WS

Gas-Insulated switchgear up to 36 kV

Operation - Maintenance
Technical Instruction

No. AGS 531591-01
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Remarks on this manual

As our products are subject to continuous further development, we reserve the right to make changes regarding the standards, illustrations and technical data. All dimensions specified in this manual are in millimeters.

Purpose and target group

This Technical Manual describes operation and maintenance of gas-insulated medium-voltage switchgear units of the WS series. It is exclusively intended for use by the manufacturer’s staff or by persons certified for the WS series (training certificate).

The work described in this manual may only be performed by specialist electricians with proven experience in conjunction with
■ the WS series (training certificate)
■ all relevant safety provisions.

This Technical Manual is an integral part of the product and must be stored so that it is readily accessible at all times for and can be used by persons who are to work on the switchgear. If the switchgear is relocated to another site, this Technical Manual must be passed on to the new operators along with the unit.

This Technical Manual cannot describe every imaginable individual case or every customer-specific version of the product. For information which is not included in this manual, please contact the manufacturer.

Reference documents

■ Purchase contract with the agreements on the configuration of the switchgear and with the legal details
■ Installation Instructions
■ the contract specific switchgear circuit diagrams / documentation
■ the Operating Instructions of the devices installed in the switchgear (e.g. IVIS, devices in low-voltage cabinet)
■ the Instructions for Assembly provided by the manufacturer of the cable connection systems to be connected to the switchgear
■ the System Configuration “WS”
■ the Technical Instructions “Use and handling of insulating gas” for WS (can be requested as required).

The following additional documents for this switchgear must be observed:
Remarks on this manual

Terms and symbols used

This Technical Manual uses certain terms and symbols. They warn about dangers or provide important information which must be complied with in order to avoid danger to persons and damage to equipment:

- **“Danger!”**
  This danger symbol warns about dangerous electrical voltage. Contact with voltage may result in fatal injury!

- **“Warning!”**
  This danger symbol warns about the risk of injury. Please comply with all the provisions identified by this symbol in order to avoid death or serious injury.

- **“Important:”**
  This instruction symbol is used for information which is important to avoid material damage.

Abbreviations used

- $U_r$: Rated voltage
- $I_r$: Rated current
- BB: Busbar

Any questions or suggestions?

Do you have any questions or suggestions regarding this manual, or do you require further information?

We always strive to provide you with the best-possible information for optimum, safe use of our products. Thus, do not hesitate to contact us if you have any recommendations, amendments or proposals for improvement.
1 Safety provisions

The work described in this manual may only be performed by specialist electricians with proven experience in conjunction with the WS series and the applicable safety provisions.

Read the instructions carefully before you work on the switchgear.

Applicable standards and regulations:

- Metal-enclosed AC switchgear for rated voltages > 1 kV up to including 52 kV: IEC 62271-200
- Use and handling of sulphur hexafluoride (SF$_6$) in high-voltage switchgear: IEC 62271-303
- The locally applicable accident prevention, operating and work instructions must be complied with.
- Installation: IEC 61936-1 / EN 50522
- Operation of electrical equipment: EN 50110-1

1 The national standards applicable in the country where the equipment is to be installed must be complied with.

Before performing work on the panels, it is essential that you comply with the following instructions:

**Danger!**

Mortal danger due to high voltage. Before performing assembly or maintenance work, the system must be isolated from high voltage, and earthed.

**Danger!**

Mortal danger due to supply voltage. Before performing assembly or maintenance work, the system must be isolated from the supply voltage.

**Warning!**

Risk of injury from movable parts in mechanical drives. Before performing maintenance work,
- isolate the system from the supply voltage
- release the circuit-breaker’s energy storing device by OFF-ON-OFF operation and in case of a make-proof earthing switch, by the appropriate ON-operation.

**Warning!**

After the removal of covers from a switchgear, operator safety regarding internal arcs may be reduced unless the switchgear is isolated from the power supply. Optimum operator safety is only ensured if the switchgear is completely isolated from the power supply and earthed for assembly work.

Behaviour in case of incidents or accidents

For the case of an internal fault, the switchgear WS is equipped with pressure relief ports which prevent the panels and the switchgear from bursting.

This Technical Manual does not include information regarding the safety of buildings in case of internal faults (pressure load of the switchgear room and necessary pressure relief ports). Pressure calculations for switchgear rooms incl. recommendations regarding pressure relief ports can be provided on request against a fee. For further details, please contact the manufacturer.

In case of fire or of internal faults, toxic and caustic decomposition products may be produced. Comply with the locally applicable accident and safety provisions.

Make sure that first-aid measures are taken in case of injury to persons.
2 Technical data

2.1 Applied standards

WS switchgear units are

- metal-enclosed
- SF₆ insulated
- type-tested
- tested for internal arc faults
- dimensioned for indoor installation

WS switchgear units meet the following standards and regulations:

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear</td>
<td>IEC 62271-200</td>
</tr>
<tr>
<td></td>
<td>IEC 62271-1</td>
</tr>
<tr>
<td>Circuit-breaker</td>
<td>IEC 62271-100</td>
</tr>
<tr>
<td>Earthing switch</td>
<td>IEC 62271-102</td>
</tr>
<tr>
<td>Disconnector switch</td>
<td>IEC 62271-102</td>
</tr>
<tr>
<td>Current transformer</td>
<td>IEC 61869-2</td>
</tr>
<tr>
<td>Voltage transformer</td>
<td>IEC 61869-3</td>
</tr>
<tr>
<td>Voltage detection systems</td>
<td>IEC 61243-5</td>
</tr>
<tr>
<td>Protection against accidental contact, foreign objects and water</td>
<td>IEC 60529</td>
</tr>
<tr>
<td>Installation</td>
<td>IEC 61936-1</td>
</tr>
<tr>
<td>Operation of electrical equipment</td>
<td>EN 50110</td>
</tr>
</tbody>
</table>

Degree of protection against accidental contact and foreign objects

<table>
<thead>
<tr>
<th>Degree of protection against accidental contact and foreign objects (acc. IEC 60529)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main electric circuits</td>
</tr>
<tr>
<td>Drives</td>
</tr>
<tr>
<td>Low-voltage cabinet</td>
</tr>
<tr>
<td>Cable connection compartment</td>
</tr>
</tbody>
</table>

¹ optional IP 5X  
² optional

Insulating gas

<table>
<thead>
<tr>
<th>Insulating gas acc. IEC 60376</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Rated pressure pₚ at 20 °C</td>
</tr>
</tbody>
</table>

³ See section 4.1 from page 18.

2.2 Environmental and operating conditions

WS switchgear may only be operated under normal operating conditions according to the specifications EN 62271-1 or the IEC Publication 62271-1.

Operation under conditions deviating from these is only admissible upon consultation with and approved by the manufacturer.

<table>
<thead>
<tr>
<th>Ambient conditions (acc. IEC 62271-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature class</td>
</tr>
<tr>
<td>Min./max. ambient temperature</td>
</tr>
<tr>
<td>Average value over 24 hours (max.)</td>
</tr>
<tr>
<td>Average rel. air humidity: 24 h / 1 month</td>
</tr>
<tr>
<td>Max. installation altitude above sea level</td>
</tr>
</tbody>
</table>

¹ other values possible on request
### 2.3 Ratings for Switchgear WS

<table>
<thead>
<tr>
<th>Rated voltage $U_r$ [kV]</th>
<th>12</th>
<th>17.5</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated lightning impulse withstand voltage $U_p$ [kV]</td>
<td>75</td>
<td>95</td>
<td>125</td>
<td>170</td>
</tr>
<tr>
<td>Rated short-duration power-frequency withstand voltage $U_d$ [kV]</td>
<td>28</td>
<td>38</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>Rated normal current busbar $I_r$ max. [A]</td>
<td>2500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated normal current feeder $I_f$ max. [A]</td>
<td>2500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated peak withstand current $I_p$ max. [kA]</td>
<td>82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated short-circuit breaking current $I_{sc}$ max. [kA]</td>
<td>31.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated short-time withstand current $I_t$ max. [kA]</td>
<td>31.5 (3 s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated frequency $f_r$ [Hz]</td>
<td>50/60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.4 Nameplate

The type designation of the switchgear panels on the nameplate (Fig. 1) specifies the essential technical data.

The following example shows the composition of the type designation:

Example:

Series WS  WSA 8/36 - 2/623

A = Single busbar
B = Double busbar

Rated peak withstand current 80 kA

Rated voltage 36 kV

Rated lightning impulse withstand voltage 170 kV

Panel width 600 mm
Panel height 2300 mm

When submitting enquiries to the manufacturer or when ordering spare parts, the following information is required:

- Type designation
- Serial number
2.5 Control and operating devices

The switchgear panels have been designed on principle for manual operation. The drive mechanisms of the individual switching devices can be equipped, depending on the specific customer's model, with additional electrical control and operating devices. These are characterized in the switchgear-specific circuit diagram (see switchgear documentation).

Component fitting options:
- for charging the energy-storing device (closing spring)
- for actuation of the disconnector and earthing switch

Motor
- 1 unit

Closing release
- max. 2 units

Opening release
- max. 2 units (Maximum equipment – opening release and secondary release, 3 units in total)

Secondary release (CT-powered release)
- 1 unit

Undervoltage release
- Blocking coils prevent the circuit breaker from being closed and opened via the mechanical pushbuttons “ON” or “OFF”, as well as actuation of the interlocking levers of the disconnectors and earthing switches.

Overview rated supply voltages
| DC voltage: [V] | 24/48/60/110/125/220 |
| AC voltage: [V] | (110) 120/(220) 230 |

Power consumption, solenoids and motor

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>DC approx. [W]</th>
<th>AC 50/60 Hz approx. [VA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closing release</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>Opening release without auxiliary spring energy store</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>Opening release with auxiliary spring energy store</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Undervoltage release</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>200–250</td>
<td></td>
</tr>
<tr>
<td>Blocking coil</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>CT-powered release</td>
<td>–</td>
<td>12</td>
</tr>
</tbody>
</table>

Please enquire at the manufacturer’s for details of the motor’s starting current. The auxiliary voltage data is required to this effect.
Auxiliary Switches

Auxiliary switches are always actuated directly by the switch shaft via an intermediate linkage. Their position always corresponds to that of the main contacts. Switching functions on delivery: refer to circuit diagram.

<table>
<thead>
<tr>
<th>Rated supply voltage</th>
<th>DC [V]</th>
<th>AC [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Switching capacity</td>
<td>[A]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Time constant T = L/R</td>
<td>[ms]</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Rated short-time current</td>
<td>100 A/30 ms</td>
<td></td>
</tr>
<tr>
<td>Rated continuous current</td>
<td>[A]</td>
<td>10</td>
</tr>
</tbody>
</table>

2.6 Use in accordance with the intended purpose

WS gas-insulated medium-voltage switchgear units are exclusively intended for switching and distributing electrical power. They may only be used in the scope of the specified standards and the appropriate switchgear-specific technical data. Any other use constitutes improper use and may result in dangers and damage.

Disclaimer of liability

The manufacturer shall not be held responsible for damage which occurs if:
- instructions in this manual are not complied with,
- the switchgear is not operated according to its intended use (see above),
- the switchgear is assembled, connected or operated improperly,
- accessories or spare parts are used which have not been approved by the manufacturer,
- the switchgear is modified without the manufacturer’s approval, or if inadmissible parts are attached.

No liability is accepted for parts provided by customers, e.g. voltage transformers.

2.7 Disposal at the end of service life

A material and recycling data sheet can be provided on request for the disposal of series WS switchgear units at the end of their service life.

Disposal is performed as a service by the manufacturer’s Service Center and is subject to a fee.

The operating equipment contains the fluorinated greenhouse gas SF₆ covered by the Kyoto Protocol with a global warming potential (GWP) of 22,200.

SF₆ must be recovered and must not be released into the atmosphere. When transporting and handling SF₆, the specifications in IEC 62271 High-Voltage Switchgear and Controlgear – Part 303 Use and Handling of Sulphur Hexafluoride (SF₆), must be complied with.
3.1 Single busbar panel WSA

The illustrations show the panel types with their respective basic equipment.
Customized models or additional equipment are described in the switchgear-specific documentation.

Fig. 2
1 Drive with front control panel
2 Circuit-breaker compartment
3 Busbar tank with disconnector and earthing switch
4 Cable test sockets
5 Supporting structure with cable connection area
6 Low voltage cabinet
7 IVIS voltage indicator
Basic modules of a single busbar WSA switchgear

- Circuit-breaker panel
  - Circuit-breaker
  - Disconnecting / earthing switch
  - Toroidal-core current transformer
  - Single cable connection

- Circuit-breaker panel
  - Circuit-breaker
  - Disconnecting / earthing switch
  - Toroidal-core current transformer
  - Multi-cable connection
  - Disconnectable, flangemounted voltage transformers

- Circuit-breaker panel
  - Circuit-breaker
  - Disconnecting / earthing switch
  - Toroidal-core current transformer
  - Multi-cable connection
  - Disconnectable, flangemounted voltage transformers with primary fuse protection (on request in case of 36 kV)

- Circuit-breaker panel
  - Circuit-breaker
  - Disconnecting / earthing switch
  - Toroidal-core current transformer
  - Single cable connection
  - Disconnectable, flangemounted voltage transformers on the busbar

- Bus section coupler
  - Circuit-breaker
  - Disconnecting / earthing switch
  - Toroidal-core current transformer
  - Lower busbar tie connection in gas-filled compartment

- Bus sectionalizer
  - Circuit-breaker
  - Disconnecting / earthing switch
  - Toroidal-core current transformer
  - Lower busbar tie connection in gas-filled compartment
End panel
Cable connection in downward direction for inner cone-type bushings size 1 – 3, or fully insulated conductor bar terminal

End panel
Cable connection in upward direction for inner cone-type bushings size 1 – 3, or fully insulated conductor bar terminal

Busbar metering panel with current transformers in the busbar run

Busbar metering panel with current transformers in the busbar run and metal-enclosed voltage transformers in feeder panel area, connected via cable

Busbar earthing with earthing switch in the busbar run

1 Cable connection and earthing for work purposes on the busbar, e.g. for metal-enclosed busbar voltage transformers or cable connections. Inner cone-type bushings, size 1 or 2
2 Fully insulated conductor bar terminal forward, to busbar ends
3.2 Double busbar panel WSB

Fig. 3
1. Drive with front control panel
2. Tank with circuit breaker
3. Busbar tank 1 with disconnector and earthing switch
4. Busbar tank 2 with disconnector
5. Supporting structure and cable connection
6. Low voltage cabinet
7. Cable test sockets
8. IVIS voltage indicator
3 Variant overview

Basic modules of a double busbar WSB switchgear

Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Single cable connection

Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Multi-cable connection
- Disconnectable, flangemounted voltage transformers

Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Multi-cable connection
- Disconnectable, flangemounted voltage transformers with primary fuse protection (on request in case of 36 kV)

Bus coupler
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Lower busbar tie connection in gas-filled compartment

Bus coupler in single-panel width with
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Up to max. 1250 A

Bus section coupler lower busbar
(upper busbar analogously)
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
3 Variant overview

Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Single cable connection
- Disconnectable, flangemounted voltage transformers on the busbar

Bus sectionalizer
with disconnecter in the busbar run

Busbar earthing
with earthing switch in the busbar run

Busbar metering panel
with current transformers in the busbar run and metal enclosed voltage transformers in feeder panel area, connected via cable

End panel
Cable connection in downward and upward connection, depending on the busbar position, for inner cone-type bushings, size 1 – 3, or fully insulated conductor bar terminal

1 Cable connection and earthing for work purposes on the busbar, e.g. for metal-enclosed busbar voltage transformers or cable connections. Inner cone-type bushings, size 1 or 2
2 Fully insulated conductor bar terminal forward, to busbar ends
## 4.1 Technical data

### Type of insulating gas:
Sulfur hexafluoride SF₆ according to IEC 60376.

**“Sealed Pressure System”**
The tanks of the switchgear have been designed as “Sealed Pressure System” as defined by the IEC publication 62271-200. Thanks to the design of the “Sealed Pressure System”, the insulating gas contents do not require any maintenance. During the expected service life, no gas handling will be required under normal operating conditions acc. to IEC 62271-1. For further details on this aspect, also refer to the Technical Instruction "Use and handling of insulating gas" for WS panels, which is available on request.

### Important:
The switchgear-specific gas compartment diagram must be complied with.

### Rated pressure and pickup values of pressure gauge / IGIS

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>[kV]</th>
<th>12/24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated (normal) current</td>
<td>[A]</td>
<td>\leq 1250</td>
<td>&gt; 1250</td>
</tr>
<tr>
<td>Rated pressure</td>
<td>[MPa]</td>
<td>0.030*</td>
<td>0.075*</td>
</tr>
<tr>
<td>Pre-alarm in case of a drop in pressure</td>
<td>[MPa]</td>
<td>0.019*</td>
<td>0.062*</td>
</tr>
<tr>
<td>Main alarm in case of a drop in pressure</td>
<td>[MPa]</td>
<td>0.014*</td>
<td>0.057*</td>
</tr>
</tbody>
</table>

* The relative pressure data indicated in the Table refer to an ambient temperature of +20°C and an atmospheric pressure of 101.3 kPa abs..

### Measures to be taken at the various warning thresholds

<table>
<thead>
<tr>
<th>Warning threshold</th>
<th>Dielectric state of the gas compartment</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-alarm in case of a drop in pressure (signalling contact 1)</td>
<td>The insulating level is not restricted up to the warning threshold &quot;main warning&quot; and corresponds to the data on the rating plate.</td>
<td>Replenish insulating gas¹ Contact the manufacturer.</td>
</tr>
<tr>
<td>Main alarm in case of drop in pressure (signalling contact 2)</td>
<td>Reduced insulating level</td>
<td>In case of a main alarm, isolate the switchgear compartment in question! Contact the manufacturer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Insulating gas pressure has decreased to atmospheric pressure</th>
<th>Switchgear rated voltage</th>
<th>Insulating level</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 kV</td>
<td>Rated lightning impulse withstand voltage 75 kV</td>
<td></td>
</tr>
<tr>
<td>17.5 kV</td>
<td>Rated lightning impulse withstand voltage 95 kV</td>
<td></td>
</tr>
<tr>
<td>24 kV</td>
<td>Rated lightning impulse withstand voltage 145 kV</td>
<td></td>
</tr>
</tbody>
</table>

¹ Insulating gas may only be replenished by trained specialist staff. Refer to the applicable safety provisions and data sheets. For use and handling of sulphur hexafluoride (SF₆) in high-voltage switchgear, IEC 62271-303 must be complied with.

² Penetration of air may further reduce the insulating level.
4.2 Pressure gauge

The pressure indication on the pressure gauge is ambient-temperature compensated, i.e. the pressure indicated corresponds to a temperature of 20°C in the switchroom. The pressure indication remains constant if the operating mode remains unchanged, even if the temperature in the switchgear room changes.

Fig. 4
Pressure gauge
1 Signalling contact 1
2 Signalling contact 2
3 Pressure indication

<table>
<thead>
<tr>
<th>Signalling contact</th>
<th>Switching function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>closes if pre-alarm is reached during drop in pressure</td>
</tr>
<tr>
<td>2</td>
<td>closes if main alarm is reached during drop in pressure</td>
</tr>
</tbody>
</table>

Fig. 5
Insulating gas monitoring with individual monitoring of the circuit-breaker compartments and integrated monitoring of the busbar compartment (example)
1 Pressure gauge for circuit-breaker compartment
2 Gas connector socket for circuit-breaker compartment M24 x 1.5 (DIN6)
3 Pressure gauge for busbar compartment
4 Gas connector socket for busbar compartment M24 x 1.5 (DIN6)
4.3 IGIS

IGIS measures the pressure of an integrated gas compartment and the temperature within the switchgear room in order to determine the temperature-compensated insulating gas pressure.

This temperature-compensated insulating gas pressure is the insulating gas pressure at a switchgear compartment temperature of 20 °C. In line with the concept of integrated gas compartments, it is a measure which indicates the insulating level of the switchgear.

The number of the channels for the pressure transmitters and the configured pickup values are specifically designed for the corresponding gas-insulated switchgear.

**Important:**
Comply with the IGIS Operating Manual AGS 531 741-01.

---

Fig. 6
1 Busbar compartment 2
2 Busbar compartment 1
3 Circuit-breaker compartments
4 IGIS
5 Voltage Detecting Systems (VDS)

5.1 Integrated Voltage Detecting System IVIS

IVIS is an integrated voltage detecting system with an integrated display unit used to determine zero voltage / line voltage according to IEC 61243-5. (Fig. 8).

The IVIS system has been designed for maximum operating reliability. It does not require supply from an external source. It features climateproof encapsulated electronics and is maintenance-free, due to permanent monitoring of the indication thresholds.

Flash arrow symbols on the indicators display the mains voltage still existing within the defined response thresholds (Fig. 7). The IVIS system does not require the electrical repeat tests common for voltage detection systems.

**Important:** For a description of all functions and messages of the IVIS system, please refer to the separate Operating Manual "IVIS" (No. AGS 531 751-01).

5.2 Pluggable voltage detection system

The line voltage or the zero voltage state of the feeder panels is detected via a separate voltage detection system according to IEC 61243-5. Socket-contacts for the indicators are located on the panel front as well as on the rear side of the panel (Fig. 10). Capacitive voltage indicators of all the approved manufacturers can be used (Fig. 9).

**Warning!** The indicators must not be plugged in at the front and rear simultaneously (offset response limits).

**Important:** Comply with the manufacturer's Operating Manual of the voltage indicators used.

All three phases L1, L2 and L3 must always be checked together.

**Important:** For a description of all functions and messages of the IVIS system, please refer to the separate Operating Manual "IVIS" (No. AGS 531 751-01).
5 Voltage Detecting Systems (VDS)

5.3 Phase monitors

Important: Before connecting live switchgear components for the first time, always check phase coincidence.

If IVIS is used, phase comparison can be performed by means of the phase monitor DEHNcap/PC-LRM (Fig. 12).

Fig. 11
Phase monitor for HR system, type ORION 3.0 (manufacturer: Horstmann GmbH)

Fig. 12
Phase monitor DEHNcap/PC-LRM
6.1 Operator interfaces

for WSA (single busbar) and WSB (double busbar)

Fig. 13
Example: WSA operator interface (feeder panel with single busbar)

Fig. 14
Example: WSB operator interface (feeder panel with double busbar)

1. Insertion opening
   Energy-storing device – manual operation

2. Circuit-breaker:
   Status indicator of the energy-storing device
   Position indicator
   ON button
   OFF button

3. Earthing switch:
   Interrogating lever
   Switch position indicator
   Insertion opening for switch operation

4. Disconnector:
   Interrogating lever
   Switch position indicator
   Insertion opening for switch operation

5. Mechanical lock-out

6. Circuit-breaker operations counter

7. Busbar 1 (corresponds to the lower busbar tank)

8. Busbar 2 (corresponds to the upper busbar tank)

(Different, switchgear-specific determinations must be taken into consideration accordingly.)
6.2 Interlocks

**Warning!**
Complete switchgear interlocking can only be ensured with complete locking devices.

**Warning!**
Regarding the implementation of the interlocking systematics, the purchase contract and the switchgear-specific circuit diagram must be complied with!

**Internal mechanical interlocks of the panel**
- Only one interrogating lever ("disconnector" or "earthing switch") can be actuated at the same time.
- The cranks for the disconnectors and earthing switches can only be removed in their appropriate end positions.
- The earthing switch can only be actuated in direction ON with the circuit-breaker’s energy storing device charged (intertripping circuit of circuit-breaker during earthing, see sect. 6.3). When the energy-storing device is not charged, direction reversal from OFF to ON is prevented during the OFF actuation.
- When the crank for actuation of disconnector or earthing switches has not been removed, or if the interrogating lever has been actuated, the circuit-breaker cannot be switched ON. (Push-button ON cannot be pressed or the ON pulse is interrupted. This also applies for couplers).

**Mechanical lock-out mechanism with cylinder lock (optional)**

<table>
<thead>
<tr>
<th>Turn key</th>
<th>Key</th>
<th>Actuations on front control panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>clockwise</td>
<td>removable</td>
<td>actuation not possible *)</td>
</tr>
<tr>
<td>counter-clockwise</td>
<td>not removable</td>
<td>actuation possible</td>
</tr>
</tbody>
</table>

*) In the case of feeder panels, the circuit-breaker button "OFF" can be actuated
Mechanical lock-out mechanism with padlocks (optional)  

Padlock not in scope of delivery

Electromagnetic interlocks

Electro-magnetic blocking coils prevent, depending on the switching position, actuation of the interrogating levers and of the ON/OFF buttons of the circuit-breaker.

**Important:**

In case of failure of the supply voltage, all electromagnetic interlocks are in their "locked" position.

**Measure:**

Re-establish the supply voltage.
Interlocks in case of feeder panels, single busbar switchgear WSA

on front control panel (all interlocks mechanical)
The interlocks act as appropriate in case of remote control

<table>
<thead>
<tr>
<th>Circuit-breaker</th>
<th>ON</th>
<th>OFF</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF button</td>
<td>free</td>
<td>–</td>
<td>blocked</td>
<td>–</td>
</tr>
<tr>
<td>Energy-storing device</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>released</td>
</tr>
<tr>
<td>Disconnector</td>
<td>ON/OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Interrogating lever</td>
<td>blocked</td>
<td>free</td>
<td>blocked</td>
<td>free</td>
</tr>
<tr>
<td>Earthing switch</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Interrogating lever</td>
<td>blocked</td>
<td>blocked</td>
<td>free</td>
<td>free</td>
</tr>
<tr>
<td>Crank</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>blocked</td>
</tr>
</tbody>
</table>

– of no significance as regards interlocks

Interlocks in case of feeder panels, double busbar switchgear WSB

on front control panel (interrogating lever locked electro-magnetically)
The interlocks act as appropriate in case of remote control

<table>
<thead>
<tr>
<th>Circuit-breaker</th>
<th>ON</th>
<th>OFF</th>
<th>ON</th>
<th>OFF</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF button</td>
<td>free</td>
<td>–</td>
<td>blocked</td>
<td>–</td>
<td>free</td>
<td>–</td>
</tr>
<tr>
<td>Energy-storing device</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>released</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Disconnector 1</td>
<td>ON/OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Interrogating lever 1</td>
<td>blocked</td>
<td>free</td>
<td>blocked</td>
<td>free</td>
<td>blocked</td>
<td>free</td>
</tr>
<tr>
<td>Disconnector 2</td>
<td>ON/OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Interrogating lever 2</td>
<td>blocked</td>
<td>blocked</td>
<td>blocked</td>
<td>free</td>
<td>free</td>
<td>free</td>
</tr>
<tr>
<td>Earthing switch</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Interrogating lever</td>
<td>blocked</td>
<td>blocked</td>
<td>free</td>
<td>free</td>
<td>blocked</td>
<td>blocked</td>
</tr>
<tr>
<td>Crank</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>blocked</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

– of no significance as regards interlocks
Interlocks in case of bus coupler in two panel widths

on front control panel (interrogating lever locked electro-magnetically)
The interlocks act as appropriate in case of remote control

- Bus section coupler: analogously in case of single and double busbar switchgear
- Bus coupler: analogously in one panel width
- Interlocks: apply analogously even if BB1 and BB2 are interchanged

<table>
<thead>
<tr>
<th>Circuit-breaker</th>
<th>ON</th>
<th>OFF</th>
<th>ON</th>
<th>OFF</th>
<th>OFF</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF button</td>
<td>free</td>
<td>–</td>
<td>blocked</td>
<td>–</td>
<td>–</td>
<td>blocked 2)</td>
</tr>
<tr>
<td>Energy-storing device</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>released</td>
<td>–</td>
</tr>
<tr>
<td>Disconnector panel 1</td>
<td>ON/(OFF)</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Interrogator lever, panel 1</td>
<td>blocked</td>
<td>free</td>
<td>blocked</td>
<td>free</td>
<td>free</td>
<td>blocked</td>
</tr>
<tr>
<td>Disconnector panel 2</td>
<td>OFF/(ON)</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Interrogator lever, panel 2</td>
<td>blocked</td>
<td>free</td>
<td>blocked</td>
<td>free</td>
<td>free</td>
<td>blocked</td>
</tr>
<tr>
<td>Earthing switch, panel 1</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Interrogator lever, panel 1</td>
<td>blocked</td>
<td>blocked</td>
<td>free</td>
<td>blocked</td>
<td>blocked</td>
<td>blocked</td>
</tr>
<tr>
<td>Earthing switch, panel 2</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Interrogator lever, panel 2</td>
<td>blocked</td>
<td>blocked 1)</td>
<td>blocked</td>
<td>blocked</td>
<td>blocked</td>
<td>blocked</td>
</tr>
</tbody>
</table>

1) Blocked, if a disconnector in at least one feeder panel of BB1 is ON; interlocks apply analogously even if BB1 and BB2 are interchanged
2) Blocked, if both disconnectors are in position "ON" in at least one feeder panel (only valid for bus couplers)
– of no significance as regards interlocks

Interlocks in case of busbar earthing switch and bus sectionalizer

<table>
<thead>
<tr>
<th>Switch position</th>
<th>Interlock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The earthing switch can only be switched on if all disconnectors assigned to the busbar are &quot;OFF&quot;.</td>
</tr>
<tr>
<td></td>
<td>Earthing switch &quot;ON&quot;. The interlock acts on all disconnectors assigned to the busbar.</td>
</tr>
<tr>
<td></td>
<td>Bus sectionalizer locked in &quot;ON&quot; or &quot;OFF&quot; position, except when all disconnectors in a busbar section are in &quot;OFF&quot; position.</td>
</tr>
</tbody>
</table>
6.3 Switching Circuit breaker, Disconnector, Earthing switch

General information

- The switchgear may only be switched by specialist electricians. Specialist electricians in terms of this provision are persons who, due to their electrotechnical training, have knowledge in the handling of medium-voltage switchgear according to EN 50110-1.
- Check whether the supply voltage is ON.
- The switchgear can also be actuated manually using the crank.
- After each switching operation for which you have used a crank, remove the crank and place it in the instrument niche in the side plate.

**Important:**
While the auxiliary circuit is not available, blocking coils (locking the interrogating levers and circuit-breaker push-buttons, depending on design), are in “locked” position. An undervoltage release (optional) has dropped out.

Charging the circuit-breaker's energy storing device

Initial position:
- Circuit-breaker "OFF"
- Energy-storing device: “released”

Manual charging

1. Turn slide in the insertion opening to the left, and insert crank.

2. Perform approx. 40 turns to the right until the position indicator indicates the "Charged" condition (Fig. 19). (If the motor starts during this process, this does not constitute a risk.)

3. Remove crank and keep it in a safe place.

Charging by means of a motor

The energy storing device is charged automatically, as soon as the power supply is available. The position indicator of the energy storing device indicates the “charged” condition.
Switching operations on the circuit-breaker

Switching ON (Closing)
- Push button “ON” (s. Fig. 20)
- Actuate closing release

The energy-storage device indicates the “released” condition. The position indicator indicates the “ON” position (Fig. 21).

**Important:**
The energy storing device can be charged again immediately (manually) after ON actuation. When the auxiliary circuit is on, the energy storing device is charged automatically via the motor.

Switching OFF (Opening)
- Push button “OFF” (Fig. 22)
- Actuate opening release
- by means of the secondary release or the low-voltage release

Position indicator indicates the “OFF” position (Fig. 23).

Position indicators on circuit-breaker and possible operating sequences

<table>
<thead>
<tr>
<th>Item</th>
<th>Position indicator</th>
<th>Energy-storing device (closing spring)</th>
<th>Position indicator</th>
<th>ON/OFF switch position</th>
<th>Possible operating sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>released</td>
<td></td>
<td>OFF</td>
<td>none</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>charged</td>
<td></td>
<td>OFF</td>
<td>C - O</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>released</td>
<td></td>
<td>ON</td>
<td>O</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>charged</td>
<td></td>
<td>ON</td>
<td>O - C - O</td>
</tr>
</tbody>
</table>

C = Closing (ON) O = Opening (OFF)
**Operation**

---

**Danger!**
**Risk of injury due to faulty switching!**

- Disconnectors and earthing switches must not be used to switch load or short-circuit currents.
- For both switching devices, switching operations may only be performed while the main circuit is isolated from the power supply.

---

**Important:**

- Motor drive (optional):
  During actuation of the interrogation lever or while the crank is inserted in the crank insertion opening, the motor circuit is interrupted.

- Intertripping circuit:
  The circuit-breaker is switched ON automatically after reaching its earthing position. The “OFF” actuation of the circuit-breaker is blocked.
  To switch OFF, proceed analogously. The circuit-breaker is first switched off automatically.

---

### Disconnector Operating sequence for disconnector and earthing switches

<table>
<thead>
<tr>
<th>Initial situation:</th>
<th>Switching ON manually:</th>
<th>Switching OFF manually:</th>
</tr>
</thead>
</table>
| Circuit-breaker OFF
Disconnecter OFF
Earthing switch OFF | 1. Turn interrogating lever to release the appropriate insertion opening.
2. Insert crank and turn it clockwise 10 times. The position indicator shows “ON”.
3. Remove crank. | 1. Turn interrogating lever to release the appropriate insertion opening.
2. Insert crank and turn it counterclockwise 10 times. The position indicator shows “OFF”.
3. Remove crank. |

---

![Fig. 24](image1)

**Fig. 24**

![Fig. 26](image2)

**Fig. 26**

**Disconnecter “ON”**

![Fig. 28](image3)

**Fig. 28**

**Disconnecter “OFF”**

---

![Fig. 25](image4)

**Fig. 25**

---

![Fig. 27](image5)

**Fig. 27**

**Disconnecter “ON” *)**

---

![Fig. 29](image6)

**Fig. 29**

**Earthing switch “OFF”**

---

* *) Earthing switch
6.4 Standard switching operations

**Warning!**
The interlocking conditions acc. to section 6.2 must be complied with in each case!

**Switching ON an feeder panel**
Initial position: Feeder panel EARTHED
1. Switch earthing switch OFF
2. Switch disconnector ON
3. Switch circuit-breaker ON
Feeder panel "ON"

**Earthing an feeder panel**
Initial position: Feeder panel ON
1. Switch circuit-breaker OFF
2. Switch disconnector OFF
3. Switch earthing switch ON
Feeder panel "EARTHED"

**Switching over an feeder panel to the other busbar without interruption of power supply**
Only possible with the bus coupler switched ON.

Initial position: Feeder panel on BB1
1. Switch disconnector 2 ON (Feeder panel on BB1 and BB2)
2. Switch disconnector 1 OFF (Feeder panel on BB2)
6 Operation

Switching ON a bus coupler
(in two panel widths)
Initial position: bus coupler "OFF"
1. Switch disconnectors 1 and 2 ON
2. Circuit-breaker "ON"
Operating sequence performed in an analog fashion for bus couplers in one panel width and bus section coupler.

Important:
When switching off the bus coupler, at least one disconnecter must be set to "OFF" in each feeder panel of the busbar sections in question.

6.5 Earthing the busbar

Warning!
The disconnecters on the appropriate busbar sections must be “OFF”!

Earthing the busbar by means of a feeder panel via its circuitbreaker
Initial position: Feeder panel EARTHED
1. Remove cable and connect earthing device (optional). Alternatively, the earthing device can be connected to the cable test sockets, if \( I \leq 31.5 \text{kA} / 1 \text{s} \).
2. Switch earthing switch OFF
3. Switch disconnecter ON
4. Switch circuit-breaker ON
Earthing a busbar section by means of the bus coupler

Illustrated: Earthing of BB1 (lower busbar).
Initial position: bus coupler “OFF”
1. Switch disconnector of the BB1 (circuit-breaker panel) ON
2. Switch earthing switch in the busbar riser panel (right-hand panel) ON
For earthing BB2 (upper busbar), proceed analogously.

Earthing a busbar section by means of the bus section coupler

Illustrated: Earthing the left-hand busbar section
Initial position: Bus section coupler "OFF"
1. Switch on disconnector of left-hand busbar section (circuitbreaker panel)
2. Switch on earthing switch in the busbar riser panel (right-hand panel)
For earthing the right-hand busbar section, proceed analogously.
6.6 Bus sectionalizer

Warning! All disconnectors on the appropriate busbar section must be “OFF”!

6.6 Bus sectionalizer

Switching ON manually:
1. Turn interrogating lever to release the appropriate insertion opening.
2. Insert crank and turn it clockwise 10 times. The position indicator shows “ON”.
3. Remove crank.

Switching OFF manually:
1. Turn interrogating lever to release the appropriate insertion opening.
2. Insert crank and turn it counterclockwise 10 times. The position indicator shows “OFF”.
3. Remove crank.
6 Operation

6.7 Disconnecting the voltage transformer (e.g. in case of voltage tests on the switchgear)

Warning!
Isolating devices for voltage transformers can only be actuated in de-energized condition.

1. Pull locking pin upwards (Fig. 47) or downwards (Fig. 46), depending on the arrangement of the isolating device.
2. Swing lever speedily. The isolating device slides on the earthing contact (voltage transformer earthed).
3. The locking pin must lock into the bore-hole in its new end position (it must not be left in an intermediate position).

Fig. 46
Isolating device for voltage transformer on the busbar
1 Locking pin
2 Lever
3 Description of the positions

Fig. 47
Isolating device for the voltage transformer on the cable connection
1 Locking pin
2 Lever
3 Description of the positions
Bus section couplers and bus couplers or incoming feeder panels with a rated normal current $I_n = 2500$ A are provided with a fan attachment on the circuit-breaker tank and the busbar tank. The system is equipped with crossflow fans with guard screen.

**Fan operation:**

The fan does not turn until the prevailing normal current has exceeded an adjustable threshold.

Settings for ambient conditions, see sect. 2.2:

- Making threshold: 2,000 A
- Breaking threshold: 1,900 A

**Air flow monitor:**

To ensure the cooling effect required, the fan can be monitored by an air flow monitor which is directly installed in the outlet duct of the fan (optional). If there is no air flow due to failure of the fan, the air flow monitor issues a signal.

**Measures in case of failure of the fan:**

- Reduction of the maximum operating current to 2,000 A
- Contact the manufacturer’s Service Center.

---

**Fig. 48**

Fan attachment

1. Cross-flow fan with guard screen
2. Air flow monitor
3. Ventilation duct
8 Maintenance

8.1 Safety provisions

Only specialist electricians certified by the manufacturer for maintenance work and who have the required knowledge regarding handling of WS series medium-voltage switchgear are permitted to perform maintenance and cleaning work.

Warning! Refer to the safety provisions in section 1, page 6!

8.2 General

Insulating gas:
WS series panels have a hermetically sealed pressure system in accordance with IEC 62271-200. It does not require any maintenance over the panel’s entire service life (see also section 4).

Switching units:
The components in the cladded high-voltage parts of the panel (vacuum circuit-breaker, disconnector and earthing switch) do not require any maintenance either.

Gas tank:
The pressure tanks are made of stainless, non-magnetic steel.

Warning! Neither drill holes into nor open gas tanks. Risk of loss of insulating gas.

Drive mechanisms / covers:
Drive mechanisms and covers outside of the enclosure are corrosionprotected. Damage to the paint, scratches and deterioration must be repaired immediately to avoid corrosion.

Depending on the constraints occurring during normal operation and on the operating conditions, a visual inspection of the panels should be performed at regular intervals (every 4 years).

If dirt or condensation is detected, the panels must be cleaned professionally. To this effect, only the detergents which have been approved by the manufacturer may be used (see Annex).

When performing cleaning, make sure that the lubrication in the drive mechanisms is not removed. If the drive mechanisms are no longer sufficiently lubricated, new lubrication must be applied.

Warning! The drives must not be disassembled for service and maintenance work. Disclaimer of liability (see section 2.6, page 11).

Important:
In case of frequent condensation or air pollution (dust, smoke and corrosive gases), the maintenance intervals must be adapted to the actual conditions.

In case of ambiguities or irregularities, please contact the manufacturer’s Service Center immediately.
### 8.3 Lubrication instructions

Maintenance work should only be performed by specialists who are familiar with the installed switching devices and drive mechanisms they use. The switching devices and drives must not be disassembled for service and maintenance work.

**Warning!**

*The safety provisions acc. to section 1 must be complied with.*

The closing and opening springs must be released!

Once the front cover has been removed, the drive is accessible from the switchgear front end.

1. To this effect, remove the slotted screws of the interrogating levers (one per lever) and of the front cover (4 ea.).
2. Remove interrogating lever. Remove the front cover by lifting it forward.

Access to the disconnecting and earthing switch drives is facilitated if the front cover of the right-hand adjacent panel is also removed.

Once maintenance work has been terminated, reverse disassembly sequence to re-mount the interrogating levers and the front cover.

**Points of lubrication:**

The entire drive mechanism is lubricated at the factory using the redcoloured lubricant KL, which makes it easily recognizable.

All surfaces and joints in the circuitbreaker, disconnector and earthing switch drives which are sliding on each other must be lubricated.

**Important:**

*The following elements are not lubricated:*

- motor
- ball bearings
- auxiliary releases
- push switches
- blocking coils
- auxiliary switches

---

<table>
<thead>
<tr>
<th>Maintenance interval</th>
<th>Work to be performed</th>
<th>Qualification / Work performed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 4 years</td>
<td>■ Visual inspection of the switchgear panels.</td>
<td>Staff certified accordingly for the work to be done</td>
</tr>
<tr>
<td></td>
<td>■ If necessary, clean panels and test run drive mechanisms manually.</td>
<td></td>
</tr>
<tr>
<td>After 12 years</td>
<td>■ Lubricate the drive mechanisms and perform switching tests.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ Check releases/blocking coils.</td>
<td></td>
</tr>
<tr>
<td>once the max. admissible number of breaking operations for the vacuum chambers has been reached (see section 8.4)</td>
<td>Exchange pole sections with vacuum chambers.</td>
<td>Manufacturer’s Service Center</td>
</tr>
<tr>
<td>■ after 10,000 operating cycles of the circuit-breaker or</td>
<td>Revision of the switching device.</td>
<td></td>
</tr>
<tr>
<td>■ after 2,000 operating cycles of the disconnector or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000 operating cycles of the earthing switch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 49
Removal of the front cover

Fig. 50
The lubrication points can be accessed
Lubrication procedure

- **Lubricant (KL)**
  for surfaces sliding on each other.

Clean lubrication points, e.g. using a lint-free cloth or a soft paint-brush and detergent (use sparingly, just moisten points of lubrication). Apply a thin film of multi-purpose lubricant (e.g. using a paint-brush)

- **Liquid lubricant FL**
  for bearings, joints and guide assemblies.

Pour drops of liquid lubricant (oil can, drip feed lubricator) into the bearing gap. Liquid lubricant gets between the bearing surfaces due to the capillary effect. In case of inaccessible lubrication points, use an extension tube or spray.

Fig. 52
Lubrication points in the circuit-breaker drive
Fig. 53
Disconnector and earthing switch drive WSA

Fig. 54
Disconnector and earthing switch drive WSB
Lubrication procedure

- **Lubricant (KL)**
  for surfaces sliding on each other.
  Clean lubrication points, e.g. using a lint-free cloth or a soft paint-brush and detergent (use sparingly, just moisten points of lubrication). Apply a thin film of multi-purpose lubricant (e.g. using a paint-brush)

- **Liquid lubricant FL**
  for bearings, joints and guide assemblies.
  Pour drops of liquid lubricant (oil can, drip feed lubricator) into the bearing gap. Liquid lubricant gets between the bearing surfaces due to the capillary effect. In case of inaccessible lubrication points, use an extension tube or spray.

---

Fig. 55
Lubrication points in the disconnector and earthing switch drive
8.4 Max. number of breaking operations for the vacuum chambers

The diagram (Fig. 56) define exclusively the admissible number of breaking operations of the vacuum interrupter chambers. They indicate whether the vacuum interrupter chambers need to be replaced.

Fig. 56
Max. number of breaking operations for the vacuum chambers
$I_r =$ Rated normal current $= 0.630$ kA
$I_{sc} =$ Short-circuit breaking current $= 31.5$ kA

The data for the rated normal current and rated short-circuit opening current are indicated on the rating plate (Fig. 57):

Fig. 57
Data for the rated normal current $I_r$ and rated short-circuit opening current $I_{sc}$ on the rating plate
9.1 Auxiliary products

The auxiliary products are available from the manufacturer. The use of other auxiliary products is not admissible.

<table>
<thead>
<tr>
<th>Auxiliary product</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning agent, 1 l can</td>
<td>S 008 152</td>
</tr>
<tr>
<td>Lubricant (KL), 0.5 kg can</td>
<td>ST 312-111-835</td>
</tr>
<tr>
<td>Liquid lubricant FL, 0.5 l can</td>
<td>S 008 153</td>
</tr>
</tbody>
</table>

9.2 Accessories

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crank (for circuit-breaker, disconnector, earthing switch, bus-bar earthing switch)</td>
<td>AGS C54 850-01</td>
</tr>
<tr>
<td>Double-bit key</td>
<td>AGS 434 101-01</td>
</tr>
<tr>
<td>If equipped with IVIS:</td>
<td></td>
</tr>
<tr>
<td>Phase monitor DEHNcap/PC-LRM (optional)</td>
<td>AGS C26 320-01</td>
</tr>
<tr>
<td>Constant voltage indicator: Manufacturer: Horstmann</td>
<td>S 065 081</td>
</tr>
</tbody>
</table>
As our products are subject to continuous development, we reserve the right to make changes regarding the standards, illustrations and technical data described in this Technical Manual. For any requests, please contact the address given below.

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