SF$_6$-insulated, extensible circuit-breaker panel

Type GAE630 -1LSF(G)-/6/ for accessible switchgear rooms
for rated voltages of up to 24 kV
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Fig. 2

Assembly components for panel screw connection

1. Top panel screw connection (guide pin)
2. Bushing with contact springs
3. Contact bolt
4. Double seal
5. Bottom panel screw connection (guide pin)
Installation components for circuit-breaker panel, if it is an end panel in the switchgear:

1. Sealing end side bushing
2. Fastening angle
3. Busbar bushing (inside taper)
4. Contact springs
5. Single seal
6. Cover
7. Screw plug
8. Stiffening plate
9. Arc proofed protection sheet
1 General

1.1 Liability and warranty

All information and notes concerning operation and maintenance of the circuit-breaker panel are provided under due consideration of our present experience and to the best of our knowledge. These instructions describe the standard circuit-breaker panel.

All technical information and data contained in these operating instructions are up to date at the day of printing. We reserve the right for technical changes in the course of further development without changing these instructions.

Therefore, no claims can be made based on the information and descriptions in these instructions.

We will not assume liability for damage or malfunctions resulting from operating errors, failure to observe these operating instructions or incorrect repairs.

Genuine spare parts from Ormazabal have been specially designed and tested for Ormazabal circuit-breaker panels.

It is highly recommended to purchase spare parts and accessories only from Ormazabal. We would like to make explicitly clear, that any spare parts and accessories not supplied by us require the approval by Ormazabal.

The assembly and use of other products may have a negative effect on design specific characteristics of the circuit-breaker panel and thereby impair the safety for man, circuit-breaker panel or other property.

For damage resulting from the use of spare parts and accessories not approved by Ormazabal any liability by Ormazabal is excluded.

Any unauthorized conversions and changes to the circuit-breaker panels are prohibited for safety reasons and cause the exclusion of any liability by Ormazabal for any damage resulting from this.

1.2 Service information

The customer service department of Ormazabal is always available for any technical information on Ormazabal circuit-breaker panels.

Should you encounter any difficulties with our equipment, please contact the local manufacturing plant. The address of the local manufacturing branch can be found on the last page of these operating instructions.
2 Safety regulations

2.1 Intended use

The SF₆-insulated circuit-breaker panel of type GAE630 is a prefabricated, type-tested, metal encapsulated interior switching panel for accessible switchgear rooms. By standard the circuit-breaker panel can be extended with switchgear panels of the GAE type on both sides.

The circuit-breaker panel can be used in combination with a busbar for alternating current of up to 630 A (rated normal current) at rated operational voltages of up to 24 kV.

The circuit-breaker panel is designed for a rated normal current of up to 630 A. Circuit-breaker panels are used for e.g.:

- Power grids
- Industrial plants
- Consumer’s installations
- Wind turbine generators etc.

These operating instructions are part of the circuit-breaker panel. When passing on the circuit-breaker panel (relocation, selling or similar) the operating instructions must also be handed over.

The circuit-breaker panel unit must only be serviced and repaired by authorised persons, who have been instructed or trained accordingly.

These operating instructions must be carefully read and strictly observed before installing and commissioning the cable panel.

Every person involved in the installation, commissioning, operation, maintenance and repair of the unit must have read and understood these operating instructions, especially the chapter on safety and any other safety instructions.

We recommend that the user/owner obtains written confirmation of compliance with this requirement.

Only the exact knowledge of these operating instructions helps to avoid operating errors and ensures trouble-free operation.

The general safety and accident prevention instruction issued by the legislator and possible regulations of the insurer, which may be different from country to country, must be strictly observed when operating and servicing the circuit-breaker panel.

These operating instructions are part of the circuit-breaker panel. When passing on the circuit-breaker panel (relocation, selling or similar) the operating instructions must also be handed over.

2.2 Explanation of symbols and notes

Observe these instructions and exercise extreme care in such cases. Hand out all notes on health and safety also to all persons who are involved in work on the equipment. Besides the notes in these operating instructions you must also comply with the generally valid safety and accident prevention instructions (e.g. DIN EN 50110, VDE 0105 part 100, BGV A3).

Health and safety symbols

These special health and safety symbols warn against dangers due the risk of electric voltage.

Attention!

Cautionary instruction

These special health and safety symbol warns against dangers due the risk of electric voltage.

In these operating instructions this instruction appears at all points where particular care is required to comply with directives, regulations, instructions and the correct work sequence, and to avoid damage to the circuit-breaker panel.
2.3 General health and safety instructions

The circuit-breaker panels from Ormazabal are designed on the basis of the latest technical standard and under due consideration of all relevant safety instructions.

However, dangers for people and property may arise from these circuit-breaker panels if they are used incorrectly by untrained personnel or for purposes they are not intended for, if they are manipulated or if the safety regulations are disregarded. Each person involved in the installation, commissioning, operation or servicing of the circuit-breaker panels must therefore have read and understood these instructions.

2.3.1 Operation

When operating the circuit-breaker panel the responsibilities must be clearly specified and complied with, so that no unclear competences regarding safety will arise.

Before commissioning the circuit-breaker panel and after service work or modifications the circuit-breaker panel must be inspected by qualified personnel for safe working condition.

Before starting operation all persons within the danger zone around the circuit-breaker panel must be warned and asked to leave this area. There must not be any objects blocking the access to the controls.

The user must operate the circuit-breaker panel only in perfect condition.

Any changes that degrade safety must be reported immediately to the supervisor.

Changes to the circuit-breaker panel are only permitted in coordination with Ormazabal and under the supervision of expert personnel.

Experts are persons who, due to their professional education and experience, have sufficient knowledge in the field of electro technology and are acquainted with the relevant accident prevention instructions, guidelines (BGV A3), and the generally accepted technical rules and regulations (e. g. VDE regulations, DIN standards).

2.3.2 Safety features

Safety features must not be altered, dismantled or rendered ineffective. Unprotected parts of the system can cause fatal injuries.

All safety installations, e. g. shrouds, must always be fully functional and correctly in place. Operation of circuit-breaker panel with faulty safety features is not allowed.

2.3.3 Auxiliary device for operation, maintenance and repair

If any auxiliary devices (tools or similar) are required for operation, maintenance or repair of the circuit-breaker panel, these must be in safe condition and should be used in a safe way.

Any unnecessary and endangering use of auxiliary devices of any kind on the circuit-breaker panel is not permitted.

2.3.4 Statutory health and safety regulations

Apart from these notes on prevention of accidents and the notes attached to the circuit-breaker panel the locally valid accident prevention instructions must also be observed.
3 Transport and installation

3.1 Safety notes for transport

1. Lifting tackle must only be used at points intended for this purpose.
2. Ropes, chains or other lifting tackle must be fitted with safety hooks.
3. Do not use any torn or worn ropes.
4. Ropes and chains must not be knotted.
5. Ropes and chains must not touch any sharp edges.
6. Use only ropes and chains of sufficient load bearing capacity. (for weight of GAE630 circuit-breaker panel see Table 1)
7. Use only lifting gear of sufficient loading capacity. (For weight of GAE630 circuit-breaker panel see Table 1)
8. Do not lift loads over persons.

3.2 Transport and unloading

The panel is delivered packed upright on a pallet. It is strapped to the pallet with tightening straps (Fig. 4).

For transportation or intermediate storage you should always use the original packaging and secure the circuit-breaker panel with tightening straps (tightening belts), in the same way as for delivery.

When attaching the tightening straps make sure to attach these as shown in Fig. 4, as otherwise the cable connection compartment may be damaged.

During transport comply with the warning and safety notes on circuit-breaker panel and packaging!

When unloading observe the notes on safety (see 3.1) and the applicable accident prevention instructions.

Unloading must only be performed by experienced persons who are fully familiar with the lifting gear. Observe the permissible hoisting weight of lifting tackle and lifting gear (forklift truck, crane).

Weight of circuit-breaker panel

<table>
<thead>
<tr>
<th>Type</th>
<th>Weight*</th>
<th>Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAE630 -1LSF(G)-/6/ (for pressure relief into the cable trench)</td>
<td>Approx. 255 kg</td>
<td>Approx. 5 kg</td>
</tr>
<tr>
<td>GAE630 -1LSF(G)-/6/ (for pressure relief into the rear pressure absorber channel)</td>
<td>Approx. 345 kg</td>
<td>Approx. 5 kg</td>
</tr>
</tbody>
</table>

* The exact weight is dependent on the order-related secondary equipment (configuration of the relay cabinet etc.)

Table 1

Fig. 4
3.3 Arrival and unpacking

Upon arrival check the circuit-breaker panel immediately for any signs of transport damage:

- **Externally visible damage** must be confirmed by the driver on the freight documents. For insurance reasons, damage must be reported in writing to the delivering freight carrier within a period of 3 days (!).

- **Hidden damage** can only be detected after removing the packaging material. Claims for transport damage found at a later date can only be accepted by us within one week.

Remove the tightening straps - the circuit-breaker panel is now unsecured. Due to the design of the circuit-breaker panel the centre of gravity is located in the middle of the unit.

⚠️ The circuit-breaker panel may only be attached using the transport brackets provided. The transport bracket screw connections (Fig. 6) must be checked for tightness before lifting (tightening torques see chapter 8, Table 11).

⚠️ In case of unsecured handling of the circuit-breaker panel there is a risk of the panel tipping over!

This is of particular importance when transporting the circuit-breaker panel to its final place of installation. It is not allowed to use levers to transport the circuit-breaker panel to its final position. This action could cause damage to the enclosure.

The circuit-breaker panel must be transported with a 2-rope lifting tackle to avoid damage (Fig. 5).

When using lifting tackle use a 2-rope tackle with a rope length of at least 500 mm. Shorter rope lengths can lead to damage to the circuit-breaker panel!

For particularly narrow transport passages (e.g. tower stations) the cable connection compartment can be disassembled. In such case contact the customer service of Ormazabal.

After transporting the circuit-breaker panel to the place of installation remove the transport brackets (Fig. 6) and close the fastening threads of the brackets with the hexagon screws.

For a possible later transport of the circuit-breaker panel store the transport brackets in an easily accessible place. In order to ensure a tight fit of the screws in case of a later installation of the transport brackets, the screws must be tightened with a torque according to chapter 8, Table 11.
Check the delivery for completeness.

The serial number on the delivery note must conform with the serial number mentioned on the rating plate (Fig. 7) of the circuit-breaker panel.

### 3.4 Storage

In the factory the circuit-breaker panel is packed ready for transport and storage. It is only to be stored in dry, clean rooms and is to be protected against excessive soiling.

The environmental conditions must comply with IEC 62271-1 / DIN EN 62271-1 and VDE 0670 part 000, ambient temperature class “minus 5 indoor”.

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**Fig. 7 Rating plate (example)**

1. **Serial number**
2. **Technical data**
3. **Standards applied**
4. **Document numbers of the corresponding operating instructions** (German/English)
5. **Type of unit**
6. **Manufacturing date: month/year**
3.5 Installation and assembly

For installation of the circuit-breaker panel follow the illustrated installation plan. In order to assure secure standing of the circuit-breaker panel use all fastening bores provided.

In order to assure the extensibility of all possible unit/panel combinations within the GA/GEA product ranges, the foundation projection must be drawn at a distance of 200 mm from the rear wall! On the variant with pressure absorber channel the minimum distance is 100 mm.

To simplify assembly of the modular switchgear GAE630 -1LSF-, we recommend the following lateral wall distances when attaching from left to right:
- Distance from left wall at least 100 mm
- Right wall distance at least 300 mm.

In the case of installation from right to left, the distances from the side walls are reversed.

The area for the floor opening must not be reduced in size, so that, in case of an arc incident, the hot gases can be safely discharged.

A straight and level floor surface is a prerequisite for the stress-free installation of the circuit-breaker panel. Observe the specifications of DIN 43661. In particular the tolerance on the evenness (maximum 1 mm over a measured length of 1 m) and the tolerance on the straightness (maximum 1 mm per metre and maximum 2 mm over the entire length of the foundation rail) are to be observed.

The fastening material is not included in the items supplied.

To anchor the switch panel to an elevated intermediate floor, we recommend the following fastening material:
- Hexagon screw M10 (minimum M8, strength class 5.6) DIN EN ISO 4017
- Washers DIN EN ISO 7093 (switch panel side)
- Washers DIN EN ISO 7089/7090 (intermediate floor side) or tapered washers for anchoring to U-sections
- Spring lock ring DIN 127 / DIN 128
- Hexagon nut M10 DIN EN ISO 4032

In the case of installation on concrete with a strength of $\geq 25$ N/mm², we recommend the following fixing material:
- Fischer plastic dowels of type S12
- Wood screw DIN 571-10x80-St
- Washer DIN 125 A10

To attach GAE630 panels, follow the assembly instructions "Panel screw connection for extendable GAE630 panels", article no. 12244002.

As standard the bushings on the side of the circuit-breaker panels are closed with polystyrene caps as a protection against dirt. The side wall sealing ends are to be fitted in accordance with the assembly instructions stated above.
3.6 Planning of installation

3.6.1 Floor fastening measurements

Fig. 8 and Table 2 show the floor fastening and floor opening measurements for a pressure relief only into the cable trench/raised floor.

<table>
<thead>
<tr>
<th>Equipment installation depth [mm]</th>
<th>Connection compartment [mm]</th>
<th>A [mm]</th>
<th>B [mm]</th>
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</thead>
<tbody>
<tr>
<td>740</td>
<td>316 (standard)</td>
<td>634</td>
<td>351</td>
</tr>
<tr>
<td>800</td>
<td>376 (deep)</td>
<td>694</td>
<td>411</td>
</tr>
</tbody>
</table>

Table 2

Fig. 9 and Table 3 show the floor fastening and floor opening measurements for a pressure relief via the rear pressure absorber channel into the switchgear room.

<table>
<thead>
<tr>
<th>Equipment installation depth [mm]</th>
<th>Connection compartment [mm]</th>
<th>A [mm]</th>
<th>B [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1149</td>
<td>316 (standard)</td>
<td>1121</td>
<td>416</td>
</tr>
<tr>
<td>1209</td>
<td>376 (deep)</td>
<td>1181</td>
<td>476</td>
</tr>
</tbody>
</table>

Table 3

Fig. 8 (Dimensions in mm)

Fig. 9 (Dimensions in mm)
3.6.2 Dimensions of outgoing circuit-breaker panels

**Fig. 10** Dimensions GAE630 -1LSF630-/6/ with pressure relief into the cable trench/raised floor

**Fig. 11** Dimensions GAE630 -1LSF630-/6/ with pressure relief into the pressure relief duct
3.6.3 Dimensions of the bus sectionaliser circuit-breaker panels (sectionaliser to metering panels)

Fig. 12 Dimensions GAE630 -1LSFG630-/6/ (sectionaliser to -1M1(5)-) with pressure relief into the cable trench/raised floor

Fig. 13 Dimensions GAE630 -1LSFG630-/6/ (sectionaliser to -1M1(5)-) with pressure relief into the pressure relief duct

4) Long bushings
3.6.4 Dimensions of the bus sectionaliser circuit-breaker panels (sectionaliser to bus riser panel)

Fig. 14 Dimensions GAE630-1LSFG630-/6/ (sectionaliser to -1H1-) with pressure relief into the cable trench/raised floor

Fig. 15 Dimensions GAE630-1LSFG630-/6/ (sectionaliser to -1H1-) with pressure relief into the pressure relief duct

Long bushings
3.6.5 Possible installations

Installation possibility for circuit-breaker panels in accessible switchgear rooms.

Attention!

During installation make sure not to damage the bursting plate in the bottom of the gas tank (Fig. 16).

This diaphragm opens in case of an internal arc fault. The gases emerging must be discharged as shown in Fig. 16.

The cable trench must have a defined minimum cross-section. For the optional pressure relief of the cable trench the following rule of thumb must be applied:

- up to 3 panels: a metal cooling stretch arrangement (400 x 600 mm)
- from 4 panels: a second metal cooling stretch arrangement of the same size.

The metal cooling stretch arrangement provided by the customer must be arranged in a way that the cable trench is evenly divided.

In order to enhance the stability the circuit-breaker panel can be fastened to the rear wall of the station with two steel angles (not included in the scope of delivery).

For this purpose use the screw connections from the transport device.

Please ask for our assistance in the planning and installation of the station.

The construction of the building and the switchgear room must withstand the expected mechanical loads and the internal pressure caused by a short-circuit arc. Appropriate calculations for these purposes are recommended. Switchgear related pressure calculations can be requested as part of the services provided by the sales department at Ormazabal GmbH.

Fig. 16
3.7 Installation of the supply line for the auxiliary and control circuits

There are openings for laying the supply line for the auxiliary and control circuits in the roof of the relay cabinet.

Flexible plugs are fitted in these openings, which provide a cable bushing protected against dust and moisture. For adaptation to the cable diameter use the separating lines on the plugs.

The supply line from a neighbouring panel on the left or right (loop cable) is laid through openings in the related side wall on the relay cabinet (Fig. 17).

If the relay cabinet on the neighbouring panel is fitted offset, the cable can be laid through the openings in the roof of the relay cabinet (Fig. 18).
3.7.1 Terminal connection diagrams for the individual extension groups

Fig. 19 shows the arrangement of auxiliary switches for the circuit-breaker and the earthing switch on the drive carrier.

Fig. 20...22 show the connection diagrams for the individual attachment groups.

Additional information of relevance for the wiring of the circuit-breaker panel can be found in the enclosed circuit documentation.
3.8 Connection of the power cables

Please proceed as follows to connect the power cables:

– Remove the front cover (see Chapter 5, “Operation”).

– Dismantle the Z profile.

– Only on variants with bottom plates: Remove the front bottom plate and the rubber cable grommets. Push the rubber cable grommets onto the power cables to be connected.

– Route the power cables through the floor opening, cut to length, put in place and mount the male cable connector or cable adapter by following the instructions of the respective manufacturer.

– Only on variants with bottom plates: Insert the power cables with the rubber cable grommets into the cut-outs in the rear bottom plate.

– Connect power cables to the panel.

– Fix power cables to the cable fixing iron using the cable clamps so they are free of strain.

– Connect the earthing cables to the earthing terminals of the cable fixing iron.

– Only on variants with bottom plates: Re-fit the front bottom plate. During this process ensure the rubber cable grommet is correctly inserted between the bottom plates.

– Re-fit Z profile.
3.9 Earthing

The earthing of the circuit-breaker panel must be in accordance with DIN VDE 0141/101.

The circuit-breaker panel is fitted with an earthing bus, which stretches over the entire width of the panel (Fig. 24).

As a measure to ensure an electrically conductive connection of the metal enclosure, earthing bus and enclosure are bolted with contact washers.

This makes sure that, in case of an earth fault or a double earth fault, the fault currents are safely discharged to the earth connection.

In each panel area the earthing bar is equipped with a screw terminal (M12) for the connection of an earthing lead to establish earthing of the unit.

In order to ease assembly of the earthing line the earthing terminals of the earthing bus and the cable fixing iron are fitted with insert nuts.

On the cable fixing iron the cable lugs of the cable screens are fastened to the earthing terminals (M10). The cable fixing iron is designed with freely assignable earthing terminals.

Fig. 24
4 Technical description

4.1 Description of the circuit-breaker panel

The SF$_6$-insulated circuit-breaker panel type GAE630 is characterised by the following features.

Primary switchgear and busbar are installed in a common gas tank. Sulphurhexafluoride (SF$_6$) is used as insulation and extinguishing medium. In combination with the busbar the circuit-breaker panel can be used up to a rated voltage of 24 kV with a rated normal current of 630 A.

The circuit-breaker is characterised by

- metal-enclosed,
- almost low maintenance,
- suitable for severe climatic conditions,
- type-tested,
- extensible.

It complies with the specifications of the applicable standards and regulations as well as the statutory regulations. During manufacturing the circuit-breaker panels are subjected to the quality guidelines of ISO 9001.

Circuit-breaker

The circuit-breaker is characterised by the following main components:

- three-position switch
- integrated switch-on resistant earthing switch
- circuit-breaker
- no additional isolating gap generator required
- the isolating gap is bridged without insulating material
- arc extinction by quenching coil principle
- SF$_6$ as insulating and quenching gas.
- low maintenance drive not capable of automatic reclosing (force storing mechanism only for switching off)

Protection technology

The circuit-breaker requires a protection technology for the monitoring of the connected working equipment.

Tripping may be accomplished via a shunt trip release and/or a low energy transformer-operated trip. All commercially available relays may be used as protection relays. Depending on the relay type, a corresponding transformer must be a split-core current transformer in the outgoing. It is possible to mount the transformer on the bushing. This ensures that the sealing end is inside the protection range of the protection relay. The protection relay is installed in a relay cabinet on the drive housing, or on switchgear without a relay cabinet in the front panel on the drive housing (e. g. protection relay SEG type WIG).

The system components, such as drive mechanism housing with drives, cable connection compartment and pedestal are attached to the gas tank in modular mode (see Fig. 1).

For enhanced personnel protection the circuit-breaker panel can be executed in an arc-fault resistant design. In this case both the outside walls and the cover of the cable connection compartment and the front covers are reinforced.

The gas tank is reinforced with burn-out protection sheets as a protection against internal faults.

In case of an internal fault the pressure increase inside the gas tank is limited by the bursting plate (in the bottom of the gas tank). The burst protection, a clamped metal foil of low mass, opens at a gas overpressure of 200 kPa. The opening created by the pressed out metal foil controls the directed pressure relief of the hot gases into the compartment under the SF$_6$ gas tank and from there into the cable trench/raised floor or via a rear pressure absorber channel into the switchgear room (see Fig. 16).

The front cover provides a pressure-proof seal for the cable connection zone. It is plugged onto panhead rivets on the lateral field walls, then pushed vertically down and thereby locked in the cable connection compartment.

Front covers can be additionally provided with inspection windows.

As standard the circuit-breaker panel is equipped with various interlocking devices for safety reasons.

Switching interlock:

- An interlock against an unauthorized operating sequence between the actuating shafts of a panel

Front cover interlock:

- An interlock against unauthorized removal of the front cover during operation

Anti-reverse interlock (optional)

- An interlock against unauthorized switching-on of the load-break switch when the front cover is removed.

For further details please refer to chapter 4.6.

All active parts are located in the gas tank filled with SF$_6$-insulating gas. The energy supply or energy transfer from/to the extended panels or block modules of the GAE630 series is accomplished by means of contact bolts through the lateral cast resin bushings. For cable connections conventional kits with outside cone according to DIN 47836 must be used (see chapter "Technical data").

All control and indicator elements of the circuit-breaker panel are clearly arranged on the front panel.

Switch position indicators and actuating shafts are integrated in the mimic diagram. The front panel is provided with padlocking facilities and panel nameplates as standard.

The capacitive voltage detecting system is arranged on the right side of the front panel. On the front panel all symbols of relevance for the earthing circuit appear in red, whereas the symbols for the main current path are printed in black.

With the coloration of the front panel background all elements are clearly assigned to the respective switchgear panel.
4.2 Extension of the circuit-breaker panel

The circuit-breaker panel GAE630 - 1LSF- can be extended with all panels/block modules from the GAE series on both sides.

The design of the complete switchgear is oriented to the customer’s requirements. The busbars of the entire system are phase separated and arranged vertically above each other in the gas tank. The busbars of the panels to be attached are connected by means of contact bolts, which are inserted with double seals into the lateral bushings. The panels to be attached are laterally connected at two panel screw connection points.

When installing a Ring Main Unit without attaching, the lateral bushings must be secured with sealing ends to guarantee the dielectric strength of the switchgear. The screw plug must be inserted into the bottom panel screw connection point. GAE630 Ring Main Units can be delivered with pre-assembled sealing ends on the lateral bushings.

Fig. 25

The external side walls of the cable connection compartment in end panels must be secured with stiffening plates and arc proofed protection sheets.

Attention!

To install the extensible panels/modules, follow the assembly instructions "Panel screw connection for extendable GAE630 panels", order no. 12244002.

Fig. 26

Fig. 27
4.3 Circuit-breaker panel version

The circuit-breaker panel of type GAE630 -1LSF- /6/ is available in a 1400 mm high version for accessible switchgear rooms.

Circuit-breaker panels with pressure absorber channel are available in the heights 2000 mm and 2300 mm.

Type breakdown

<table>
<thead>
<tr>
<th>GAE630 -1LSFG630-</th>
<th>Width 600 mm</th>
<th>Extensible to the right 630 A rated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal current outgoing</td>
<td>Sulphur hexafluoride</td>
</tr>
<tr>
<td></td>
<td>Circuit-breaker 1-panel</td>
<td>Extensible to the left 630 A rated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal current busbar Extensible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit panel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gas insulated</td>
</tr>
</tbody>
</table>

The panel can be optionally fitted with short bushings connected to window-type current transformers or with long bushings to insert three-phase transformers. Window-type/bushing-type current transformers are available on request.

With both designs the protection relay can be installed in the cable connection compartment of the circuit-breaker. For this purpose a metal-encapsulated relay cabinet with lockable front flap can be installed above the bushings.

The equipment of the relay cabinets is customised acc. to order and may differ from the following description:

- terminal strip,
- remote control relay for ON or OFF to control the circuit-breaker,
- circuit-breakers to protect motors and control circuit,
- reversing switch for local remote control,
- push button to switch the circuit-breaker ON/OFF
- the complete wiring to the electric components of the GA-system, such as:
  - motor, auxiliary contact, shunt release, tripping signal contact, short-circuit indicator.
- secondary net protection features with:
  - UMZ/AMZ relay
  - current transformer connection
  - test sockets
  - electrical position indicator
- motor operators for remote activation and deactivation
- relay cabinet on the drive housing for installation of secondary technology

The base of the circuit-breaker panel is back-closed as standard. In case of an arc fault the hot gases are discharged into the cable trench/raised floor. The cable trench must have a pressure relief opening (see Fig. 16).

In the case of circuit-breaker panels with pressure absorber channel (incl. metal absorber) the pressure relief is into the switchgear room (see Fig. 16).

For enhanced personnel protection the circuit-breaker panel can be executed in an arc-fault resistant design.
4.4 Three-position switch

The circuit-breaker is designed as three-position switch. The switching positions ON-OFF-EARTHED can be selected with a single control element. Fig. 29 shows a schematic representation of the three-position switch.

The technical design of the three-position switch (blade switch) is simple and reliable. In each phase a pair of switch blades, vertically arranged above each other in the gas tank, which slides onto the contact elements, is effective.

Contact elements and switch blades are coated with a burn-out and wear-resistant material. This results in a long lifetime of the switch elements. The lifetime of the circuit-breaker depends on the extent and number of short circuit breaks (see chapter 8 "Technical Data").

The fixed contact elements of the individual switchgear units are connected with the busbar. The switch blades are connected with the bushings. The unit earthing contact/actuating shaft is triggered via the drive and transmits the rotary movement via the coupling rod to the switch blades.

Circuit-breaker

Function:
The circuit-breaker is switched off by an over-current or a short circuit current.

The essential components of the protection system are:
- current transformer
- protection relay
- tripping coil

The current transformers measure over current and short-circuit current. The protection relay assess the measured current.

If the adjusted limit values are exceeded, the protection relay will send a tripping pulse to the transformer-operated trip.

The transformer-operated trip unlocks the stored-energy drive by means of the tripping shaft and switches the circuit-breaker to OFF position.

(Adjust the accurate relay position as specified by the relay manufacturer.)

For the circuit-breaker a quenching coil is used as an extinguishing device. When the switching blade leaves the contact piece an arc is created between switching blade and contact piece. After a short while the arc root commutes from the contact piece to the metal core of the quenching coil, creating a magnetic field, which causes rotation of the arc in the coil.

Due to this rotation the arc is cooled in the SF₆-gas and goes out in case of current zero. The circuit-breaker has switched off.

---

Fig. 29

1 Bushing
2 Gas tank
3 Switching blade
4 Coupling bar
5 Earthing contact/switching shaft unit
6 Contact element (main current path)
7 Quenching facility
8 Busbars
9 Switch position: ON
10 Switch position: OFF
11 Switch position: EARTHED
4.5 Drive mechanism

4.5.1 General

Circuit-breaker panels are delivered with spring drive with accumulator (LS-drive), (Fig. 30) as standard.

The accumulator of the drive is activated by the protection system via the transformer-operated trip (or optionally push button, shunt trip release). The switch position indicator of the circuit-breaker shows the message TRIPPED for this drive.

The LS-drive switches the circuit-breaker and the earthing switch of the circuit-breaker panel to ON and OFF position.

The power accumulator of the LS-drive switches the circuit-breaker from switch position ON to OFF.

Tripping of the power accumulator is accomplished by push button or shunt trip release.

The function of the actuating shafts and their arrangement is shown in the mimic diagram on the front panel.

All parts of the drive susceptible to corrosion are galvanically zinc coated.

4.5.2 Design and function

The drive is installed on a U-shaped drive carrier, whereby the actuating shafts for circuit-breaker on the right and earthing switch on the left are resting in plain bearings integrated in the webs of the drive carrier.

Between these two actuating shafts a compression spring works on a pin guide, which is rotably mounted on each actuating shaft by two welded tongues. Both actuating shafts are hollow shafts.

The blade inhibitor for the earthing switch is integrated in the accumulator. They prevent back-swinging of the switch blades to the opposite contact of the three-position switch when switching off.

The accumulator is a unit that is freely rotating on the actuating shaft of the circuit-breaker. It consists mainly of tripping lever, accumulator tension spring and toggle link.

The transfer of the rotary movement of the actuating shafts to the switching shaft vertically arranged in the gas tank is accomplished by toggle links.

On the actuating shafts the toggle links are fastened to lugs with actuating cams and rotably mounted by means of bolt connections.

The operating lever, which is horizontally mounted on the switching shaft, has the function of a counter bearing for the two toggle links. The drivers fastened with pins to the ends of the toggle links are designed with a freewheel, so that they can decouple each other during the switching process.

Fig. 30

1 Earthing switch actuating shaft
2 Switch position indicator - slide
3 Tripping lever
4 Accumulator tension spring
5 Load-break switch actuating shaft
6 Blade inhibitor for earthing switch
7 Tripping roller
8 Linkage for front cover interlock
9 Toggle link
10 Switching shaft
11 Operating lever
12 Drive carrier
13 Toggle link for earthing switch
14 Compression spring for earthing switch
15 Compression switch for load-break switch

The operating lever controls the switch position indicator mounted to the drive carrier.
While tensioning the pressure spring (left hand turn) the tripping roller, rotably mounted on the pressure spring unit, locks at the front face of the tripping latch. When turning the actuating shaft for the circuit-breaker clockwise the compression spring is relieved and the accumulator tensioning spring is tensioned. The accumulator is relieved by excitation of the transformer-operated trip via the protection relay. The stroke rod of the transformer operated trip (lift magnet) swivels the angle contact face to the side. This overrides the locking of the tripping shaft and releases the tripping lever (see Fig. 31). With the help of a control cam the tripping lever presses the tripping roller out of its locked position on the accumulator. The accumulator is relieved, the circuit-breaker is switched to OFF position. The push button in the front panel swivels the angle contact face to the side via a linkage and triggers the accumulator in the same way as the transformer-operated trip.

A shunt trip release (lift magnet) can be optionally installed above the transformer-operated trip, which will, when excited, relieve the accumulator in the same way as the transformer operated trip.

In case of manual deactivation with the switching lever the tripping roller is pressed out of its lock by a lever system, in order to relieve the accumulator.

4.5.3 Motor drive (optional)

A motor drive system can optionally be retrofitted to all drive types - even subsequently.

For details see "Motor operator system for SF₆-insulated switchgear systems of type GA/GAE
- Load-break switch panels K, TS
- Circuit-breaker panels LSF", Article no. 12265423.
4.6 Panel interlocks

The switchgear panels are equipped with the following interlocks as standard:

Switching interlock
– between circuit-breaker and earthing switch

Front cover interlock
– between earthing switch and front cover

Anti-reverse interlock (optional)
– between fastener and circuit-breaker

Switching interlock and front cover interlock are activated or deactivated during the switching process via lever and rod drives.

4.6.1 Switching interlock (Fig. 32)

The interlock between circuit-breaker and earthing switch is accomplished by the position indicator plate, whereby the downward extended plate tongue slides laterally into the horizontal recess in the actuating shaft (earthing/load-break switch). During this process always the opposite plug-in opening for the switching lever (actuating shaft), which is switched to ON-position, is closed. When the actuating shaft for earthing is switched to ON-position, the actuating shaft for the circuit-breaker of this panel is closed (and vice versa). When switching both actuating shafts to OFF position the plugging openings for both actuating shafts are open.

4.6.2 Front cover interlock (Fig. 33)

On the front cover interlock a bolt is inserted into a recess on the front cover. Controlled via the drive the pin is only retracted from the front cover when the earthing switch is switched to ON-position. The front cover can be removed.
4.6.3 Anti-reverse interlock (optional) (Fig. 34)

The anti-reverse interlock is switched on or off with the fastener key and the fastener in the front cover via a link drive. When closing/opening the front cover the anti-reverse interlock is activated/deactivated at the same time.

A sheet metal tongue (in front of the position indicator blade) turns sideways into the horizontal recess in the actuating shaft and closes the plugging opening for the switching lever.

With the fastener opened on the circuit-breaker panel the sheet metal tongue closes the actuating shaft for the circuit-breaker and prevents activation of the circuit-breaker after the front cover has been removed.

With the front panel removed the earthing switch can be switched off in order to check the cables.

Function of fastener:

- Turn the fastener clockwise to the end stop!
  The front cover is locked, the sheet metal tongue does not cover the plugging opening for the actuating shaft.

- Turn the fastener anti-clockwise to the end stop!
  The front cover is unlocked, the sheet metal tongue covers the plugging opening for the actuating shaft (Fig. 34).
4.7 Gas tank

The gas tank is made of stainless steel. The lateral bushings for panel/module extension and the bushings with outside cone (in accordance with DIN EN 50181) for the connection of power cables are individually checked for compliance with the maximum permissible partial discharge values. Copper bars connect the three-position switch to the cable bushings.

Three copper busbars are laid along the rear wall inside the gas tank with one outgoing per phase to the contact element for the three-position switch (Fig. 29). On the right hand side wall of the gas tank the copper busbars are bolted to the lateral bushings, by which the circuit-breaker panel can be extended by another GAE-panel.

The guarantee for safe functioning of the sealed pressure system requires optimal mechanical processing of all mechanical components and an strict leak tightness of the tank. Bushings, sealing flange for actuating shaft and bursting plate are sealed towards the tank by means of sealing rings.

The rotating stainless steel switching shaft of the three-position switch are sealed towards the tank by a double pair of radial seals.

After the evacuation process each circuit-breaker panel is filled with dry $\text{SF}_6$-gas, in accordance with IEC 60376. The additional installation of a molecular sieve absorbs smallest amounts of moisture and permanently regenerates the $\text{SF}_6$. The performance of a leak test according to IEC 62271-200 is proof that the permissible leak rate ($10^{-7}$ mbar I/s) of the hermetically welded tank is not exceeded.

4.8 Gas leakage indicator

The gas pressure is indicated by an aneroid diaphragm pressure gauge, which is connected to the tank via a check valve. The pressure gauge is corrosion-resistant against normal environmental influences. The indication range (Fig. 35) is divided into two measuring ranges.

![Fig. 35](image)

Red: Not ready for switching! Green: Ready for switching

Before each switching process the gas leakage indicator and therefore the gas filling inside the tank must be checked.

4.9 Density monitor (optional)

For remote monitoring the switchgear can optionally be equipped with a density monitor, which works as a normally closed contact in the auxiliary circuit.

The bottom switching point of the density monitor is 140 kPa abs. If the pressure in the gas tank drops to 140 kPa abs., the density monitor will report this pressure drop.

The bottom switching point of the density monitor corresponds with the transition to the red measuring range on the scale of the gas leakage indicator. The density monitor is fastened to the non-return valve, together with the gas leakage indicator.
4.10 Capacitive voltage detecting system

For detection of the de-energised state each panel section is fitted with a capacitive coupling element (voltage indication ledge, Fig. 36) in the front panel, which is wired with the switchgear panel.

It is a HR-system acc. to VDE 0682, part 415 and IEC 61243-5.

The measuring bar consists of a plastic housing with all electronic components cast in.

The test sockets integrated into the voltage indication ledge make it possible to connect commercially available HR voltage testers.

The coupling part must be subjected a requalification test at regular intervals (approx. every 6 years). This test must be performed at the operational voltage using appropriate test units or adapters.

Captive shrouds protect the test sockets against dirt, dust and moisture (Fig. 36). For voltage testing they must be swivelled by 90°.

The test must be performed with an appropriate voltage tester (Table 4) (Fig. 37).

<table>
<thead>
<tr>
<th>Pfisterer</th>
<th>Type DSA-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horstmann</td>
<td>Type HO-ST-1</td>
</tr>
<tr>
<td>ELSIC</td>
<td>Type HO-SA</td>
</tr>
<tr>
<td>Jordan</td>
<td>Type DSP-HR</td>
</tr>
<tr>
<td>Dehn</td>
<td>Type DEHN cap/P-HR</td>
</tr>
</tbody>
</table>

Table 4

With a flashing indicator these units indicate that voltage is applied to the testing point of the bushing.

⚠️ During each switching process (connection to or disconnection from the mains) the function of the capacitive voltage detecting system must be checked, if a de-energised state is detected (see Chapter 6.2). Always check all phases L1, L2, L3!
4.11 Protection technology

4.11.1 Transformer protection with transformer current dependent relay

For protection of a transformer we recommend the use of a dependent overcurrent time-lag relay with transformer-operated trip. This is especially suitable for medium-voltage switchgear in transformer or distributor substations without substation battery.

The protection system is characterised by the following features:

- The system consists of an AMZ relay, transformer and a low-energy breaking trip
- no auxiliary voltage required
- tripping pulse repetition, until the primary current is interrupted
- each protection system factory tested
- a wide selection of characteristic curves
- selectivity between medium voltage and low voltage
- fully encapsulated, therefore independent from climatic conditions
- complies with requirements acc. to VDE 0345 part 303, IEC 255

4.11.2 Line protection with transformer current dependent relay

For the protection of a line or transformer branch we recommend a two-stage independent overcurrent time-lag relay with transformer-operated trip. This is especially suitable for medium-voltage switchgear in distributor substations without substation battery.

The protection system is characterised by the following features:

- The system consists of an UMZ relay, transformer and a low-energy breaking trip
- no auxiliary voltage required
- tripping pulse repetition, until the primary current is interrupted
- each protection system factory tested
- no intervention in the protection system during installation of the switchgear
- separately adjustable overcurrent and short-circuit current stage
- fully encapsulated, therefore independent from climatic conditions
- complies with requirements acc. to VDE 0345 part 303, IEC 255

Further protection relay systems on request. The installation of customer owned protection systems needs our approval.
5  Operation

5.1  Switching accessories

The following accessories are needed to switch the switch panel (Fig. 40):

1  Switching lever for earthing switch (red shaft)
   (optional for load-break switch and earthing switch (only in conjunction with 1-lever drive)).

2  Switching lever for circuit-breaker (bright shaft)
   (only in conjunction with 2-lever drive).

3  Square socket key for front cover fastener (controls the anti-reverse interlock).

The switching levers used to switch the switch panel are fitted with a torque reducing safety feature, which avoids damage to the drives. When trying to continue a switching operation in a switch position (ON/OFF) by application of force, the knob of the switching lever will bend.

Attention!

Never leave the switching lever plugged in the actuating shaft since the switching interlock of the panel is damaged by switching the other actuating shaft.
5.2 Padlocking facility

The circuit-breaker panel is fitted with padlocking facilities as standard (Fig. 41). The padlocking facility is opened by pressing the thumb against the locking resistance of the locking cover in clockwise direction. The padlocking facility stops in end position by means of an integrated stop, so that also the adjacent padlocking facility can be opened. The access to the actuating shafts can be secured with a maximum of three locks.

**Note!**

In the description of the switching operations in chapters 5.5 and 5.6 the padlocking facilities are not shown, for the purpose of a clearer representation of switch position indicators and actuating shafts.
5.3 As delivered state of the circuit-breaker panel

Upon delivery the circuit-breaker panel is in the following switch position:

![Fig. 42](image1)

Fastener closed (Anti-reverse interlock optional).

![Fig. 43](image2)

Earthing switch activated. Circuit-breaker deactivated and locked by switching interlock.

![Fig. 44](image3)

Turn the fastener anti-clockwise with the fastener key to the end stop. Fastener opened (Anti-reverse interlock optional).

![Fig. 45](image4)


![Fig. 46](image5)

Front cover interlock

In the switch position described the front cover is removable, because the pin of the front cover interlock (see Chapter 4.6 "Panel interlocks") has been pulled out of the front cover (Fig. 46).

![Fig. 47](image6)

Front covers

Remove front cover:
- Lift the front cover up against the stop (Fig. 47/1).
- Pull the front cover off to the front (Fig. 47/2).

Note!

For reasons of clarity the drawings in chapters 5.3 to 5.6 do not show any padlocking facilities.

Removal of front cover

Before removing the front cover the particular panel has to be switched off and earthed (see chapter Chapter 5.6).
5.4 Switching of the circuit-breaker panel

Before switching the circuit-breaker panel check the gas pressure gauge.

In case of a red indication the circuit-breaker panel must not be switched!
In such a case inform the customer service of Ormazabal.

Fig. 48
Gas overpressure correct - panel may be switched.

Fig. 49
Gas overpressure not correct - panel must not be switched.

Prior to switching the circuit-breaker panel, the front cover must be fitted. The fastener must be closed with the fastener key (Fig. 50). For this purpose turn the fastener key clockwise to the end stop (Fig. 51).

The switch position of earthing and circuit-breaker can be read from the indicating device in the mimic diagram of the panel (Fig. 51).

Note!

Circuit-breaker and related earthing switch are mechanically locked together.
If the earthing switch is switched to ON, the plug-in opening on the switching shaft of the circuit-breaker is closed by a locking plate.

Fig. 50

If the switching procedure includes safety disconnection and earthing/short-circuiting, the integral voltage detecting systems and suitable voltage testers should in any case be used in compliance with VDE 0105 part 100.
5.5 Switching on the circuit-breaker panel

**Fig. 52**
Switch position with deactivated circuit-breaker, tripped message and activated earthing switch.

**Fig. 53**

**Note!**
The side plate "TRIPPED" of the switch position indicator is only displayed when the circuit-breaker is switched off by the push button, the shunt trip release (optional) or the transformer-operated trip.

**Fig. 54**
Switch off the earthing switch. Turn the switching lever (red shaft) anti-clockwise against the stop. (no pressure from counter spring).

**Fig. 55**
Switch position with deactivated earthing switch and deactivated circuit-breaker.

**Fig. 56**
Tension the circuit-breaker.

**Note!**
No counter spring pressure on circuit-breaker. Insert the switching lever (bare shaft) until it bottoms and turn anti-clockwise.

**Fig. 57**
Switch position after tensioning the closing spring. The tripped signal in the switch position indicator is no longer visible.
Switch on the earthing switch.

Turn the switching lever (bare shaft) clockwise.

Switch position with switched on circuit-breaker and switched off earthing switch.
5.6 Switching off and earthing the circuit-breaker

1. State with activated circuit-breaker and deactivated earthing switch.

2. Switch off circuit-breaker. Press the push button.

3. Switch position after deactivating the circuit-breaker.

4. Switch on the earthing switch. Hold the switching lever (red shaft) depressed to the end stop against spring pressure and turn it clockwise.

5. Switch position with deactivated circuit-breaker and activated earthing switch.

Verify safe isolation from supply acc. to VDE 0105 part 100 (if earthing is required). Always check all phases L1, L2, L3!
6 Commissioning

For commissioning the correct function of the circuit-breaker panel must be assured by testing the following points:

– Please compare the data of rating plate, delivery note and order documents.
– Check the wiring of the secondary equipment by following the specifications in the circuit documentation provided for the respective equipment configuration.
– Check all screwed connections (cable connections, equipment joints, system earthing, fuse installation) for tight fit (torque) and proper fastening.
– Check the available operating pressure on the gas pressure gauge (the pointer must be in the green sector).
– In case of an installed density monitor check the reading on the pressure gauge when the voltage supply is switched on.
– Check the function of the switches after installing the circuit-breaker panel.

When installing a circuit-breaker panel as end panel make sure that the sealing ends are correctly fitted to the lateral bushings and that the bottom screw connection point is closed with the screw plug. Please observe the assembly instructions "Panel screw connection for extendable GAE630-panels", article no. 12244002.

We recommend during commissioning on site, after completion of the assembly, to perform a power frequency voltage withstand test as per VDE 0671 part 200 / DIN EN 62271-200 section 7.105.

The indication states of the switch position indicator are to be checked mechanically and with the supply voltage.

For this purpose, as described above, switch the drive and check the mechanical and electrical switch position.

Switching of the circuit-breaker panel via the shunt trip release (option)

– Switch on the circuit-breaker panel with the switching levers.
– For switching tests of the shunt release activate the voltage supply.
– Actuate the push button or the respective control transmitter on the remote trip until the circuit-breaker panel is switched off and the switch position indicator shows "TRIPPED".

Comply with the following operating sequences.

6.1 Switching (manually by means of switching lever/push button)

SWITCHING ON
– Switch off the earthing switch.
– Tension the circuit-breaker (spring accumulator).
– Switch on the circuit-breaker.

SWITCHING OFF
– Switch off the circuit-breaker/push button.
– Switch on earthing switch.
6.2 Verifying the safe isolation from supply

Before disconnecting an operating circuit-breaker panel from and connecting a circuit-breaker panel to the mains supply net the panel must be checked for a de-energised state with the capacity voltage testing system.

Attention!

Tests must always be performed in triplepole mode! Compliance with VDE 0105 part 100 is mandatory!

When checking the circuit-breaker panel the following steps must be performed:

- With the circuit-breaker panel switched on open the capacitive measuring points by turning the shrouds.
- Insert 3 voltage testers (see Table 4, chap. 4.10) into the measuring sockets on the circuit-breaker panel (Fig. 66).

The voltage testers must flash.

- Switch the circuit-breaker to "OFF".
- Isolate also the second cable end.

The voltage testers must no longer flash!

- Switch the earthing switch to "ON".

The outgoing cable is now electrically isolated.

- Upon completion of the test remove the voltage testers and turn back the shrouds to close the capacitive measuring points.

Fig. 66
6.3 Phase comparison

On the insulated test sockets a phase comparison can obviously also be performed between two outgoings (e.g. manuf. Horstmann: type ORION, Manuf. Pfisterer: type EPV, Manuf. ELSIC: type HO-PV). The correct function of the phase comparison device must be checked in compliance with the instructions of the manufacturer (Fig. 67).
6.4 Cable test

The cable test is performed on the appropriately equipped cable set. Fig. 68 shows a male cable connector of type AWKS with assembled testing adapter of type PAK 630. For the execution of a cable test the following steps must be performed:

– Open the plugs for the capacitive measuring points by turning.
– Insert 3 voltage testers into the measuring sockets.

The voltage testers **must** flash.

– Switch the circuit-breaker to "OFF".
– Isolate also the second cable end.

The voltage testers **must no longer** flash!

– Switch the earthing switch of the circuit-breaker to "ON".
– Remove the front cover.
– Unscrew the threaded insert from the male cable adapter.
– Screw the test adapter onto the threaded pin of the male cable adapter (observe the tightening torque).
– Switch the earthing switch to “OFF”.
– Perform measurement/test.

The circuit-breaker panel can be tested with a direct voltage of maximum $6 \times U_0 = 72$ kV.

The busbars may conduct an operating voltage of maximum 24 kV!

After completion of the cable test:

– Switch the earthing switch to "ON".
– Unscrew the testing adapter.
– Screw the threaded insert from the male cable adapter (observe tightening torque).
– Insert the front cover.

The circuit-breaker panel can be activated.
7 Maintenance

Maintenance and repair work as well as subsequent modifications must only be performed by skilled personnel and in compliance with the operating instructions, the accident prevention instructions and the regulations of the liability associations.

7.1 Inspection
Depending on the operating and local conditions an inspection of the circuit-breaker panel should be performed every 4 years in order to check the condition of the circuit-breaker panel.

Test switching of the circuit-breaker panel should be performed every 10 years.
During this test the function of the accumulator in the circuit-breaker panel drive should be checked by:
– switching off with the push button (Fig. 69)
– manual tripping with the switching lever.

![Fig. 69](image)

The tripping shaft mechanically releases the TRIPPED message, which is displayed in the switch position indicator of the circuit-breaker switch.
The function of the shunt release (optional) shall also be checked by tripping (electrically).

Protective equipment should be inspected locally at regular intervals.
The duration of the inspection interval depends on the type of the relay used and the specific operating conditions of the panel.

During the relay test all relay functions, including the adjustment values and tripping characteristics and tripping times must be checked.
If the protection transformers include a testing coil, this should be used for the relay test.

In case of operation under severe environmental conditions (temperature, dirt, gases) shorter inspection intervals may be necessary. The operating pressure of the SF₆-gas tank should thereby be checked for pressure losses. As long as the pointer in the gas leakage indicator is in the green sector the pressure is sufficient. The switching station should be subjected to a general visual examination. Check the switchgear for any peculiarities such as dirt deposits or changes caused by other environmental influences.

7.2 Maintenance
The drives and the circuit-breakers themselves are maintenance free.
The gas tank is welded gas-tight and all components inside are maintenance-free. The SF₆ gas is resistant to ageing and is not consumed during the switching operations.
Under normal conditions the SF₆ gas does not need to be refilled during the lifetime of the panel.

7.3 Cleaning
Before starting cleaning work the switch panel must be isolated.
As a measure to avoid impermissible switching processes the voltage supply must be switched off.

– Switch the earthing switches on the individual panels to ON-position.
– Open the fasteners and remove the front covers (if required).
Carefully clean off all dirt, especially from the surfaces of insulating materials.
Clean off strongly adhesive, e. g. greasy, dirt with a lint-free cloth soaked in a commercial detergent, then wipe off with clear water and dry.

7.4 Return of switchgear
For Ormazabal switchgear at least a 30-year operating time is assumed. The "sealed pressure system" acc. to IEC does not require refilling of the SF₆-gas over the entire operating time. Due to the high reliability of the switchgear arc faults are almost completely ruled out. The handling and implementation of safety measures for switchgear, that has failed or has been taken out of operation because of such incidents, is described in the brochure SF₆-systems, issued by the liability association for precision engineering and electrical engineering.

In 1993 the plant in Krefeld was certified acc. to DIN EN ISO 9001 for its quality system and in 1998 acc. to DIN EN ISO 14001 for its environment management system. As a competent partner Ormazabal offers you the return of your switchgear after the expiration of the above mentioned operating time. The costs involved depend on the legal requirements applicable at the time of return.
This switchgear contains the fluorinated greenhouse gas SF₆ covered by the Kyoto Protocol and with a global warming potential (GWP) 22200. SF₆ shall be recovered and not released into the atmosphere.

For further information on use and handling of SF₆ please refer to IEC 62271-303: High-voltage switchgear and controlgear – Part 303 Use and handling of sulphur hexafluoride (SF₆).
All other materials of this switchgear should also be recycled.
8 Technical data

8.1 General data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated filling pressure of insulating gas at 20 °C and 101.3 kPa</td>
<td>150 kPa (50 kPa overpressure)</td>
</tr>
<tr>
<td>Minimum service pressure of insulating gas at 20 °C and 101.3 kPa</td>
<td>130 kPa</td>
</tr>
<tr>
<td>Insulating gas</td>
<td>SF₆</td>
</tr>
<tr>
<td>SF₆-filling capacity at 20 °C and 101.3 kPa</td>
<td>1.16 kg</td>
</tr>
<tr>
<td>Rated density of insulating gas</td>
<td>9.1 kg/m³</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td></td>
</tr>
<tr>
<td>– with secondary equipment</td>
<td>− 5 to + 40 °C ¹)</td>
</tr>
<tr>
<td>– with reduced rated currents</td>
<td>over + 40 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>max. 95 % (indoor conditions)</td>
</tr>
<tr>
<td>Enclosure of HV compartment</td>
<td>sealed pressure system acc. to IEC, IP65</td>
</tr>
<tr>
<td>Enclosure of drive housing</td>
<td>IP44 / IP3XD</td>
</tr>
<tr>
<td>Enclosure of cable connection compartment</td>
<td>IP44</td>
</tr>
<tr>
<td>Internal arc classification as per VDE 0671 part 200 and IEC 62271-200</td>
<td>IAC AFL 20 kA 1 s for HV compartment and</td>
</tr>
<tr>
<td></td>
<td>connection compartment</td>
</tr>
<tr>
<td>Coloration of equipment</td>
<td>RAL 7035 (light grey)</td>
</tr>
<tr>
<td>Loss of service continuity category</td>
<td>LSC 2A</td>
</tr>
<tr>
<td>Partition class</td>
<td>PM</td>
</tr>
<tr>
<td>Weight</td>
<td>see page 11, Table 1</td>
</tr>
</tbody>
</table>

¹) Usage at lower temperatures on request

Table 5

8.2 Technical data for circuit-breaker panel

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GAE630 -1LSF- /6/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit-breaker</td>
<td>Earthing switch</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>fᵣ</td>
</tr>
<tr>
<td>50 / 60 Hz</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>Uᵣ</td>
</tr>
<tr>
<td>12kV</td>
<td>24kV</td>
</tr>
<tr>
<td>Rated normal current busbar</td>
<td>Iᵣ</td>
</tr>
<tr>
<td>250 / 630 A</td>
<td>–</td>
</tr>
<tr>
<td>Rated normal current outgoing panel</td>
<td>Iᵢᵢ</td>
</tr>
<tr>
<td>630 A</td>
<td>–</td>
</tr>
<tr>
<td>Rated short-duration power-frequency withstand voltage 1 min</td>
<td>Uᵢᵢ</td>
</tr>
<tr>
<td>28kV</td>
<td>50 kV</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage</td>
<td>Uᵢᵢ</td>
</tr>
<tr>
<td>75kV</td>
<td>125 kV</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage of the air gap</td>
<td>85kV</td>
</tr>
<tr>
<td>145 kV</td>
<td>–</td>
</tr>
<tr>
<td>Rated short-circuit-breaking current</td>
<td>I₀sc</td>
</tr>
<tr>
<td>20 kA</td>
<td>16 kA</td>
</tr>
<tr>
<td>Rated peak withstand current</td>
<td>Iₚ</td>
</tr>
<tr>
<td>50 kA</td>
<td>40 kA</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>Iₛ</td>
</tr>
<tr>
<td>20 kA</td>
<td>16 kA</td>
</tr>
<tr>
<td>Rated duration of short circuit</td>
<td>tᵢᵢ</td>
</tr>
<tr>
<td>1 s (3 s)</td>
<td>1 s (3 s)</td>
</tr>
<tr>
<td>Rated short-circuit making current</td>
<td>Iᵢᵢᵢ</td>
</tr>
<tr>
<td>50 kA</td>
<td>40 kA</td>
</tr>
<tr>
<td>Number of switching operations at rated short-circuit-breaking current</td>
<td>n</td>
</tr>
<tr>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Number of switching operations at rated short-circuit making current</td>
<td>n</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Number of mechanical operating cycles</td>
<td>n</td>
</tr>
<tr>
<td>2000</td>
<td>1000</td>
</tr>
<tr>
<td>Class</td>
<td>E2 M1</td>
</tr>
<tr>
<td></td>
<td>E2</td>
</tr>
</tbody>
</table>

Table 6
8.3 Processing time guide values for circuit-breaker

<table>
<thead>
<tr>
<th>Nominal switching sequence (with motor operator and shunt trip release)</th>
<th>–</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical switching delay of motor operator</td>
<td>s</td>
<td>6</td>
</tr>
<tr>
<td>Opening time</td>
<td>ms</td>
<td>Approx. 44</td>
</tr>
<tr>
<td>Arcing time</td>
<td>ms</td>
<td>Approx. 17</td>
</tr>
<tr>
<td>Total opening time</td>
<td>ms</td>
<td>Approx. 61</td>
</tr>
<tr>
<td>Nominal switching sequence –</td>
<td>–</td>
<td>O - 3 min - CO - 3 min - CO</td>
</tr>
</tbody>
</table>

Table 7

8.4 Shunt trip release

Lift magnet for transformer-operated trip

<table>
<thead>
<tr>
<th>Nominal voltage (V)</th>
<th>VA rating (W)</th>
<th>DF %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>71</td>
<td>5</td>
</tr>
<tr>
<td>48</td>
<td>72</td>
<td>6</td>
</tr>
<tr>
<td>60</td>
<td>75</td>
<td>6</td>
</tr>
<tr>
<td>110</td>
<td>65</td>
<td>6</td>
</tr>
<tr>
<td>220</td>
<td>67</td>
<td>6</td>
</tr>
<tr>
<td>Alternating current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>71</td>
<td>6</td>
</tr>
<tr>
<td>230</td>
<td>69</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 8

8.5 T-connection kits

T-connection kits are to be used on the discretion of the operator. To be connected to bushings acc. to DIN EN 50181 connection type C (630 A) with outside taper and screw contact (M16). On uncontrolled systems the installation instructions of the manufacturer must be strictly observed.

Installation possibilities for cable connection kits:

<table>
<thead>
<tr>
<th>NKT</th>
<th>Südkabel</th>
<th>tyco Electronics</th>
<th>Euromold/Nexans</th>
<th>Prysmian</th>
<th>Cellpack</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 kV</td>
<td>20 kV</td>
<td>10 kV</td>
<td>20 kV</td>
<td>10 kV</td>
<td>20 kV</td>
</tr>
<tr>
<td>XLPE-Cable</td>
<td>CB12</td>
<td>CB24</td>
<td>SET12</td>
<td>SET24</td>
<td>RSTI</td>
</tr>
<tr>
<td>CC12</td>
<td>CC24</td>
<td>SEHDT13</td>
<td>SEHDT23</td>
<td>RICS...</td>
<td>K430TB</td>
</tr>
<tr>
<td>CB36</td>
<td>CB36</td>
<td>SEHDT13.1</td>
<td>SEHDT23.1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>AB12</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>AC12</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 10

Note!

Depending on the mounting depth of the cable connection compartments, deep front covers or deep cable connection compartments may be necessary. Information on further connection possibilities is available from our application information GAE830 as well as on request.
8.6 Tightening torques

<table>
<thead>
<tr>
<th>Thread nominal diameter</th>
<th>Screw connections strength class 8.8</th>
<th>Welded stud</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>6 Nm</td>
<td>--</td>
</tr>
<tr>
<td>M6</td>
<td>10 Nm</td>
<td>5.9 Nm</td>
</tr>
<tr>
<td>M8</td>
<td>25 Nm</td>
<td>14.7 / -0.2 Nm</td>
</tr>
<tr>
<td>M10</td>
<td>49 Nm</td>
<td>--</td>
</tr>
<tr>
<td>M12</td>
<td>86 Nm</td>
<td>--</td>
</tr>
</tbody>
</table>

Note! The table values do not apply for tightening torques specially mentioned in the documents!

Table 11

8.7 Switching forces with manual operation

<table>
<thead>
<tr>
<th>Drive type/Actuating shaft</th>
<th>Switch position</th>
<th>Torque actuating shaft (Nm)</th>
<th>Force to be applied (N) (manual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS-drive earthing switch</td>
<td>Making / breaking</td>
<td>85</td>
<td>200</td>
</tr>
<tr>
<td>LS-drive circuit-breaker</td>
<td>Tensioning</td>
<td>110</td>
<td>280</td>
</tr>
<tr>
<td></td>
<td>Making</td>
<td>70</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td>Breaking</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 12

8.8 Materials

<table>
<thead>
<tr>
<th>Metals</th>
<th>Steel, copper, aluminium, zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic materials</td>
<td>PC, PA, EPDM, NBR, EP, POM, Q, (PF/MF, PBT, GFK optional)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Aluminium oxide, lubricants, SF₆ gas</td>
</tr>
</tbody>
</table>

Table 13

8.9 Permissible number of operating cycles for the circuit-breaker

![Graph showing permissible number of operating cycles for different short-circuit-breaking currents.](image)

Fig. 70
8.10 Regulations and standards

8.10.1 Test specifications

The circuit-breaker panel complies with the following VDE standards and/or IEC publications.

IEC 60265-1 (62271-103 1\)
IEC 60529 / VDE 0470 part 1
IEC 61243-5 / VDE 0682 part 415
IEC 62271-1 (60694 2\) / VDE 0670 part 1000 (VDE 0671 part 1 1\)
IEC 62271-100 / VDE 0671 part 100
IEC 62271-102 / VDE 0671 part 102
IEC 62271-200 (60298 2\) / VDE 0671 part 200 (VDE 0670 part 6 2\)
IEC 62271-303 1\) / VDE 0671 part 303 1\)

DIN EN ISO 9001
BImSchV Federal Gazette 1996, part 1 no. 66 dated 20/12/1996

1\) Future
2\) Former

8.10.2 Female connector (bushing)

Design of terminal components acc. to DIN EN 50181 connection type C (630 A) with external taper and screw contact M16.
9 Accessories

9.1 Assembly components

Order no. 12238780  Assembly kit panel screw connection GAE-standard / GAE-standard
Order no. 12248719  Assembly kit panel screw connection GAE-standard / GAE-metering panel
Order no. 12246868  Additional tool
Order no. 12238777  Assembly kit end panel
Article no. 12238779  Extension kit end panel