GAS-INSULATED SWITCHGEAR

GMA

Gas-Insulated Switchgear up to 24 kV

Assembly Instructions

No. AGS 531526-01
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Remarks on this manual

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

As our products are subject to continuous further development, we reserve the right to make changes regarding the standards, illustrations and technical data described in this Technical Manual.

All dimensions specified in this manual are in millimeters.

Purpose and target group

This Technical Manual describes the assembly of gas-insulated medium-voltage GMA series switchgear units.

It is exclusively intended for use by the manufacturer’s staff or by persons certified for the GMA series (training certificate).

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

Reference documents

The following additional documents must be observed for this switchgear:

- sales agreement with the stipulations regarding the switchgear-specific equipment and the legal details
- the switchgear-specific circuit diagrams / documentation
- Operating instructions GMA (AGS 531 521-01)
- Operating instructions GMA double busbar (AGS 532 521-01)
- the operating instructions for the devices installed in the switchgear:
  - voltage detection systems, e.g. IVIS (AGS 531 757-01)
  - devices in the low-voltage cabinet
- the assembly instructions of the manufacturer of the cable connection systems to be connected to the switchgear
- the assembly drawings supplied with the switchgear
- "Use and handling of sulphur hexafluoride (SF6) in high-voltage switchgear" (AGS 535 051-01)

Terms and symbols used

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

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

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

**“Warning!”**
This danger symbol warns about the risk of falling.

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

For reasons of simplification, the following abbreviations are used in this manual:

- **BB** = busbar
- **VT** = voltage transformer
- **$U_r$** = Rated voltage
- **$I_r$** = Rated current

Any questions or suggestions?

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

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

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

- 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 must be complied with.
- Installation: IEC 61936-1 / EN 50522
- Operation of electrical equipment: EN 50110-1

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

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

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

**Warning!**
After removal of covers, operator safety in accordance with IEC 62271-200 may be restricted if the appropriate part of the switchgear unit has not been isolated from the power supply.

**Danger!**
Before performing work in the drive area of the switchgear panels, switch off the supply voltage and prevent it from being switched ON again.

**Warning!**
There is a risk of injury when working on the drive mechanism. Before commencing work, release the energy-storing device by – the OFF-ON-OFF (Open/Close/Open) operating sequence on the circuit-breaker

Behaviour in case of incidents or accidents

For the case of an internal fault, the GMA switchgear features pressure relief ports which prevent the panels and the switchgear unit from bursting.

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.

In case of personal injury, take first-aid measures or cause them to be taken.
2.1 Circuit-breaker panel GMA

Fig. 1
Circuit-breaker panel with current and voltage transformers, panel width 600 mm

1 Low-voltage cabinet with control device
2 Pressure gauge (temperature-compensated)
3 Voltage detection systems
4 Instrument niche
5 Manual operator interface
6 Cable connection three-fold combination
7 Earthing link bar
8 Voltage transformer (optional)
9 Disconnecting device for voltage transformer (optional)
10 Toroidal-core current transformer
11 Earthing switch
12 Circuit-breaker
13 Disconnector
14 Busbar
2.2 Basic switchgear panels

Fig. 2
Switchgear panel with circuit-breaker

Fig. 3
Switchgear panel with circuit-breaker, voltage transformer, double cable connection

Fig. 4
Switchgear panel with switch disconnector

Fig. 5
Switchgear panel with switch fuse combination
2.3 Dimensional drawings

Fig. 6
1 Panel width for single panel
2 modules with 2 to max. 4 panels; panel width 450 mm
3 modules with 2 to max. 3 panels; panel width 600 mm

Fig. 7
Panel height and depth of GMA panel variants
1 Switch disconnector panel with fuse
2 Circuit-breaker panel without and with cooler, depending on the rated current of the switching devices
3 Circuit-breaker panel with voltage transformer and 1 outer cone-type coupler for each phase
4 Circuit-breaker panel with voltage transformer and 2 outer cone-type couplers for each phase
5 Cooler (only with rated current 1250 A)
6 Voltage transformers in the feeder panel
7 Rear-mounted gas cooler for rated short-time current > 20 kA
### 2.4 Panel variants

All typical standard variants for the GMA series are specified. Not included in this overview:
- Air-insulated metering panels; see page 53
- Panel variants for GMA double busbar switchgear units; see Operating Manual AGS 532521-01
- Customized designs; see customized switchgear documentation

#### Branch-circuit panels

<table>
<thead>
<tr>
<th>I&lt;sub&gt;n&lt;/sub&gt; (outgoing feeder) [A]</th>
<th>Panel width [mm]</th>
<th>Depth [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disconnector</strong></td>
<td>450</td>
<td>800</td>
</tr>
<tr>
<td><strong>Circuit-breaker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Earthing switch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Switch disconnector</strong></td>
<td>450</td>
<td>800</td>
</tr>
<tr>
<td><strong>Earthing switch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Switch fuse combination</strong></td>
<td>450</td>
<td>800</td>
</tr>
<tr>
<td><strong>H.V.H.R.C. fuses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 earthing switches</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Busbar riser with disconnector</strong></td>
<td>450</td>
<td>800</td>
</tr>
<tr>
<td><strong>Earthing switch (optional)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Busbar riser with earthing switch (optional)</strong></td>
<td>450</td>
<td>800</td>
</tr>
</tbody>
</table>

1 Panel depth 1000 with attachment gas cooler, see Fig. 7
## Design, description, variants

<table>
<thead>
<tr>
<th>Busbar links</th>
<th>$I_{(Busbar)}$ [A]</th>
<th>Panel width [mm]</th>
<th>Depth [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus section coupler</td>
<td>≤ 1000</td>
<td>800/1000$^1$</td>
<td>800/1000$^1$</td>
</tr>
<tr>
<td>Busbar riser</td>
<td>1200</td>
<td>860/1000$^1$</td>
<td>860/1000$^1$</td>
</tr>
<tr>
<td>Bus section coupler</td>
<td>≤ 630</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>Busbar riser</td>
<td>600</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>Bus sectionalizer</td>
<td>≤ 630</td>
<td>600</td>
<td>800</td>
</tr>
</tbody>
</table>

$^1$ Panel depth 1000 with attachment gas cooler, see Fig. 7

### 2.5 Busbar attachments

<table>
<thead>
<tr>
<th>Busbar attachments</th>
<th>$I_{(Busbar)}$ [A]</th>
<th>Panel width [mm]</th>
<th>Depth [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Busbar earthing switch</td>
<td>≤ 1250</td>
<td>450</td>
<td>800</td>
</tr>
<tr>
<td>Voltage transformer flanged on the busbar coupling tank</td>
<td>≤ 1250</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Voltage transformer flanged on the busbar coupling tank with disconnecting device</td>
<td>≤ 1250</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Current transformer on the busbar</td>
<td>≤ 1250</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>Cable connection on the busbar with busbar end tank</td>
<td>≤ 1250</td>
<td>450</td>
<td>800</td>
</tr>
</tbody>
</table>
2.6 Weights

The total weight results from the sum of the individual weights depending on the devices fitted in the switchgear.

<table>
<thead>
<tr>
<th>Weights</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Circuit-breaker</td>
<td>630 A</td>
<td>≤ 250 kg</td>
</tr>
<tr>
<td>1 Circuit-breaker</td>
<td>1250 A</td>
<td>≤ 450 kg</td>
</tr>
<tr>
<td>1 Switch disconnector panel without fuse</td>
<td></td>
<td>≤ 180 kg</td>
</tr>
<tr>
<td>1 Switch disconnector panel with fuse</td>
<td></td>
<td>≤ 250 kg</td>
</tr>
<tr>
<td>1 Set of voltage transformers</td>
<td></td>
<td>≤ 125 kg</td>
</tr>
<tr>
<td>1 Side wall</td>
<td></td>
<td>≤ 50 kg</td>
</tr>
<tr>
<td>1 Low-voltage cabinet</td>
<td></td>
<td>≤ 70 kg</td>
</tr>
<tr>
<td>1 Module connection</td>
<td></td>
<td>≤ 30 kg</td>
</tr>
</tbody>
</table>

2.7 Utilization in line with the intended purpose

Gas-insulated GMA medium-voltage switchgear units are exclusively intended for switching and distributing electrical energy. They may only be used in the scope of the specified standards and the switchgear-specific technical data. Any other utilization 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 Technical 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.
2.8 Applied standards

GMA switchgear units are

- metal-enclosed
- \( \text{SF}_6 \)-insulated
- type-tested
- tested for internal faults
- dimensioned for indoor installation

---

### Designation Standard

<table>
<thead>
<tr>
<th>Designation</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear</td>
<td>IEC 62271-1</td>
</tr>
<tr>
<td></td>
<td>IEC 62271-200</td>
</tr>
<tr>
<td>Internal arc classification (IAC)</td>
<td>IEC 62271-200</td>
</tr>
<tr>
<td>Circuit-breaker</td>
<td>IEC 62271-100</td>
</tr>
<tr>
<td>Earthing switch</td>
<td>IEC 62271-102</td>
</tr>
<tr>
<td>Disconnector</td>
<td>IEC 62271-102</td>
</tr>
<tr>
<td>Switch disconnector</td>
<td>IEC 60265-1</td>
</tr>
<tr>
<td>Switch fuse disconnector combination</td>
<td>IEC 62271-105</td>
</tr>
<tr>
<td>Current transformers</td>
<td>IEC 61869-2</td>
</tr>
<tr>
<td>Voltage transformers</td>
<td>IEC 61869-3</td>
</tr>
<tr>
<td>Voltage Detecting Systems</td>
<td>IEC 61243-5</td>
</tr>
<tr>
<td>Protection against accidental contact, foreign bodies and water</td>
<td>IEC 60529</td>
</tr>
<tr>
<td>Installation</td>
<td>IEC 61936-1</td>
</tr>
<tr>
<td>Operation of electrical equipment</td>
<td>EN 50110</td>
</tr>
<tr>
<td>Insulating gas sulphur hexafluoride ( \text{SF}_6 )</td>
<td>IEC 60376</td>
</tr>
<tr>
<td>Use and handling of sulphur hexafluoride ( \text{SF}_6 )</td>
<td>IEC 62271-303</td>
</tr>
</tbody>
</table>

### Degrees of protection against accidental contact and foreign objects (according to IEC 60529)

| Main electric circuits                  | IP 65                   |
| Drives                                  | IP 2X<sup>1</sup>        |
| Low-voltage cabinet                     | IP 3X<sup>2</sup>        |
| Cable connection compartment            | IP 3X                   |

<sup>1</sup> optional IP 5X

<sup>2</sup> optional IP 52
2 Design, description, variants

2.9 Environmental and operating conditions

GMA is an indoor switchgear which may only be operated under normal operating conditions in acc. with IEC 62271-1 regulations. Operation under conditions deviating from these is only admissible upon consultation and with the approval of the manufacturer.

<table>
<thead>
<tr>
<th>Ambient conditions (in accordance with IEC 62271-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature class</strong></td>
</tr>
<tr>
<td><strong>Ambient temperature min./max</strong></td>
</tr>
<tr>
<td><strong>Average value over 24 hours</strong></td>
</tr>
<tr>
<td><strong>Average rel. air humidity: 24 hours / 1 month</strong></td>
</tr>
<tr>
<td><strong>Installation altitude above sea-level</strong></td>
</tr>
</tbody>
</table>

¹ higher values available on request

2.10 Disposal after the end of the service life

A material and recycling data sheet can be provided on request for the disposal of series GMA 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).
3 Packaging, transport, storage

3.1 Shipping units

Delivery is effected in terms of modules comprising 1 to 4 panels ready for connection.

In the case of restricted accessibility of the switchgear room, the low-voltage cabinets can be delivered separately upon request.

Busbar link, earth bus, switchgear covers, busbar voltage transformers etc. are delivered as accessories.

If packed exclusively for truck transport, the panels are delivered on a pallet with PE protective film.

For sea transport, the units are packed in sealed aluminium foil with desiccant and in a closed wooden case with tightly closed wooden base (also for container transport).

In case of air transport, the panels are packed in wooden crates with a protective PE film hood (dust protection) or in wooden crates, also with closed wooden bases, however without protective hoods (dust protection).

3.2 Transport

When transporting the switchgear panels, it must be ensured that the units do not slip or tip (if necessary, nail down transport pallets to the loading surface).

The panel may only be transported on a pallet.

The entire length of the forks must be placed under the transport unit (Fig. 9).

---

Fig. 8
Do not tip the transport units

Fig. 9
Transport using a forklift truck
3 Packaging, transport, storage

Delivery

- Handle shipping units carefully when unloading and unpacking them.
- Shipping units must be checked upon receipt. Any damage which may have occurred in transit must be recorded and reported to the manufacturer immediately.
- Check completeness of consignment based on the transport documents.
- The supplier must be notified in writing without delay about any deviations.

3.3 Storage

Warning!

Sufficient stability and evenness of the supporting area (floor) must be ensured.

If the panels are not installed immediately after delivery, they can be stored under the following conditions:

![Diagram showing the storage conditions](image)

- Switchgear panels may only be stored vertically and must not be stacked.
- Storage is only admissible indoors.
- Panels and accessories must be packed in sealed aluminium foil with desiccant and in a wooden crate (storage max. two years after the date of packaging).
4 Installation of panels

4.1 Safety provisions and instructions for assembly

The switchgear panels may only be installed and assembled by the manufacturer’s staff or by persons who have been certified for this work.

- **Warning!** Comply with the safety provisions on page 7.

- **Warning!** Risk of accidents Pay attention to floor openings!

The GMA series switchgear panels are delivered with the circuit breaker set to “OFF”, the energy storing device released and the earthing switch set to “ON”.

- **Warning!** Risk of injuries! The energy storing devices for circuit breaker and earthing switch must not be charged during installation, assembly and connection.

- **Danger!** Danger due to insufficient dielectric strength of high-voltage connections in case of assembly under aggravated ambient conditions. It is essential that condensation, dirt and dust are avoided during assembly in any case.

- **Notice:**
  - Switchgear units with pressure relief duct (see Section 6.5): The lateral fixing brackets must be installed before positioning the panel on the base frame.
  - For all screw connections which are not defined directly in the assembly description, the tightening torques mentioned in the Annex must be used.
  - Before starting assembly, comply with the design drawings included with the shipment.
4.2 Requirements regarding the switchgear room

Before installing the switchgear panels, make sure that the switchgear room is checked according to the switchgear documentation (Fig. 11):

- Width of opening for placing the unit ≥ 1100 mm, height ≥ 2300 mm (if specified height is undercut: delivery without attached low-voltage cabinet)
- Check ducts for high-voltage and low-voltage cables.
- Check location of base frame.
- The load-bearing capacity of the fastening areas must correspond to the weight of the switchgear (perform a stress analysis of the building).
- Observe the minimum distance between the switchgear and the rear wall of the building.
- Check base frame for dimensions and positional tolerances.

Before the switchgear is positioned at its site of installation, check that the base frames are level. Any unevenness must not exceed ± 1 mm/meter.

Notice:
Observe switchgear-specific space assignment plan.

Fig. 11
Floor opening and position of the base frame
1 Steel base frame 40 x 40 x 4
2 Switchgear panel floor area (600 mm x 1000 mm)
3 Switchgear panel floor area (450 mm x 1000 mm)
4 Area for cross-bracing
5 Opening for secondary lines
6 Opening for primary cable outgoing feeders
7 Fastening bore-holes
8 Floor area 3-unit module (1350 mm x 800 mm)
9 Building wall
10 Side wall
11 Rear gap cover
12 Lateral gap cover
Examples for the position of switchgear panels in the switchgear room

Fig. 12  
Switchgear not accessible from the rear, without / with voltage transformer in a feeder panel  
1 Height depending on the minimum bending radius of the high-voltage cable

Fig. 13  
Switchgear accessible from the rear  
1 Height depending on the minimum bending radius of the high-voltage cable
4.3 Transporting the modules on the construction site

Warning! Risk of tipping over! During transport, pay attention to the weight distribution. The center of gravity is at gas tank level in the upper part of the switchgear panel and is marked by a label. Never move panels without using transport aids.

Warning! Make sure the rope/chain or U profile is strong enough to bear the weight of the transport unit. The specific regulations applicable for hoisting equipment must be complied with.

Warning! Sufficient stability and evenness of the supporting area (floor) must be ensured.

Transport using a crane:

Screw-fasten transport brackets laterally on each module in accordance with Fig. 14 (M12). Attach the crane mounting harness to the transport brackets via hooks. Loosen module fastening on the pallet. Lift the module carefully and deposit it slowly on the floor at the intended location. Remove the transport brackets.

![Transport using a crane](image)

Fig. 14
Transport using a crane
1 Fastening crane mounting harness to the transport bracket
2 Module fastening
Transport by means of lift trolley:

1. Screw-fasten lift trolley to both sides of the module. At the rear fastening points, spacers must be used between the lift trolley and the panel supporting structure, in order to align the lift trolley parallel to the panel side.

2. Lift the module on the left and right uniformly using the hydraulic lifting device.

3. Place two U profiles (not included in scope of supplies) on the base frame as traversing aid and block them by (lower) stops against slipping in the base frame. Adjust the distance between the two U profiles in accordance with the panel width.

4. Position the module on the base frame by means of the transport rollers. To this effect, each transport roller must be positioned in the appropriate U profile.

5. Lower the module down to the base frame using the star handle on the hydraulic cylinder.

6. Remove the lift trolley. Remove the U profiles.
4.4 Removing the cable compartment cover and other covers

Prior to installation, mounting and connection of the switchgear, remove cable compartment cover and operating cover if required.

4.4.1 Remove the cable compartment cover

1. Earthing switch "ON".
2. Unlock the cable compartment cover. To this effect, press interlocking slide upwards.
3. Lift and remove cable compartment cover.

Switchgear panels with earthing switch in the outgoing feeder cable:

Mechanical interlocking table

<table>
<thead>
<tr>
<th>Cable compartment cover</th>
<th>Earthing switch</th>
<th>Cable compartment cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>mounted</td>
<td>unlocked</td>
<td>–</td>
</tr>
<tr>
<td>removed</td>
<td>locked</td>
<td>–</td>
</tr>
<tr>
<td>Earthing switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>–</td>
<td>unlocked</td>
</tr>
<tr>
<td>OFF</td>
<td>–</td>
<td>locked</td>
</tr>
</tbody>
</table>
**Special panels:**

- Risers without earthing switch
- Bus section coupler and bus coupler
- Panels for double busbar
  These variants are not equipped with a cable compartment cover with dependent interlock.
  In these panels, the cable compartment cover is secured against removal by operating cover.
  The cable compartment cover cannot be removed before the operating cover positioned above has been removed (see chapter 4.4.2).

**Danger!**

Risk of fatalities due to high voltage. Isolate the high-voltage terminals from the power supply and earth them.

1. Detach, lift and remove the operating cover (see chapter 4.4.2).
2. Lift and remove cable compartment cover.

**4.4.2 Removing the operating cover**

For removal of the cable compartment cover of special panels (see Chapter 4.4.1) or attachment of the side walls, (Chapter 6.2), the operating cover must be removed.

- Loosen the four securing bolts and remove the operating cover in forward direction.
- The bolts remain secured on the operating cover.

**Notice:**
Identify panel in accordance with the nameplate on the operating cover to avoid confusion.
4.5 Installing and connecting the modules

Notice:
The safety provisions and assembly instructions on page 18 must be complied with.

1. The position of the first panel is decisive for placement of the subsequent panels, thus it is essential that measuring is effected with the utmost precision!
2. Place the module on the base frame according to the switchgear-specific space assignment plan. In order to be better able to subsequently position the modules correctly, the base frame can be greased.
3. Align the modules. Check the panel front for correct horizontal and vertical position. If applicable, lift the panel and place shims in the direct vicinity of the fastening areas, until the horizontal position has been reached.
4. Position the following module on the base frame next to the first panel according to the switchgear-specific space assignment plan.
5. Push panels carefully together. Align the panels in accordance with Fig. 19 and Fig. 20. If applicable, lift the panel and place shims in the direct vicinity of the fastening areas, until the horizontal position has been reached.

6. Screw-fasten the panels to one another at the front (Fig. 21).

Assembly drawing AGS C92691-01.
Before screw-fastening the panels at instrument-niche level, remove the respective covers (item 2), and reinstall them subsequently.
4 Installation of panels

Bus section coupler / metering panel

For bus section coupler / metering panel according to the design shown in Chapter 10.4, each of which consists of 2 single panels, an additional rear panel screw fastening is necessary.

Assembly drawing AGS C93003-01.

Mount connecting link to the insulating gas tanks.

Fig. 21
Screw-fastening the panels to one another (self-locking connections)
1 Low-voltage cabinet
2 Instrument niche (tightening torque 15 ± 1.5 Nm)
3 Cable connection compartment
4.6 Fastening the modules onto the base frame

**Notice:**
Panel fastening with seismic qualification or vibration-proof characteristics can be supplied on request.

Cut thread M8 into the base frame at the fastening points provided (Fig. 22). To this effect, drill initially a hole of Ø 6.8 mm. Screw-fasten the module to the base frame at four points.

![Fig. 22](image)
Panel fastening on base frame
1. Base frame
2. Module fastening points
3. Module supporting structure

4.7 Busbar link

**Warning!**
The valves for flooding the busbar tank must not be opened during assembly. Risk of insulating gas escaping!

**Warning!**
Make sure that the lubricants MS and KL are not mixed, as in this case, the function of the lubricants can no longer be ensured.

4.7.1 Removing the transport protection cover

1. Remove the caps (2).
2. Loosen the securing bolts (3).
3. Lift and remove the transport protection (1).

![Fig. 23](image)
Removing the transport protection cover
1. Transport protection cover
2. Caps
3. Screw-fastening
4.7.2 Assembly for standard coupling tank

Assembly drawing: AGS C27813-01
1. Coat cord sealing ring and sealing surfaces with SF6 multi-purpose lubricant MS (refer to Annex).
2. Insert cord sealing ring at the bottom of the coupling tank.
3. Position the busbar coupling tank and tighten self-locking nuts M8 uniformly and crosswise.

Fig. 24
Assembly of coupling tank
1  Busbar coupling tank
2  Cord sealing ring (seal)
3  Self-locking nut M8
4.7.3 Assembly of special coupling tank

<table>
<thead>
<tr>
<th>Designation</th>
<th>Primary fuse in VT</th>
<th>Disconnecting device for VT</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module connection tank with voltage transformer (VT) on the busbar</td>
<td>without</td>
<td>without</td>
<td>AGS C27649-01</td>
</tr>
<tr>
<td></td>
<td>without</td>
<td>with</td>
<td>AGS C92694-01</td>
</tr>
<tr>
<td></td>
<td>with</td>
<td>with</td>
<td>AGS C92592-01</td>
</tr>
</tbody>
</table>

1. Coat cord sealing ring and sealing surfaces with SF₆ multi-purpose lubricant MS (refer to Annex).
2. Apply spacing strips to the panel.
3. Apply cord sealing ring.
4. Position the busbar coupling tank and tighten self-locking nuts M8 uniformly and crosswise.

![Fig. 25](image-url)  
Assembly of coupling tank  
1 Busbar coupling tank  
2 Cord sealing ring (seal)  
3 Spacing strip  
4 Self-locking nut M8
### 4.7.4 Mounting the busbars

<table>
<thead>
<tr>
<th>Designation</th>
<th>Busbar rated current</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design without additional function on the busbar</td>
<td>630 A</td>
<td>AGS C27653-01</td>
</tr>
<tr>
<td></td>
<td>1250 A</td>
<td>AGS C27654-01</td>
</tr>
<tr>
<td>Design with VT / capacitive voltage indicator on the busbar without disconnecting device</td>
<td>630 A</td>
<td>AGS C27851-01</td>
</tr>
<tr>
<td></td>
<td>1250 A</td>
<td>AGS C27652-01</td>
</tr>
<tr>
<td>Design with VT on the busbar with disconnecting device</td>
<td>630 A</td>
<td>AGS C53798-01</td>
</tr>
<tr>
<td></td>
<td>1250 A</td>
<td>AGS C53797-01</td>
</tr>
</tbody>
</table>

1. Preparation of the contact surfaces:
   - Clean and degrease the threaded areas by means of cleaning agent (see Annex).
   - Coat contact surfaces with contact lubricant KL (see Annex).

2. Place connecting rails on the copper pins of the busbar duct.
   Busbar rated current:
   - 1 copper bar per phase: \( I_r \leq 630 \) A
   - 2 copper bars per phase: \( 630 \) A < \( I_r \) \leq 1250 A

3. Use bolts M10 with micro-encapsulated glue for the busbar screw-fastening. Tightening torque 10±1 Nm.

**Notice:**
Please observe position and number of cup springs (see Fig. 26).

![Fig. 26 Module screw fastening](image)

1. Busbar coupling tank
2. Connection bars for 630 A busbar
3. Fillister head screw M10, 3 cup springs, washer
4. Two connection bars for 1250 A busbar
5. Painted areas (1250 A) are located on the outside
For coupling tanks with voltage transformer attachment, please note:

after screw-fastening the busbars, check the position of the contact pins for the voltage transformers according to Fig. 27.

Notice:
After the cover plate has been mounted, the contact pins must contact the inner cone-type connecting sockets!

Fig. 27
Module screw-fastening for coupling tanks with voltage transformer attachment
1 Busbar
2 Inner cone-type connecting socket, size 1
3 Sprung contact pin

4.7.5 Transition resistance measurement

Notice:
Comply with the manufacturer’s specifications regarding the ohmmeter.

1. Connect the measuring device.
2. Measure transition resistance $R$ between the individual busbar sections using direct current.
3. If one value exceeds the value specified in the Table, release busbar screw fastening, clean contact surfaces carefully and re-mount.

Fig. 28
Schematic diagram for transition resistance measurement of the busbar link (design 630 A shown)

<table>
<thead>
<tr>
<th>Rated current, busbar</th>
<th>Admissible resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>630 A</td>
<td>$\leq 9 , \mu\Omega$</td>
</tr>
<tr>
<td>1000 A /1250 A</td>
<td>$\leq 7 , \mu\Omega$</td>
</tr>
</tbody>
</table>
4.7.6 Mounting the cover plate

**Notice:**
Observe the position of the valve actuating device in the cover plate based on the gas compartment diagram.

1. Coat cord sealing ring and sealing surfaces with SF₆ multi-purpose lubricant MS (refer to Annex).
2. Apply spacing strip to the coupling tank.
3. Insert cord sealing ring on the inside of the plate.
4. Position the cover on the coupling tank and fasten self-locking nuts M8 uniformly and crosswise.

---

**Fig. 29**
Mounting the cover plate
1. Spacing strip
2. Sealing ring (on the inside of the cover plate)
3. Cover plate for coupling tank
4. Bushing for valve actuation
5. Gas connector socket for tank
6. Self-locking nut M8
4.8 Flooding the busbar coupling tank with insulating gas

Fig. 30 shows the valve positions on the coupling tank after flooding.

- The left-hand valve is opened fully. Identification by code number 2. Open the valve to its stop using a size 6 Allen key. This results in pressure compensation and flooding of the busbar coupling tank with insulating gas. Re-mount the cap.
- The right-hand valve remains closed. Identification by code 0.

<table>
<thead>
<tr>
<th>Valve closed</th>
<th>Valve open</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12 ± 1</td>
</tr>
</tbody>
</table>

Fig. 30
Sectional view of coupling tank from the panel front after flooding

1. Left-hand valve: Position 2 (open): Check dimension 12 ± 1 after opening
2. Right-hand valve: Position 0 (closed)

Notice:
After opening the valves of the busbar coupling tank, the following waiting periods must be observed before high voltage may be connected.

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Waiting period</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 kV</td>
<td>none</td>
</tr>
<tr>
<td>17.5 kV</td>
<td>min. 24 h</td>
</tr>
<tr>
<td>24 kV</td>
<td>min. 48 h</td>
</tr>
</tbody>
</table>

The waiting period can be foregone if the coupling tank is evacuated before the valves are opened.

Notice:
By evacuating the busbar coupling tank, the switchgear must be re-filled until the rated pressure $p_r = 0.03$ MPa has been reached. After filling, a new tag indicating the correct, complete amount of SF6 for the module must be attached and signed.

Performing leakage test:
After approximately 24 hours, the flange couplings must be checked and leakage-tested for SF6. Observe the instructions of the leakage detector’s manufacturer or the appropriate operating instructions.

Warning!
Should a leakage be detected, the valves in the coupling tank must be re-closed. Coupling tanks must be evacuated before being opened. Comply with the provisions of IEC 62271-303 “Use and Handling of Sulphur Hexafluoride (SF6)”.
4 Installation of panels

Gas compartment technology with all functional elements:
Type of insulating gas: Sulphur hexafluoride SF₆ according to IEC 60376
The following tanks form together a segregated insulating gas compartment.
- Module comprising 1 to 4 panels
- 1 connection tank, located at the right end of each module
- Busbar end tank

Each insulating gas compartment has a temperature-compensated pressure gauge, gas compartment connectors, pressure relief ports.

Fig. 31
Gas compartment diagram
1 Modules comprising 1 to 4 panels
2 Busbar coupling tank
3 Gas connector socket
4 Check valve
5 Pressure gauge with temperature compensation
6 Gas-proof electrical bushing
7 Valve open (code 2)
8 Valve closed (code 0)
9 Pressure relief port
10 Busbar end tank
4.9 Attachment of the earth bus

The earth bus is screw-fastened to the lower cross-beam on the front of each panel. The complete attachment is included in the accessories or can also be pre-assembled in the factory.

1. Clean all contact areas of the earthing, connecting and fastening bar in the switchgear panels and coat them with lubricant KL (see Annex).
2. Slip the connection bar into the adjacent panel’s supporting structure through the cutout in the panel.
3. Screw-fasten the connection bar on both sides to the earth bar in question by means of the fixing bracket and screw-fasten the fixing bracket to the panel (see Fig. 32).
4. Connect the earth bus to the earthing system of the switchgear building. (Connecting lines are not included in the scope of supplies). The earth bus should preferably be connected to the building earth at the end of each earthing cable.

On principle, each panel features a connection facility to the building earth.

Notice:
Observe the specific standards referring to earthing systems which apply in your country.

Fig. 32
Earth bar
1 Earth bar
2 Fixing bracket
3 Connection bar
4 Connection to the building earth (M12)
5 Bolt, spring washer, washer, nut M8
6 Self-locking bolt, washer, nut M8

<table>
<thead>
<tr>
<th>Designation</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>For each 450 mm panel</td>
<td>AGS C90730-01</td>
</tr>
<tr>
<td>For each 600 mm panel</td>
<td>AGS C90731-01</td>
</tr>
<tr>
<td>For each bus section coupler 1x 600 mm</td>
<td>AGS C90731-01</td>
</tr>
<tr>
<td>For each bus section coupler 2x 600 mm</td>
<td>2x AGS C90731-01</td>
</tr>
</tbody>
</table>
5 Attachment of voltage transformers to the busbar

The inductive, single-pole metal-enclosed voltage transformers are used for voltage measurement on the busbar.

**Danger!**
Risk of fatalities due to high voltage. Isolate the busbar from the power supply and earth it (see Operating Manual)!

**Notice:**
- Remove grease and silicone from the contact surfaces and insulating areas on the inner cone-type appliance couplers in the tank and on the voltage transformers before assembly.
- Comply with the assembly instructions of the voltage transformers.
- The weight of the transformers must be taken into consideration! Support the transformer or secure it by attaching a crane hook to the transformer jack rings.

---

**Assembly**

Fig. 33
Voltage transformer on the busbar coupling tank
1 Busbar coupling tank
2 Voltage transformer
3 Insulating and control element
4 Contact surface
5 Inner cone-type appliance couplers
5 Attachment of voltage transformers to the busbar

1. Expose metallic contact surfaces on the transformer connector and inside the inner cone-type appliance coupler (see Annex).
2. Clean the insulating areas of the transformer connector and inside the inner cone-type appliance coupler carefully, and apply a uniform film of special paste (see assembly instructions for voltage transformer).
3. Slip voltage transformer (item 1) in correct axial position into the inner cone-type appliance coupler and screw-fasten it. 4 x M8 self-locking nut.
4. Connect the transformer secondary lines (plug-in contacts, item 2). Comply with the marking!

Observe the assignment of cables and connections in the low-voltage cabinets.

Notice:
The switchgear-specific circuit diagram must be complied with.

Fig. 34
Voltage transformer on the busbar coupling tank
1 Voltage transformer
2 Transformer secondary lines
3 Low-voltage cabinet
6.1 Switchgear without pressure relief duct (IAC AFL)

Front and lateral covers are necessary if the qualification IAC AFL in acc. with IEC 62271-200 is required.

Shown (Fig. 35): The switchgear is accessible from the front and on the right-hand side (the switchgear is located in the left-hand corner of the room).

Additional variants (not shown):

- The switchgear is accessible from the front and from the left-hand side (the switchgear is located in the right-hand corner of the room).
- The switchgear is accessible from the front and from both sides (the switchgear is located against the wall of the building, but not in a corner of the room).

**Notice:**
Comply with the appropriate documentation for the switchgear. It defines the applicable variant in accordance with the customer’s requirements.

All individual parts are included in the accessories. Design is identical for the right-hand and left-hand sides.

![Diagram of switchgear in the left-hand corner of the room with labels for each part.]

Fig. 35
Switchgear GMA in the left-hand corner of the room
1 Attachment, switchgear wall (Chapter 6.2)
2 Attachment of the rear gap cover (Chapter 6.3)
3 Attachment of the lateral gap cover (Chapter 6.4)
4 Building wall
5 Switchgear GMA in the left-hand corner of the room
6.2 Attachment, switchgear wall

<table>
<thead>
<tr>
<th>Height</th>
<th>Attachment end</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100 mm</td>
<td>left-hand</td>
<td>AGS C92254-01</td>
</tr>
<tr>
<td></td>
<td>right-hand</td>
<td>AGS C92255-01</td>
</tr>
<tr>
<td>2300 mm</td>
<td>left-hand</td>
<td>AGS C92258-01</td>
</tr>
<tr>
<td></td>
<td>right-hand</td>
<td>AGS C92259-01</td>
</tr>
</tbody>
</table>

1. Before attaching the wall to the right-hand end panel, remove the spacing strip (9) (release plastic rivet).
2. Screw-fasten front side wall (1) to the module (8).
3. Fasten cable duct (2) to the front side wall (7).
4. Screw-fasten cable duct (2) on the rear 2 x to the lateral compartment reinforcing section and 1x at the bottom to the module supporting structure (6).
5. Mount (5) cable duct cover (3).

Fig. 36
Attachment, switchgear wall
1 Front side wall
2 Cable duct
3 Cable duct cover
4 Fastening points, tool board
5 Fastening of the cable duct cover (16 ea. M16)
6 Fastening cable duct - rear wall (3 ea. M8x25 and 1 spacer sleeve)
7 Fastening cable duct - front side wall (6 ea. M8x18)
8 Fastening front side wall to panel (4 ea. M8x12)
9 Remove spacing strip from right-hand end panel
6 Switchgear covers

6.3 Rear gap cover

<table>
<thead>
<tr>
<th>Height</th>
<th>Rated dimension</th>
<th>Area covered</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100 mm</td>
<td>100 mm</td>
<td>90 - 110 mm</td>
<td>AGS C92288-01</td>
</tr>
<tr>
<td>300 mm</td>
<td>250 - 470 mm</td>
<td>AGS C91624-01</td>
<td></td>
</tr>
</tbody>
</table>

Gap covers are provided between the mounted switchgear wall and the building wall.

Mount side wall as described in section 6.2.

1. Screw-fasten front gap cover to wall (self-locking bolt M8).
2. Apply rear gap cover acc. to the drawing and mark securing bore-holes on the building wall and - if necessary - on the front gap cover (if dimension A > 250 mm).
3. Remove rear gap cover and provide securing bore-holes on the building wall (diameter 10 mm) and, if applicable, on the front gap cover (diameter 4.6 mm). Now fit the dowel pins.
4. Screw-fasten rear gap cover to the building wall (Fig. 38, item 5, tightening torque 10 Nm).
5. Screw-fasten the two gap covers to one another (Fig. 38, item 6).

Fig. 37
Assembly of gap cover
1 Building wall
2 Rear gap cover
3 Front gap cover, adjustable
4 Side wall
Fig. 38
Dimensions for the gap cover (the illustration shows the attachment for the left side)
1 Building wall
2 Rear gap cover
3 Front gap cover, adjustable
4 Side wall
5 Dowel pin with bolt
6 Sheet metal bolt M5

6.4 Lateral gap cover

<table>
<thead>
<tr>
<th>Height</th>
<th>Attachment end</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100 mm</td>
<td>left-hand</td>
<td>AGS C92292-01</td>
</tr>
<tr>
<td></td>
<td>right-hand</td>
<td>AGS C92293-01</td>
</tr>
<tr>
<td>2300 mm</td>
<td>left-hand</td>
<td>AGS C92450-01</td>
</tr>
<tr>
<td></td>
<td>right-hand</td>
<td>AGS C92451-01</td>
</tr>
</tbody>
</table>
The lateral gap cover is installed between the end panel and the side wall of the building (Fig. 39).
The nominal width of the gap cover is always 100 mm.
Before attaching the gap cover, remove the spacing strip (3) from the right-hand end panel (release plastic rivet).
1. Screw-fasten the fixing bracket (1) to the panel. (M8 self-locking bolt)
2. Apply gap cover (2) as shown in the drawing and mark fastening bore-holes on the building wall.
3. Remove gap cover and provide fastening bore-holes. Now fit the dowel pins.
4. Screw-fasten gap cover to the wall of the building.
5. Screw-fasten gap covers and fixing brackets to one another. (M8 self-locking bolt)
6 Switchgear covers

6.5 Attachment of rear wall in case of free-standing installation (IAC AFLR)

<table>
<thead>
<tr>
<th>Rear / side</th>
<th>Panel width</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>450 mm without gas cooler</td>
<td>AGS C91810-01</td>
</tr>
<tr>
<td></td>
<td>600 mm without gas cooler</td>
<td>AGS C91812-01</td>
</tr>
<tr>
<td></td>
<td>600 mm with VT without gas cooler</td>
<td>AGS C91814-01</td>
</tr>
<tr>
<td></td>
<td>450 mm with gas cooler</td>
<td>AGS C91565-01</td>
</tr>
<tr>
<td></td>
<td>600 mm with gas cooler</td>
<td>AGS C91567-01</td>
</tr>
<tr>
<td></td>
<td>600 mm with VT without gas cooler</td>
<td>AGS C91584-01</td>
</tr>
<tr>
<td>Side, left-hand</td>
<td></td>
<td>AGS C91579-01</td>
</tr>
<tr>
<td>Side, right-hand</td>
<td></td>
<td>AGS C91580-01</td>
</tr>
</tbody>
</table>

If GMA switchgear units are installed free-standing in the switchgear room and if IAC AFLR is required (access to the switchgear from the front, sides and rear), one rear wall is provided for each panel.

Notice:
Mount fixing brackets (Fig. 41, item 4) before installing the panel, as they are no longer accessible afterwards.

Fig. 40
GMA switchgear with rear wall
1 Attachment, switchgear wall (page 39)
2 Side wall extension
3 Pressure relief duct
4 Building wall
5 Rear wall
6 Switchgear covers

The screws already mounted must be used for screw connections to the panel supporting structure.

1. Attachment of the switchgear side walls acc. to Chapter 6.2.
2. Only in case of module tanks covering several panels: mount the upper fixing brackets (3) to the panel partition.
3. Screw-fasten side wall extension (1) to the switchgear wall.
4. Screw-fasten side wall extension, rear wall (7) and reinforcement (2) to one another according to the illustration. In the lower area, a screw connection is established with the panel supporting structure, not with the reinforcement (2).
5. The further rear walls (7) are screw-fastened for each panel with the rear (6) and front (5) reinforcements (see Fig.). Depending on their location, the lateral and upper fixing brackets are additionally included in the screw connection. In the lower area, a screw connection is established with the panel supporting structure, not with the front reinforcement (5).
6. In the case of pressure relief ports to the rear in the panel supporting structure, a pressure relief duct (8) is mounted instead of the rear walls (7).

Fig. 41
Attachment, rear wall

1 Side wall extension
2 Reinforcement
3 Upper fixing bracket
4 Lower fixing bracket
5 Front reinforcement
6 Rear reinforcement
7 Rear wall
8 Pressure relief duct
9 Base plate
7 Low-voltage cabinet

7.1 Attachment of low-voltage cabinet

Assembly

Assembly drawing: AGS C90691-01

The low-voltage cabinets are either supplied as accessories or may already be mounted to the panel, depending on the transport requirements.

1. Remove the two cover plates from the instrument niche.
2. Assign the low-voltage cabinet to the appropriate panel and remove the packaging. Position low-voltage cabinet carefully on top of the appropriate panel from above.
3. Open cabinet door with double-bit key and screw-fasten low-voltage cabinet on the rear (see Fig. 42). 2x M8 self-locking bolt.
4. Screw-fasten the low-voltage cabinets to each other at the sides (see Chapter 4.5).

Connect internal control lines of panel:

1. Plug terminals of drive wiring onto the terminal strips in the low-voltage cabinet (Fig. 42) according to the codes provided.
2. Close the bottom of the low-voltage cabinet by means of the two cover plates and screw-fasten it together with the panel - 4x M8 self-locking screw fastening.
7.2 Connecting ring circuits

1. Route the ring circuits for the intra-panel wiring through the lateral rubber sleeves (3) of the low-voltage cabinet (Fig. 43).
2. The ring circuits are connected to the appropriate terminal strips in the low-voltage cabinet in acc. with the wiring diagram.
3. Fasten the ring circuits using appropriate cable supports.

![Fig. 43](Image)

Ring circuit between panels
1. Ring circuits
2. Terminal strips
3. Rubber sleeves
4. Cable support

7.3 Placing external control cables

Customized low-voltage cables are always placed on the right side of a panel from the cable basement to the low-voltage cabinet (see Fig. 44) as standard.

Center panels

1. Place external cables from the cable basement in the right-hand cable duct of the panel to the low-voltage cabinet. Fasten cables to the panel using cable clamps (Fig. 44, item 5).
   If the floor opening for external control cables acc. to Fig. 11, page 19, is missing, the cable duct within the panel is accessible through a detachable sheet metal opening (Fig. 44, item 4).
2. Connect external cables to the terminal strip in the low-voltage cabinet according to the circuit diagram. Additionally, ground shielded lines on the cable supports.
3. Re-fasten metallic cable duct covers in the supporting structure.
End panel

In the end panels, the following complementary options are possible for each lateral attachment (see Chapter 6). Attachment is identical for the right-hand and left-hand sides:

- Lateral placing of cables on the panel, fastened by means of cable clamps and, if necessary, cementing clips (Fig. 44, item 2). Access to the low-voltage cabinet via the ring line openings (left-hand side) or via the instrument niche (right-hand side)

- Placing the cables in the cable duct of the side wall (Fig. 45). Access to the low-voltage cabinet via the ring line openings.

Fig. 44
Placing external control cables
1 Switchgear room wall
2 Additional placing of cables in an end panel (left-hand side shown)
3 Cable duct for external control cables
4 Cutout with predetermined breaking point as additional access facility
5 Flap with access to cable duct
6 Connection of external cables in low-voltage cabinet

Fig. 45
Placing external control cables in the cable duct of the side wall (left-hand side shown)
1 Cable duct in side wall
2 External control cables
8.1 Description of the panel connections

The switchgear has been designed as standard with outer cone-type appliance couplers for mains outgoing feeder cable and transformer feeder:

- Appliance coupler in acc. with EN 50181, terminal type C
  - $I_r = 630 \text{ A (screwed contact with internal thread M16)}$
  - $I_r = 1250 \text{ A (screwed contact with internal thread M16 and reinforced conductor pin)}$

Optional for transformer outgoing feeder:

- Appliance coupler in acc. with EN 50181, terminal type A
  - $I_r = 250 \text{ A (plug-in contact 7.9 mm)}$

Practically all the commercially available cable connection systems (fully insulated, metal-enclosed or partially insulated) can be connected to the medium-voltage switchgear. In case of doubt, please clarify the intended cable connection system in advance with the manufacturer.

Tools and accessories (cable clips, screws etc.) for the assembly of the cable connection systems (cable connectors and T connectors) are not included in the scope of supplies.

Notice:
The Assembly Instructions of the manufacturers for cables and cable connectors must be complied with precisely.

Danger!
Close vacant outer cone-type appliance couplers with surge-proof caps. Surge-proof caps are not included in the scope of supplies.

8.2 Dimensional diagrams for the cable connection compartment

Fig. 46
Cable connection compartment with one (left-hand) or two (right-hand) outer cone-type bushings per phase

1 Toroidal-core current transformer
2 One outer cone-type bushing / phase
3 Two outer cone-type bushings / phase
4 Cable supports, adjustable
High-voltage connection

Switch disconnector / transformer outgoing feeder
Ir = 630 / 250 A without current transformer

Feeder panel, Ir = 630 A and current transformer

Feeder panel, Ir = 630 A or 1250 A and current transformer

Feeder panel, Ir = 1250 A and current transformer; 2 outer cone-type bushings per phase
### 8.3 Cable connection compartment with base plates (optional)

The cable connection compartment of a panel can be designed at the factory with mounted base plates. Thus, the cable connection compartment is segregated from the cable basement.

1. For assembly of the high-voltage cables, remove the front base plates and the plastic sleeves.
2. Cut the plastic sleeves to fit the cable diameter and slip them over the cable before mounting the cable connectors.
3. After mounting the cables, position plastic sleeves, then reinsert and screw-fasten the removed base plate.

---

**Fig. 47**
Assembly of the base plates (1 cable per phase)
1. Rubber sleeve
2. High-voltage cable
3. Base plate, part 1
4. Base plate, part 2
5. Fixing bracket

---

**Fig. 48**
Base plates with 2 cables per phase, consisting of 3 parts.
1. Base plate, part 1
2. Base plate, part 2
3. Base plate, part 3
8.4 Mounting high-voltage cable connectors

<table>
<thead>
<tr>
<th>Danger!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of fatalities due to high voltage!</td>
</tr>
<tr>
<td>The transport protection caps provided by the factory on the high-voltage terminals are not voltage-proof.</td>
</tr>
<tr>
<td>► Before commissioning, replace the transport protection caps by voltage-proof covers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Warning!</th>
</tr>
</thead>
<tbody>
<tr>
<td>The cable support must be adjusted and the cable must be fastened so that no additional forces act on the outer cone-type appliance coupler! The bushings may be damaged due to inadmissible stress, so that insulating gas may escape.</td>
</tr>
</tbody>
</table>

1. Mount cable connector onto the high-voltage cable as specified by the manufacturer.
2. Remove transport protection covers of the outer cone-type appliance couplers.
3. Connect cable connector to the panel.
  1. Expose metallic surface of the Cu insert on the outer cone-type appliance coupler and coat it with a thin film of lubricant KL (see Annex). Clean insulating surfaces on T connector and appliance coupler carefully while applying special paste (see Manufacturer’s specifications).
  2. Position cable connector and align it in parallel.
  3. Screw-type contact:
     - Screw-fasten contact (thread M16) applying a tightening torque of max. 50 Nm. Position and screw-fasten terminating elements according to the manufacturer’s specifications.

![Fig. 49](image)
Cable connector for terminal type C in acc. with EN 50181 (screw-type contact)
1 Retaining plate
2 Do not release screw fastening
3 20-30 mm thread reach

![Fig. 50](image)
Cable connector for terminal type A in acc. with EN 50181 (plug-in contact)
1 Fastening links Ø 4.5 mm
2 Retaining plate
4. Put the adjustable cable supports into the required position (horizontally and vertically adjustable) and fasten them. Fasten the cables to the cable supports using the cable clips. For 3-phase cable terminals (Fig. 52), the cable supports can be turned around with the lateral carriers, and mounted downwards. Thus, the space available for the cable end box is increased.

5. Coat contact surfaces of the earth cables (connector housing and Cu shield) (see Annex). Screw-fasten earth lines to the cable supports. If surge arresters are provided, the switchgear can be equipped additionally (option) with retaining plates to which the fasteners for surge arresters can be mounted.

- For assembly, refer to the instructions of the manufacturer of the surge arresters!
- The contact areas of the earth connections must be coated as described in the Annex.

---

**Fig. 51**
Cable connection for single-conductor cable
1 Earthing conductors
2 Cable clip
3 Cable supports, adjustable

**Fig. 52**
Cable connection for three-conductor cable
1 Earthing conductors
2 Cable clip
3 Cable supports, adjustable
9.1 Variants and technical details

Fig. 53
Air-insulated metering panel M1
1 Voltage transformer
2 Ball pin
3 Current transformer
4 Cable links to the adjacent panels
5 Cable compartment cover
6 Operating cover

Fig. 54
Air-insulated metering panel M3
1 Coupling tank
2 Gas-tight bushing
3 Current transformer
4 Ball pin
5 Voltage transformer
6 Cable link to adjacent panel
7 Earth bus
8 Cable compartment cover
9 Operating cover
10 Upper front cover
11 Low-voltage cabinet
## Air-insulated metering panels

### Technical data:
- **Panel width:** 1000 mm
- **Rated voltage:** $U_r \leq 24$ kV
- **Rated current:** $I_r = 630$ A
- **Rated short-time current:**
  - $I_k \leq 21$ kA (3s) for type M1
  - $I_k \leq 25$ kA (3s) for type M2/M3

The current and voltage transformers must be defined in acc. with DIN 42600 Part 8 and 9, narrow design.

### Dimensions:

#### Fig. 55
Dimensions, metering panel type M1

![Fig. 55 Dimensions, metering panel type M1](image)

#### Fig. 56
Dimensions, metering panel types M2 and M3

![Fig. 56 Dimensions, metering panel types M2 and M3](image)
9.2 Assembly procedure for metering panel type M1

Notice:
The assembly instructions of the manufacturer of the pre-assembled cable connections must be complied with precisely.

1. A guard plate must be mounted to the rear of the metering panel for room heights below 2400 mm (comply with switchgear-specific documentation). Assembly drawing: AGS C92906-01.

2. Between the metering panel M1 and the left-hand and right-hand adjacent panel, a switchgear side wall (see page 39) is attached to each adjacent panel.

3. Place and align the metering panel on the base frame according to the switchgear-specific space assignment plan.

4. Remove cable compartment cover. For access to the inside of the metering panel, remove the sheet metal fairing behind the cable compartment cover.

5. Screw-fasten the metering panel to the base frame (see page 27) and connect it to the earthing system of the switchgear building. (Connecting lines are not included in the scope of supplies).

6. Mount the pre-assembled cable connections to the adjacent panels. Before mounting the cable, remove the (optional) base plates from the metering panel, and remount them afterwards.

7. Mount the upper front cover acc. to the assembly drawing AGS C91992-01.
9.3 Assembly procedure for panel types M2 and M3

**Warning!**
*During and after assembly of the conductor bars, the bushings must not be subjected to additional forces. The bushings may be damaged due to inadmissible stress, so that insulating gas may escape.*

**Notice:**
The assembly instructions of the manufacturer of the pre-assembled cable connections must be complied with precisely.

<table>
<thead>
<tr>
<th>Assembly drawing</th>
<th>Screw connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGS C92691-01</td>
<td>front for M2 and M3</td>
</tr>
<tr>
<td>AGS C92340-01</td>
<td>rear for M2</td>
</tr>
<tr>
<td>AGS C92320-01</td>
<td>rear for M3</td>
</tr>
</tbody>
</table>

1. Place and align the metering panel on the base frame according to the switchgear-specific space assignment plan.
2. Remove cable compartment cover. For access to the inside of the metering panel, remove the sheet metal fairing behind the cable compartment cover.
3. Screw-fasten metering panel to the adjacent panels.
4. Screw-fasten the metering panel to the base frame (see page 27) and connect the earth bus (see page 35).
5. Assembly of coupling tank:
   - Attachment of coupling tank to the adjacent panel in question: Assembly drawing AGS C92096-01 (M2 and M3)
   - Installation of the busbars: Assembly drawing AGS C92325-01 (for M2) or AGS C91868-01 (for M3)
6. Screw-fasten the conductor bars in the air-insulated metering panel to the bushings of the coupling tank.
7. Mount the pre-assembled cable connections to the adjacent panels. Before mounting the cable, remove the (optional) base plates from the metering panel, and remount them afterwards.
8. Attach the low-voltage cabinet to the left top side of the panel and place the control cables and ring circuits in acc. with Chapter 7. Mount the upper front cover acc. to the assembly drawing AGS C92319-01.
9. Attach an additional panel rear wall if the panel is accessible from the rear (see also page 43).

<table>
<thead>
<tr>
<th>Assembly drawing</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGS C92409-01</td>
<td>Standard</td>
</tr>
<tr>
<td>AGS C92443-01</td>
<td>with increased corrosion protection</td>
</tr>
</tbody>
</table>
9 Air-insulated metering panels

Fig. 57
Busbar link of metering panels M2 and M3 (shown M3)

Fig. 58
Fastening of metering panels M2 and M3 (shown M3)
1 Panel screw fastening
2 Floor fastening points
Special modules

10.1 Busbar voltage transformer with disconnecting device

Coupling tanks with integrated voltage transformer attachment to the busbar are optionally available with a disconnecting device.
In case of single panels with a width of 450 mm, attachment is only possible within certain limits subject to consultation with the manufacturer.

Assembly:

1. Assembly of the coupling tanks and the busbars is effected according to Chapter 4.
2. Moreover, the assembly drawing no. AGS C92592-01 must be complied with for adjustment and actuation of the disconnecting device.
3. Assembly of the busbar voltage transformer, see page 36.

![Diagram of Voltage Transformer on Busbar](image-url)

Fig. 59 
Voltage transformer on busbar
1 Voltage transformer
2 Coupling tank with integrated disconnecting device
3 Actuation of the disconnecting device
10 Special modules

10.2 Current transformers on the busbar

To this effect, toroidal-core current transformers mounted via a solid-insulated conductor bar system can be used.

The conductor bar system is connected to the busbar on the left and right sides via connection tanks in the adjacent panels.

The standard connection tanks are equipped with standardized outer cone-type appliance couplers in acc. with EN 50181, terminal type C, screw-type contact with internal thread M16 and reinforced conductor pin for 1250 A rated current.

Panels with current transformer on the busbar have a panel width of 600 mm.

A completely closed and uniform panel front is possible thanks to a dummy panel (without insulating gas tank). This permits at the same time inter-panel earth and low-voltage cables to be routed.

**Warning!**
The outer cone-type appliance couplers must be cleaned by means of a cleaning agent before assembly of the conductor bar connectors, so as to remove grease and silicone (see Annex).

**Warning!**
During and after assembly of the conductor bar system, the outer cone-type bushing must not be subjected to additional forces. The bushings may be damaged due to inadmissible stress, so that insulating gas may escape.

**Notice:**
Comply precisely with the assembly instructions of the manufacturer of the conductor bar connection.

**Assembly**

1. Line up dummy panel. The mounting process corresponds to that of a standard panel, however without busbar link.
2. Attachment of busbar end tank to the left-hand and right-hand adjacent panel. Assembly drawing AGS C91196-01.
3. Assembly of support for current transformers. Assembly drawing AGS C91595-01.
   Adjust support vertically and screw-fasten current transformer.
4. Push fully insulated connection bars through the current transformers and assembly conductor bar system completely.
5. Coat the contact surfaces of the earth connection as described in the Annex, and screw-fasten them to the retaining plate.
Fig. 60
1  Dummy panel without insulating gas tank
2  Fully insulated conductor bar connection
3  Current transformer
4  Busbar connection tank
5  Support for the current transformers
10.3 Cable connection on busbar

A cable connection tank for direct cable connection to the busbar can be mounted to the left-hand and/or right-hand busbar end.

The standard connection tank is equipped with standardized outer cone-type appliance couplers in acc. with EN 50181, terminal type C, screw-type contact with internal thread M16 and reinforced conductor pin for 1250 A rated current.

The cable entry may be effected from the bottom and top alike. In case of top cable entry, the cable support is mounted above the connection tank.

The contact-proof cover features a panel width of 450 mm and a panel depth of 800 mm. Thus, attachment of the panel side (see page 39) is foregone.

Assembly

1. Assembly of the connection tank. Assembly drawing AGS C92699-01.
2. Attachment of the cable supports and the panel rack. Assembly drawing AGS C92809-01.
3. For assembly of cables and cable connectors, the same specifications as per Chapter 8 High-voltage connection must be complied with.

Fig. 61
Cable at busbar
1 Cable connection tank, outer cone-type appliance coupler
2 Cable support
3 High-voltage cable with connector
4 Panel rack
10.4 Bus section coupler / metering panel with solid-insulated connection bars

This panel combination can be used both as busbar section coupler and as metering panel. Functionally, the combination consists of 2 single panels which are equipped with appropriately customized switching devices. The standard lower high-voltage connections are equipped with standardized outer cone-type appliance couplers in acc. with EN 50181, terminal type C, screw-type contact with internal thread M16 and reinforced conductor pin for 1250 A rated current.

The single panels are interconnected via a solid-insulated conductor bar system. Each of the conductor bars is connected in the type-tested cable connection compartment; thus, after installation of the cable compartment covers, they are contact-proof and arc-proof.

Design data:
- Rated voltage: ≤ 24 kV
- Rated current: ≤ 1250 A,
- Panel width: 2 x 600mm = 1200 mm.

The multi-functional use as metering panel is achieved via easily accessible transformer attachments.
- Toroidal-core current transformers located outside, in one or two single panels
- Flanged voltage transformers with disconnecting device in the right-hand panel

**Warning!**
The outer cone-type appliance couplers must be cleaned by means of a cleaning agent before assembly of the conductor bar connectors, so as to remove grease and silicone (see Annex).

**Warning!**
During and after assembly of the conductor bar system, the outer cone-type bushing must not be subjected to additional forces. The bushings may be damaged due to inadmissible stress, so that insulating gas may escape.

**Notice:**
Comply precisely with the assembly instructions of the manufacturer of the conductor bar connection.
1. Install and align the single panels. Adjust the spacing for the conductor bar connection according to Fig. 62.

2. Subsequently, screw-fasten the panels to each other and mount the coupling tanks with the busbar links to the adjacent panels (see Chapter 4.7).

3. Additional rear panel coupling required:
   - Assembly drawing AGS C93003-01

4. Assembly of the conductor bar connection.

5. Coat the contact surfaces of the earth connection as described in the Annex, and screw-fasten them to the retaining plate.

---

**Fig. 62**
Solid-insulated connection bars

---

**Fig. 63**
Rear panel screw connection of bus section coupler

1. Screw-fasten connecting link
10.5 Panels with high-voltage connection on the rear

Panels can be supplied optionally with high-voltage connection on the rear.

**Design**

Voltage transformers (1) in the outgoing feeder cable can be installed as required; they are located in the front part, in the empty cable connection compartment, behind the cable compartment cover. The disconnecting device is actuated, as usual, from the front (see Operating Manual).

The panel features additionally another earth bar (4) on the back which is connected to the adjacent panels during assembly and must be connected to the building earth. The earth bar is used to connect the earth screens of the high-voltage cables.

**High-voltage connection:**

The outer cone-type appliance couplers (3) are designed in accordance with EN 50181, terminal type C. For further information, please refer to Chapter 8 High-voltage connection.

The detailed designs and versions for the high-voltage connection on the rear must be coordinated with the manufacturer.

---

**Warning!**

No cable supports are mounted at the manufacturer’s works. The cable must be fastened so that no additional forces act on the outer cone-type appliance coupler! The bushings may be damaged due to inadmissible stress, so that insulating gas may escape.

---

![Fig. 64 Panels with high-voltage connection on the rear](image)

1. Voltage transformer (optional)
2. Current transformer
3. Outer cone-type bushing
4. Additional earth cable
11.1 Requirements regarding the switchgear room

In analogy to Chapter 4.2.

Fig. 65
Location of the panels in the switchgear room

Fig. 66
Floor opening and base frames of double busbar switchgear
1 Switchgear panel floor area
2 Steel base frame 40 x 40 x 4
3 Panel fastening points
4 Opening for secondary lines
5 Side wall
6 Opening for primary cable outgoing feeders
7 Area for cross-bracing
8 Operator side of switchgear
11 Double busbar

11.2 Installing and connecting the panels

**Notice:**
*First, the panels of busbar section 1 are assembled, then busbar section 2 follows.*

1. Installation and line-up of the panels for busbar section 1:
   - In analogy to Chapter 4.
   - Comply with space assignment plan!
2. Installation of busbar section 2:
   - Align first panel of busbar section 2 in analogy to the description of Chapter 4.
   - Comply with space assignment plan!
3. Line up panels in analogy to Chapter 4.
   - Screw-fastening the switchgear panels
   - Busbar link through coupling tank
   - Module fastening on base frame
   - Mounting of the side walls

At the same time, make sure that the main and mating panels of a double busbar panel are lined up precisely.

Comply with the specified center distance of the bus link, referred to the connection bushings: 698±2 mm.

**Conductor bar connection**

The switchgear panels have been equipped as standard with standardized outer cone-type appliance couplers in acc. with EN 50181 for the conductor bar connection.

Terminal type C (I: 630A or 1250 A; screw-type contact with internal thread M16).

**Warning!**
The outer cone-type appliance couplers must be cleaned by means of a cleaning agent before assembly of the conductor bar connectors, so as to remove grease and silicone (see Annex).

On assembling or after having assembled the conductor bar connection, make sure that the outer cone-type bushings are not exposed to any additional mechanical strain. Mount the conductor bar connection as specified by the manufacturer.

**Warning!**
The instructions for assembly of the manufacturer of the conductor bar connection (including the tightening torques) must be complied with precisely.

Coat the contact surfaces of the earth connection as described in the Annex, and screw-fasten them to the retaining plate (screw connection M8).
11.3 Connecting duct for low-voltage cabinets

Assembly drawing: AGSC91338-01
To connect panel-related secondary lines.
1. The narrow connecting duct is screw-fastened to the low-voltage cabinet (screw connection M8).
2. Perform wiring according to the circuit diagram.
3. Mount the connecting duct cover (screw connection M6).
11.4 Mounting the side partition

Assembly drawing: AGSC91334-01

- Assemble the walls according to page 39, unless this has already been done.
- Mount the two fixing brackets (2) on the opposite side walls (5). Each with 5x self-locking bolt (3) and setting nut M8 (4).
- Secure the side partition (1) to the fixing brackets. 10x self-locking bolt M8 (3)

Fig. 68
Attachment of the side partition
1 Side partition
2 Fixing bracket
3 Self-locking bolt M8
4 Setting nut M8
5 Side wall
12 Final steps / commissioning

12.1 Final steps

12.1.1 Attachment of the tool board

1. Fasten tool board at choice on left or right side of the side wall depending on switchgear installation (see also Fig. 69).
   2x screw fastening M8.

2. Provide tool board with control elements and instruction manuals according to Fig. 69.

12.1.2 Clean and check assembly

- Clean the switchgear, removing contamination resulting from assembly work.
- Remove all the attached information tags, cards, brochures and instructions no longer needed.
- Check the tightening torques of all screw fastenings and connections established on the site of installation:
  - cable fitting on the appliance couplers
  - surge-proof caps on appliance couplers
  - earth bus
  - panel screw fastenings
  - special attachments
12 Final steps / commissioning

12.1.3 Remount covers (see Chapter 4.4)
- Lateral low-voltage cable duct cover
- Cable compartment cover
- Operating cover

12.1.4 Damage to the paint
The components are powder-coated. Minor damage to the paint can be repaired using commercially available paint (standard colour RAL 7044 or corresponding colour).

12.1.5 Inspection
- Check the switchgear for damage which might be due to transport or assembly work.
- Compare data on nameplate with the required ratings.
- Check isolating gas monitoring.
- Check rated supply voltage of control and operating devices.
- Check wiring laid on site.

12.2 Commissioning

Danger!
The high-voltage supply must not be connected. All active parts must be earthed.

Notice:
- Refer to the operating manual of the GMA series.
- While the supply voltage is not available, blocking coils (locking the interrogation slides and circuit-breaker push-buttons, depending on design) are in "locked" position.
- An undervoltage release (optional) has dropped out. In this case, first perform items 3 to 5.
- The energy-storing device of the circuit-breaker drive is charged autonomously as soon as the supply voltage is applied.

1. Perform manual switching trials on the individual switching devices.
2. Check switch position indicators.
3. Apply supply voltage.
4. Check electrical functions of control and operating devices.
   - Motor drives for disconnector and earthing switches (optional)
   - Closing and opening releases for circuit-breaker
5. Check switch position indicators and interlocks.
6. Insert H.V.H.R.C. fuses into panels with switch fuse combination (see Operating Manual, Chapter 7)
7. Before connecting to power supply, check the connected supply cables for phase coincidence (see Operating Manual, Chapter 5).
13 Optional high-voltage test on commissioning

13.1 Power frequency test of busbar

A power frequency test of the busbar can be performed optionally, depending on the order specification. To this effect, a test unit and a test cable are required (not included in scope of supplies).

**Warning!**
Comply with the safety provisions on page 7.

**Danger!**
No high-voltage cables must be connected in the incoming feeder panel for the voltage test and on the busbar. All high-voltage terminals must be closed surge-proof during the test phase. Earth the residual phases using commercially available earthing devices.

**Notice:**
All the switching operations mentioned in this context must be performed in accordance with the applicable Operating Manual GMA.

1. All panels must be isolated from the power supply and earthed.
2. Incoming feeder panel:
   - Remove the cable compartment cover
   - Earth the voltage transformers and capacitive measuring points.
   - Mount test cable to the outer cone-type appliance coupler. Earth the residual phases using commercially available earthing devices. Close open high-voltage terminals in a surge-proof fashion.
3. Busbar:
   - Disassemble and, if possible, earth voltage transformer / surge arrester. Close open high-voltage terminals on coupling tank in a surge-proof fashion.
   - Earth capacitive measuring points.
4. Perform power-frequency test of the busbar with the incoming feeder panel.
   - Connect test unit to the test cable.
   - Switch OFF earthing switch (free the insertion opening by simulating the cable compartment cover; see Operating Manual, section Cable Test).
   - Switch disconnector and circuit-breaker ON
   - Perform power-frequency tests for all three phases (L1, L2, L3) according to the specifications of the test unit manufacturer. Comply with the admissible test values for the switchgear!

**Notice:**
It is essential that the admissible test values for power-frequency tests after installation of the switchgear in accordance with IEC 62271-200 are complied with.
5. Once the power-frequency test has been completed:
   – Earth all tested high-voltage cables again.
   – Remove test unit and test cables.
   – Reconnect earthed or removed voltage transformers, capacitive measuring connectors or surge arresters.
   – Mount high-voltage cable or surge-proof covers on the incoming feeder panel and reinsert cable compartment cover.

Fig. 70
Switch positions during the power-frequency test for 4 panels
1  Outgoing feeder panel
2  Incoming feeder panel
3  Voltage transformer
4  Busbar
5  Test unit, e.g. test transformer
6  Test cable

13.2 Cable test
Performing cable tests at the cable connection. During the cable test in the feeder, the busbar can remain operative.

**Warning!**
Comply with the safety provisions on page 7.

**Danger!**
In case of d.c. voltage tests, flashover may occur in case of over-voltage at the busbar. The safety provisions must be complied with!

**Notice:**
- The test unit and test adapter are not included in the scope of supplies!
- The assembly, operating and testing instructions for cable fittings and connectors and the test unit must be taken into consideration.

<table>
<thead>
<tr>
<th>$U_r$ [kV]</th>
<th>DC test voltage for initial / repeat test [kV] max. 15 min</th>
<th>0.1 Hz AC test voltage [kV] max. 60 min.</th>
<th>45-65 Hz AC test voltage [kV] max. 60 min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>34</td>
<td>19</td>
<td>12</td>
</tr>
<tr>
<td>24</td>
<td>67</td>
<td>45</td>
<td>24</td>
</tr>
</tbody>
</table>

Perform cable test for all phases.
13 Optional high-voltage test on commissioning

Preparations

1. Isolate outgoing feeder cable of the appropriate switchgear panel.
2. Isolate outgoing feeder cable in remote station.
3. Earth outgoing feeder cable.
4. Remove cable compartment cover (see page 23).
5. Disconnect and - if necessary, earth - the following devices:
   - Disconnecting device of voltage transformers
   - Pluggable surge arresters
   - Capacitive voltage measurement

Perform cable test

6. Connect the test adapter/test cable to the cable connection (Fig. 73) and test unit (comply with the manufacturer’s instructions).

**Notice:**
Make sure that the distance between the metallic components of the test adapter and the earthed supporting structure of the panel is sufficiently dimensioned.

7. Free insertion opening for earthing switch actuation by simulating a cable compartment cover (Fig. 72).

**Warning!**
Interrupting the interlocking protection: With the cable compartment cover removed, the earthing switch interlock may only be eliminated during cable test! Mount signs prohibiting switching operation to the (switch) disconnector.

8. Switch the earthing switch OFF.
9. Perform cable check observing the instructions of the cable or cable connector manufacturer.

Once the cable test has been completed:

10. Earth outgoing feeder cable again.
11. Re-connect the disconnected devices.
12. Remove the test set and connect the high-voltage cable in surge-proof condition.
13 Optional high-voltage test on commissioning

13.3 Cable jacket test

If there are no documents to inform whether a cable jacket test may be performed on the cable connection system, the manufacturer of the cable connection system must be consulted before performing such a test.

Isolate the outgoing feeder from the power supply and earth it.

1. To perform the cable jacket test, disconnect the earth connections (Cu shield) from the cable support.

2. To determine any damage on the outer plastic jacket or sheathes between the cable’s Cu shield and the earth, apply DC test voltage in accordance with the applicable standard or the instructions of the cable manufacturer.

3. Once the cable jacket test is completed, re-mount the earth connection (Cu shield) on the cable support (refer to chapter 8.4).
14 Replacement of components and panels

Drive mechanisms, current transformers, voltage transformers, testing and monitoring systems and complete switchgear panels can be replaced as required.

Should you have any queries regarding replacement of components or panels, please contact the manufacturer’s Service Center.

For correct processing of your enquiry, the following data of the nameplate of the panel in question are required (see Operating Instructions AGS 531 521-01, Chapter 2.1):

- Type designation
- Serial number
- Year of construction
15.1 Auxiliary products

The auxiliary products are available from the manufacturer. The use of alternative auxiliary products is not permissible.

**Warning!**
Risk of injury if the auxiliary products are handled improperly. Comply with the safety data sheets of the auxiliary products.

<table>
<thead>
<tr>
<th>Auxiliary products</th>
<th>Item no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning agent for insulating gas compartments</td>
<td>S 009 002</td>
</tr>
<tr>
<td>Cleaning agent, 1 l can (outside of SF₆ compartments)</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>SF₆ multi-purpose lubricant MS, 0.75 kg can</td>
<td>S 008 134</td>
</tr>
<tr>
<td>Touch-up pen RAL 7044 silk-grey, 50 ml</td>
<td>S 009 561</td>
</tr>
<tr>
<td>Touch-up pen, special paint (specify colour shade)</td>
<td>S 009 562</td>
</tr>
</tbody>
</table>

15.2 Treatment of firmly screw-connected contact surfaces

1. Contact areas must be subjected to preliminary treatment before screw-fastening (see Table below).

2. Immediately after the pre-treatment, coat the contact surfaces with a thin film of lubricant KL so that the space between the contact surfaces is completely filled once the screws have been fastened (grease sparingly).

**Notice:** Contact areas coated with lubricant KL should not be touched, if possible.

<table>
<thead>
<tr>
<th>Material of contact surfaces</th>
<th>Pre-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver-plated contact surfaces</td>
<td>Clean¹</td>
</tr>
<tr>
<td>Copper or copper alloy</td>
<td>Clean¹, expose metallic surface²</td>
</tr>
<tr>
<td>Zinc-plated steel</td>
<td>Remove passivation, not, however, the zinc layer³</td>
</tr>
<tr>
<td>Hot-galvanized sheet-metal</td>
<td>Clean¹, passivation need not be removed</td>
</tr>
</tbody>
</table>

¹ Clean by means of lint-free cloth; use cleaning agent in case of serious contamination (see above)

² Expose metallic surface
   – by treating the entire surface with emery cloth or a rotating grinding tool (grain size 100 or 80) or
   – using a wire brush which is clearly marked for use exclusively for aluminium or exclusively for copper

³ using a brass brush, steel brush
15.3 Screw fastenings

The following elements must be used for all screw fastenings:

- Screws and bolts: Grade $\geq 8.8$
- Nuts: Grade 8

The tightening torques apply to all screw fastenings, unless specified expressly in the drawing.

**Notice:**

*Screw connections must not be greased.*

All screw connections with lock ring and washer, except screw connection with self-locking elements and spring washers.

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>max.</td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>3.8</td>
<td>4.7</td>
<td>Nut (except self-locking nuts)</td>
</tr>
<tr>
<td>M6</td>
<td>7</td>
<td>9</td>
<td>M8</td>
</tr>
<tr>
<td>M8</td>
<td>16</td>
<td>24</td>
<td>M8</td>
</tr>
<tr>
<td>M10</td>
<td>36</td>
<td>44</td>
<td>M10</td>
</tr>
<tr>
<td>M12</td>
<td>63</td>
<td>77</td>
<td>M12</td>
</tr>
</tbody>
</table>

Table 1:

Hex. bolts and socket-head cap screws and nuts (except self-locking bolts and nuts)

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>max.</td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>12.5</td>
<td>15.5</td>
<td>M6</td>
</tr>
<tr>
<td>M8</td>
<td>32</td>
<td>40</td>
<td>M8</td>
</tr>
<tr>
<td>M10</td>
<td>65</td>
<td>79</td>
<td>M10</td>
</tr>
<tr>
<td>M12</td>
<td>90</td>
<td>110</td>
<td>M12</td>
</tr>
</tbody>
</table>

Table 3:

Self-locking bolts and nuts

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
<th>Thread size</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>max.</td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>7</td>
<td>9</td>
<td>M6</td>
</tr>
<tr>
<td>M8</td>
<td>16</td>
<td>24</td>
<td>M8</td>
</tr>
<tr>
<td>M10</td>
<td>36</td>
<td>44</td>
<td>M10</td>
</tr>
<tr>
<td>M12</td>
<td>63</td>
<td>77</td>
<td>M12</td>
</tr>
</tbody>
</table>

Table 4:

Screw fastening for current transmission, conductor material: copper
15.4 Overview of assembly drawings

List of all assembly drawings specified in this manual. This does not apply to special modules or customer-specific special designs.

According to the switchgear configuration in question, only such drawings from the list are supplied by the factory as are actually required.

<table>
<thead>
<tr>
<th>Attachment</th>
<th>Page</th>
<th>Assembly drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw-fastening switchgear panels</td>
<td>25</td>
<td>AGS C92691-01</td>
</tr>
<tr>
<td>Screw-fastening switchgear panels, bus section coupler</td>
<td>26</td>
<td>AGS C93003-01</td>
</tr>
<tr>
<td>Attachment, standard coupling tank</td>
<td>28</td>
<td>AGS C27813-01</td>
</tr>
<tr>
<td>Attachment, special coupling tank</td>
<td>29</td>
<td>AGS C27649-01, AGS C92694-01, AGS C92592-01</td>
</tr>
<tr>
<td>Attachment, busbar</td>
<td>30</td>
<td>AGS C27653-01, AGS C27654-01, AGS C27851-01, AGS C27652-01, AGS C53798-01, AGS C53797-01</td>
</tr>
<tr>
<td>Attachment, earth bus</td>
<td>35</td>
<td>AGS C90730-01, AGS C90731-01</td>
</tr>
<tr>
<td>Attachment, switchgear wall</td>
<td>39</td>
<td>AGS C92254-01, AGS C92255-01, AGS C92258-01, AGS C92259-01</td>
</tr>
<tr>
<td>Attachment, rear gap cover</td>
<td>40</td>
<td>AGS C92288-01, AGS C91624-01</td>
</tr>
<tr>
<td>Attachment, lateral gap cover</td>
<td>41</td>
<td>AGS C92292-01, AGS C92293-01, AGS C92450-01, AGS C92451-01</td>
</tr>
<tr>
<td>Attachment</td>
<td>Page</td>
<td>Assembly drawing</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Attachment, rear wall in case of free-standing installation (IAC AFLR)</td>
<td>43</td>
<td>AGS C91810-01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AGS C91812-01</td>
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<tr>
<td></td>
<td></td>
<td>AGS C91814-01</td>
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<td></td>
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<td></td>
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<td></td>
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<td>AGS C91584-01</td>
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<td></td>
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<td>AGS C91579-01</td>
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<td></td>
<td></td>
<td>AGS C91580-01</td>
</tr>
<tr>
<td>Attachment, low-voltage cabinet</td>
<td>45</td>
<td>AGS C90691-01</td>
</tr>
<tr>
<td>Assembly, guard plate, rear plate of metering panel M1</td>
<td>55</td>
<td>AGS C92906-01</td>
</tr>
<tr>
<td>Assembly, front cover, metering panel M1</td>
<td>55</td>
<td>AGS C91992-01</td>
</tr>
<tr>
<td>Assembly, metering panels M2 and M3</td>
<td>56</td>
<td>AGS C92691-01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AGS C92340-01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AGS C92320-01</td>
</tr>
<tr>
<td>Screw connection, metering panels M2 and M3</td>
<td>56</td>
<td>AGS C92409-01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AGS C92443-01</td>
</tr>
<tr>
<td>Attachment, coupling tank, metering panels M2 and M3</td>
<td>56</td>
<td>AGS C92096-01</td>
</tr>
<tr>
<td>Attachment, busbar metering panel M2</td>
<td>56</td>
<td>AGS C92325-01</td>
</tr>
<tr>
<td>Attachment, busbar metering panel M3</td>
<td>56</td>
<td>AGS C91868-01</td>
</tr>
<tr>
<td>Attachment, low-voltage cabinet, metering panels M2 and M3</td>
<td>56</td>
<td>AGS C92319-01</td>
</tr>
<tr>
<td>Voltage transformer on coupling tank, adjustment</td>
<td>58</td>
<td>AGS C92592-01</td>
</tr>
<tr>
<td>Attachment, busbar end tank for BB current transformer</td>
<td>59</td>
<td>AGS C91196-01</td>
</tr>
<tr>
<td>Attachment, support for BB current transformer</td>
<td>59</td>
<td>AGS C91595-01</td>
</tr>
<tr>
<td>Attachment, busbar end tank for cable on BB</td>
<td>61</td>
<td>AGS C92699-01</td>
</tr>
<tr>
<td>Attachment, support for cable on BB</td>
<td>61</td>
<td>AGS C92809-01</td>
</tr>
<tr>
<td>Panel screw connection, bus section coupler with solid-insulated conductor bar</td>
<td>63</td>
<td>AGS C93003-01</td>
</tr>
<tr>
<td>Connecting duct for low-voltage cabinets</td>
<td>67</td>
<td>AGS C91338-01</td>
</tr>
<tr>
<td>Mounting the side partition</td>
<td>68</td>
<td>AGS C91334-01</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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