Gas-insulated switchgear

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Operating Instructions
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Remarks on this manual

This manual describes the operation of gas-insulated WI series medium voltage switchgear. This Operating Manual is an integral part of the product and must be stored so that it is at any time readily accessible for and can be used by persons who are to work on the switchgear. If the switchgear is sold to new owners, they must receive this document along with the switchgear.

The following additional documents must be complied with for this switchgear:

- assembly instructions
- the appropriate switchgear-specific circuit diagrams/documetation
- the Operating Manuals 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 Switchgear Configuration “WI”
- the Operating Manual “Use and handling of insulating gas” for WI (can be requested as required).

Since our products are constantly developed further, changes are concerning images, technical data and standards reserved.

All not defined measures are millimeter data.

Terms and symbols used

This manual uses certain symbols which warn about dangers or provide important information which must be complied with to avoid danger to personnel and damage to equipment:

"Danger!"
This symbol warns of dangerous electrical voltage. Contact with voltage may result in fatal injury!

"Warning!"
This symbol indicates important instructions. Non-compliance may result in serious injury, death or damage to the equipment.

"Important:"
This symbol is used for information which is important to avoid damage.
1 Safety provisions

The work described in this manual may only be performed by specialist electricians who have proved their experience with the WI series (training certificate) and the applicable safety provisions.

Please comply with:
- Common regulations for high-voltage switchgear and control gear: IEC 62271-1
- Use and handling of sulphur hexafluoride (SF₆) in high-voltage switchgear: IEC 62271-303
- the locally applicable accident prevention, operating and work instructions
- Assembly: IEC 61936-1/HD 637 S1
- Operation of electrical equipment: EN 50110-1

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

Read these instructions carefully before you work on the switchgear, and perform the work detailed in it as described. Only perform such work if you have understood the instructions. Do not perform any work on the switchgear which is not described in this manual.

Before performing work on the panel, make sure to comply with the following instructions:

**Danger!**
Before starting work on the high-voltage components, de-energize the system, verify it for zero voltage and earth the system according to the applicable safety rules pursuant to EN 50110-1.

**Danger!**
Before performing work on the drives, switch off the supply voltage and prevent it from reclosing.

**Warning!**
After removal of covers, operator safety from internal faults may be restricted if the appropriate part of the switchgear unit has not been isolated from the power supply.

**Warning!**
There is a risk of injury when working on the drive mechanism. Release the circuit-breaker’s energy storing device by performing the corresponding • OFF-ON-OFF operating sequence.
• in case of a make-proof earthing switch, by the appropriate ON-operation.

**Important:**
Operating reliability and useful life depend on correct operation.

**Behaviour in case of incidents or accidents**

For the case of an internal fault, the switchgear 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 Variants overview

Fig. 1
Single busbar series WIA up to 38 kV
(40,5 kV; Isc ≤ 31,5 kA)
1 Drive with front control panel
2 Tank with circuit-breaker, disconnector and earthing switch
3 Busbar tank
4 Supporting structure with cable connection area
5 Low voltage cabinet

Fig. 2
Single busbar series WIA up to 52 kV
(40,5 kV; Isc ≤ 40 kA)
Fig. 3
Double busbar, series WIB up to 38 kV
(40,5 kV; Isc ≤ 31,5 kA)
1 Drive with front control panel
2 Tank with circuit-breaker, disconnector and earthing switch
3 Busbar tank 1
4 Busbar tank 2
5 Supporting structure with cable connection area
6 Low voltage cabinet

Fig. 4
Double busbar, series WIB up to 52 kV
(40,5 kV; Isc ≤ 40 kA)
WI series switchgear units are:

WI series switchgear units meet the following standards and regulations:

### 3.1 Applied standards

- metal-enclosed
- SF₆ insulated
- type-tested
- tested for internal faults

<table>
<thead>
<tr>
<th>Designation</th>
<th>IEC standard</th>
<th>EN standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear</td>
<td>IEC 62271-200</td>
<td>IEC 62271-200</td>
</tr>
<tr>
<td></td>
<td>IEC 62271-1</td>
<td>EN 62271-1</td>
</tr>
<tr>
<td>Circuit-breaker</td>
<td>IEC 62271-100</td>
<td>EN 62271-100</td>
</tr>
<tr>
<td>Earthing switch</td>
<td>IEC 62271-102</td>
<td>EN 62271-102</td>
</tr>
<tr>
<td>Disconnector</td>
<td>IEC 62271-102</td>
<td>EN 62271-102</td>
</tr>
<tr>
<td>Current transformer</td>
<td>IEC 60044-1</td>
<td></td>
</tr>
<tr>
<td>Voltage transformer</td>
<td>IEC 60044-2</td>
<td>–</td>
</tr>
<tr>
<td>Voltage detection systems</td>
<td>IEC 61243-5</td>
<td>–</td>
</tr>
<tr>
<td>Protection against accidental contact, foreign objects and water</td>
<td>IEC 60529</td>
<td>EN 60529</td>
</tr>
<tr>
<td>Installation</td>
<td>IEC 61936-1</td>
<td>HD 637 S1</td>
</tr>
<tr>
<td>Operation of electrical equipment</td>
<td>–</td>
<td>EN 50110</td>
</tr>
</tbody>
</table>

#### Degree of protection against accidental contact and foreign objects (acc. IEC 60529)

<table>
<thead>
<tr>
<th>Component</th>
<th>Degree of protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main electric circuits</td>
<td>IP65</td>
</tr>
<tr>
<td>Drives</td>
<td>IP2X₁</td>
</tr>
<tr>
<td>Low-voltage cabinet</td>
<td>IP3X₁</td>
</tr>
<tr>
<td>Cable connection compartment</td>
<td>IP3X</td>
</tr>
</tbody>
</table>

₁ optional IP 52

### 3.2 Environmental and operating conditions

WI series switchgear may only be operated under normal operating conditions according to the specifications EN 60694 or the IEC Publication 60694. Operation under conditions deviating from these is only admissible upon consultation with and approved by the manufacturer.

#### Ambient conditions (acc. to IEC 62271-1)

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>„Minus 5 indoors”¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min./max. ambient temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Average value over 24 hours</td>
<td>°C</td>
</tr>
<tr>
<td>Max. installation altitude above sea level</td>
<td>m</td>
</tr>
</tbody>
</table>

#### Insulating gas (acc. to IEC 60 376)

<table>
<thead>
<tr>
<th>Type</th>
<th>Sulphurhexafluorid (SF₆)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated pressure pₐₘ at 20 °C</td>
<td>MPa 0.08-0.22³</td>
</tr>
</tbody>
</table>

¹ Optional: “minus 25 indoors”

² Higher installation altitudes possible on request

³ See section 7.
3 Technical data, control and operating devices

3.3 Type designation

The type designation of the switchgear panels - see rating plate - informs about:

- design
- rated peak withstand current
- rated voltage
- dimensions

![Typeplate Image]

Fig. 5
Nameplate
1 Type designation
2 Serial number
3 Year of construction
4 Rating

Example:

Series WI

A = Single busbar
B = Double busbar

Rated peak withstand current $I_p = 100 \text{kA}$

Rated voltage $U_r = 40.5 \text{kV}$

Rated lightning impulse voltage $U_{lp} = 200 \text{kV}$

Panel width $600 \text{mm}$

Panel height $3300 \text{mm}$

(2114, 2664, 2750)

In case of queries and orders for spare parts, the following data on the rating plate must be specified:

- Type designation
- Serial number
- Year of construction.
### 3.4 Control and operating devices

The drive mechanism is designed on principle for manual charging of the energy storing device (closing spring).

The drive can be equipped with additional operating and control devices which are characterized according to the switchgear-specific circuit diagram.

Component fitting options:

- **Motor**
  - for charging the energy-storing device (closing spring)
  - actuation of the disconnector and earthing switch

- **Closing release**
  - 1 unit

- **Opening release**
  - max. 2 units

- **Secondary release (CT-powered release)**
  - max. 2 units (Maximum equipment – opening release and secondary release, 3 units in total)

- **Undervoltage release**
  - 1 unit

- **Blocking coil**
  - Blocking coils prevent the circuit breaker from being closed and opened via the push-buttons "ON" or "OFF", as well as actuation of the interrogating levers of the disconnectors and earthing switches.

- **Operating counter**
  - The operating counter indicates the number of switching operations.

### Power consumption, solenoids and motor

<table>
<thead>
<tr>
<th>Component</th>
<th>Power consumption DC approx. [W]</th>
<th>AC 50/60 Hz approx. [VA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closing release</td>
<td>160</td>
<td>160</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></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 supply voltage data is required to this effect.

### Auxiliary switch

Switching functions on delivery: refer to circuit diagram.

<table>
<thead>
<tr>
<th>Rated supply voltage [V]</th>
<th>DC 24</th>
<th>48</th>
<th>60</th>
<th>110</th>
<th>220</th>
<th>AC 120</th>
<th>230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching capacity [A]</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Time constant T=L/R [ms]</td>
<td>≤2 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated short-time current</td>
<td>100 A for a duration of 30 ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated continuous current [A]</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3 Technical data, control and operating devices

3.5 Use in the line with the intended purpose
WI series 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 converted without the manufacturer’s approval, or if inadmissible parts are attached.
No liability is accepted for parts provided by customers, e.g. current transformers.

3.6 Disposal after the end of the useful life
A material and recycling data sheet can be provided on request for the disposal of series WI switchgear at the end of its service life.
Disposal is performed as a service by the manufacturer’s Service Center which is subject to a fee.
The operating equipment contains the fluorinated greenhouse gas SF₆ mentioned in 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 using and handling SF₆, comply with the specifications in the standard IEC 62271 High-Voltage Switchgear and Controlgear – Part 303 Use and Handling of Sulphur Hexafluoride (SF₆).
4 Voltage Detecting Systems (VDS)

4.1 IVIS (Intelligent Voltage Information System)

IVIS is an integrated voltage detecting system with an integrated display unit used to determine zero voltage according to IEC 61243-5. Logic flash arrow symbols on the indicators display the mains voltage still existing within the defined response thresholds. The IVIS system does not require electrical maintenance tests for voltage detection systems.

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

When using IVIS, phase comparison can be performed by means of the phase monitor DEHNcap/PC-LRM.

IVIS meets the requirements according to IEC 61243-5 for integrated voltage detection systems.

**Important:**

Observe the Assembly and Operating Manuals of the IVIS system.

![Abb. 6 IVIS display](image)

![Fig. 7 1 IVIS on the panel front side](image)

![Fig. 8 2 IVIS on the panel rear side](image)
4.2 HR-System (High Resistance System)

The system voltage or the zero voltage state of the outgoing feeders is detected via a separate voltage detecting system according to IEC 61243-5. Socket-contacts for the indicators are located on the front as well as on the rear side of the panel. We supply voltage indicators made by authorized manufacturers.

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

**Important:**
- Observe the Operating Manual of the voltage indicators used.
- All three phases L1, L2 and L3 must always be checked.

![Horstmann indicator (HR-ST)](image1)

**Fig. 9** Horstmann indicator (HR-ST)

![Constant voltage indicator, manufacturer: Pfisterer (type DSA 2)](image2)

**Fig. 10** Constant voltage indicator, manufacturer: Pfisterer (type DSA 2)

![Connecting sockets for HR system on the panel front side. Panel rear side similar to Fig. 8.](image3)

**Fig. 11**
1. Connecting sockets for HR system on the panel front side. Panel rear side similar to Fig. 8.
5.1 Operator interfaces and variants for WIA (single busbar) and WIB (double busbar)

**Important:**
All the information about double busbar switchgear is subject to the following determination as regards the position of the busbars.

- **SS1:** busbar 1 (corresponds to the lower busbar tank)
- **SS2:** busbar 2 (corresponds to the upper busbar tank)

Different, switchgear-specific determinations, must be taken into consideration accordingly.

---

**Fig. 12**
Example: WIB operator interface (double busbar feeder panel)

1. Push-button, circuit-breaker ON
2. Push-button, circuit-breaker OFF
3. Port for charging the energy-storing device by means of crank handle
4. Position indicator, energy-storing device (charged/released)
5. Switch position indicator, circuit-breaker
6. Switch position indicator, disconnector (SS2)
7. Port for operation of the disconnector (SS2)
8. Interrogating lever, disconnector
9. Position indicator of earthing switch
10. Port for operation of the earthing switch
11. Interrogating lever, earthing switch
12. Switch position indicator, disconnector (SS1)
13. Port for operation of the disconnector (SS1)
14. Interrogating lever, disconnector
15. Mechanical lock-out mechanism with cylinder lock
16. Rating plate
17. Insulating gas monitoring
18. Operations counter
19. Information plate
5 Operation

Operator interfaces of series WIA and WIB

- Feeder panel WIA
- Bus section coupler Circuit-breaker panel for WIA and WIB (lower busbar SS1)
- Bus section coupler Busbar riser panel for WIA and WIB (lower busbar SS1)
- Metering panel with voltage transformer within gas compartment for WIA and WIB
- Bus sectionalizer WIA
- Bus sectionalizer WIA
  1 Lower busbar SS1
  2 Upper busbar SS2
5 Operation

Operator interfaces of series WIB

- Feeder panel WIB
- Bus section coupler Circuit-breaker panel (upper busbar SS2)
- Bus riser (upper busbar SS2)
- Bus coupler / riser in one panel width
- Bus coupler Circuit-breaker panel (lower busbar SS1)
- Bus riser (upper busbar SS2)
5.2 Interlocks

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

Warning!
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 a time.
- The cranks for the disconnectors and earthing switches can only be removed in their appropriate end position.
- 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. 5.3). Reverse actuation during the switching operation is prevented. Each actuation of the earthing switch must be performed to its end.
- 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).

Important:
Incomplete interlocks call for a mechanical lock-out mechanism and are identified by an information plate on the control panel. (Fig. 14).

<table>
<thead>
<tr>
<th>Turn key</th>
<th>Key</th>
<th>Actuations on front plate</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 circuit panels, the circuit-breaker button “OFF” can be actuated

Mechanical lock-out mechanism with cylinder lock (optional)  
(Fig. 14)

Mechanical lock-out mechanism pad lockable (optional)  
(Fig. 13)

Padlock not in scope of delivery

---

Fig. 13
1 Pad lockable lid for push-button
2 Pad lockable lid for actuation of disconnector

Fig. 14
1 Mechanical lock-out mechanism with cylinder lock
2 Information plate (enlarged)
### Electro-magnetic interlock

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 electro-magnetic interlocks are in locked position.

### Interlocks in case of outgoing feeders, single busbar switchgear WIA

on front control panel (all interlocks mechanical). The interlocks act accordingly in case of remote control.

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

(– of no significance as regards interlocks)

### Interlocks in case of outgoing feeders, double busbar switchgear WIB

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

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

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 SS1 and SS2 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 disconnector in at least one outgoing feeder of SS1 is ON; interlocks apply analogously even if SS1 and SS2 are interchanged

\(^2\) Blocked, if both disconnectors are in position "ON" in at least one outgoing feeder (only valid for bus couplers)

– of no significance as regards interlocks
### Interlock, if earthing switch located at end of busbar (blocking coils)

<table>
<thead>
<tr>
<th>Switch position</th>
<th>Interlock</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>The earthing switch can only be closed if all associated disconnectors are open.</td>
</tr>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>The interlock acts on the interrogating levers of all disconnectors assigned to the busbar.</td>
</tr>
</tbody>
</table>

### Interlocks in case of bus sectionalizer (blocking coils)

<table>
<thead>
<tr>
<th>Switch position</th>
<th>Interlock</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>The interlock acts on interrogating levers, “earthing switch” and “disconnector”, if the disconnectors in the appropriate busbar sections</td>
</tr>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>- in all feeder panels and</td>
</tr>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>- in the bus coupler (in case of WIB)</td>
</tr>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>are not in “OFF” position.</td>
</tr>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>The interlock acts on interrogating lever “earthing switch” of both busbar sections.</td>
</tr>
<tr>
<td><img src="image" alt="Interlock Diagram" /></td>
<td>The interlock acts on interrogating levers of all disconnectors assigned to the earthed busbar section.</td>
</tr>
</tbody>
</table>

### 5.3 Switching operation circuit-breakers, disconnectors, earthing switches

**General information**

- The switchgear may only be switched by specialist electricians. Specialist electricians in terms of this provision are persons who, due to their electro-technical 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 power supply is not available, blocking coils (locking the interrogating levers and circuit-breaker push-buttons, depending on design) in locked position. An undervoltage release has dropped.

Fig. 15
Crank to charge the energy storing device and to actuate the disconnector and earthing switch.
Charging the circuit-breaker's energy storing devices
Initial position:
- Circuit-breaker in “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 (clockwise) until position indicator “charged” appears (starting of motor during this procedure does not involve danger).
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 motor power supply is available.
The position indicator of the energy storing device indicates the “charged” condition.

Switching operations on the circuit-breaker

Closing
- Push the ON button (manually) or
- Actuate closing release (electrically)
Position indicator indicates the “ON” position.
The energy storing device can be charged again immediately (manually) after ON actuation.
When the power supply is on, the energy storing device is charged automatically via the motor.

Opening
- Push the OFF button (manually)
- Actuate opening release, secondary release or undervoltage release (electrical)
Position indicator indicates the “OFF” position
## 5 Operation

### Position indicators on circuit-breaker and possible operating sequences

<table>
<thead>
<tr>
<th>Item</th>
<th>Position indicator energy storing device (closing spring)</th>
<th>Position indicator ON/OFF switch position</th>
<th>Opening spring</th>
<th>possible switching sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><img src="image" alt="released" /></td>
<td>OFF</td>
<td>released</td>
<td>none</td>
</tr>
<tr>
<td>2</td>
<td><img src="image" alt="charged" /></td>
<td>OFF</td>
<td>released, is charged by C</td>
<td>C - O</td>
</tr>
<tr>
<td>3</td>
<td><img src="image" alt="released" /></td>
<td>ON</td>
<td>charged</td>
<td>O</td>
</tr>
<tr>
<td>4</td>
<td><img src="image" alt="charged" /></td>
<td>ON</td>
<td>charged, is re-chaged by C</td>
<td>O - C - O</td>
</tr>
</tbody>
</table>

C = Closing  O = Opening
5 Operation

### Disconnector Operating sequence for disconnector and earthing switches

**Initial situation:**
- Circuit-breaker OFF
- Disconnector OFF
- Earthing switch OFF

**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.

**Important:**
- Motor drive (optional):
  The motor current circuit is interrupted while the interrogating lever is being actuated or while the crank is inserted in its port.

**Important:**
- 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.
5.4 Standard switching operations

**Important:**
The locking conditions acc. to section 5.2 must be complied with in each case!

Switching ON an outgoing feeder
Initial position: outgoing feeder EARTHED
1. Switch off earthing switch
2. Switch on disconnector
3. Switch on circuit-breaker
   Outgoing feeder “ON”

Earthing an outgoing feeder
Initial position: Outgoing feeder ON
1. Switch off circuit-breaker
2. Switch off disconnector
3. Switch on earthing switch
   Outgoing feeder “EARTHED”

Switching over an outgoing feeder to the other busbar without interruption of power supply
Only possible with the bus coupler switched ON.
Initial position: Outgoing feeder on SS1
1. Switch on disconnector 2 (outgoing feeder on SS1 and SS2)
2. Switch off disconnector 1 (outgoing feeder on SS2)

Switching on a bus coupler in 2 panel widths
(Bus coupler in 1 panel width and bus section coupler analogously)
Initial position: bus coupler “OFF”
1. Switch on both disconnectors
2. Switch on circuit-breaker
For switching off, reverse the above sequence of operations.

**Important:**
When switching off the bus coupler, at least one disconnector must be set to “OFF” in each feeder panel on the corresponding bus section.
5.5 Earthing the busbar

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

Earthing switch in bus sectionalizer
1. Switch off connector, if applicable
2. Switch on earthing switch of the appropriate busbar branches

Earthing switch on busbar end
1. Insert detachable lever
2. Push unlocking button and swing detachable lever approx. 20° out of its locked position (see symbol indicating the actuating direction)
3. Then, continue to actuate the lever speedily with both hands until the earthing switch is changed over. (Total operating angle approx. 90°)
4. Remove detachable lever

Earthing the busbar by means of an outgoing feeder via its circuit-breaker
Initial position: Outgoing feeder EARTHED
1. Remove cable and connect earthing device
2. Switch off earthing switch
3. Switch on disconnecter
4. Switch on circuit-breaker

Set earthing switch on busbar end to “OFF”.
1. Unlocking button
2. Actuating direction
3. Position indicator
4. Detachable lever

Outgoing feeder “EARTHED”
Busbar “EARTHED”
**5 Operation**

**Earthing a busbar by means of the bus coupler**

Illustrated: earthing the SS1 (lower busbar).
Initial position: bus coupler “OFF”
1. Switch on the disconnector of the SS1 (circuit-breaker panel)
2. Switch on the earthing switch in the busbar riser panel (right-hand panel, upper busbar)
For earthing the SS2 (upper busbar), proceed analogously.

![Bus coupler “OFF”](image1)

**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 (circuit-breaker panel)
2. Switch on earthing switch in the busbar riser panel (right-hand panel)
For earthing the right-hand busbar section, proceed analogously.

![Bus section coupler “OFF”](image2)

![Bus coupler: SS1 “EARTHED”](image3)

![Bus section coupler: left-hand busbar section “EARTHED”](image4)
5.6 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.

In case of flanged-on voltage transformers on the outgoing feeder cable end or on the busbar with isolating device, proceed as follows:
Initial position: isolating device “ON”
1. Pull locating pin upwards
2. Swing lever speedily; the isolating device slides on to the earthing contact (voltage transformer earthed)
3. Lock locating pin into bore-hole (it must not be left in an intermediate position)
5 Operation

Busbar metering panel with voltage transformer in insulating gas tank for single and double busbar:

The operating port and the position indicator are located on the operator front panel.
Initial position: isolating device “ON”
1. Swing interrogating lever and insert crank
2. Actuate crank speedily; the isolating device moves on to the earthing contact (voltage transformer earthed)
3. Remove crank

Voltage transformer connected to switchgear unit via pluggable cables

Disconnecting the voltage transformers:

Warning! Isolate and earth outgoing feeder cable or busbar. Comply with EN 50110-1!
1. Disassembly of the cable fitting on the switchgear end.
2. Observe the assembly instructions of the cable manufacturer!
3. Close connecting socket “voltage-proof” using blanking plugs.
5.7 Fan attachment

Bus couplers and bus couplers or incoming feeder panels with a rated normal current \( I_n \) of 2500 A are provided by the factory with a fan attachment on the circuit-breaker gas tank.

A high-capacity axial tube fan with guard screen has been fitted.

The fan is designed for min. 20,000 operating hours.

**Fan operation:**

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

Settings for ambient conditions, see sect. 1.4:

- Making threshold: 2200 A
- Breaking threshold: 2000 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 intake duct of the fan housing (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:**

- Reduce the maximum normal current to 2200 A
- Contact the manufacturer’s Service Center.

![Fig. 26](image-url)

**Fig. 26**

Fan attachment

1. Fan
2. Flow monitor
6 Cable test

Cable tests with the cables connected can be performed at the multiple connector via a free connecting socket per phase.

**Warning!**
Comply with the safety provisions in section 1.

**Important:**
- The busbar can be operated with rated voltage during cable tests in the outgoing feeder (see rating plate).
- Observe the assembly and test instructions for the cable fittings and the terminating connectors.

<table>
<thead>
<tr>
<th>$U_r$ [kV]</th>
<th>DC test voltage max. 15 min.</th>
<th>0.1 Hz Power-frequency test voltage max. 60 min.</th>
<th>20-300 Hz Power-frequency test voltage max 1 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>34</td>
<td>19</td>
<td>–</td>
</tr>
<tr>
<td>24</td>
<td>67</td>
<td>45</td>
<td>–</td>
</tr>
<tr>
<td>36</td>
<td>76</td>
<td>57</td>
<td>–</td>
</tr>
<tr>
<td>52</td>
<td>26 (max. 24 h)</td>
<td>–</td>
<td>52</td>
</tr>
</tbody>
</table>

1. Isolate outgoing feeder cable of the appropriate switchgear panel.
2. Isolate outgoing feeder cable in remote station.
3. Earth outgoing feeder cable.
4. Unplug/disconnect the following devices and earth them if required:
   - Plug-in type voltage transformers;
   - Plug-in type overvoltage arresters;
   - Measuring amplifier for capacitive voltage measurement. If non-detachable voltage transformers (connected via cable) are used, these must be disconnected on the switchgear end and the sockets must be closed “voltage-proof” using dummy plugs.
5. Remove test socket dummy plugs.
6. Connect the test adapter on multiple connector and test unit (observe the manufacturer’s instructions).

**Important:**
Make sure that the distance between the metallic components of the test adapter and the earthed subconstruction of the switchgear is sufficiently dimensioned.

Fig. 27
1 Multiple connector
2 Test cable connector
6 Cable test

7. Switchgear panel in test position:
   In case of the intertripping circuit, the circuit-breaker is switched off by actuation of the earthing switch towards “OFF”:
   Turn interrogating lever “earthing switch” and insert the crank.
   Turn crank counter-clockwise by approx. 1 turn, until the circuit-breaker has switched off. The test position is reached.

8. Perform cable check observing the instructions of the cable or cable connector manufacturer.

Once the cable test has been completed:

9. Earth outgoing feeder cable again:
   – Turn off earthing switch completely
   – Charge the energy storing device
   – Turn earthing switch on again

10. Reconnect all devices which have been disconnected.

11. Remove test set and close test socket “voltage-proof” using the dummy plug.

Cable test from the opposite end with the cables connected, on the WI switchgear:
For test set-up and implementation, refer to the instructions of the cable manufacturer. Refer to items 1-4 an 7-10 of this section.
7.1 General data
Type of insulating gas: Sulphur hexafluoride $\text{SF}_6$ according to IEC 60376.
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 useful life, no gas handling will be required acc. to IEC 60694 under normal operating conditions.

Warning!
Do not drill holes into the gas tank. Do not open the gas tank.

For further details on this aspect, also refer to the Operating Manual "Use and handling of insulating gas" for the WI switchgear panels, which is available on request.

7.2 Monitoring the insulating gas
The pressure indication on the pressure gauge is temperature compensated via a temperature probe of the switchgear room (ambient temperature) and referred to a temperature of 20°C. If the temperature of the switchgear room changes, the indication remains constant.

The density of the insulating gas is monitored by a pressure indication which is referred to an insulating gas temperature of 20°C. The pressure indication on the pressure gauge is temperature compensated via a temperature probe in the appropriate compartment. If the insulating gas temperature changes, the indication remains constant.

<table>
<thead>
<tr>
<th>Signalling contact</th>
<th>Switching function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>closes if prealarm is reached during drop in pressure</td>
</tr>
<tr>
<td>2</td>
<td>closes if main alarm is reached in case of drop in pressure</td>
</tr>
<tr>
<td>3 (optional)</td>
<td>closes if main alarm is reached during pressure increase</td>
</tr>
</tbody>
</table>

Fig. 28
Indication of pressure gauge/density controller
1 Pressure indication
2 Signalling contact 1
3 Signalling contact 2
4 Signalling contact 3 (optional)
Fig. 29
Pressure gauge / density controller for the circuit-breaker compartment on the operator front panel

Fig. 30
Each of the busbar sections is monitored by a pressure gauge/density controller on the appropriate busbar section.

Rated filling pressure and response value of insulating gas monitoring

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>[kV]</th>
<th>12/24</th>
<th>12/24/36</th>
<th>40.5</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated normal current</td>
<td>[A]</td>
<td>1600</td>
<td>2500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring device</td>
<td>Pressure gauge</td>
<td>Density gauge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated filling pressure</td>
<td>[MPa]</td>
<td>0.08</td>
<td>0.13</td>
<td>0.145</td>
<td>0.22</td>
</tr>
<tr>
<td>Pre-alarm in case of a drop in pressure</td>
<td>[MPa]</td>
<td>0.05</td>
<td>0.10</td>
<td>0.115</td>
<td>0.19</td>
</tr>
<tr>
<td>Main alarm in case of drop in pressure</td>
<td>[MPa]</td>
<td>0.03</td>
<td>0.07</td>
<td>0.10</td>
<td>0.18</td>
</tr>
<tr>
<td>Main alarm in case of pressure increase</td>
<td>[MPa]</td>
<td>0.14</td>
<td>0.20</td>
<td>0.22</td>
<td>0.26</td>
</tr>
</tbody>
</table>

The pressure data refer to +20 °C and an atmospheric pressure of 0.1013 MPa abs.

Measures to be taken at the various warning thresholds

<table>
<thead>
<tr>
<th>Warning threshold</th>
<th>Dielectric state of insulating gas compartment</th>
<th>Measures</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 “main warning” and corresponds to the data on the rating plate.</td>
<td>Replenish insulating gas*)</td>
</tr>
<tr>
<td>Main alarm in case of drop in pressure (signalling contact 2)</td>
<td>The insulating level corresponds to a rated lightning impulse withstand voltage of 95 kV. The insulating properties may be impaired due to penetrating ambient air.</td>
<td>In case of main alarm disconnect the affected compartment of the switchgear from supply!</td>
</tr>
<tr>
<td>Insulating gas pressure has dropped to atmospheric pressure</td>
<td>The insulating level corresponds to the data on the rating plate.</td>
<td>Gas compartments were filled excessively. Reduce excessive filling pressure to rated filling pressure *</td>
</tr>
<tr>
<td>Excessive pressure (Signalling contact 3 optional)</td>
<td>The insulating level corresponds to the data on the rating plate.</td>
<td></td>
</tr>
</tbody>
</table>

*) Refer to the instructions for the “Use and handling of insulating gas” for WI
8.1 General
The high-voltage part of WI series switchgear is maintenance-free over a period of more than 20 years.

A visual inspection of the switchgear, including switching tests, is recommended at intervals of at least 4 years, depending on the stress the switchgear is subject to during operation, and on the operating conditions.

In case of soiling, the switchgear panels must be cleaned by qualified staff.

In case of doubt or if deviations from the WI switchgear’s proper working order are detected, the manufacturer should be contacted.

*Important:* Only specialist electricians who are familiar with WI switchgear are allowed to perform maintenance work.

*Warning!* Comply with the safety provisions in section 1!

8.2 Servicing schedule

<table>
<thead>
<tr>
<th>Maintenance intervals</th>
<th>Maintenance work</th>
</tr>
</thead>
<tbody>
<tr>
<td>annually</td>
<td>Fan drive (refer to section 5.7): Check fan ball bearing annually for smooth operation. Comply with the assembly and operating instructions of the fan manufacturer.</td>
</tr>
</tbody>
</table>
| 4 years               | ■ Visual inspection (external condition)  
                        ■ Check insulating gas pressure (see section 7) |
| 12 years              | ■ Lubricate circuit-breaker drive and disconnector / earthing switch drive (see section 8.4)  
                        ■ Check release/blocking coils with 100% ON duration (e.g. undervoltage release):  
                        ■ Check armature for easy operation. |

Once the summation current limit has been reached (refer to section 8.3)

Replace circuit-breaker poles with drive. Contact the manufacturer.
8.3 Numbers of breaking operations up to summation current limit

The diagrams define exclusively the admissible summation current limit of the vacuum interrupter chambers. They indicate whether the vacuum interrupter chambers need to be replaced.

The data for the rated normal current and rated short-circuit opening current are indicated on the nameplate:

**Fig. 31**
Admissible numbers of switching operations for vacuum interrupter chambers in WIA/B series

\[ I_r = \text{Rated normal current} \,[\text{A}] \]
\[ I_{sc} = \text{Rated short-circuit breaking current} \,[\text{kA}] \]

**Fig. 32**
Data for the rated normal current and rated short-circuit opening current
8.4 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 levers. Remove the front cover by lifting it forward.

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

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

The following elements are not lubricated:

- motor
- gripping mechanism
- ball bearings and sliding bearings
- auxiliary release
- push switch
- blocking coils
- auxiliary switches
Lubrication procedure

- **Multipurpose lubricant KL**
  for surfaces sliding on each other.
  Clean lubricating 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, articulations 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. 35
Circuit-breaker drive, points of lubrication
Fig. 36
Disconnector and earthing switch drive, points of lubrication of bus sectionalizer: analogously.
9.1 Auxiliary products

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

Warning!
Risk of injury in case of inappropriate handling. Observe the safety data sheets of the manufacturers of the auxiliary products.

<table>
<thead>
<tr>
<th>Auxiliary product</th>
<th>Ref. no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning agent</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>Lever for make-proof earthing switch on busbar end</td>
<td>AGS 410 210-01</td>
</tr>
<tr>
<td>If equipped with IVIS: Phase monitor DEHNcap/PC-LRM</td>
<td>AGS C26 320-01</td>
</tr>
<tr>
<td>Constant-voltage indicator:</td>
<td></td>
</tr>
<tr>
<td>Manuf. Horstmann</td>
<td>AGS C06 981-01</td>
</tr>
<tr>
<td>Manuf. Pfisterer</td>
<td>S 065 860</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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