PRODUCT MANUAL

VD4
Vacuum circuit-breaker

- Global proven reputation
- Accountable solution for safety and reliability
- Wide range offering, easy business and convenient installation
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.

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

1.1 General
(Figures 2/1 to 2/8)

The vacuum circuit-breakers of type VD4 are intended for indoor installation in air-insulated switchgear systems. They have a switching capacity capable of handling the loads occurring at start-up and shutdown of equipment and plant units both in normal and in fault state.

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 autore-closing, and have exceptionally high operating reliability and long life.

The vacuum circuit-breakers of type VD4, designed in column form, can be supplied both as individual units for fixed installation and mounted on chassis. Their basic structure is shown in figures 2/1 to 2/8.

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:

- 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 above 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: +40 °C
  - Maximum 24 hour average: +35 °C
  - Minimum (according to “minus 5 indoor class”): −5 °C
- **Humidity**:
  - the average value of the relative humidity, measured over a period of 24 h, does not exceed 95%
  - the average value of the water vapour pressure, over a period of 24 h, does not exceed 2,2 kPa
  - the average value of the relative humidity, over a period of one month, does not exceed 90%
  - the average value of the water vapour pressure, over a period of one month, does not exceed 1,8 kPa
- **Maximum 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 damage in areas:
    - with high humidity and/or
    - with major rapid temperature fluctuations.
  - Implement preventive measures (e.g. electric heaters) to preclude condensation phenomena.
Technical data and weight

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</table>

1) When the operating voltage is lower than the rated voltage, the same values apply as for rated voltage. Higher values on request.

2) Individual unit (without chassis) with motor-operated mechanism and basic release equipment.
Guideline values for function times:

<table>
<thead>
<tr>
<th>Function</th>
<th>Value</th>
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<tbody>
<tr>
<td>Closing time</td>
<td>approx. 60 ms</td>
</tr>
<tr>
<td>Opening time</td>
<td>≤ 45 ms</td>
</tr>
<tr>
<td>Arcing time (at 50 Hz)</td>
<td>≤ 15 ms</td>
</tr>
<tr>
<td>Break time</td>
<td>≤ 60 ms</td>
</tr>
<tr>
<td>Minimum command time on closing</td>
<td>20 ms ¹) (120 ms ²)</td>
</tr>
<tr>
<td>Minimum command time on opening</td>
<td>20 ms ¹) (80 ms ²)</td>
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</table>

¹) At the rated supply voltage.
²) If the activating relay contact cannot itself interrupt the release coil current.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Rated voltage</td>
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<td>12</td>
<td>17.5</td>
</tr>
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<td>24</td>
<td></td>
</tr>
<tr>
<td>Rated frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>50/60</td>
<td>50/60</td>
</tr>
<tr>
<td>50/60</td>
<td></td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage</td>
<td>kV</td>
</tr>
<tr>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>125</td>
<td></td>
</tr>
<tr>
<td>Rated power frequency withstand voltage</td>
<td>kV</td>
</tr>
<tr>
<td>28¹)</td>
<td>38¹)</td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Rate of rise of transient recovery voltage</td>
<td>kV/μs</td>
</tr>
<tr>
<td>0.34</td>
<td>0.42</td>
</tr>
<tr>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>Peak of transient recovery voltage</td>
<td>kV</td>
</tr>
<tr>
<td>20.6</td>
<td>30</td>
</tr>
<tr>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

| Operating sequence                          |        |
| O-3 min-CO-3 min-CO                         |        |
| O-0.3 s-CO-3 min-CO                         |        |

| Rate of rise of transient recovery voltage    | kV/μs   |
| 0.34                                         | 0.42    |
| 0.47                                         |         |
| Peak of transient recovery voltage            | kV      |
| 20.6                                         | 30      |
| 41                                           |         |

2.2 Technical data

Releases and blocking magnet

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<th>Equipment</th>
<th>Power consumption ¹)</th>
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<td></td>
<td>AC</td>
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<tr>
<td></td>
<td>VA</td>
</tr>
<tr>
<td>Shunt release OFF</td>
<td>-Y2 ³)</td>
</tr>
<tr>
<td></td>
<td>-Y2 ⁴)</td>
</tr>
<tr>
<td>Shunt release ON</td>
<td>-Y3 ³)</td>
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<tr>
<td></td>
<td>-Y3 ⁵)</td>
</tr>
<tr>
<td>Blocking magnet</td>
<td>-Y1 ³)</td>
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<tr>
<td>Undervoltage release:</td>
<td>-Y4</td>
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<tr>
<td>• undelayed ³) ⁵)</td>
<td>11</td>
</tr>
<tr>
<td>• delayed ⁴)</td>
<td>10</td>
</tr>
<tr>
<td>Indirect overcurrent release with intermediate current transformer:</td>
<td>-Y7</td>
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<tr>
<td>• two-phase</td>
<td>3.5 ⁶) /15</td>
</tr>
<tr>
<td>• three-phase</td>
<td>2.0 ⁷) /15</td>
</tr>
</tbody>
</table>

¹) Approximate values
²) With short-circuited intermediate current transformer
³) Rated supply voltages AC: 110 and 220 V, DC: 24, 48, 60, 110 and 220 V.
⁴) See RN3U for supply voltage
⁵) Rated supply voltage AC: 240 V, DC: 125 and 240 V.
### Technical data

#### Motor-operated mechanisms

<table>
<thead>
<tr>
<th>Gefeg-Motor</th>
<th>Groschopp-Motor</th>
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<tr>
<td><strong>Rated supply voltage</strong></td>
<td><strong>Rated supply voltage</strong></td>
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<tr>
<td>V</td>
<td>VA/W</td>
</tr>
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<td>---</td>
<td>---</td>
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<td>AC</td>
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<tr>
<td></td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>240</td>
</tr>
</tbody>
</table>

1) Approximate values
2) At rated supply voltage

---

**Figure 2/1:** VD4 circuit-breaker for fixed installation, 12 kV, 1250 A, mechanism side

**Figure 2/2:** VD4 circuit-breaker for fixed installation, 12 kV, 1250 A, pole side
Figure 2/3: VD4 circuit-breaker for fixed installation, 24 kV, 1250 A, mechanism side

Figure 2/4: VD4 circuit-breaker for fixed installation, 24 kV, 1250 A, pole side

Figure 2/5: Vacuum circuit-breaker, type VD4, high-current, for 12 kV and rated current 2000 A, mechanism side

Figure 2/6: Vacuum circuit-breaker, type VD4, high-current, for 12 kV and rated current 2000 A, pole side
Figure 2/7:  VD4 circuit-breaker, on withdrawable part, 12 kV, 630 A, mechanism side

Figure 2/8:  VD4 circuit-breaker, on withdrawable part, 12 kV, 630 A, pole side
2.4 Permissible number of vacuum interrupter switching operations

Figure 2/9: Permissible number of vacuum interrupter operating cycles $n$ as a function of the breaking current $I_a$.
(Reference see section 2.1 and 3.1 – Technical data page 6 and 17)
Figure 2/9: Permissible number of vacuum interrupter operating cycles $n$ as a function of the breaking current $I_a$.
(Reference see section 2.1 and 3.1 – Technical data page 6 and 17)
2.5 Dimensional drawings
Circuit-breakers for fixed installation

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Rated short-circuit breaking current</th>
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</thead>
<tbody>
<tr>
<td>kV</td>
<td>A</td>
<td>kA</td>
</tr>
<tr>
<td>12</td>
<td>630/1250</td>
<td>... 31.5</td>
</tr>
<tr>
<td>17.5</td>
<td>630/1250</td>
<td>... 31.5</td>
</tr>
</tbody>
</table>

K = Cable entry
T = Handling bores, both sides
A = View “A”
GA = Tested terminal zone
M = Minimum distance to DIN VDE 0101
A1 = Terminal for 630 A
A2 = Terminal for 1250 A
A3 = Terminal bar to DIN 46 433, for 17.5 kV shrink sleeve fitted
= Earthing conductor terminal, use contact washer

Figure 2/10: Dimensional drawing of circuit-breaker type VD4:
- 12 kV, 630 A and 1250 A, ... 31.5 kA
- 17.5 kV, 630 A and 1250 A, ... 31.5 kA

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Rated short-circuit breaking current</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV</td>
<td>A</td>
<td>kA</td>
</tr>
<tr>
<td>24</td>
<td>630/1250</td>
<td>... 25</td>
</tr>
</tbody>
</table>

K = Cable entry
T = Handling bore, both sides
A = View “A”
GA = Tested terminal zone
M = Minimum distance to DIN VDE 0101
A1 = Terminal for 630 A
A2 = Terminal for 1250 A
A3 = Terminal bar to DIN 46 433, for 24 kV shrink sleeve fitted
= Earthing conductor terminal, use contact washer

Figure 2/11: Dimensional drawing of circuit-breaker type VD4:
24 kV, 630 A and 1250 A, ... 25 kA.
1) Breakers with rated currents 2500 A are fitted with a cooling element.

Figure 2/13: Dimensional drawing of circuit-breaker type VD4: high-current.

- 12/17.5 kV, 1600 A, 40 kA
Figure 2/14: Dimensional drawing of circuit-breaker type VD4: high-current, 24 kV, ... 2500 A, ... 25 kA.

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Rated short-circuit breaking current</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV</td>
<td>A</td>
<td>kA</td>
</tr>
<tr>
<td>24</td>
<td>... 2500</td>
<td>1)</td>
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</table>

1) Breakers with rated currents 2500 A are fitted with a cooling element.

K = Cable entry
T = Handling bores, both sides
Note: Remove the lifting lugs on both sides before commissioning
A = View "A"
GA = Tested terminal zone
M = Minimum distance to DIN VDE 0101
A1 = Terminal for contact arm
A2 = Terminal for connecting bar
A3 = Terminal bar to DIN 46 433, for 24 kV shrink sleeve fitted
2 = Earthing conductor terminal, use contact washer

Figure 2/14: Dimensional drawing of circuit-breaker type VD4: high-current, 24 kV, ... 2500 A, ... 25 kA.
2.6 Circuit-breaker wiring diagram

Shown with the spring energy storage 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:
Shunt releases and blocking magnets are fundamentally wired with rectifiers (e.g. magnet holder 40 with integrated rectifiers -V1, -V2, -V3 and -V9). Rectifiers function as free-wheeling diodes if d.c.-supply.

See page 54 for comparison of VDE/IEC designations.

Figure 2/15: Wiring diagram
Arrangement for DC 24, 48, 60, 110, 125, 220, 240 V; AC 110, 220, 240 V
## Technical Data

### Circuit-breakers on withdrawable part

### 3.1 Technical data and weight

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1) For more details to cell-type allocations see section dimensional drawings.
2) When the operating voltage is lower than the rated voltage, the same values apply as for rated voltage.
Higher values on request.
3) With manual charging mechanism.
Weight is increased by around 5 kg if charging motor is fitted.
Weight is increased by around 5 kg if the motor-driven withdrawable assembly is used.
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<th>Rated current</th>
<th>Rated short-circuit breaking current symm.(^1)</th>
<th>Rated short-circuit breaking current asymm.(^2)</th>
<th>Rated short-circuit making current (peak)(^3)</th>
<th>Pole centres(^1)</th>
<th>Weight (^{1,3})</th>
<th>Permissible number of vacuum interrupter switching operations</th>
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<td>190/195</td>
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<td>195/200</td>
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<td>2500(^4)</td>
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<td>275</td>
<td>205</td>
<td>Diagram E</td>
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</tbody>
</table>

\(^1\) For more details to cell-type allocations see section dimensional drawings.

\(^2\) When the operating voltage is lower than the rated voltage, the same values apply as for rated voltage.

Higher values on request.

\(^3\) With manual charging mechanism.

Weight is increased by around 5 kg if charging motor is fitted.

Weight is increased by around 2 kg if the motor-driven withdrawable assembly is used.

\(^4\) > 2300 A with fan cooling
3.2 **Dimensional drawings**

![Diagram of a vacuum circuit-breaker](image)

**Table 1**

| Panel type             | Parameters  | Parameters  | p | A | C | D | E | J | Y | Z | Weight (ca. kg) |
|------------------------|-------------|-------------|---|---|---|---|---|---|---|----------------|
| ZS1/Powerbloc/         | 630 A, ...31.5 kA | 630 A, ...31.5 kA | 150 | 502 | 466 | 490 | 503 | 492 | x | - | 105 |
| Mounting frame         | 630 A, ...31.5 kA | 630 A, ...31.5 kA | 210 | 650 | 616 | 640 | 653 | 636 | - | x | 110 |
| 1250 A, ...31.5 kA     | 1250 A, ...31.5 kA | 1250 A, ...31.5 kA | 150 | 502 | 466 | 490 | 503 | 492 | - | x | 125 |
| UniSafe/UniGear Type ZS1 | 630 A, ...31.5 kA | 630 A, ...31.5 kA | 150 | 502 | 466 | 490 | 503 | 492 | x | - | 105 |
| Mounting frame 1250 A, ...31.5 kA | 1250 A, ...31.5 kA | 1250 A, ...31.5 kA | 150 | 502 | 466 | 490 | 503 | 492 | - | x | 120 |

**Table 2**

<table>
<thead>
<tr>
<th>Panel type</th>
<th>p</th>
<th>F₁</th>
<th>G₁</th>
<th>N</th>
<th>O</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
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<tbody>
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<td>203</td>
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<td>624</td>
<td>618</td>
<td>628</td>
<td>618</td>
<td>118</td>
<td>120±1</td>
</tr>
<tr>
<td>UniSafe/UniGear Type ZS1</td>
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<td>38</td>
<td>203±1</td>
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<td>618</td>
<td>628</td>
<td>620±2</td>
<td>128±1</td>
<td>120±1</td>
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</tbody>
</table>

**Figure 3/1: Vacuum circuit-breaker on withdrawable part, type VD4.**

- Use in ZS1, UniGear Type ZS1, UniSafe and Powerbloc or mounting frame
- 12 kV, ...1250 A, ...31.5 kA
- 17.5 kV, ...1250 A, ...31.5 kA

1) Exists only for withdrawable parts of SACE (z.B. UniSafe)
2) Versions up to 630 A with insulating tube
3) Versions from 1250 A with shrink sleeve
4) With manual charging mechanism.
   - Weight is increased by around 5 kg if charging motor is fitted.
   - Weight is increased by around 2 kg if the motor-driven withdrawable assembly is used.
5) Rail
6) Front edge of bar
Figure 3/2: Vacuum circuit-breaker on withdrawable part, type VD4.

- Use in ZS1, UniGear Type ZS1, UniSafe and Powerbloc or mounting frame
- 12/17.5 kV, ...1600 A, 40 kA

1) Rail
2) Front edge of bar
3) Not available for Powerbloc/Mounting frame

- Weight (manual charging mechanism) 185 kg.
- Weight is increased by around 5 kg if charging motor is fitted.
- Weight is increased by around 2 kg if the motor-driven with drawable is used

1) Only fitted on withdrawable parts for SACE (z.B. UniSafe)
2) Remove the lifting lugs on both sides before commissioning
3) Not available for Powerbloc/Mounting frame

Table 1:

<table>
<thead>
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<th>Panel type</th>
<th>Parameters</th>
<th>p</th>
<th>A</th>
<th>D</th>
<th>E</th>
<th>J</th>
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<td>636</td>
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<td>1600 A, 40 kA</td>
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<th>G₁</th>
<th>N</th>
<th>O</th>
<th>Q</th>
<th>R</th>
<th>S</th>
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<td>698</td>
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20
Figure 3/3: Vacuum circuit-breaker on withdrawable part, type VD4.

- Use in ZS1, UniGear Type ZS1, UniSafe and Powerbloc or mounting frame
- 12/17.5 kV, 1600 ... 2500 A, ... 40 kA

**Table 1**

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<th>A</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<th>M</th>
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<th>Z ($)</th>
<th>Weight ($)</th>
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<td>650</td>
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**Table 2**

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</tbody>
</table>

*) Rail
**) Front edge of bar

- Only fitted on withdrawable parts for SACE (e.g. UniSafe)
- Cooler elements only fitted for rated currents of 2500 A and above
- Remove the lifting lugs on both sides before commissioning
- Not available for Powerbloc/Mounting frame
- Versions for 1250 A to 2000 A (with shrink sleeve)
- Versions for 2500 A (with cooler elements, without shrink sleeve)
- With manual charging mechanism.
  - Weight is increased by around 5 kg if charging motor is fitted.
  - Weight is increased by around 2 kg if the motor-driven withdrawable is used
Figure 3/4: Vacuum circuit-breaker on withdrawable part, type VD4.

- Use in ZS8.4
- 12 kV, ...1250 A, ...25 kA
- 17.5 kV, ...1250 A, ...20 kA

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<th>S ± 3</th>
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<td>200</td>
<td>110</td>
</tr>
<tr>
<td>ZS8.4 with tee-off partitioning</td>
<td>630 A, ...25 kA</td>
<td>630 A, ...20 kA</td>
<td>283</td>
<td>250</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>1250 A, ...25 kA</td>
<td>1250 A, ...20 kA</td>
<td>283</td>
<td>250</td>
<td>110</td>
</tr>
</tbody>
</table>

1) • With manual charging mechanism.
• Weight is increased by around 5 kg if charging motor is fitted.
• Weight is increased by around 2 kg if the motor-driven withdrawable assembly is used.
Table 1

<table>
<thead>
<tr>
<th>Panel type</th>
<th>Parameters</th>
<th>24 kV</th>
<th>p</th>
<th>A</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>J</th>
<th>Y</th>
<th>Z</th>
<th>Weight</th>
</tr>
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<tbody>
<tr>
<td>ZS1/Powerbloc/</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting frame</td>
<td>630 A, ...25 kA</td>
<td>210</td>
<td>650</td>
<td>612</td>
<td>636</td>
<td>653</td>
<td>632</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>630 A, ...25 kA</td>
<td>275</td>
<td>850</td>
<td>812</td>
<td>836</td>
<td>853</td>
<td>842</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>115</td>
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<tr>
<td></td>
<td>1250 A, ...25 kA</td>
<td>210</td>
<td>650</td>
<td>612</td>
<td>636</td>
<td>653</td>
<td>632</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>120</td>
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<tr>
<td></td>
<td>1250 A, ...25 kA</td>
<td>275</td>
<td>850</td>
<td>812</td>
<td>836</td>
<td>853</td>
<td>842</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>125</td>
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<tr>
<td>UniSafe/UniGear Type ZS1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>630 A, ...25 kA</td>
<td>210</td>
<td>650</td>
<td>612</td>
<td>636</td>
<td>653</td>
<td>632</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>1250 A, ...25 kA</td>
<td>210</td>
<td>650</td>
<td>612</td>
<td>636</td>
<td>653</td>
<td>632</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>110</td>
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Table 2

<table>
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<tr>
<th>Panel type</th>
<th>p</th>
<th>F₁</th>
<th>G₁</th>
<th>N</th>
<th>O</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
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<tr>
<td>ZS1/Powerbloc/</td>
<td>210</td>
<td>44</td>
<td>144</td>
<td>232</td>
<td>780</td>
<td>770</td>
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<tr>
<td>Mounting frame</td>
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<td></td>
<td></td>
<td>232</td>
<td>780</td>
<td>770</td>
<td>785</td>
<td>16</td>
<td>164</td>
</tr>
<tr>
<td>UniSafe/UniGear Type ZS1</td>
<td>210</td>
<td>44±1</td>
<td>232</td>
<td>772±2</td>
<td>770</td>
<td>788</td>
<td>768±2</td>
<td>19±1</td>
<td>119±1</td>
</tr>
</tbody>
</table>

Figure 3/5: Vacuum circuit-breaker on withdrawable part, type VD4.

- Use in ZS1, UniGear Type ZS1, UniSafe and Powerbloc or mounting frame
- 24 kV, ...1250 A, ...25 kA

1) Exists only for withdrawable parts of SACE (i.e. UniSafe)
2) Not available for Powerbloc/Mounting frame
3) Versions up to 630 A with insulating tube
4) Versions from 1250 A with shrink sleeve
5) • With manual charging mechanism.
   • Weight is increased by around 5 kg if charging motor is fitted.
   • Weight is increased by around 2 kg if the motor-driven withdrawable assembly is used.
• Use in ZS1, UniGear Type ZS1 and UniSafe
• 24 kV, 1600 ...2500 A, ...25 kA

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

***Rail
**Front edge of bar

1) Exists only for withdrawable parts of SACE-CBE
2) Remove the lifting lugs on both sides before commissioning.
3) With cooling element and forced ventilation for rated currents of 2500 A and above.
4) • Weight with manual charging mechanism approx. 205 kg.
• Weight is increased by around 5 kg if charging motor is fitted.
• Weight is increased by about 2 kg if the motor-driven withdrawable assembly is used.

<table>
<thead>
<tr>
<th>Panel type</th>
<th>p</th>
<th>F₁</th>
<th>G₁</th>
<th>N</th>
<th>O</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>Weight ca. kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZS1</td>
<td>275</td>
<td>144</td>
<td>232</td>
<td>820</td>
<td>815</td>
<td>825</td>
<td>815</td>
<td>16</td>
<td>376</td>
<td>205</td>
</tr>
<tr>
<td>UniSafe/ UniGear Type ZS1</td>
<td>275</td>
<td>144±1</td>
<td>232±1</td>
<td>817±1</td>
<td>815</td>
<td>834</td>
<td>814±2</td>
<td>191</td>
<td>119±1</td>
<td>205</td>
</tr>
</tbody>
</table>

Stroke 8 - 11 mm
Weights:
- Weight with manual charging mechanism approx. 110 kg.
- Weight is increased by around 5 kg if charging motor is fitted.
- Weight is increased by about 2 kg if the motor-driven withdrawable assembly is used.

Figure 3/7: Vacuum circuit-breaker on withdrawable part, type VD4.
- Use in ZS8.4, with or without tee-off partitioning
- 24 kV, ...1250 A, ...25 kA
Figure 3/8: Wiring diagram for VD4 vacuum circuit-breaker on manually movable withdrawable assembly.

- **Type A of withdrawable part**
- **Maximum of equipment**
- **Control wiring plug 58-pole**
- **Use in panel system ZS, in powerbloc and mounting frame**
- **Drawing no. GCE2032404**

Note: The wiring diagrams comprise 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: Please see section 8.5 for explanation to the withdrawable part.

See page 54 for comparison of VDE/IEC designations.
Figure 3/9: Wiring diagram for VD4 vacuum circuit-breaker on manually movable withdrawable assembly.

- Type B of withdrawable part
- Maximum of equipment
- Auxiliary switch -S5 wired
- Control wiring plug 58-pole
- Use in panel system ZS in powerbloc and mounting frame
- Drawing no. GCE2132701P0101

See page 54 for comparison of VDE/IEC designations.
Figure 3/10: Wiring diagram for VD4 vacuum circuit-breaker on motor-driven withdrawable assembly.

- **Y1** Closing block magnet with rectifier -V1
- **Y2** 1. Shunt release OFF with rectifier -V2
- **Y3** Closing release with rectifier -V3
- **Y4** Undervoltage release U< with rectifier -V4
- **Y7** Indirect overcurrent release
- **Y9** 2. Shunt release OFF with rectifier -V9
- **M0** Charging motor
- **K0** Antipumping relay

See page 54 for comparison of VDE/IEC designations.

Mode of presentation:
- Aux. switch -S1 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:
  a) C.b.-unit in test position:
     - Earth. switch can be operated
  b) Earth. switch open position:
     - C.b.-unit can be moved in the service position

*) Connection points when undervoltage release -Y4 or indirect overcurrent release -Y7 are fitted:
  - Y4: 42-43
  - Y7: 42-43

- **S1** Auxiliary switch on mechanism
- **S2** Auxiliary switch on block magnet -Y1
- **S3** Auxiliary switch on switch shaft
- **S4** Auxiliary switch on switch shaft
- **S5** Auxiliary switch on switch shaft
- **S7** Fleeting contact ≥ 30 ms for c.b. tripped indication
- **S8** Limit switch test position
- **S9** Limit switch service position
- **M1** Motor drive for draw out

**Notes:**
- Type B of withdrawable part
- Maximum of equipment
- Auxiliary switch -S5 free used
- Control wiring plug 58-pole
- Use in panel system ZS, in powerbloc and mounting frame
- Drawing no. GCE2132702P0101
-Y0 Block Magnet on truck with rectifier -V0
-Y1 Closing block magnet with rectifier -V1
-Y2 1. Shunt release OFF with rectifier -V2
-Y3 Closing release with rectifier -V3
-Y4 Undervoltage release U< with rectifier -V4
-Y7 Indirect overcurrent release
-Y9 2. Shunt release OFF with rectifier -V9
-M0 Charging motor
-X0 Antipumping relay
-S1 Auxiliary switch on mechanism
-S2 Auxiliary switch on block magnet -Y1
-S3 Auxiliary switch on switch shaft
-S4 Auxiliary switch on switch shaft
-S5 Auxiliary switch on switch shaft
-S6 Auxiliary switch at c.b.-unit
-S7 Fleeting contact 35ms for c.b. tripped indication
-S8 Limit switch test position
-S9 Limit switch service position

Mode of presentation:
- Aux. switch -S1 shown for c.b.-mechanism discharged
- C.b.-unit in service position
- Control wiring plug 64-pole
- Earthing switch mechanical interlock with c.b.-unit:
  a) C.b.-unit in test position:
    Earth. switch can be operated
  b) Earth. switch open position:
    C.b.-unit can be moved in the service position

See page 54 for comparison of VDE/IEC designations.

Figure 3/11: Wiring diagram for VD4 vacuum circuit-breaker on manually movable withdrawable assembly.
- Type B of withdraw part or/and with auxiliary switch -S6 at withdrawable part
- Maximum of equipment
- Control wiring plug 64-pole
- Use in panel system ZS, in powerbloc and mounting frame
- Drawing no. GCE2009153
Mode of presentation:

- Auxiliary switch -S1 shown for c.b.-mechanism discharged
- C.b.-unit in service position
- Control wiring plug 64-pole
- Earthing switch mechanical interlock with c.b.-unit:
  a) C.b.-unit in test position: Earth switch can be operated
  b) Earth switch open position: C.b.-unit can be moved in the service position

Figure 3/12: Wiring diagram for VD4 vacuum circuit-breaker on manually movable withdrawable assembly.

- Type B of withdrawable part
- Maximum of equipment
- With closing block magnet -Y1
- Auxiliary switch - SS wired
- Control wiring plug 64-pole
- Use in panel system ZS8.4
- Drawing no. GCE66692/51S0101

See page 54 for comparison of VDE/IEC designations.
See page 54 for comparison of VDE/IEC designations.
4 Structure and function

4.1 Basic structure of the circuit-breaker on withdrawable breaker assembly
(Figures 4/1 to 4/3 and 7/1)

The withdrawable part, which can be moved manually or by a motor if fitted, consists of a steel sheet structure on which the circuit-breaker with its ancillary components is mounted.

Insulated contact arms 6 with the spring-loaded contact systems 7 are fitted to the circuit-breaker poles. These create the electrical connection to the panel when the withdrawable part is inserted into the service position.

A multi-pole control wiring plug connector 8 connects the signalling, protection and control wiring between the panel and the withdrawable part.

The withdrawable assembly and the circuit-breaker are connected via a multi-pole control wiring plug connector 8.3.

As soon as the withdrawable part has been slid into the panel and its base frame has engaged in the test/disconnected position, it is positively connected to the panel. At the same time, it is earthed by its travel rollers in their rails. The stored-energy spring mechanism of the circuit-breaker, including its controls and indicators, is accessible at the front of the withdrawable part.

Withdrawable parts of the same version are interchangeable. With the same dimensions but different circuit-breaker equipment, coding of the control wiring plug prevents impermissible combinations of withdrawable parts and panels.

4.2 Structure of the breaker poles
(Figures 4/2, 4/5 and 4/6)

The poles in column design are mounted on the bracket-shaped rear part of mechanism enclosure 9.1. The live parts of the breaker poles are enclosed in cast resin and protected from impacts and other external influences.

With the breaker closed, the current path leads from the upper breaker terminal 21 to the fixed contact 20.2 in the vacuum interrupter 20, then via the moving contact 20.3 and flexible connector 23 (or via multi-contact strips, depending on rated current) to the lower breaker terminal 22.

The switching motions are effected by means of the insulated link rod 26 with internal contact force springs 25.

4.3 Structure of the breaker operating mechanism
(Figures 4/4, 4/6 and 4/7)

The operating mechanism is of the stored-energy spring type. 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 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 9.1.

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 storage mechanism 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 9.2, and another at the lower front right in mechanism enclosure 9.1.

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

- Shunt release OFF -Y2
- Five-pole auxiliary switch -S4 for annunciation purposes
- Auxiliary switch -S7 for fault annunciation
- Mechanical ON push-button 11
- Mechanical OFF push-button 12
- Mechanical position indicator 13
- Charging condition indicator 18 for the spring energy storage mechanism
- Mechanical operating cycle counter 14.

The following additional equipment can be installed:

- Blocking magnet -Y1 with auxiliary switch -S2
- Shunt release ON -Y3
- Second shunt release OFF -Y9
- Indirect overcurrent release -Y7
- Undervoltage release -Y4
- Five-pole auxiliary switches -S3 and -S5
- Charging motor -M0
- Five-pole auxiliary switch -S1 to switch the charging motor.

4.3.1 Releases, blocking magnet and auxiliary switches
(Figures 2/15, 4/4, 4/7 and 8/1 to 8/3)

- 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 of figure 2/15.
• The five-pole auxiliary switch -S1 is operated by the charging condition indicator 18. It controls the charging motor -M0, serves as an electrical interlock for shunt release ON -Y3 when the spring mechanism is not sufficiently charged, and also provides an electrical switching readiness signal.

• Operation of the five-pole auxiliary switches -S3, -S4 and -S5 is dependent on the switching position of the circuit-breaker.

• Auxiliary switch -S3 interrupts the circuit of the optional additional shunt release OFF -Y9 with the circuit-breaker in the open position, and the circuits of shunt release ON -Y3 and the optional blocking magnet -Y1 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 -Y1 mechanically locks the ON half shaft and simultaneously acts on the corresponding auxiliary switch -S2 to interrupt the circuit of shunt release ON -Y3.

• Blocking magnet -Y1 is accessible when front plate 9.2 is removed.

• Auxiliary switch -S4 interrupts the circuit of shunt release OFF -Y2 with the circuit-breaker in the open position. One further NOC and three NCCs are available for annunciation, control and interlock purposes.

• Auxiliary switch -S5 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 figure 2/15.

• The single pole auxiliary switch -S7 (fleeting contact time $\geq 30$ ms) serves to provide a fault signal ("breaker released").

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

– Shunt release OFF -Y2 or
– Shunt release OFF -Y9 or
– Undervoltage release -Y4 or
– Indirect overcurrent release -Y7.

Note:

1. Shunt releases OFF (-Y2) and ON (-Y3) are exclusively provided for opening and closing in normal operation. For safety breaking operations, the second shunt release OFF (-Y9) 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 (-Y4) and/or indirect overcurrent release (-Y7) are pure safety and protection releases and must not be used for switching in normal operation.

4.3.2 Mounting of the VD4 on trucks from other manufacturers

VD4 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 -Y3.

Similarly to auxiliary switches -S8 and -S9 in Calor Emag withdrawable parts, no electrical 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.

4.4 Function

4.4.1 Charging of the spring energy storage mechanism (Figures 4/6, 4/7 and 7/1)

To provide the necessary motive energy, the spring energy storage mechanism, either charged automatically by a charging motor or manually in a vertical pumping action with charging lever 19, depending on the equipment fitted to the circuit-breaker. The current charging condition is shown at charging condition indicator 18.

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.

Closings procedure (Figures 4/4, 4/6 and 4/7)

The closing process is started by the mechanical ON push-button 11, or by activation of shunt release ON -Y3. The release mechanism 31 then permits drive shaft 30 to be rotated by the (previously) charged spiral spring. The moving contact 20.3 in vacuum interrupter 20 is moved until the contacts touch by cam disk 29 and further kinematic links. In the further sequence of motion, spring arrangement 25 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 27 are simultaneously tensioned.
4.4.3 Opening procedure
(Figures 4/4, 4/6 and 4/7)
The opening procedure is initiated by mechanical OFF push-button 12 or by activation of one of releases -Y2, -Y4, -Y7 or -Y9. Observe the notes in section 4.3.1 on control of the releases. Release mechanism 31 then permits drive shaft 30 to be turned further by the spring energy storage mechanism, which is still sufficiently charged. Opening spring 27, which is thus released, moves contact 20.3 into the open position at a defined speed.

4.4.4 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.

4.4.5 Quenching principle of the vacuum interrupter
Due to the extremely low static interrupter chamber pressure of \(10^{-4}\) to \(10^{-8}\) mbar, 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.

4.5 Interlocks/protection against maloperation for the withdrawable circuit-breaker part
A series of interlocks are provided to prevent dangerous situations and any maloperation. The interlocks of the panel system ZS and/or the mounting frame, which are normally effective, are as follows (concerning the circuit-breaker):

- The withdrawable part can only be moved from the test/disconnected position into the service position (and back) with the circuit-breaker open and the earthing switch open (that means that the breaker must opened before)
- The circuit-breaker can only be closed when the withdrawable part is precisely in the defined test position or service position (mechanical interlock, with additional electrical interlock for circuit-breakers with electrical releases).
- The circuit-breaker can only be opened manually in the service or test position when no control voltage is applied, and cannot be closed (electromechanical interlock).
- Connection and disconnection of the control wiring plug connector (8.1) is only in the test/disconnected position possible.
- The earthing switch can only be closed when the withdrawable part is in the test/disconnected position or the removed position (mechanical interlock).
- The withdrawable part cannot be moved from the test/disconnected position into the service position when the earthing switch is closed (mechanical interlock).
- Details of any additional interlocks, e.g. in connection with a blocking magnet on the withdrawable part and/or earthing switch operating mechanism, can be found in the order documents for each individual case (see also section 8.5.6).
Figure 4/1: Withdrawable part with circuit-breaker, mechanism side.

3 Withdrawable assembly
8.1 Control wiring plug
9 Circuit-breaker operating mechanism
9.3 Handling hole on both sides
10 Breaker pole

Figure 4/2: Withdrawable part with circuit-breaker, pole side.

6 Contact arm with insulating sleeve
7 Contact system

Figure 4/3: Withdrawable assembly with built-in auxiliary switch (type B, see section 8.5)

- S8 Test position indicator
- S9 Service position indicator
3 Control wiring connector plug for withdrawable assembly
4 Spindle
4.1 Scenes head on spindle
8.3 Control wiring connector plug for withdrawable assembly
Figure 4/4: Circuit-breaker front with controls and annunciations
9.1 Mechanism enclosure
9.2 Front plate
11 ON push-button
12 OFF push-button
13 Mechanical position indicator
14 Mechanical operating cycle counter
15 Recess for charging lever 19
17 Rating plate
18 Mechanical charging condition indicator

Figure 4/5: Partial section of a vacuum interrupter, simplified schematic diagram
(Details vary according to the specified switching duties)
20.1 Insulator
20.2 Fixed contact
20.3 Movable contact
20.4 Metal bellows
20.5 Screen
20.6 Guide
20.7 Interrupter lid

Figure 4/6: Basic structure of the stored-energy spring mechanism
15 Recess
19 Charging lever
20 Vacuum interrupter
20.3 Movable contact
21 Upper breaker terminal
22 Lower breaker terminal
23 Flexible connector
25 Contact force spring
26 Insulated coupling rod
27 Opening spring
28 Shift lever pair
29 Cam disk
30 Drive shaft
31 Release mechanism
32 Stop disk
33 Drum with spiral spring
34 Chain drive
35 Ratchet wheel
36 Left-hand control cam

Figure 4/7: View of the stored-energy spring mechanism and auxiliary equipment with the front plate removed
15 Recess for charging lever 19
31 Release and control mechanism on the drive shaft
33 Drum with spiral spring
34 Chain drive
35 Ratchet wheel
37 Charging motor
38 Release and control mechanism area
39 Auxiliary switch block
Despatch and storage

5.1 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 60694, thus verifying their correct structure and function.

5.2 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 according to DIN 55473.

5.3 Transport
Loading of the package units must only be carried out with a
- crane,
- fork-lift truck 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. Use the lifting lugs T for hoists.

5.4 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/carer 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.

5.5 Intermediate storage
Intermediate storage of the switchgear 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.
   - 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 intermediate storage is to continue.
7 Commissioning / Operation

7.1 Note on safety at work

- This 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 „Standards and specifications“.

7.2 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.
- Lifting lugs for high current circuit-breakers, if still fitted, must be removed.
- Check the primary and secondary connections and the protectiv conductor terminal.
- Check mechanical and electrical interlocks for effectiveness, without using force.
- Charge the spring energy storage mechanism by hand (see section “Charging the spring energy storage mechanism”).
- For test purposes, switch the mechanism on and off using the mechanical operating elements 11 or 12 (note in this context any specified design supply voltage and any interlocks installed).
- Check the charging motor on circuit-breakers with motor-operated mechanisms by applying supply voltage.
- On motor-driven withdrawable parts, check the direction of rotation of the travel motors as described in section „Checking the direction of rotation of the travel motors...“.
- For any further questions on the functions of the withdrawable circuit-breaker part and its testing, see section „Testing withdrawable parts“.
- Ensure that the Instruction Manual is available to the operators at all times.

7.3 Movement of the withdrawable breaker part
(Figures 4/1, 4/2, 4/3, 7/1 to 7/4)

Perform switching operations with the front doors shut.

7.3.1 Manual insertion from the test/disconnected position to the service position

- Connect control wiring plug 8.1.
- Close the front door.
- Ensure that the circuit-breaker is in the OFF position.
- Fit hand crank 5 on square spigot 4.2 of the spindle mechanism 4.

---

### Recommended rated tightening torque ¹)

<table>
<thead>
<tr>
<th>Thread size</th>
<th>without (try)</th>
<th>Oil or grease</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 6</td>
<td>10.5</td>
<td>4.5</td>
</tr>
<tr>
<td>M 8</td>
<td>26</td>
<td>10</td>
</tr>
<tr>
<td>M 10</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>M 12</td>
<td>86</td>
<td>40</td>
</tr>
<tr>
<td>M 16</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

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) 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.

---

6 Installation and mounting of the breaker

Careful and professional installation of the switchgear is one of the fundamental conditions of trouble-free circuit-breaker operation.

- Install the mechanism enclosure in the panel without tension or distortion, inserting dished washers below the nuts or bolt heads at each of the four mounting points (dependent on the order).
- 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 „Servicing“.

---

### Recommended rated tightening torque ¹)

<table>
<thead>
<tr>
<th>Thread size</th>
<th>without (try)</th>
<th>Oil or grease</th>
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<tr>
<td>M 6</td>
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<td>M 8</td>
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<td>M 16</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

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) 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.
Note:
In order to avoid damage to the operating mechanism, use the original hand crank only:
- Standard version without slip clutch
- Optional version with slip clutch.

- Turn the crank clockwise according to the table until the stop is reached and the withdrawable part is in the service position.

Note:
Do not force to move the withdrawable breaker part (max. torque 25 Nm)! Comply with the conditions for movement of the withdrawable part as set out in section 8.5.6!

<table>
<thead>
<tr>
<th>Panel type</th>
<th>Number of crank turns</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/17.5 kV</td>
<td>24 kV</td>
</tr>
<tr>
<td>ZS1, Powerbloc, mounting frame</td>
<td>20</td>
</tr>
<tr>
<td>ZS8.4 without feeder partitioning</td>
<td>20</td>
</tr>
<tr>
<td>ZS8.4 with feeder partitioning</td>
<td>25</td>
</tr>
</tbody>
</table>

- Observe the position indicator.
- Remove hand crank 5 by pressing first against the hand crank and then remove.

Note:
When removing the crank, it is essential to ensure that the spring-loaded scene head 4.1 slides into the untensioned front position. Spindle 4 is thus locked in place, preventing inadvertent turning of the spindle. Turning of the spindle opens auxiliary switches -S8/-S9 and thus prevents the circuit-breaker from being operated.

Note:
The withdrawable part must not be stopped at any position in the travel range between the service position and test/disconnected position!

7.3.2 Manual withdrawal from the service position into the test/disconnected position
- Ensure that the circuit-breaker is in the OFF position.
- Reverse the procedure described above for insertion into the service position.

Note:
Withdrawable parts with blocking magnet -Y0 may not be forcibly moved during power failures. In such a case they are blocked in the service and test positions. For deblocking, see section 8.5.6.

7.3.3 Motor-driven movement of the withdrawable part
- Briefly operate the electrical control for insertion or withdrawal (the withdrawable part then automatically moves into the opposite position).
- Observe the position indicator.

Note:
When the motor fails, the withdrawable part can be moved in emergency manual operation. If the drive motor fails during movement of the withdrawable part, the withdrawable part must be moved into a limit position in emergency manual operation.

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.

Emergency manual operation:
Emergency manual operation is carried out with the hand crank 5 on the spindle mechanism 4, in a similar manner to operation of a withdrawable breaker part with manual systems:
- Turn off the supply voltage (m.c.b.), since the motor would otherwise be braked electrically.
- Turn hand crank 5 in the required direction.
  When the withdrawable part moves, the motor turns. The motor functions in such a case like a generator, i.e. it can lead to reverse voltages in the terminals.
  The motor protection device must not be changed from the specified type and rated value, or the behaviour of the permanent magnet motor could be irreversibly impaired

7.3.4 Withdrawal from the test/disconnected position onto the service truck
- Open the door of the circuit-breaker compartment.
- Release control wiring plug 8.1 and engage it in the storage position on the withdrawable part.
- Position service truck 48 with the guide pins 48.2 of the adjustable bench top at the correct height facing the panel front, and allow catch 48.3 to engage.
- Move sliding handles 3.1 inwards against the springs to release withdrawable part 1, withdraw onto the service truck and secure it in the catches on the truck.
- Press the release lever (at the front underneath the bench top) and release the service truck from the panel.
7.3.5 Insertion from the service truck into the test/disconnected position
• Carry out the procedure as described above for withdrawal, changing the order accordingly.

7.4 Operation of the circuit-breaker
(Figures 4/4 and 7/1)

7.4.1 Charging the spring energy storage mechanism
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 19 into recess 15 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 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.

7.4.2 Closing and opening the circuit-breaker
With the withdrawable part in the service position, on and off switching operations should only be carried out with the doors closed.
• Closing operation:
  Press mechanical ON push-button 11, or operate the electrical control unit.

• Opening operation:
  Press mechanical OFF push-button 12, or operate the electrical control unit.
Observe the notes in section 4.3.1.

The operating cycle counter 14 is automatically incremented by one complete figure with each switching cycle. On completion of a switching operation the position indicator 13 in the window of front plate 9.2 shows the appropriate position of the circuit-breaker.

• Anti-pumping relay:
  The anti-pumping relay-K0 (wiring diagram in figure 2/15) 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 11 is possible at any time.
  – With blocking magnet -Y1 fitted:
    On failure of the control voltage, blocking magnet -Y1 mechanically locks the ON halfshaft and simultaneously interrupts the circuit shunt release ON -Y3 via the corresponding auxiliary switch -S2.

    Closing with the blocking magnet de-energised requires manipulation of the circuit-breaker operating mechanism:
    – Remove front plate 9.2.
    – Take care to avoid rotating parts!

• Opening on failure of supply voltage:
  On failure of the supply voltage, mechanical opening by means of OFF push-button 12 is possible at any time.
Figure 7/1: Manual operation and mechanical indicators of a withdrawable breaker part, withdrawable circuit-breaker part in test/disconnected position

Note:
Test switching of the circuit-breaker without primary voltage can be carried out with the withdrawable part in the test position (with the control wiring plug fitted).

3.1 Sliding handle, connected to the catch in the withdrawable part base frame
(4) Spindle mechanism
4.2 Square spigot
8 Control wiring plug connection
11 Mechanical ON push-button
12 Mechanical OFF push-button
13 Mechanical position indicator
14 Mechanical operating cycle counter
18 Charging condition indicator
19 Charging lever

Figure 7/2: Movement of the withdrawable breaker part between the test/disconnected position and the service position, clockwise up to the stop for the service position and anti-clockwise for the test/disconnected position

1 Withdrawable circuit-breaker part
4 Spindle mechanism
5 Hand crank

Figure 7/3: Approaching the panel and positioning the service truck with the guide pins of the adjustable height bench top at the correct height for the catch to engage

48.1 Height adjuster
48.2 Guide pin
48.3 Catch

Figure 7/4: Service truck engaged with the panel. Withdrawable circuit-breaker part released for removal by moving the sliding handles inwards

1 Withdrawable circuit-breaker part
3.1 Sliding handle
48 Service truck (not included in supply)
Maintenance

Maintenance serves to ensure trouble-free operation and achieve the longest possible working 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

8.1 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 “Standards and specifications”
- Notes on safety at work in section “Commissioning/Operation”
- 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 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!

8.1.1 Service-life

Typical life-expectancies for VD4 circuit-breakers:
- Vacuum interrupter chambers: Up to 30,000 switching cycles, depending on chamber type (see section “Permissible numbers of switching cycles”)
- Device: Up to 30,000 cycles under normal operating conditions, depending on breaker type, and given regularly and conscientiously performed maintenance
- Withdrawable assembly: With careful operation and appropriately performed inspection work, up to 1000 movement operations can be achieved.

See also IEC 60298

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.

8.2 Inspection and functional testing

8.2.1 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.
- 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.
- Visual checking of the isolating contact system. We recommend to turn alternately the contact system in order to clean the inner contact points of the contact system.

The contact points should be cleaned if signs of unperminable overheating (discoloured surface) are visible (see section “Repair”)
- If an incorrect condition is found, appropriate servicing measures are to be initiated.

8.2.2 Stored-energy spring mechanism

Functional testing of the operating mechanism is to be performed:
- after 5000 operating cycles or
- during servicing work as set out in section „Inspection, switching devices in general“.
Prior to functional testing, switch the breaker off and

- move it into the test position (withdrawable breaker) or
- isolate the outgoing feeder (with stationary mounted breakers).

**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 energy storage mechanism 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.

8.2.3 **Breaker pole**
No inspection of the breaker pole above and beyond the stipulations of section „Inspection, switching devices in general” is necessary.

8.2.4 **Withdrawable assembly**
- The inspection should always include a visual examination of the withdrawable part assembly. Special attention is to be paid to those parts which may possibly be damaged by improper handling. (See section “Inspection/Circuit-breaker in general”.)
- Visual checking of the isolating contact system. We recommend turning the contact system alternately in order to clean the inner contact points.
- The contact points should be cleaned if signs of impermissible overheating (discoloured surface) are visible (see section “Repairs”).
- The interlock conditions and the ease of movement of the lock and release device are to be checked as described under “Repairs”.

When checking the interlock conditions, it is essential to ensure that no force is used.

**Maximum torque 25 Nm!**

8.3 **Servicing**

8.3.1 **Switching devices in general**
If cleaning is found to be necessary during inspections as set out in „Inspection, switching devices in general”, 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 Rivolta BWR 210.
- Cleaning of the insulating material surfaces and conductive components:
  - Strongly adhering contamination: with cold cleanser 716.
- Wipe down after cleaning, using clean water, and dry properly.
- 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!

8.3.2 **Stored-energy spring mechanism**
Servicing of the operating mechanism is to be performed after 10,000 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 storage mechanism by ON/OFF switching operations.
- 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 storage mechanism.
• 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.

8.3.3 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 „Permissible number of vacuum interrupter switching operations“.

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 „Permissible number of vacuum interrupter switching operations“:
• 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:
• Vacuum tester VIDAR, from Programma Electric GmbH, Bad Homberg v.d.H.

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

<table>
<thead>
<tr>
<th>Rated voltage of the circuit-breaker</th>
<th>DC test voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 kV</td>
<td>40 kV</td>
</tr>
<tr>
<td>17.5 kV</td>
<td>40 kV</td>
</tr>
<tr>
<td>24 kV</td>
<td>60 kV</td>
</tr>
</tbody>
</table>

Testing must always be performed with the device switched off:
• 12 to 24 kV: with rated contact distance
• 36 kV: with additional provisions (obtainment of information from breaker manufacturer necessary)

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.

8.4 Repair
8.4.1 VD4 circuit-breaker run-on block
In case of any irregularity in the area of the inner control mechanism and of the charging function of the stored-energy spring mechanism, the run-on block disables the immediately subsequent switching operation.

This is a protective measure to prevent damage to the circuit-breaker

Release of the run-on block is described in instruction manual BA 383/E.

8.4.2 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 storage mechanism must be discharged.

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

8.4.3 Touch up of 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.
  – 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).
8.4.4 Circuit-breaker in general:

- Check that the bolt connections at the contact points in the busbar system are tight, and that the isolating contact system functions correctly.
- Regrease the contact points and mechanism of the withdrawable part insertion system as necessary, or, when lubrication is inadequate or missing, thoroughly clean the areas concerned and regrease with Isoflex Topas NB 52 lubricant.
- Where required, regrease or thoroughly clean slide plates and bearings in the panel and regrease them with Isoflex NB 52 lubricant.

8.4.5 Replacement of contact systems

(Unless illustration of „Maintenance“ section)

Remove the contact system for thorough cleaning as described below (Figures):

- Slide the two inner annular tension springs facing the breaker pole to a position beside the other two outer annual tension springs, thus releasing contact system, and remove the contact system from contact arm.
- Fit a new contact system back to front on the thin end of arbor, and slide it forwards onto the thicker part of the shank.
- Fit arbor onto the relevant contact arm, slide the contact system over onto the contact arm, and withdraw the arbor.
- Check all contact fingers and annular tension springs for perfect fit.

Note:
The set installation position of contact arms must not be changed by the improper use of force.

8.4.6 Replacement of the withdrawable assembly

(Figures 8/7, 8/10 and 8/11)

- Disconnect plug connector 8.3 (only for withdrawable assembly of type B)
- Remove interlock rod 46.5 with pin 46.4 from the withdrawable assembly
- For motorized withdrawable assemblies, remove the two socket head bolts which are accessible from below the assembly
- Unbolt the circuit-breaker from the withdrawable assembly (4 x M12 bolts)
- Mount the circuit-breaker on a new withdrawable assembly in the reverse order, using new circlip and special pliers for pin 46.4
- Check the setting of interlocking rod 46.5:
  - Turn spindle 4 anti-clockwise to the stop for the disconnected position:
    - The distance between lever 46.3 and cam 46.2 must be 2⁻¹ mm.
    - The distance between roller 46.1 and blocking bracket 46.8 must be 0.2-0.5 mm.
  - Turn spindle 4 clockwise to the stop for the service position:
    - The distance between lever 46.3 and cam 46.2 must be 2⁻¹ mm.
    - The distance between roller 46.1 and blocking bracket 46.8 must be 0.2-0.5 mm.
    - Loosen bolts 46.7 or 46.9 for any necessary adjustment.

8.5 Testing withdrawable parts with a VD4 type circuit-breaker

When functional tests are carried out on withdrawable parts, compliance with the conditions listed below should also be checked. In this context, a distinction should be made between two types of the devices for the VD4 withdrawable part:

- **Type A:** Withdrawable assembly without integrated auxiliary switches (manual operation only).
- **Type B:** Withdrawable assembly with integrated auxiliary switches (manual or motorized operation).

8.5.1 Motor-driven withdrawable parts

(non-standard)

Carry out testing of motor-driven withdrawable parts in the same way as for manually operated withdrawable part:

- Turn off the supply voltage (m.c.b.), since the motor could otherwise be braked electrically.
- Turn hand crank 5 in the required direction.

Note:
When the withdrawable part moves, the motor turns. The motor functions in such a case like a generator, i.e. it can lead to reverse voltages in the terminals.

8.5.2 Checking the correctness of dimensional settings

(Figures 8/7 to 8/11)

1. The distance between lever 46.3 operated by link rod 46.5 and plastic cam 46.2 should be 2⁻¹ mm. If adjustment is required, release the two bolts 46.6 and 46.7. Deviations from the specified value can have the following effects:
   - Dimensions too large: blocking system for the drive spindle deactivated.
   - Dimensions too small: proper action of the electrical interlock no longer guaranteed.

Note:
The set installation position of contact arms must not be changed by the improper use of force.
2. The distance between roller 46.1 and angle lever 46.8 should be 0.2-0.5 mm when the circuit-breaker is closed.

If adjustment is required, release the two bolts 46.7 and 46.6.

8.5.3 Checking auxiliary switch settings on type A withdrawable parts
(Figure 8/7)

Compliance with the interlock conditions in the areas of the test/disconnected position and the service position is ensured by auxiliary switch -S6, located in the breaker housing and factory-set.

In test operations, the withdrawable part must be moved by hand with the crank 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 -S6 just operates.

   In this position, it must still just be possible to move closing push rod 11.1. For this test, the function of the blocking magnet -Y0 (dependent on the order) 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:
     Auxiliary switch -S9 must then switch over just before the stop is reached.

8.5.4 Checking auxiliary switch settings on type B withdrawable parts
(Figures 4/3 and 8/7)

Compliance with the interlock conditions in the test/disconnected and service position areas is ensured by position signalling switches -S8 and -S9 located in the withdrawable assembly and factory-set.

In test operations, the withdrawable part must be moved by hand with the crank fitted with the motor power switched off.

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.

   Auxiliary switch -S8 must then switch over just before the stop is reached.

   - Slowly insert the withdrawable part from the test/disconnected position towards the service position until auxiliary switch -S8 just operates.

   In this position, it must still just be possible to move closing push rod 11.1. For this test, the function of the blocking magnet -Y0 (dependent on the order) 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:
     Auxiliary switch -S9 must then switch over just before the stop is reached.

8.5.5 Checking the direction of rotation of the travel motors on motor-driven withdrawable parts

• Move the withdrawable part by hand into a central position between the test/disconnected position and the service position.
• Remove the hand crank.
• Switch the supply voltage for the travel motor on.
• Use the local electrical controls to check that the withdrawable part moves in the correct direction.

Caution:
Do not allow the withdrawable part to run up against a block when the travel direction is incorrect! Switch the motor power off immediately (the travel process functions electrically by a seal-in system with limit position switch-off).

There may be a danger of injury when the door is open!

8.5.6 Testing of interlock conditions
(Figures 7/1, 7/2 and 8/7)

The testing procedures for type A and type B withdrawable parts are identical.

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, and the travel motor on motor-operated withdrawable parts must not be capable of being switched on.
- 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, and the travel motor on motor-operated parts must not be capable of being switched on.

Do not use force (max. torque 25 Nm)!

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, and the travel motor on motor-operated withdrawable parts must not be capable of being switched on.

3. Closing of the circuit-breaker must only be possible when the withdrawable part is in the defined test/disconnected position or service position.

The control wiring plug 8.1 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 -S6 in the breaker housing (for type A), or of auxiliary switch -S9 in the withdrawable assembly (for type B), and mechanically slightly earlier; the latter corresponds to a position approximately half a turn of the crank before stop.
- For motion into the test/disconnected position, the same enabling conditions apply analogously, in this case by means of auxiliary switch -S6 in the breaker housing (for type A) or the auxiliary switch -S8 in the withdrawable assembly (for type B).

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 -Y0 may not be moved in case of control power failure, or when there is no control power. Do not forcibly move blocked withdrawable parts! The blocking magnet -Y0 is only present on manually operated withdrawable parts.

Releasing the blocking magnet -Y0.

- Remove front plate 9.2,
- Disengage blocking magnet -Y0 by pulling the magnet armature,
- While doing so, turn crank 5 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 8.1 as well as later insertion must be blocked in the withdrawable part’s service position.

Check this condition.

8.6

Spare parts, auxiliary materials, lubricants

8.6.1

Spare parts

When parts are required, the serial number of the relevant withdrawable breaker part or circuit-breaker should always be quoted. Setting instructions are to be requested separately.

Circuit-breaker VD4:

- Shunt release, auxiliary switch: For notes on settings see drawing GCE 717 96 11
- Charging motor with gearbox: No special notes required (table 1)

Withdrawable assembly of VD4:

- Manually moveable withdrawable assembly:
  - type A: For notes on settings see drawing GCE 7003570, sheet 1 and 2
  - type B: For notes on settings see drawing GCE 7003570, sheet 1 and 2.
- Motor-driven withdrawable parts: For notes on settings see drawing GCE 7003571
- Blocking magnet -Y0: For notes on settings see drawing GCE 7003820, sheet 1. (table 2)
Table 1: VD4 circuit-breaker

<table>
<thead>
<tr>
<th>Designation</th>
<th>Item no.</th>
<th>Rated supply voltage</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Auxiliary switch</td>
<td>-S1</td>
<td></td>
<td>GCE7002397R0122</td>
</tr>
<tr>
<td>(with clamp-type terminal)</td>
<td>-S3</td>
<td></td>
<td>GCE7002397R0121</td>
</tr>
<tr>
<td></td>
<td>-S4</td>
<td></td>
<td>GCE7002397R0122</td>
</tr>
<tr>
<td></td>
<td>-S5</td>
<td></td>
<td>GCE7002397R0123</td>
</tr>
<tr>
<td>• Auxiliary switch on blocking magnet</td>
<td>-S2</td>
<td></td>
<td>GCE7003022P0101</td>
</tr>
<tr>
<td>• Auxiliary switch for fault annunciation</td>
<td>-S7</td>
<td></td>
<td>GCE0905121P0100</td>
</tr>
<tr>
<td>• 1st shunt release OFF</td>
<td>-Y2</td>
<td></td>
<td>GCE7004590P0121</td>
</tr>
<tr>
<td>• 2nd shunt release OFF</td>
<td>-Y9</td>
<td></td>
<td>GCE7004590P0121</td>
</tr>
<tr>
<td>• Shunt release ON</td>
<td>-Y3</td>
<td></td>
<td>GCE7004590P0121</td>
</tr>
<tr>
<td>• Blocking magnet</td>
<td>-Y1</td>
<td></td>
<td>GCE9478103P0121</td>
</tr>
<tr>
<td>• Undervoltage release</td>
<td>-Y4</td>
<td></td>
<td>GCE9371466R0121</td>
</tr>
<tr>
<td>with spring mechanism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Delayed undervoltage release with spring mechanism</td>
<td>-Y4</td>
<td></td>
<td>GCE9371466R0121</td>
</tr>
<tr>
<td>• Indirect overcurrent release with intermediate current transformer and</td>
<td>-Y7</td>
<td></td>
<td>GCE9371466R0112</td>
</tr>
<tr>
<td>spring mechanism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Intermediate current transformer for indirect overcurrent release</td>
<td></td>
<td></td>
<td>GCE9476148R0100</td>
</tr>
<tr>
<td>• Magnet holder, complete</td>
<td></td>
<td></td>
<td>GCE7000880R0111</td>
</tr>
<tr>
<td>(with integrated rectifiers -V1, -V2, -V3, -V9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Series rectifier</td>
<td>-V4/-V7</td>
<td></td>
<td>GCE7004046R0101</td>
</tr>
<tr>
<td>(with gearing)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Charging motor</td>
<td>-M0</td>
<td>24V...240V</td>
<td>GCE0940084P....3</td>
</tr>
<tr>
<td>(with gearing)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Push-on sleeve 4,8-2,5</td>
<td></td>
<td></td>
<td>DIN 46247 Page 2</td>
</tr>
<tr>
<td>for push-on blade 0,8 thick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(for additional external connections)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Quote contact arrangement
2) State the type of release and voltage
3) State rated supply voltage, Serial-Nr. of switch (on identification sign) as well as the manufacturer of the motor
8.6.2 Auxiliary materials

- Lubricants:
  - Isoflex Topas NB 52

- Cleaning agents for general cleaning:
  - Rivolta BWR 210
  - Observe the relevant ABB instruction manual BA 1002/E

- Cleaning agent for conductive parts, insulating-material parts, and all parts with heavy contamination:
  - Cold cleanser 716
  - Observe the relevant instruction manual BA 1006/E

- Touch-up paint:
  - Standard colour RAL 7035
  - 1 kg-box
  - Spray tin

Table 2: VD4 withdrawable assembly

<table>
<thead>
<tr>
<th>Designation</th>
<th>Item no.</th>
<th>Rated supply voltage</th>
<th>Part no. (order code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary switch for manually operated mechanism (type A)</td>
<td>-S6</td>
<td>24 V</td>
<td>GCE7004023R0101</td>
</tr>
<tr>
<td>Auxiliary switch for manually operated mechanism (type B)</td>
<td>-S8/-S9</td>
<td>30 V  48 V  60 V  110 V  125 V  220 V</td>
<td>GCE7004024R0101  GCE7004024R0103</td>
</tr>
<tr>
<td>Auxiliary switches for motor-operated driving mechanism</td>
<td>-S8/-S9</td>
<td>24 V  24...240 V</td>
<td>GCE7004024R0102  GCE7004024R0104</td>
</tr>
<tr>
<td>Blocking magnet</td>
<td>-Y0</td>
<td>30 V  48 V  60 V  110 V  125 V  220 V</td>
<td>GCE7003820R0101  GCE7003820R0102  GCE7003820R0103  GCE7003820R0104  GCE7003820R0105  GCE7003820R0106</td>
</tr>
<tr>
<td>Motor with gearbox</td>
<td>-M1</td>
<td>24 V  24...240 V</td>
<td>GCE0940150P1)</td>
</tr>
</tbody>
</table>

1) State rated supply voltage, Serial-Nr. of switch (on identification sign) as well as the manufacturer of the motor.
Figure 8/1: Auxiliary switch block, equipment example
40 Magnet holder, complete
41 Mounting plate
41.1 Upper (plug-in) fixing point
41.2 Lower fixing point
42 Auxiliary shaft
42.1 Crank
43 Fastening screw

Figure 8/2: Undervoltage release and operation area, equipment example
44 Interlock plate for -Y4
-Y1 Blocking magnet
-Y3 Shunt release ON
-Y4 Undervoltage release

Figure 8/3: Indirect overcurrent release and operation area, equipment example
11.1 ON push-rod
12.1 OFF push-rod
14 Operating cycle counter
-Y7 Indirect overcurrent release

Figure 8/4: Charging motor, charging system and spring energy store
33 Drum with spiral spring
34 Chain drive
35 Ratchet wheel
37 Charging motor with gearing
37.1 Fastening screw (gearbox)
Bild 8/5: Fit the contact system back-to-front on the thin end of the arbor and slide it onto the thicker shank area

7 Contact system
47 Arbor
47.1 Journal

Figure 8/6: Slide the contact system over from the arbor onto the contact arm and allow it to engage there

6 Contact arm
(6.1) Cheese head bolt
6.2 Insulating sleeve
7 Contact system
7.1 Internal tension springs
47 Arbor

Figure 8/7: Motor-driven withdrawable part in an intermediate position close to the test/disconnected position, with fitted crank for manual operation and breaker front plate removed

5 Hand crank
8.3 Control wiring plug connector for withdrawable assembly
11.1 ON push rod
46.1 Roller
46.3 Lever
46.8 Angle lever
(-S6) Auxiliary switch (only with type A withdrawable part)
Figure 8/8: Detailed view of the opening and closing mechanism
11.1 ON push rod
46.2 Plastic cam
46.3 Lever
-Y1 Blocking magnet

Figure 8/9: Manually moveable withdrawable part, front plate removed
-Y0 Blocking magnet for withdrawable part

Figure 8/10: Detail in the area of a withdrawable part with travel motor, viewed from the left-hand side
46.1 Roller
46.2 Cam
46.3 Lever
46.4 Pin
46.5 Link rod
46.6 Bolt
46.7 Bolt
46.8 Angle lever
46.9 Bolt
49 Travel motor

Figure 8/11: Mechanical interlock, withdrawable assembly/circuit-breaker with manually operated withdrawable parts
46.1 Roller
46.2 Cam
46.3 Lever
46.4 Pin
46.5 Link rod
46.6 Bolt
46.7 Bolt
46.8 Angle lever
46.9 Bolt
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 (ABIL 159 from 29 June 1996)).

- Application of the rated power frequency withstand voltage specified for the switching device by VDE 0671 part 100 or IEC 62271-100 is completely safe.

- Higher voltages than the rated power frequency withstand 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.
<table>
<thead>
<tr>
<th>VDE DIN 40719 Part 2</th>
<th>Description</th>
<th>IEC 61346-1/61346-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>-S1</td>
<td>Auxiliary switch on mechanism</td>
<td>-BS1</td>
</tr>
<tr>
<td>-S2</td>
<td>Auxiliary switch on block magnet -Y1</td>
<td>-BL1</td>
</tr>
<tr>
<td>-S3</td>
<td>Auxiliary switch on switch shaft</td>
<td>-BB1</td>
</tr>
<tr>
<td>-S4</td>
<td>Auxiliary switch on switch shaft</td>
<td>-BB2</td>
</tr>
<tr>
<td>-S5</td>
<td>Auxiliary switch on switch shaft</td>
<td>-BB3</td>
</tr>
<tr>
<td>-S7</td>
<td>Fleeting contact ≥ 30 ms for c.b. tripped indication</td>
<td>-BB4</td>
</tr>
<tr>
<td>-S8</td>
<td>Limit switch test position</td>
<td>-BT2</td>
</tr>
<tr>
<td>-S9</td>
<td>Limit switch service position</td>
<td>-BT1</td>
</tr>
<tr>
<td>-Y0</td>
<td>Block magnet on track with rectifier -V0</td>
<td>-RL2</td>
</tr>
<tr>
<td>-Y1</td>
<td>Closing block magnet</td>
<td>-RL1</td>
</tr>
<tr>
<td>-Y2</td>
<td>1. Shunt release OFF</td>
<td>-MO1</td>
</tr>
<tr>
<td>-Y3</td>
<td>Closing release</td>
<td>-MC</td>
</tr>
<tr>
<td>-Y4</td>
<td>Undervoltage release</td>
<td>-MU</td>
</tr>
<tr>
<td>-Y7</td>
<td>Indirect overcurrent release</td>
<td>-MO3</td>
</tr>
<tr>
<td>-Y9</td>
<td>2. Shunt release OFF</td>
<td>-MO2</td>
</tr>
<tr>
<td>-V1</td>
<td>Series rectifier for -Y1</td>
<td>-TR4</td>
</tr>
<tr>
<td>-V2</td>
<td>Series rectifier for -Y2</td>
<td>-TR1</td>
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<td>-V3</td>
<td>Series rectifier for -Y3</td>
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<td>-V4</td>
<td>Series rectifier for -Y4</td>
<td>-TR6</td>
</tr>
<tr>
<td>-V9</td>
<td>Series rectifier for -Y9</td>
<td>-TR2</td>
</tr>
<tr>
<td>-M0</td>
<td>Charging motor</td>
<td>-MS</td>
</tr>
<tr>
<td>-K0</td>
<td>Antipumping relay</td>
<td>-KN</td>
</tr>
<tr>
<td>-R0</td>
<td>Series resistor</td>
<td>-RR</td>
</tr>
<tr>
<td>-M1</td>
<td>Motor drive for draw out</td>
<td>-MT</td>
</tr>
</tbody>
</table>
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