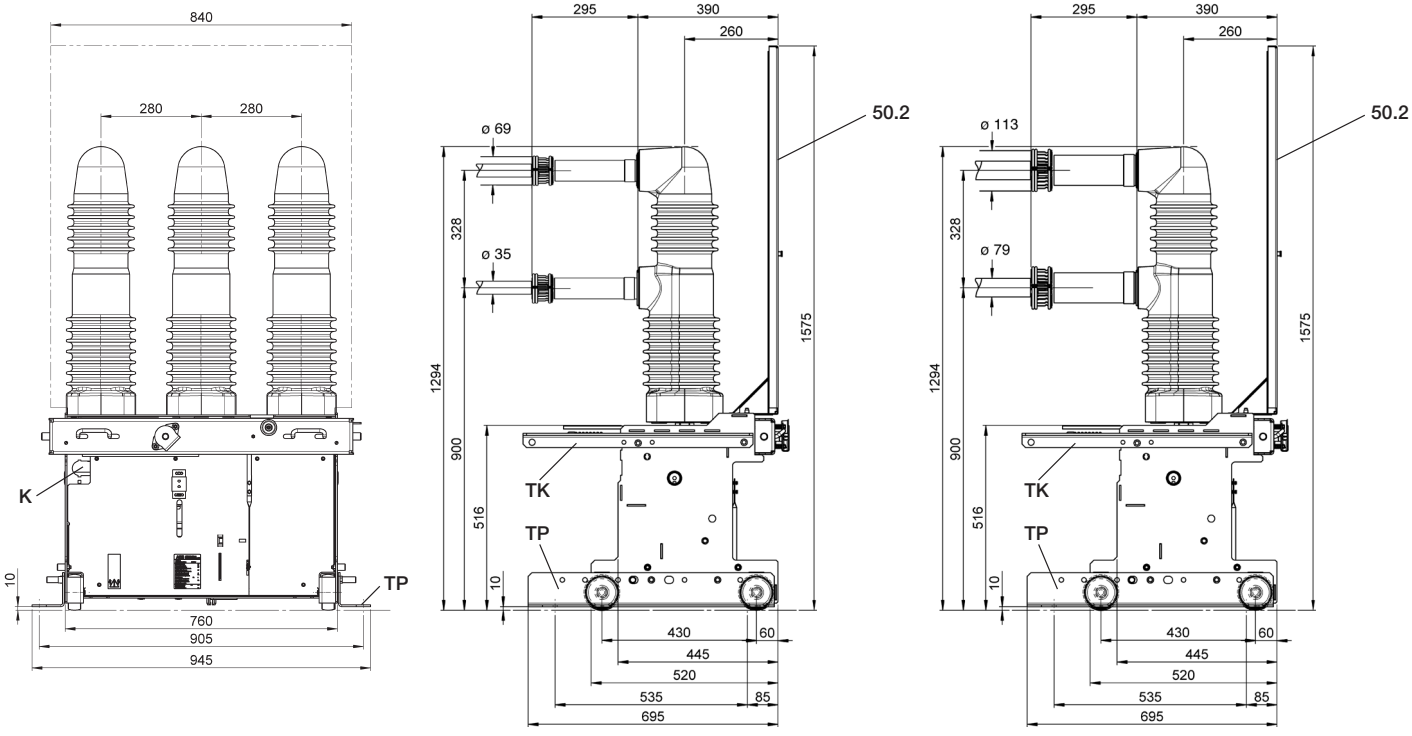


Figure 2/2: Vacuum circuit-breaker for fixed installation 36/40.5 kV, ...2500 A, ...40 kA

1) ...1250 A = 1 x 80 x 10 mm
> 1250 A...2000 A = 2 x 80 x 10 mm
2500 A = 3 x 80 x 10 mm

GA = Tested terminal zone
T = Lifting lug
TE = Handling unit (required for movement on rollers 50.8)
TW = Partition, if specially ordered
⏚ = Earthing conductor connection. Use contact washer.

2.5.2 Dimensions – Circuit-breakers on withdrawable parts



Contact arm up to 1600 A

Contact arm up to 3150 A
with fan cooling 2500 A up to 3150 A

Figure 2/3: Vacuum circuit-breaker on withdrawable part, 36/40.5 kV, ...2500 A, ...40 kA

TK = Transport bracket 147
TP = Transport profile 148
K = Entrance for control cables
50.2 = Front partition plate

Note:

Transport bracket TK (147) and transport profile TP (148) only fitted for handling. Remove and store prior to commissioning.

2.5 Dimensions

2.5.3 Dimensions – Circuit-breakers on withdrawable parts

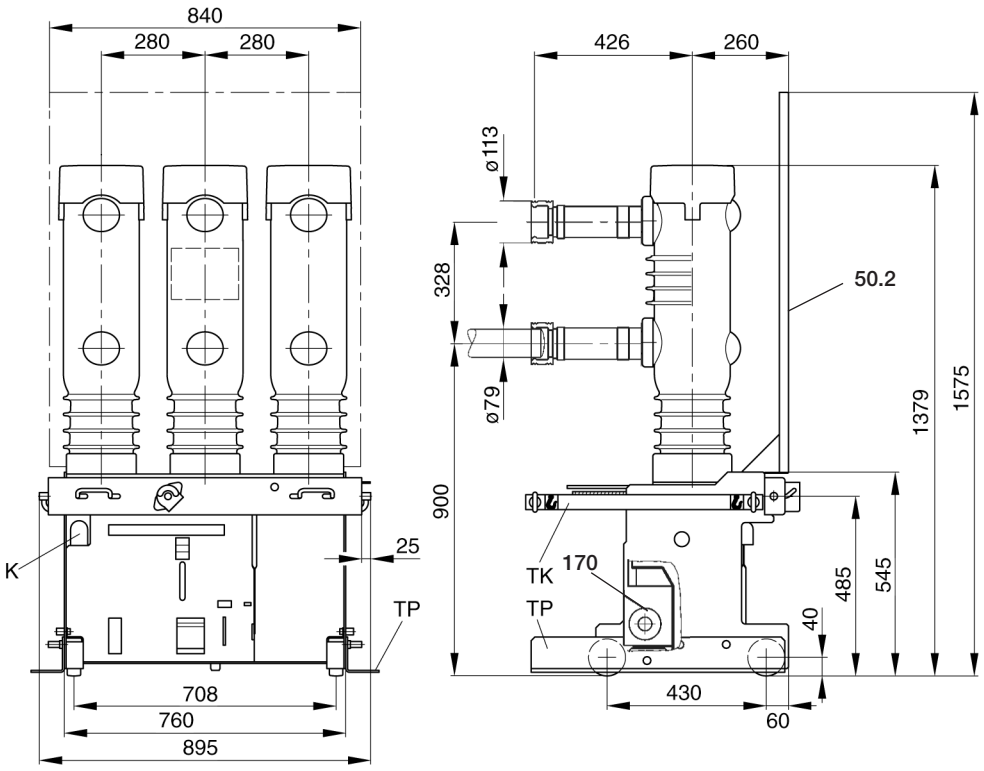


Figure 2/4: 36/40.5 kV Vacuum circuit-breaker, type VD4 with forced ventilation (fan) and assembled components on withdrawable part
2500 A at 55 °C ambient temperature
3150 A, 25/31.5 kA at 40 °C ambient temperature

TK = Transport bracket 147
TP = Transport profile 148
K = Entrance for control cables
50.2 = Front partition plate
170 = Fan cooling

3 Structure and function

3.1 Structure of the breaking poles

(Figures 3/1 to 3/6)

The circuit-breakers with a rated voltage of 36 kV and 40.5 kV were developed both for fixed installation and for installation on a withdrawable assembly. The circuit-breakers for fixed installation also have trucks.

The poles, which are constructed in column form, are mounted on a torsionally rigid enclosure substructure with rollers. The live parts of the breaker poles are embedded in epoxy resin and protected from impacts and other external influences.

In circuit-breakers for 2500 A (55 °C) and 3150 A, the live parts of the breaker poles are located in pole tubes of insulating material to protect them from impacts and other external influences.

With the breaker closed, the current path leads from the upper contact arm 57.1 to the fixed contact 58.2 in the vacuum interrupter 58, then via the moving contact 58.3 and the contact system to the lower breaker terminal or contact arm 57.2. The switching motion is effected by means of the insulated coupling rod with internal contact force springs.

The basic structure of a vacuum interrupter is explained in figure 3/10.

3.2 Structure of the breaker operating mechanism

(Figures 3/4, 3/7, 3/8, 6/1 to 6/6, 7/1 to 7/5, 7/9, 7/10)

The operating mechanism located in the housing substructure 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 storage mechanism.

The stored-energy spring mechanism essentially consists of drum 55.33 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 releases, auxiliary switches and the controls and instruments.

The operating mechanism is fundamentally suitable for auto-reclosing and, due to the short charging times, also for multi-shot autoreclosing.

The operating mechanism is normally fitted with a charging motor. There is also a facility for charging the stored-energy spring manually.

There is one rating plate 55.7 with the main data of the circuit-breaker on front cover plate left hand side 50.7, and another on the breaker mechanism housing.

The **basic version** of the stored-energy spring mechanism is fitted with the following auxiliary equipment:

- Shunt releas OFF -MO1
- Five-pole auxiliary switch -BB2 for annunciation purposes
- Auxiliary switch -BB4 for fault annunciation
- Mechanical ON push-button [1)]
- Mechanical OFF push-button [1)]
- ON-OFF operating shaft 54 [2)]
- Mechanical switch position indicator 55.4
- Charging condition indicator 55.8 for the stored-energy spring
- Mechanical operating cycle counter 55.5.

The following additional equipment can be installed:

- Blocking magnet -RL2 on the withdrawable part 2)
- Blocking magnet -RL1 with auxiliary switch -BL1
- Shunt release ON -MS
- Second shunt release OFF -MO2
- Indirect overcurrent release -MO3
- Undervoltage release -MU
- Five-pole auxiliary switches -BB1 and -BB3
- Charging motor -MS
- Five-pole auxiliary switch -BS1 to switch the charging motor
- Anti-pumping relay -KN

3.2.1 Releases, blocking magnet and auxiliary switches

(Figures 7/1 to 7/3, 7/9, 7/10)

The releases and the blocking magnet are mounted at the bottom of the stored-energy spring mechanism.

The allocation of the auxiliary switches can be seen in the wiring diagrams of figures 7/9 and 7/10.

The five-pole auxiliary switch -BS1 is operated by the charging condition indicator 55.8. It controls the charging motor -MS, serves as an electrical interlock for shunt release ON -MC when the spring-energy storage mechanism is not sufficiently charged, and also provides an electrical switching readiness signal.

Operation of the five-pole auxiliary switches -BB1, -BB2 and BB3 is dependent on the switching position of the circuit-breaker.

Auxiliary switch -BB1 interrupts the circuit of the optional additional shunt release OFF -MO2 with the circuit-breaker in the open position, and the circuits of shunt release ON -MC and the optional blocking magnet -RL1 with the circuit-breaker in the closed position. There is one further NOC for other purposes.

Auxiliary switch -BB2 interrupts the circuit of shunt release OFF -MO1 with the circuit-breaker in the open position. One further NOC and three NCCs are available for annunciation, control and interlock purposes.

[1)] For breakers for fixed installation only

[2)] For breakers on withdrawable parts only

Auxiliary switch -BB3 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 figures 7/9 and 7/10.
The single pole auxiliary switch -BB4 (fleeting contact time ≥ 30 ms) serves to provide a fault signal ("breaker released").
With remote control, the auxiliary switch is necessarily operated via:
– Shunt release OFF -MO1 or
– Shunt release OFF -MO2 or
– Undervoltage release -MU or
– Indirect overcurrent release -MO3.

Note:
1. Shunt releases OFF (-MO1) and ON (-MC) are exclusively provided for opening and closing in normal operation.
   For safety breaking operations, the second shunt release OFF (-MO2) 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 (-MU) and/or indirect overcurrent release (-MO3) are pure safety and protection releases and must **not** be used for switching in normal operation.

3.3 Function

3.3.1 Charging of the stored-energy spring
(Figur es 3/4, 3/7, 6/1, 6/2, 6/7,7/2, 7/3, 7/9 and 7/10)
To provide the necessary motive energy, the spring-energy storage mechanism is charged via chain 55.34 fitted with ratchet wheel 55.35, either automatically by a charging motor or by hand in a vertical pumping action with charging lever 128. The current charging condition is shown at charging condition indicator 55.8.
As a precondition for an autoreclosing 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.

3.3.2 Closing procedure
(Figures 3/4, 3/7, 6/1, 6/3, 6/4, 6/7, 7/2 and 7/3)
The closing process is initiated manually using mechanical ON push-button 54.2 (for fixed installation breakers) or triple bit key 145 on the ON-OFF operating shaft 54 (for breakers on withdrawable parts), or electrically by activation of shunt release ON -MC. The release mechanism then permits drive shaft 55.30 to be rotated by the (previously) charged stored-energy spring.
The moving contact 58.3 in vacuum interrupter 58 is moved until the contacts touch by the cam and further kinematic links.
In the further sequence of motion, the spring arrangement is tensioned and the appropriate amount of contact force thus applied. The available overtravel is higher than the maximum value of contact erosion during the life of the interrupter.
During the closing process, the opening springs are simultaneously tensioned.

3.3.3 Opening procedure
(Figures 3/4, 3/7, 6/1 and 6/4)
The opening process is initiated using mechanical OFF push-button 54.3 (for fixed installation breakers) or triple bit key 145 on the ON-OFF operating shaft 54 (for breakers on withdrawable parts), or electrically by activating one of releases -MO1, -MU, -MO3 oder -MO2.
Observe the notes in section 3.2.1 on control of the releases.
The release mechanism then permits drive shaft 55.30 to be turned further by the spring-energy storage mechanism, which is still sufficiently charged. The opening spring, which is thus released, moves the contact 58.3 into the open position at a defined speed.

3.3.4 Auto-reclosing sequence
An OFF-ON or OFF-ON-OFF autoreclosing sequence is activated and checked by the protection system. It is necessary for the stored-energy 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 failed). 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.

3.3.5 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 vacuum 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.

Figure 3/1: Vacuum circuit-breaker, type VD4, for fixed installation, operating side

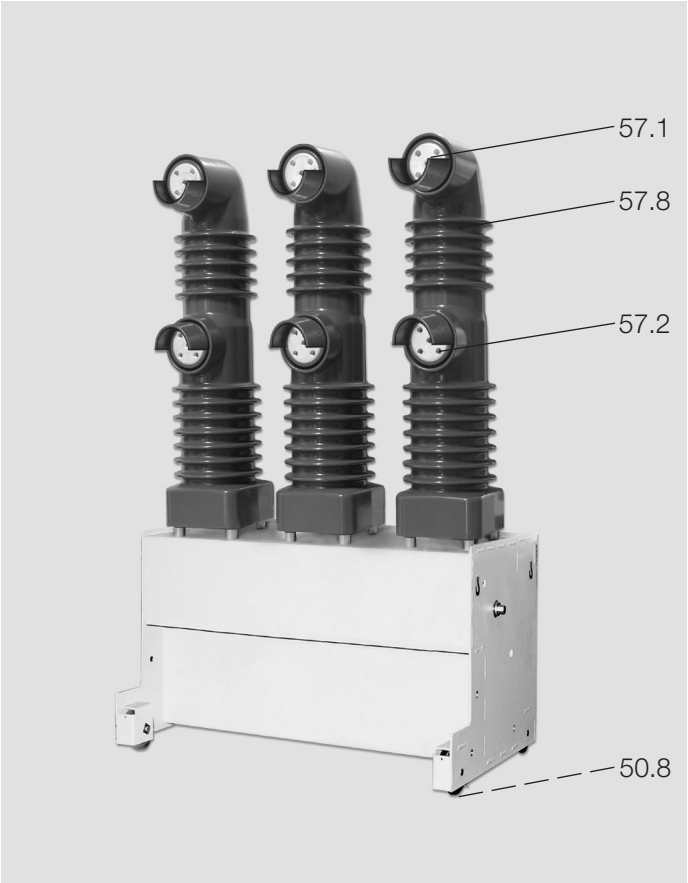


Figure 3/2: Vacuum circuit-breaker, type VD4, for fixed installation, terminal side

50.8 Rollers
57.1 Upper breaker terminal
57.2 Lower breaker terminal
57.8 Embedded pole

Figure 3/3: Vacuum circuit-breaker, type VD4, for fixed installation, version with partititon, terminal side

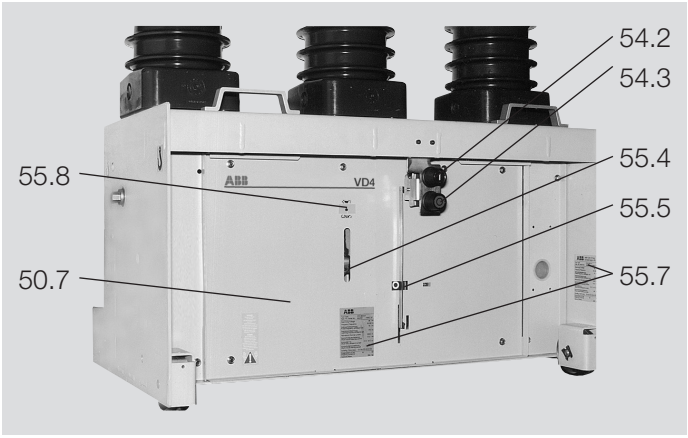


Figure 3/4: Indicators and control on a circuit-breaker for fixed installation

50.7 Front plate
54.2 Mechanical ON push-button
54.3 Mechanical OFF push-button
55.4 Mechanical switch position indicator
55.5 Mechanical operating cycle counter
55.6 Socket (for charging lever)
55.7 Rating plate
55.8 Charging condition indicator

Figure 3/5: Vacuum circuit-breaker, type VD4, on withdrawable part, operating mechanism side

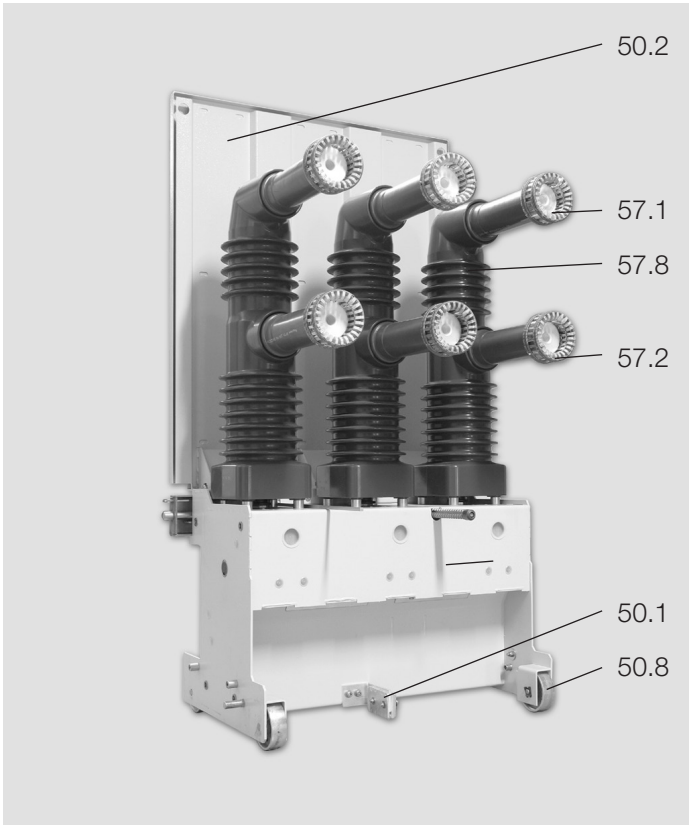


Figure 3/6: Vacuum circuit-breaker, type VD4, on withdrawable part, pole side

50.1	Earthing contact	57.1	Upper contact arm
50.2	Front partition plate	57.2	Lower contact arm
50.8	Rollers	57.8	Embedded pole

Figure 3/7: Vacuum circuit-breaker, type VD4, with assembled poles and forced ventilation (fan), on withdrawable part, operating mechanism side
2500 A at 55 °C
3150 A, 25/31.5 kA at 40 °C

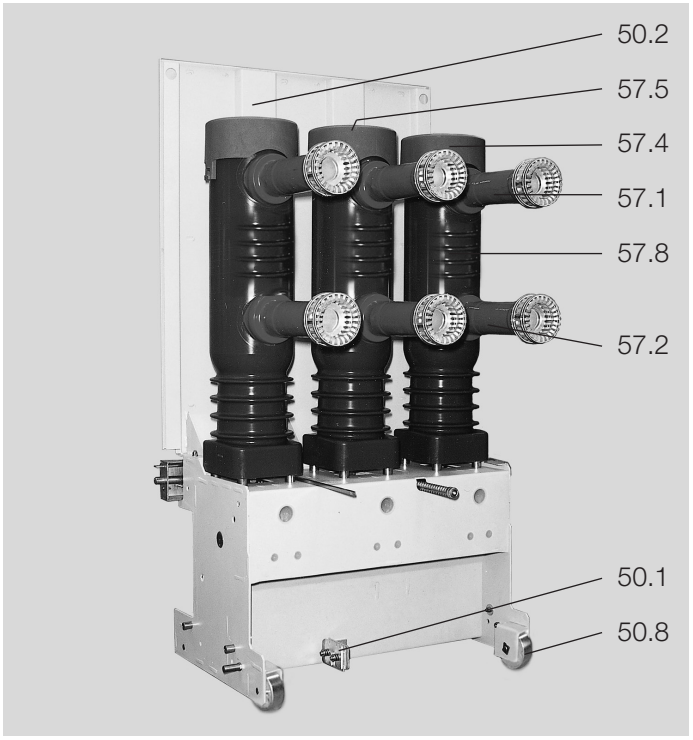


Figure 3/8: Vacuum circuit-breaker, type VD4 with assembled poles and forced ventilation (fan), on withdrawable part, pole side, 2500 A at 55 °C - 3150 A, 25/31.5 kA at 40 °C

50.1	Earthing contact	57.4	Pole tube cap
50.2	Front partition plate	57.5	Transport plug
50.8	Rollers		(not visible in illustration)
57.1	Upper contact arm	57.8	Pole tube
57.2	Lower contact arm		

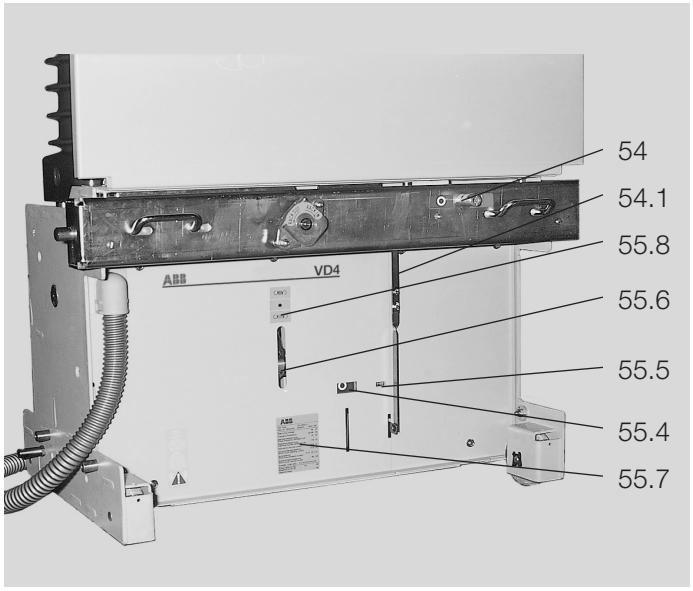


Figure 3/9: Withdrawable part with circuit-breaker, type VD4, controls for the circuit-breaker

54 ON-OFF operating shaft
54.1 Link rod
55.4 Sweitch position indicator
55.5 Operating cacle counter
55.6 Socket (for charging lever)
55.7 Rating plate
55.8 Charging condition indicator

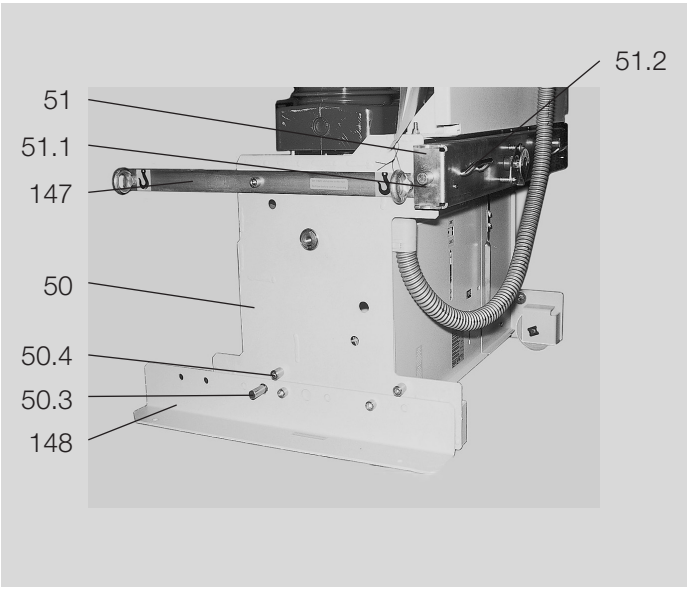


Figure 3/10: Circuit-breaker, type VD4, on withdrawable part, mechanism side viewed from the left

50 Frame of the withdrawable part
50.3 Actuating pin
50.4 Guide cam
51 Interlock yoke
51.1 Catch pin, (spring-loaded)
51.2 Sliding handle
147 Transport bracket
148 Transport profile

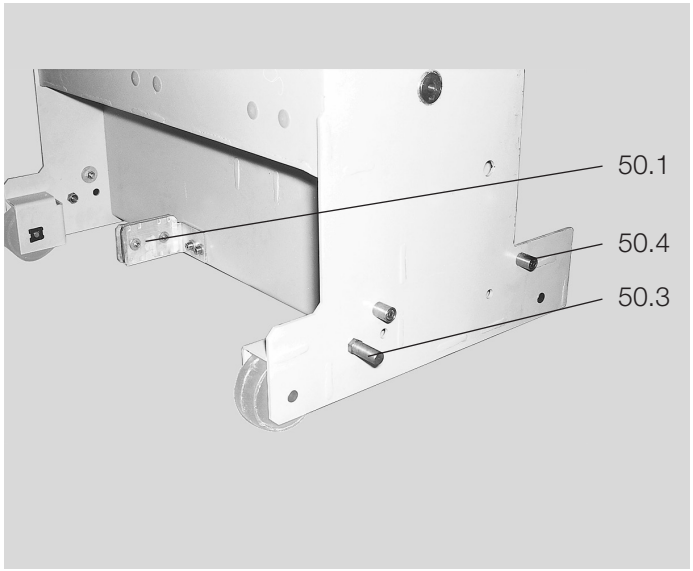


Figure 3/11: Vacuum circuit-breaker, type VD4, on withdrawable part, pole side, bottom

50.1 Earthing contact
50.3 Actuating pin (for hinged shutters)
50.4 Guide cam

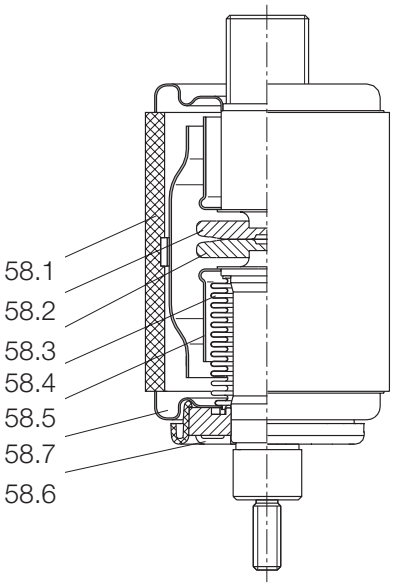


Figure 3/12: Partial section of a vacuum interrupter (58), simplified schematic diagram.
(Details vary according to the specified switching duties)

58.1 Insulator
58.2 Fixed contact
58.3 Moving contact
58.4 Metal bellows
58.5 Screen
58.6 Guide
58.7 Lid

4 Despatch and storage

4.1 Condition on delivery

The factory-assembled circuit-breakers 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 60694, thus verifying their correct structure and function.

4.2 Packaging

The circuit-breakers are mounted individually on wooden pallets 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.

4.3 Transport

(Figures 2/2, 2/3, 3/3, 3/6, 4/1 and 4/2)

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

– crane,
– Fork-lift and/or
– trolley jack.

Notes:

– 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. Consult the illustrations for positions of the lifting bores or lifting lugs.
– n moving the withdrawable part only use the sliding handles 51.2 (e.g. for racking the circuit-breaker unit into/out of the switchgear panel or for transport of the unit in the switchgear room). Never apply force to the front partition plate 50.2!
– Take care that the catch pins 51.1 on the interlock yoke 51 are engaged with the guide rails 51.3 in the panel when moving the circuit-breaker unit into the panel.
– When handling on rollers 50.8, handling unit TE (for breakers for fixed installation) or transport profiles 148 (for breakers on withdrawable parts) must be fitted (see figures 2/2 and 2/3).
– Only handle the modules by crane with bolted on transport brackets 147, suitable lifting ropes and a crane harness.

– Ensure that the circuit-breaker unit on the withdrawable part, with its high centre of gravity, cannot tip over when moving it by fork lift truck, or when handling it outside the switchgear.

4.4 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 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.

4.5 Intermediate storage

Intermediate storage of the circuit-breaker units in the switch position OFF and with 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.
– Room temperature which does not fall below – 5 °C.
– Do not remove or damage the packaging.

– Unpackaged devices:
  - Loosely cover 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 intermediate storage is to continue.

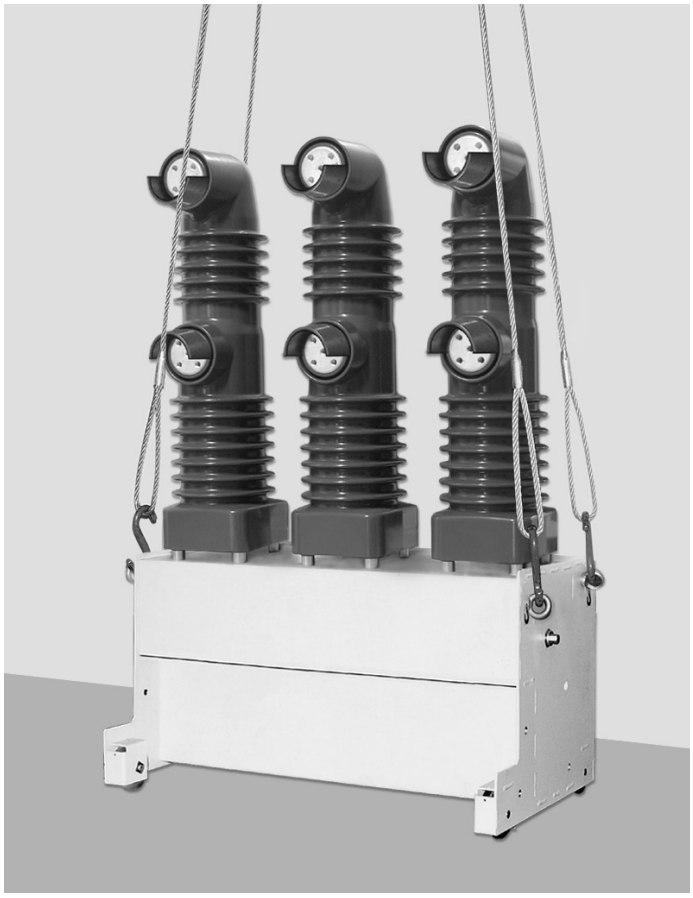


Figure 4/1: **VD4 breaker for fixed installation**

Only handle by crane when the lifting lugs are fitted. Always bear in mind that the high situated centre of gravity may induce the breaker to tip over!

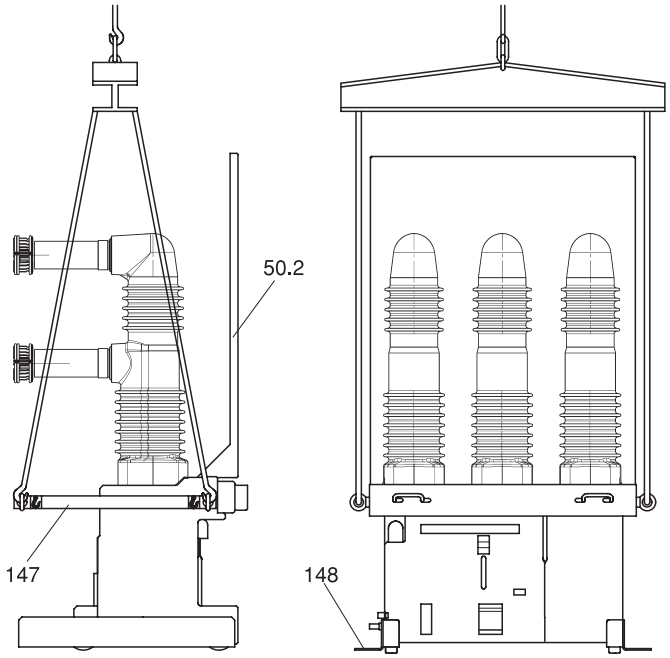


Figure 4/2: **VD4 breaker on withdrawable part**

Only handle by crane when the transport bracket 147 and crane harness are fitted. Always bear in mind that the high situated centre of gravity may induce the breaker to tip over!

50.2 Front partition plate (do not stress this plate)
147 Transport bracket (TK)
148 Transport profile (TP)

5 Installation

5.1 Assembly/installation of the circuit-breaker for fixed installation

Careful and professional installation of the switching devices is one of the fundamental conditions of trouble-free circuit-breaker operation:

– Remove handling unit TE and lifting lugs T if fitted (figure 2/2).
– Install the breaker housing in the panel without tension or distortion. The brackets of handling unit TE can also be used to fasten the breaker to the switchroom floor.
– Connect the main terminals without any permanent tension or pressure forces, exerted for example by the conductor bars.
– When connecting the conductor bars, the bolts must be inserted to the depth shown on the dimensional drawing.
– Take account of any tested terminal zone.
– Use DIN bolts of tensile class 8.8, fastening conductor bars together with dished washers.
– Make a short-circuit proof connection between the PE conductor and the main earthing bar in the switchgear, using contact washers.
– Remove any dirt. See also section 7.3.1.

	Recommended rated tightening torque [1) 2)] Nm	
	Lubricant [3)]	
Thread	**none (dry)**	**Oil or grease**
M 6	10.5	4.5
M 8	26	10
M 10	50	20
M 12	86	40
M 16	200	80

1) Rated tightening torques for fasteners without lubrication are based on the thread friction coefficient 0.14 (the actual values of which are subject to unavoidable, in some cases not insignificant, spread).
2) Rated tightening torques for fasteners with lubrication in accordance with DIN 43673.
3) Thread and contact face of head lubricated.

Take account of any tightening torques which deviate from the general table (e.g. for contact systems or device terminals) as stated in the detailed technical documentation. It is recommended that the threads or head contact surfaces of the bolts be lightly oiled or greased, so as to achieve a precisely defined rated tightening torque.

5.2 Assembly/installation of the circuit-breaker on a withdrawable part (Figures 3/8 and 4/2)

Perfect operation of the circuit-breaker depends on careful and professional handling of the withdrawable part:

– Allocate each unit to the appropriate panel in accordance with the switchgear plan and the rated electrical data.
– Remove the transport profiles 148 and transport brackets 147.
– Remove any dirt (see also section 7.3.1)
– Insert the withdrawable part into the panel. (See section 4.3.)
  Check for unimpeded motion and function sequences, including the closing of primary contacts, when the service position is reached.
– For further actions, see the instruction manual for the switchgear panels.

When the switchgear is operated in areas with high humidity and/or major rapid temperature fluctuations, there is a risk of frequent dew deposits. Action should be taken in accordance with section 1.3.2 (Special operating conditions).

6 Commissioning / Operation (Fig. 3/3, 3/6, 6/1 ÷ 6/7)

6.1 Note on safety at work

– The switchgear may only be operated by specially trained personnel who are familiar with the characteristics of the particular device.
– Observe the relevant instructions in section 1.2.
– Due to safety reasons, the circuit-breaker has to be treated as “switched on” if the switching position can not be 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 damage and restore to the proper condition where necessary.
– Remove any contamination (particularly on the insulating materials) which has occurred during transit, storage or installation.
– Check the primary and secondary connections and the earthing contact 50.1.
– Check the charging motor on circuit-breakers with motor-operated mechanisms by applying auxiliary voltage. The stored-energy spring is charged.
– On breakers with manual charging mechanisms, charge the stored-energy spring by hand (see section 6.3.1).
– Perform test closing and opening operations by pressing push-buttons 54.2 and 54.3 (for fixed installation breakers) or using the triple bit key 145 at the ON-OFF operating shaft 54 (for breakers on withdrawable parts), taking into account any required supply voltage and any relevant interlocks. Observe switch position indicator 55.4 and charging condition indicator 55.8.
– Ensure that the instruction manual is available to the operators at all times.
– The further procedure results from the interaction of the truck with the switchgear panel (see the operation manual for switchgears).

6.3 Operation of the circuit-breaker

(Figures 6/1 to 6/4 and 6/7)

6.3.1 Charging the stored-energy spring
Circuit-breakers with charging motors:
– Charging takes place automatically.
– If the charging motor breaks down, the charging process can be carried out or completed manually.

Circuit-breakers with manual charging mechanisms:
– Insert charging lever 128 into socket 55.6 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.

The following note applies to breakers on withdrawable parts:
Charging of the spring-energy storage mechanism by hand (on breakers with charging motors) should only take place when the withdrawable part is in the test/disconnected or removed position.
Key to the charging condition indications:

Discharged  Charged 

As a precondition for an autoreclosing 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
Vacuum circuit-breaker type VD4, for fixed installation
Closing:
– Press mechanical ON push-button 54.2, or operate the electrical control unit.
Opening:
– Press mechanical OFF push-button 54.3, or operate the electrical control unit.
Vacuum circuit-breaker type VD4, on withdrawable part
– Operate the local or remote electrical control unit.
– Observe switch position indicator 55.4.

The mechanical control system facilitates manual operation of the circuit-breaker in the panel with the door closed:
– Fit triple bit key 145 to ON-OFF operating shaft 54
– Turn the triple bit key approx. 15° clockwise until the stop is reached to close the circuit-breaker, or anti-clockwise to open it.

See also the note in section 3.2.1.

The operating cycle counter 55.5 is automatically incremented by one complete figure with each switching cycle. On completion of a switching operation the switch position indicator 55.4 in the window of front cover plate 50.7 shows the appropriate position of the circuit-breaker.
The anti-pumping relay K0 (wiring diagram in figure 7/8) 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.

6.3.3 Run-on block

When any irregularities occur in the internal control mechanism or with the charging function of the spring-energy storage mechanism, the run-on block stops 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.

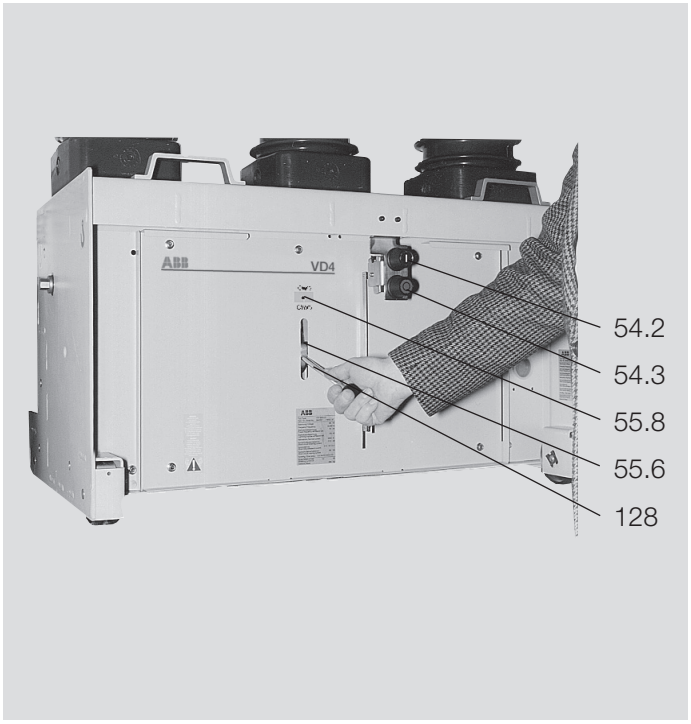


Figure 6/1: Vacuum circuit-breaker, type VD4, for fixed installation. Manual charging of the stored-energy spring

54.2 Mechanical ON push-button
54.3 Mechanical OFF push-button
55.6 Socket
55.8 Charging condition indicator
128 Charging lever

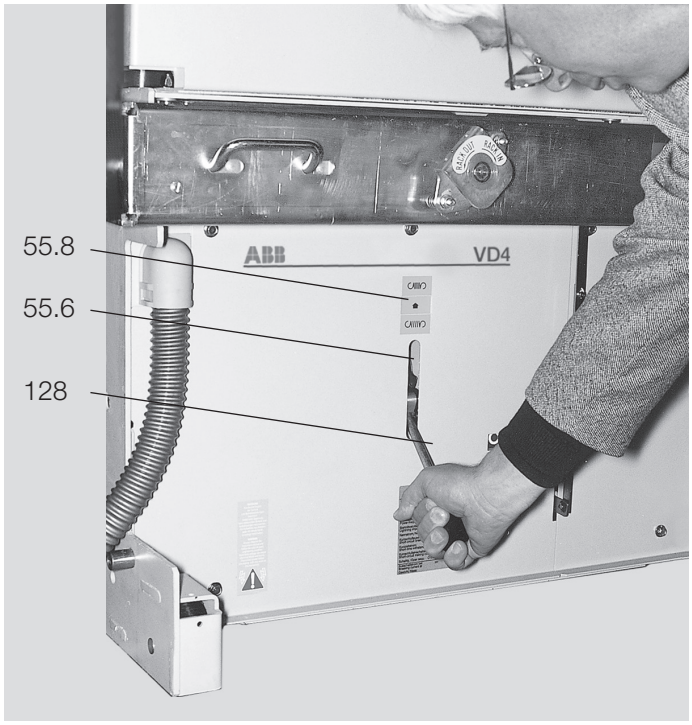


Figure 6/2: Vacuum circuit-breaker, type VD4, on withdrawable part. Manual charging of the stored-energy spring

55.6 Socket (for charging lever)
55.8 Charging condition indicator
128 Charging lever

Figure 6/3: Circuit-breaker, type VD4, on withdrawable part. Control area

50 Frame of the withdrawable part
50.4 Guide cam
50.6 Cover plate, right hand side
50.7 Cover plate, left hand side
51 Interlock yoke
51.1 Catch oin, spring-loaded
51.2 Sliding handle, connected to the catch system in the interlock yoke
52 Spindle
54.1 Link rod
55.4 Switch position indicator
55.5 Operating cycle counter
55.7 Rating plate

Figure 6/4: Manual operation of the circuit-breaker, by turning the triple bit key:
approx. 15° clockwise ON
approx. 15° anti-clockwise OFF
54 ON-OFF operating shaft
145 Triple bit key (ON-OFF operation)

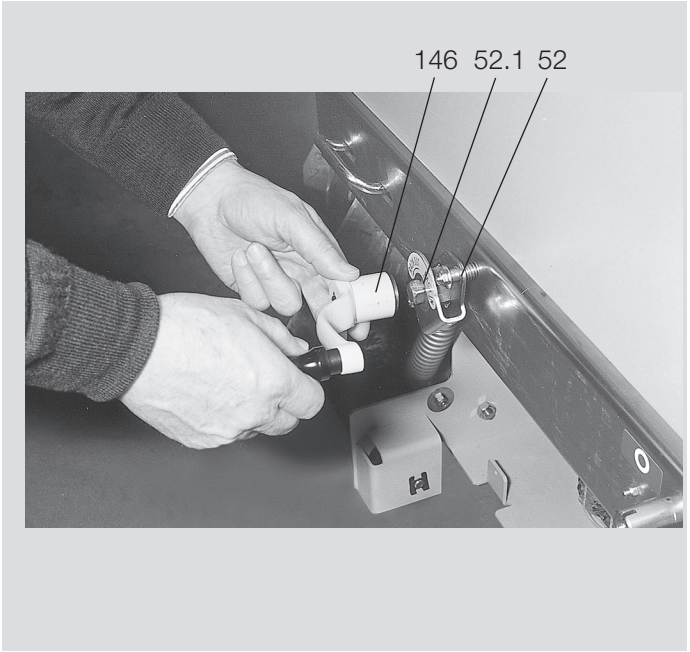


Figure 6/5: Fitting the hand crank (against a spring-loaded plate)
– clockwise into the service position
– anti-clockwise from the service position into the test/disconnected position
52 Spindle
52.1 Square spigot
146 Hand crank

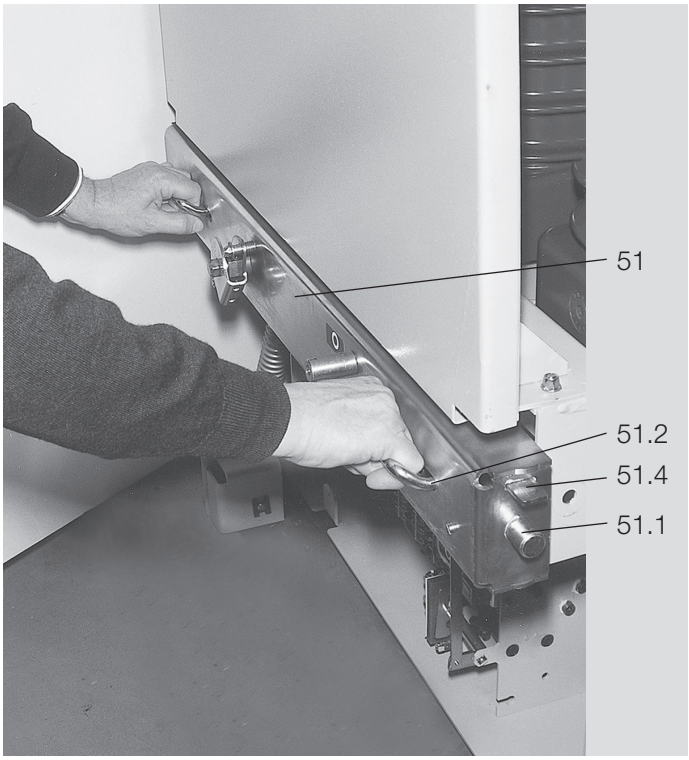


Figure 6/6: Interlock yoke with sliding handles moved inwards for withdrawal of the withdrawable part or insertion into the panel
51 Interlock yoke
51.1 Catch pin, spring-loaded
51.2 Sliding handle
51.4 Sectional rod / interlock between circuit-breaker and earthing switch

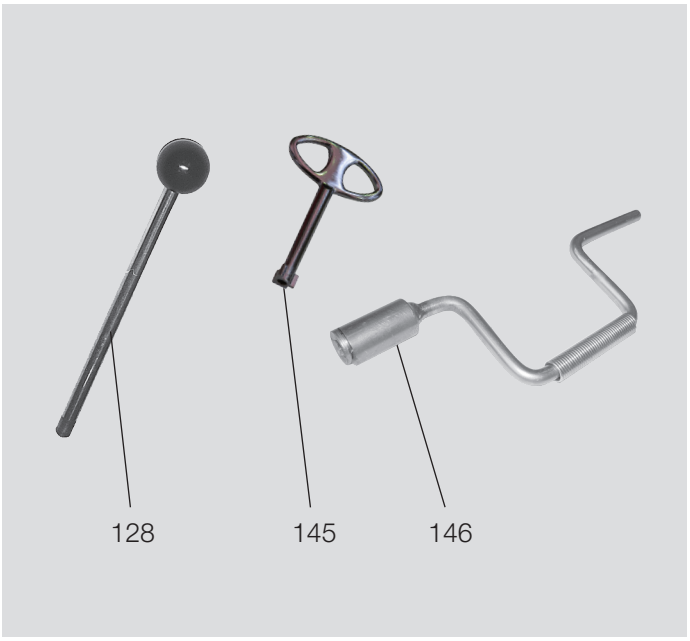


Figure 6/7: Operating accessories
128 Charging lever
145 Triple bit key
146 Hand crank

7 Maintenance

Maintenance serves to ensure trouble-free operation and achive the longest possible service life of the switchgear.
In accordance with DIN 31 051 / IEC 61208 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

(Figure 7/4)

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 service life. There is no adverse effect on the vacuum, even from frequent switching of operating and short-circuit currents or purely mechanical switching operations.
The servicing intervals and scope are determined by environmental influences, the switching frequency and number of short-circuit breaking operations.
With carefully performed inspections and servicing work, and under normal operating conditions, the circuit-breakers, depending on the type, have a service life of up to 30.000 operating cycles and more.

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 auxiliary voltage sources must also be disconnected and secured to prevent reconnection inasfar as the work to be performed permits.

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 cover plates 50.6 and 50.7 removed.
The spiral spring in the spring-energy storage mechanism, 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!

7.2 Inspection and functional testing

7.2.1 Switching device in general

The proper condition of the switching device is to be verified by regular inspection.
Under normal operating conditions, inspection by a specially trained electrician is to be performed at least every 4 years (in accordance with BGV A 3 standard).
In unusual operating conditions (including adverse climatic conditions) and/or special environmental pollution (e.g. heavy contamination and aggressive atmosphere), inspection may also be necessary at shorter intervals.
Inspection at fixed intervals may be waived if the switchgear is permanently monitored by a qualified electrician.
The checks first and foremost comprise visual examination for contamination, corrosion, moisture and discharge phenomena.
If an incorrect condition is found, appropriate servicing measures are to initiated.

7.2.2 Stored-energy spring mechanism

(Figures 7/1, 7/2, 7/3, and 7/5)

Functional testing of the operating mechanism is to be performed:
– after 5000 operating cycles or
– during servicing work as set out in 7.2.1.

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.
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 mechanism by ON/OFF switching operations.
– Visually examine the condition of the lubrication on rotary bearings, sliding surfaces, etc.
– Check the proper mechanical/electrical sequence of the individual functions.

Further additional tests for breakers on withdrawable parts

7.2.3 Checking the auxiliary switch settings on withdrawable parts (Figures 6/5, 6/7, 7/5 and 7/11)

Compliance with the interlock conditions in the areas of the test/disconnected position and the service position is ensured by auxiliary switches -BT2 and -BT1, located in the breaker's mechanism housing and set at the works.
In test operations, the withdrawable part must be moved by hand with crank 146 fitted.

1. Settings in the area of the test/disconnected position
– Move the withdrawable part out of the test/disconnected position towards the service position with a few turns of the crank.
– Slowly move the withdrawable part back to the stop.
– Slowly insert the withdrawable part from the test/disconnected position towards the service position until auxiliary switch -BT2 just operates.
  In this position, it must still just be possible to move closing push rod 55.2. For this test, the function of the blocking magnet -RL2 (if fitted) must be deactivated manually.
  This condition ensures that the electrical interlock takes effect before the mechanical interlock in the motion sequence involved.

2. Settings in the area of the service position
– Move the withdrawable part out of the limit position towards the test/disconnected position with a few turns of the crank.
– Slowly move the withdrawable part forwards again to the stop.

7.2.4 Testing of interlock conditions (Figures 6/5, 6/7, 7/4, 7/5 and 7/11)

Testing procedures for the withdrawable part.

1. The withdrawable part must only be movable from the test/disconnected position into the service position when the circuit-breaker is open and the earthing switch is open.
   Check the following conditions individually:
   – With the circuit-breaker closed, insertion of the withdrawable part towards the service position must be blocked after only half a turn of the crank in the clockwise direction.
   – With the earthing switch closed, insertion of the withdrawable part towards the service position must be blocked after only two clockwise turns of the crank.

Do not use force!

2. The withdrawable part must only be movable from the service position into the test/disconnected position with the circuit-breaker open.
   Check this condition as follows:
   – With the circuit-breaker closed, withdrawal movement of the withdrawable part must be blocked after only half a turn of the crank in the anti-clockwise direction.

3. Closing of the circuit-breaker must only be possible when the withdrawable part is in the defined (until stop) test/disconnected position or service position.
   The control wiring plug (10.2) must previously have been inserted.
   Check this condition as follows:
   – It must not be possible to close the circuit-breaker with the withdrawable part in any position between the test/disconnected position and the service position.
   – Enabling of switching when the withdrawable part moves into the service position is effected electrically by operation of auxiliary switch -BT1 in the withdrawable part.
   – For motion into the test/disconnected position, the same enabling conditions apply analogously, in this case by means of auxiliary switch -BT2 in the withdrawable part.

4. It must only be possible to open the circuit-breaker (manually) when the withdrawable part is in the service position or test/disconnected position and the control voltage has failed.
   Check this condition.

5. Withdrawable parts with order-related blocking magnet -RL2 may not be moved in the case of control power failure, or when there is no control power. Do not forcibly move blocked withdrawable parts!
   Releasing the blocking magnet -RL2:
   – Remove front cover plates 50.6 and 50.7.
   – Disengage blocking magnet -RL2 by pulling the magnet armature
   – While doing so, turn crank 146 about one half turn (either direction of rotation is permissible).
   The blocking magnet is only active in the test position and service position. In intermediate positions it has no effect.

6. Disconnection of the control wiring plug 10.2 as well as later insertion must be blocked when the withdrawable part is in the service position.
   Check this condition.

7.2.5 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 reconnection 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 Rivolta BWR 210.
– Cleaning of the insulating material surfaces and conductive components:
  - Light contamination: with Rivolta BWR 210.
  - Strongly adhering contamination: with cold cleanser 716. Wipe down after cleaning, using clean water, and dry carefully.
– Observe the manufacturer's instructions and the special ABB instruction manuals BA 1002/E or BA 1006/E on safety at work.

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
Servicing of the spring mechanism is to be performed after 10,000 operating cycles.
Prior to servicing, switch the breaker off, and isolate the outgoing feeder.
Observe the safety regulations!

Scope of servicing:

– Switch off the charging motor (if fitted) and discharge the spring mechanism by ON/OFF switching operations.
– Replace parts subject to high climatic and mechanical stresses as a precaution.
– For replacement of highly stressed parts, neutralize the basic tension of the spiral spring. Record the amount of basic tension. Take care when performing this operation!
– 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 restore the basic tension of the stored-energy spring.
– Perform comprehensive mechanical and electrical functional tests.
– Ensure that the bolted joints at the contact locations of the conductor bar system and the earthing connections are tight.

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

7.3.3 Breaker pole
The breaker pole with the vacuum interrupter is maintenance-free until the permissible number of vacuum interrupter operating cycles in accordance with section 2.4 is reached.
When the permissible number of operating cycles as a function of the breaking current has been reached, the complete breaker poles are to be replaced.
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.
Checking of the vacuum as required.
If the quality of the vacuum is to be demonstrated (without dismantling the circuit-breaker), a vacuum tester can be used.
– VIDAR vacuum tester

The following test voltages must be set for testing of the internal pressure in the vacuum interrupter with the VIDAR vacuum tester:

Rated voltage	DC test voltage at the circuit-breaker
... 17.5 kV	40 kV
24 ... 40.5 kV	60 kV

The test is to be performed at rated contact distance with the switching device off.

Procedure for testing the vacuum interrupters in switching devices:
– Isolate the working area in accordance with the safety regulations specified by DIN VDE/IEC and secure it to prevent reconnection.
– Secure the VD4 circuit-breaker.
– Earth all poles of the VD4 circuit-breaker on one side.
– Connect the earthed test leads of the VIDAR vacuum tester conductively to the system earth.
– Connect the high voltage test lead of the VIDAR vacuum tester to phase L1 on the unearthed pole side and test the vacuum interrupter with the contact gap open. Proceed in the same manner for phases L2 and L3.

Connected cables can lead to a “defective” indication on the vacuum tester due to their cable capacitance. In such cases, remove the cables.

Note:
The above mentioned work may only be performed by the after-sales service personnel from ABB or adequately trained personnel, as work directly in and on the circuit-breaker is required.

7.4 Repairs

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, the working area has been properly isolated and secured against reconnection and the stored-energy spring mechanism has been discharged.
All auxiliary voltage sources must also be disconnected and secured against reconnection during the removal and installation work.

7.4.2 Touching up surfaces
– Sheet steel parts, painted:
  - Remove rust, e.g. with a wire brush.
  - Grind off paint coat and degrease.
  - Apply anti-rust primer and top coat.
– Sheet steel parts with aluminium-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.

7.4.3 Replacement of the isolating contact systems of circuit-breakers on withdrawable parts (Figures 7/6 to 7/9)
– Draw the two internal annular tension springs 57.6 facing the breaker pole forwards beside the two external annular tension springs 57.7, and remove the contact system 57.3/57.13 thus released from the isolating contact arm.
– Slide a new contact system onto the thin end of auxiliary arbor 127/130, rear side first, and move it along onto the thicker part of the shaft.
– Insert the journal 127.1/130.1 on auxiliary arbor 127/130 into the relevant isolating contact arm, slide the contact system 57.3/57.13 over onto the isolating contact arm and withdraw the arbor.
– Check the correct fit of all contact fingers and annular tension springs.
– Grease the isolating contact system with Isoflex Topas NB 52.

Note:
The set position of the isolating contact arms must not be changed by the exertion of excessive force.

7.5 Spare parts and auxiliary materials

7.5.1 Spare parts

Designation	Breaker type VD4..	Rated voltage kV	Rated current A	Rated short-circuit breaking current, symmetrical kA	Part no. (Order ref.)
Breaker pole, complete (embedded poles)	3612-25	36	1250	25	1VB7000401 R0101 [1]
	3616-25		1600		1VB7000401 R0101 [1]
	3620-25		2000		1VB7000401 R0101 [1]
	3625-25		2500		1VB7000401 R0103 [2] [4]
	3612-31		1250	31.5	1VB7000401 R0101 [1]
	3616-31		1600		1VB7000401 R0101 [1]
	3620-31		2000		1VB7000401 R0101 [1]
	3625-31		2500		1VB7000401 R0103 [2] [4]
	3612-40		1250	40	1VB7000401 R0104 [1]
	3616-40		1600		1VB7000401 R0104 [1]
	3620-40		2000		1VB7000401 R0104 [1]
	3625-40		2500		1VB7000401 R0105 [2] [4]
	4012-25	40.5	1250	25	1VB7000401 R0101 [1]
	4016-25		1600		1VB7000401 R0101 [1]
	4020-25		2000		1VB7000401 R0101 [1]
	4025-25		2500		1VB7000401 R0103 [2] [4]
	4012-31		1250	31.5	1VB7000401 R0101 [1]
	4016-31		1600		1VB7000401 R0101 [1]
	4020-31		2000		1VB7000401 R0101 [1]
	4025-31		2500		1VB7000401 R0103 [2] [4]
	4012-40		1250	40	1VB7000401 R0104 [1]
	4016-40		1600		1VB7000401 R0104 [1]
	4020-40		2000		1VB7000401 R0104 [1]
	4025-40		2500		1VB7000401 R0105 [2] [4]
Breaker pole, complete (embedded poles)	3631-25 [3]	36	3150	25	GCE7002270 R0116
	3631-31 [3]		3150	31.5	GCE7002270 R0116
	4031-25 [3]	40.5	3150	25	GCE7002270 R0114
	4031-31 [3]		3150	31.5	GCE7002270 R0114

[1] At ambient temperature ≤ 55 °C
[2] At ambient temperature ≤ 40 °C
[3] 3150 A circuit-breaker only permissible for ambient temperature up to 40 °C
[4] 2500 A, 36 kV (55 °C) with assembled pole GCE7002270 R0116
2500 A, 40.5 kV (55 °C) with assembled pole GCE7002270 R0114

Designation	Iterm no.	Rated voltage	Part no. (order code)
Auxiliary switch	-BS1		GCE7002397R0122
(with clamp-type terminal)	-BB1		GCE7002397R0121
	-BB2		GCE7002397R0122
	-BB3		GCE7002397R01..[1]
Auxiliary switch on blocking magnet	-BL1		GCE7003022P0101
Auxiliary switch for fault annunciation	-BB4		GCE0905121P0100
1st shunt release OFF	-MO1		GCE7004590P01..[2]
2nd shunt release OFF	-MO2		GCE7004590P01..[2]
Shunt release ON	-MC		GCE7004590P01..[2]
Blocking magnet	-RL1		GCE9478103P01..[2]
Undervoltage release with energy store	-MU		GCE9371466R01..[2]
Delayed undervoltage release with energy store	-MU		GCE9371466R01..[2]
Indirect overcurrent release with intermediate current transformer and energy store	-MO3		GCE9371466R0112
Intermediate current transformer for indirect overcurrent release			GCE9476148R0100
Magnet holder (with integrated rectifiers -TR4, -TR1, -TR3, -TR2)			GCE7000880R0111
Series rectifier	-TR6		GCE7004046R0101
Charging motor (with gearbox)	-MS	24 V ... 240 V	GCE0940084P....[3]
Receptable 4.8-2.5 for tab thickness 0.8 (for all additional external connections)			DIN 46247 sheet 2

[1] State contact arrangement
[2] State the type of release and voltage
[3] State rated supply voltage, serial no. of breaker (on type plate) and manufacturer of the motor

7.5.2 Auxiliary materials

Lubrificant:		
Isoflex Topas NB 52		GCE0007249P0100

Halogen-free cleaning agents:		
Rivolta BWR 210,	(for general cleaning)	GCE0007707P0100
Relevant ABB instruction manual BA1002 E		GCEA901002P0101
Cold cleaner 716	(for conductive parts, parts in insulating material, and all parts with heavy contamination)	GCE0007706P0100
Relevant ABB instruction manual BA 1006 E		GCEA901006P0101

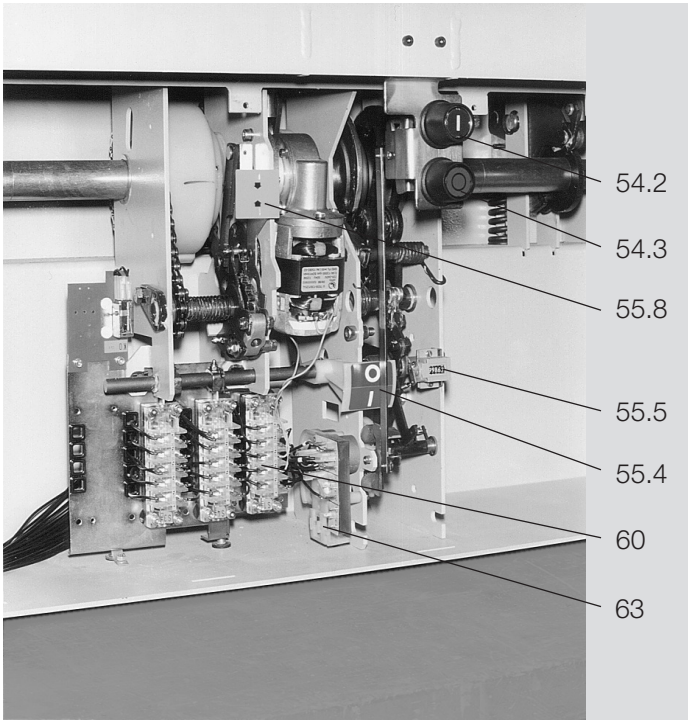


Figure 7/1: Vacuum circuit-breaker, type VD4, for fixed installation, stored-energy spring mechanism, front panel removed

54.2 Mechanical ON push-button
54.3 Mechanical OFF push-button
55.4 Mechanical switch position indicator
55.5 Mechanical operating cycle counter
55.8 Charging condition indicator
60 Auxiliary switch block
63 Magnet holder, complete

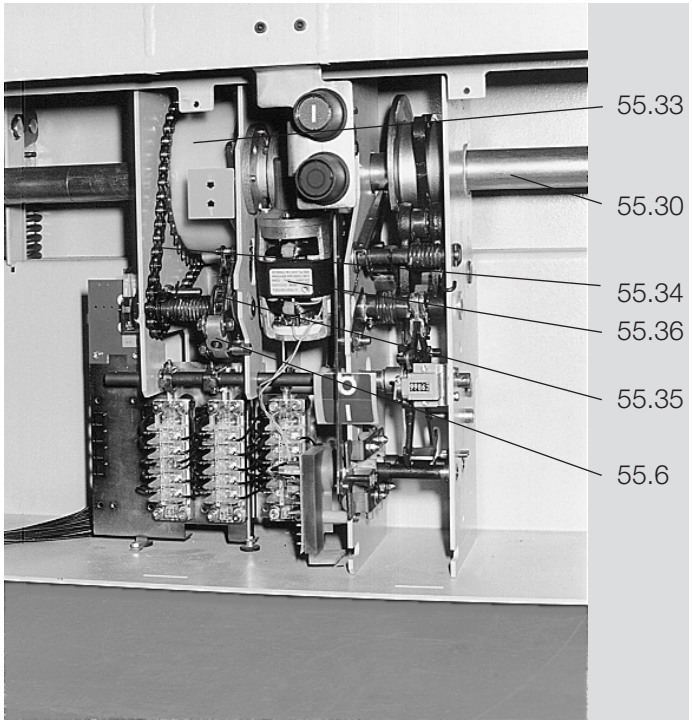


Figure 7/2: Vacuum circuit-breaker, type VD4, for fixed installation, stored-energy spring mechanism, front panel removed

55.6 Socket (for charging lever)
55.30 Drive shaft
55.33 Drum with spiral spring
55.34 Chain
55.35 Ratched wheel
55.36 Charging motors

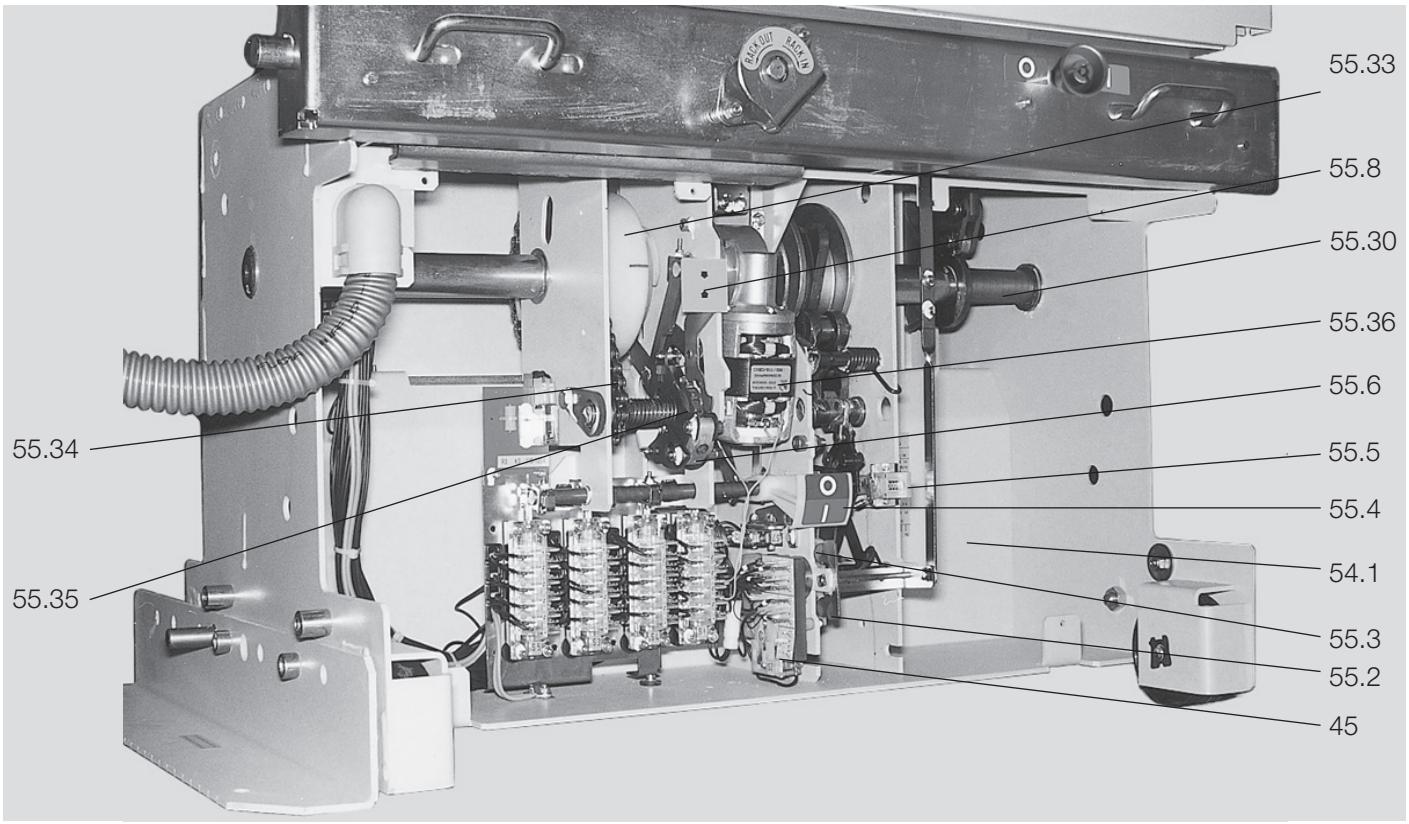


Figure 7/3: Vacuum circuit-breaker, type VD4, on withdrawable part, stored-energy spring mechanism, in withdrawable assembly frame, front covers removed

45 Magent holder, complete
54.1 Link rod
55.2 ON push rod
55.3 OFF push rod
55.4 Switch position indicator
55.5 Operating cycle counter
55.6 Socket (for charging lever)
55.8 Charging condition indicator
55.30 Drive shaft
55.33 Drum with spiral spring
55.34 Chain
55.35 Ratched wheel
55.36 Charging motor

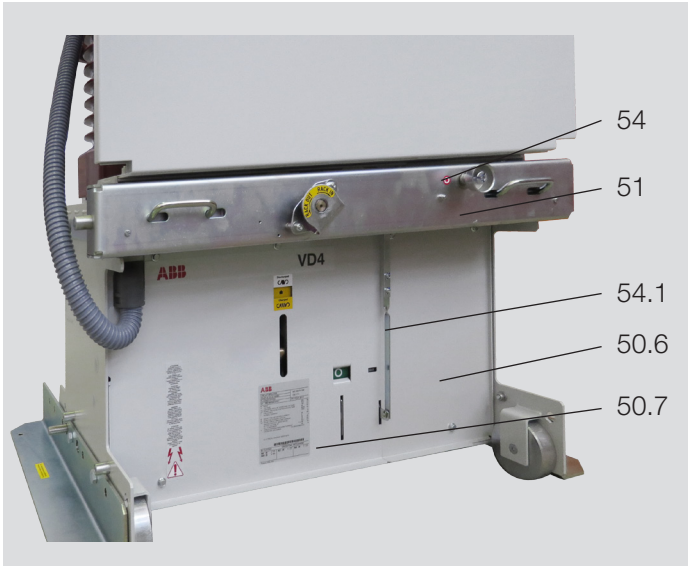


Figure 7/4: Vacuum circuit-breaker, type VD4, on withdrawable part. Removing front covers 50.7/50.8:
- Disconnect link rod 54.1 at the lower point and swing it to one side.
- Turn the hand crank anti-clockwise if necessary to move the interlock yoke 51 into the required position.

50.6 Cover plate, right hand side
50.7 Cover plate, left hand side
51 Interlock yoke
54 ON-OFF operating shaft
54.1 Link rod

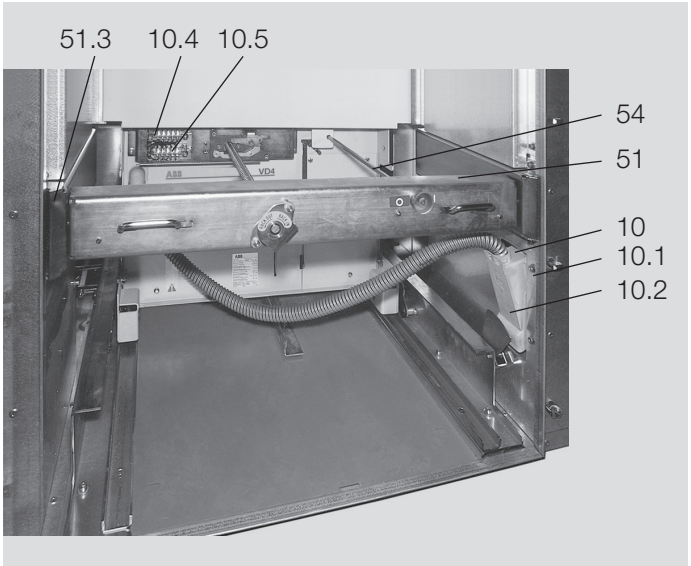


Figure 7/5: Vacuum circuit-breaker, type VD4, on withdrawable part, auxiliary switch arrangement for interlock withdrawable part and panel

10 Control wiring plug connector, closed
10.1 Control wiring socket
10.2 Control wiring plug
10.4 -BT2, limit switch for test position signal
10.5 -BT1, limit switch for service position signal
51 Interlock yoke
51.3 Guide rail (panel)
54 ON-OFF operating shaft

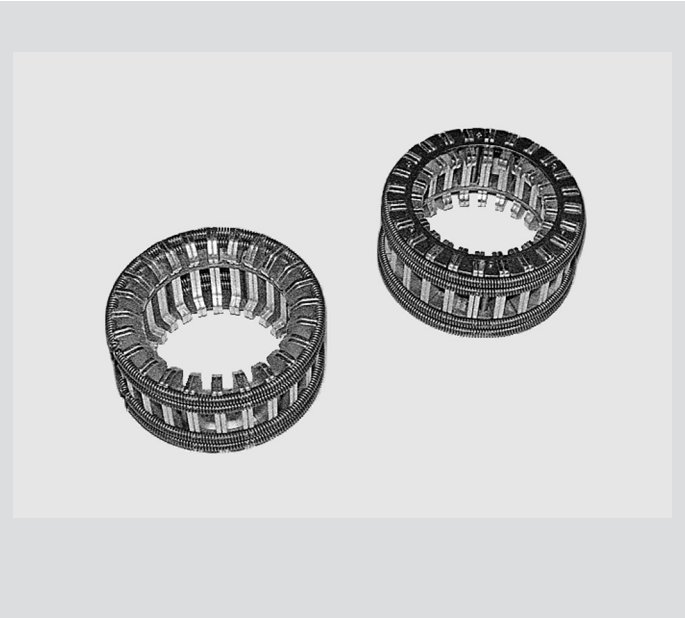


Figure 7/6: **Vacuum circuit-breaker, type VD4, on withdrawable part, contact system.**
- Left: front view
- Right: rear view

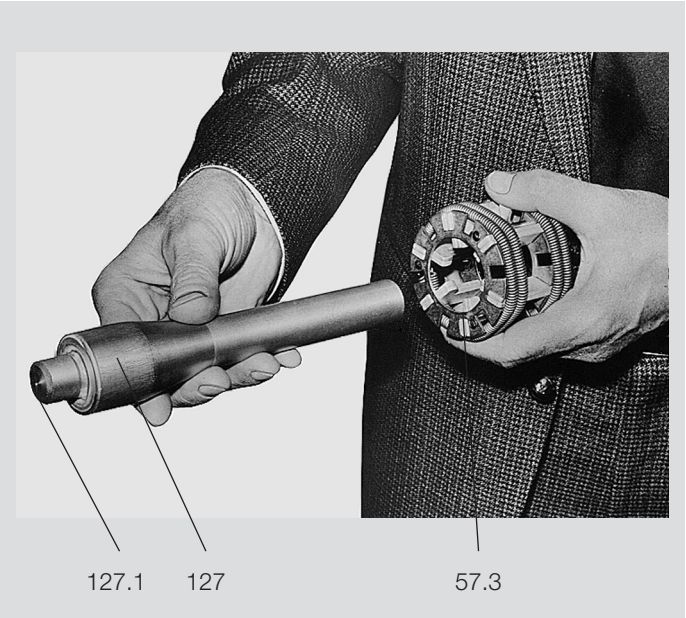


Figure 7/7: **Vacuum circuit-breaker, type VD4, on withdrawable part. Sliding the contact system onto the auxiliary arbor with the rear end first and moving it up to the thicker shaft area, here for 1600 A**

57.3 Contact system, ... 1600 A
127 Auxiliary arbor, ... 1600 A
127.1 Journal, ... 1600 A

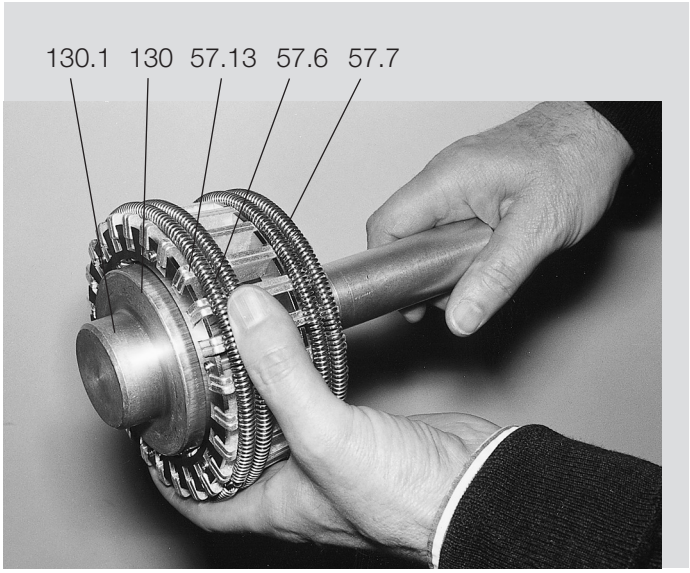
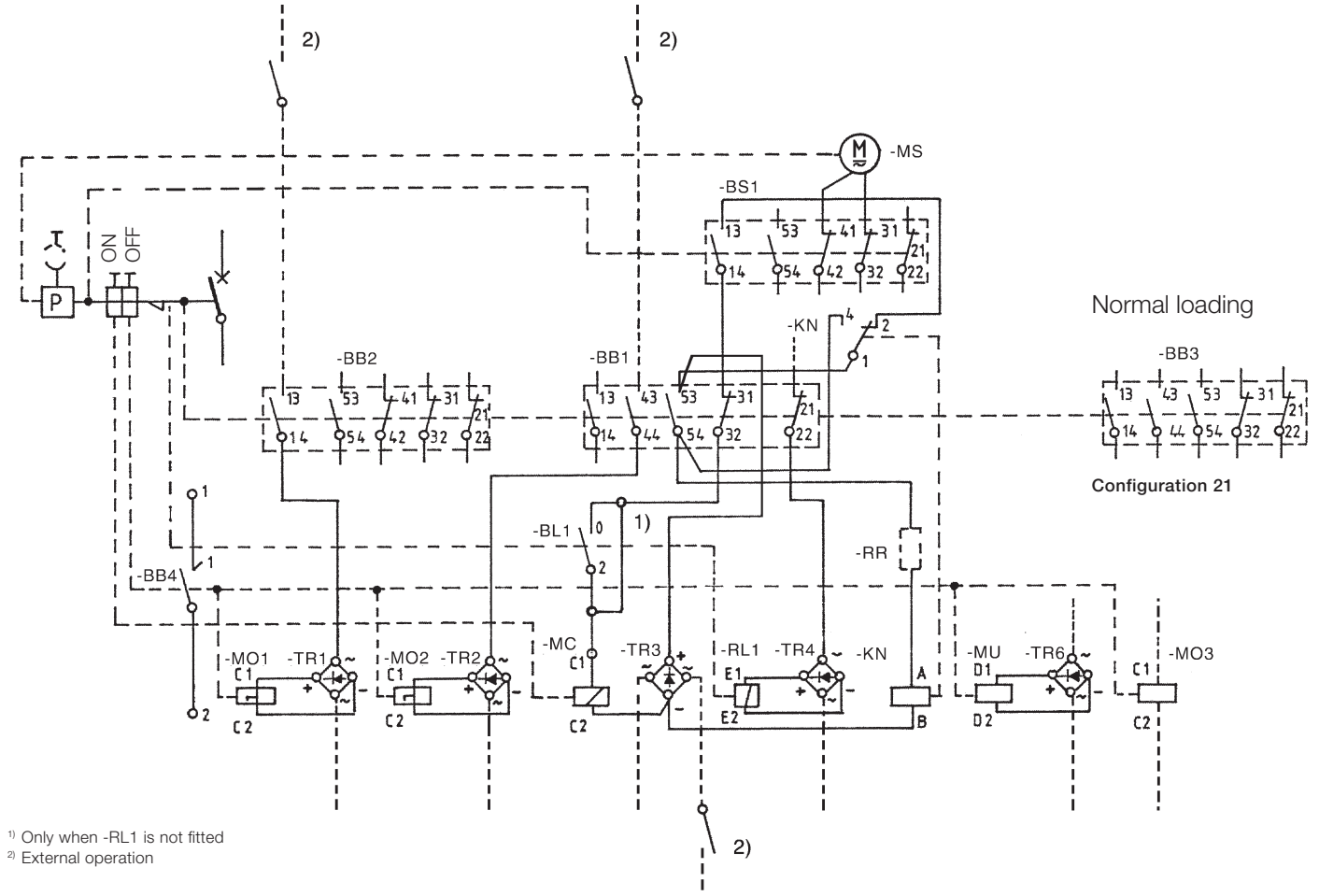


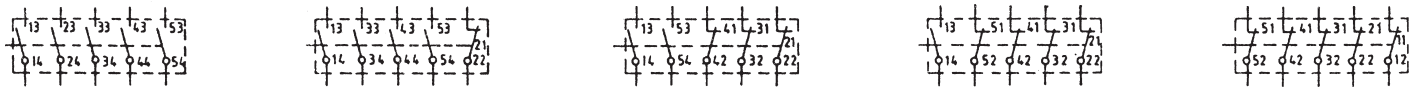
Figure 7/8: **Vacuum circuit-breaker, type VD4, on withdrawable part, contact system on auxiliary arbor, (here for 2000 A / 2500 A systems)**

57.13 Contact system, 2000 A/2500 A
57.6 Internal annular tension springs
57.7 External annular tension springs
130 Auxiliary arbor, 2000/2500 A
130.1 Journal, 2000/2500 A



[1] Only when -RL1 is not fitted
[2] External operation

Special arrangement for -BB3



Type 19 **Type 20** **Type 22** **Type 23** **Type 24**

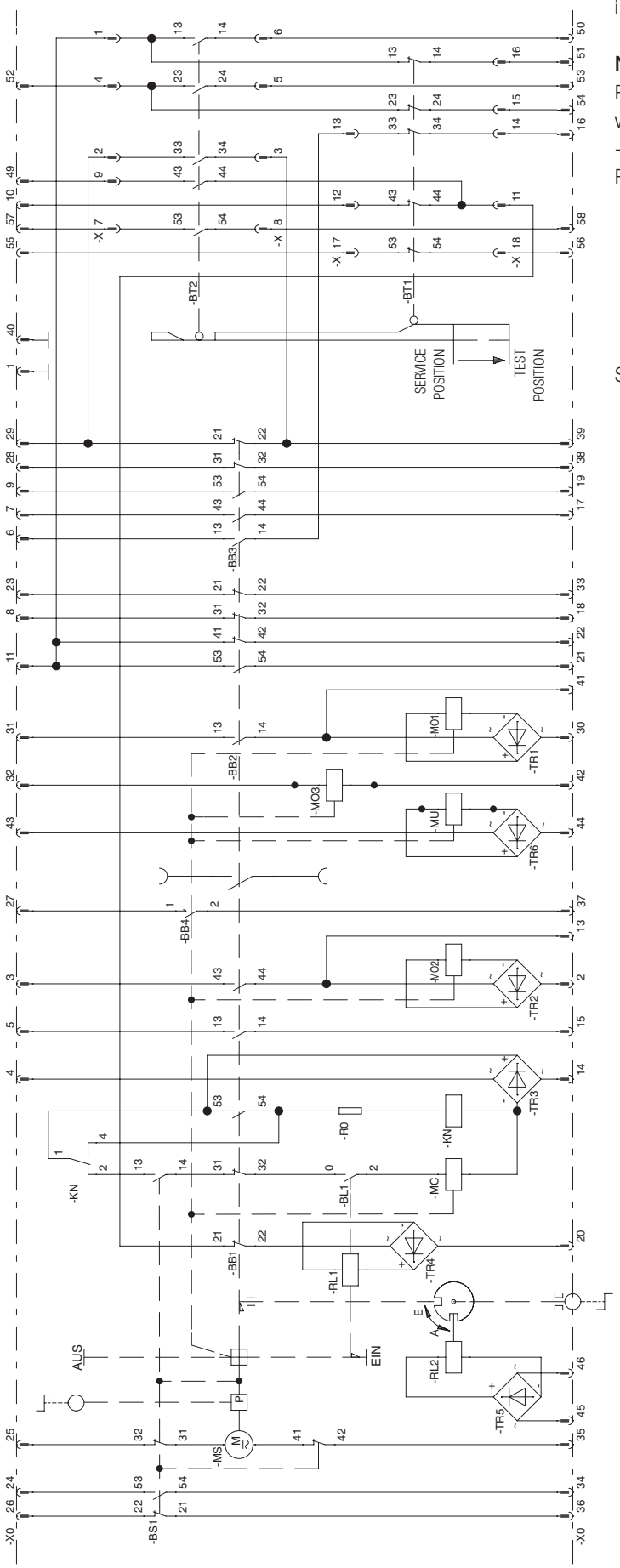
-BS1	**Auxiliary switch on operating mechanism**	**-RL1**	**Blocking magnet**	**-TR1**	**Series rectifier for -MO1**
-BL1	**Auxiliary switch on blocking magnet**	**-MO1**	**Shunt release OFF**	**-TR3**	**Series rectifier for -MC and -KN**
-BB1	**Auxiliary switch on the breaker shaft**	**-MC**	**Shunt release ON**	**-TR6**	**Series rectifier for -MU**
-BB2	**Auxiliary switch on the breaker shaft**	**-MU**	**Undervoltage release**	**-TR2**	**Series rectifier for -MO2**
-BB3	**Auxiliary switch on the breaker shaft**	**-MO3**	**Indirect overcurrent release**	**-MS**	**Charging motor for stored-energy spring**
-BB4	**Auxiliary switch for fault annunciation (fleeting contact ≥ 30 ms)**	**-MO2**	**Second shunt release OFF**	**-KN**	**Anti-pumping relay**
		-TR4	**Series rectifier for -RL1**	**-RR**	**Series resistor**

Figure 7/9: Circuit diagram for vacuum circuit-breaker type VD4, for fixed installation. Arrangement for DC 24, 48, 60, 110, 125, 220, 240 V; AC 110, 220, 240 V

See page 37 for comparison of IEC/VDE designations.

Shown with the spring operating mechanism in the discharged state. The wiring diagram comprises the basic components and all further equipment options for the various VD4 types. The scope of equipment possible within an individual type series is listed in the relevant switchgear list, and the equipment fitted in each individual case can be found in the order documentation.

Note:
Releases and blocking magnets are fundamentally wired with rectifiers (e.g. magnet holder 45 with integrated rectifiers -TR4, -TR1, -TR3 und -TR2).
Rectifiers function as free-wheeling diodes with DC supply.



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Rectifiers function as free-wheeling diodes with DC supply.

See page 37 for comparison of IEC/VDE designations.

-RL2 Block magnet on truck with rectifier -TR5
-RL1 Closing block magnet with rectifier -TR4
-MO1 1. shunt release OFF with rectifier -TR1
-MC Closing release with rectifier -TR3
-MU Undervoltage release U< with rectifier -TR6
-MO3 Indirect overcurrent release
-MO2 2. shunt release OFF with rectifier -TR2

-MS Charging motor
-KN Anti-pumping relay

-BS1 Auxiliary switch on mechanism
-BL1 Auxiliary switch on blocking magnet -RL1
-BB1 Auxiliary switch on switch shaft
-BB2 Auxiliary switch on switch shaft
-BB3 Auxiliary switch on switch shaft
-BB4 Fleeting contact 35 ms for c.b. tripped indication
-BT2 Limit switch test posiiton
-BT1 Limit switch service position

Mode of presentation:

Aux. switch -BS1 shown for c.b.-mechanism discharged
C.b.-unit in service position
Control wiring plug 58-pole
Earthing switch mechanical interlock with c.b.-unit:
– C.b.-unit in test position: Earth. switch can be operated
– Earth. switch open position: C.b.-unit can be moved in the service position

A OFF-position
E ON-position

Figure 7/10: Wiring diagram for vacuum circuit-breaker on withdrawable part for service in the ZS3.2 and Powerbloc panel series.

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 (Stipulation 96/29/Euratom of the senate from 13 May 1996 (ABI.L 159 from 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 Comparison of designations to IEC 81346-1/IEC 81346-2, IEC 61346-1/IEC 61346-2 and VDE-DIN 40719 Part 2

Description	IEC 81346-1/IEC 81346-2	IEC 61346-1/IEC 61346-2	VDE DIN 40719 Part 2
Auxiliary switch on mechanism	-BGS1	-BS1	-S1
Auxiliary switch on block magnet -RL1	-BGL1	-BL1	-S2
Auxiliary switch on switch shaft	-BGB1	-BB1	-S3
Auxiliary switch on switch shaft	-BGB2	-BB2	-S4
Auxiliary switch on switch shaft	-BGB3	-BB3	-S5
Fleeting contact ≥ 30 ms for c.b. tripped indication	-BGB4	-BB4	-S7
Limit switch test position	-BGT2	-BT2	-S8
Limit switch service position	-BGT1	-BT1	-S9
Block magnet on truck	-RLE2	-RL2	-Y0
Closing block magnet	-RLE1	-RL1	-Y1
1. Shunt release OFF	-MBO1	-MO1	-Y2
Closing release	-MBC	-MC	-Y3
Undervoltage release	-MBU	-MU	-Y4
Indirect overcurrent release	-MBO3	-MO3	-Y7
2. Shunt release OFF	-MBO2	-MO2	-Y9
Series rectifier for -RL2	-TB5	-TR5	-V0
Series rectifier for -RL1	-TB4	-TR4	-V1
Series rectifier for -MO1	-TB1	-TR1	-V2
Series rectifier for -MC	-TB3	-TR3	-V3
Series rectifier for -MU	-TB6	-TR6	-V4
Series rectifier for -MO2	-TB2	-TR2	-V9
Charging motor	-MAS	-MS	-M0
Anti-pump relay	-KFN	-KN	-K0
Series resistor	-RAR	-RR	-R0

Notes

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