

ZX0.2

Gas-insulated medium voltage switchgear



Your safety first - always!

That's why our instruction manual begins with these recommendations:

- Operate the switchgear as prescribed for its intended purpose.
- Ensure that the technical data on the name plate and in the specification are not exceeded during operation of the switchgear.
- Only install the switchgear in enclosed rooms suitable for electrical equipment.
- With the aim of a smooth installation sequence and ensuring a high quality standard, have installation at site performed by specially trained personnel or managed and supervised by the ABB Service Department.
- Ensure that installation, operation and maintenance are only performed by specialist electricians familiar with this manual.
- Comply in full with the legally recognized standards (IEC / DIN VDE), the connection conditions of the local electrical utility and the applicable safety at work regulations.
- Follow the instructions in the documentation when performing any work on switching devices and switchgear.
- Keep all documentation accessible to all persons concerned with installation, operation and maintenance.
- The user's personnel bear unlimited responsibility in all matters affecting safety at work and the correct handling of the switchgear in accordance with EN 50110 and national regulations.
- Always observe the five safety rules set out in EN 50110 on establishing and securing the off-circuit condition at the place of work for the duration of work on the switchgear. Gas-insulated switchgear are notable for maximum safety, as the circuit-breaker performs the earthing switch function in conjunction with the three position disconnecter. The sequence of safety rules therefore deviates from that proposed in the standard as follows:

Isolate,

Check the off-circuit condition,

Earth and short-circuit,

Secure to prevent reconnection,

Cover or guard off adjacent live parts.

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

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The relevant standards for switchgear over 1 kV and their switching devices		
	IEC	
Switchgear	62271-1	Common specifications for high-voltage switchgear and controlgear standards
Switchgear	62271-200	High-voltage switchgear and controlgear, Part 200: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
Circuit-breaker	62271-100	High-voltage switchgear and controlgear Part 100: High voltage alternating current circuit-breakers
Disconnecter and earthing switch	62271-102	High-voltage switchgear and controlgear Part 102: Alternating current disconnectors and earthing switches
Switch disconnector – fuse combination	62271-105	High-voltage switchgear and controlgear Part 105: Alternating current switch-fuse combinations
HRC - fuses	60282	High-voltage fuses - Part 1: Current-limiting fuses

Take particular account of the relevant standards listed below. Observe the national technical specifications and the accident prevention regulations of the country in which the switchgear is operated.

IEC 60364	Low-voltage electrical installations
IEC 61936	Power installations exceeding 1 kV a.c.
DIN EN 50110	Operation of electrical installations

National technical accident prevention regulations e.g. for electrical systems and equipment and SF₆ installations

Fundamental notes on this manual:

Read the relevant sections of this manual through in full before performing work, so as to ensure correct handling.

Paragraphs in this manual are marked in accordance with their significance. The markings mean the following:



Hazard warning, meaning in this manual that death or serious injury and considerable damage may occur if the actions described are not performed.



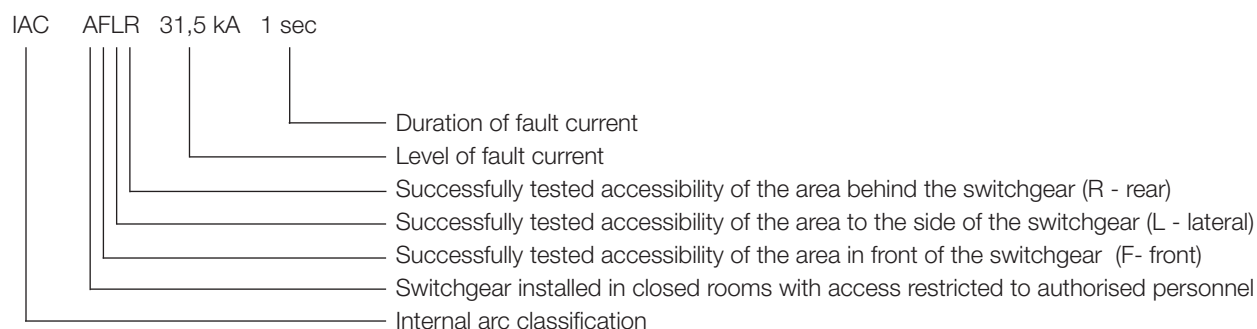
Important note, meaning in this manual that injury and damage may occur if the actions described are not performed.



Attention is drawn to further documents.

Note on safety

The internal arc classification to IEC 62271-200 confirms a tested degree of operator protection. The information on accessibility of the switchgear as required by IEC 62271-200 can be found on the type plates of the panels. The coding is as follows (exemplary):



The operator of the switchgear must prevent access by personnel to non-arc classified areas, for instance by issuing instructions.



Within the ratings stated on the type plate, the switchgear is safe for operating personnel in accordance with IEC 62271-200 when all system components are completely and properly installed.



Commissioning, servicing and extension work require special attention with regard to safety (see also IEC 62271-200).





Operator safety in accordance with IEC 62271-200 assumes that the conditions stipulated by us are complied with (see also Technical Catalogue TK 603).

The IAC qualification relies on a system consisting of at least three panels.

You have chosen a gas-insulated switchgear of series ZX0.2. This switchgear from the ZX range is notable for the following features:

- SF₆ gas-insulated with hermetically sealed pressure systems
- Solid insulated busbar
- Rated voltages up to 36 kV
- Up to 1250 A and 31.5 kA
- Single busbar design
- Stainless steel encapsulations, manufactured from laser cut sheet steel
- Modular structure
- Switchgear with a leakage rate of less than 0.1 % per year
- Integrated routine leakage testing of the panels ex-works
- Indoor installation
- Wall mounting installation and free-standing installation
- Operator controls separate from low voltage compartment
- Operator controls on the panel accessible from the outside

Please observe further documents in addition to this manual. The documents relevant to your switchgear are part of the final documentation.

	Installation checklist	MC 603
	Order documents	
	<ul style="list-style-type: none">- Single line diagram- Front view- Construction data if compiled specifically for this order- Circuit diagrams- Earthing diagram – switchgear earth to station earth (not part of ABB supply)	
	Instruction manuals	
	<ul style="list-style-type: none">- Use of SF₆ insulating gas- Circuit-breaker VD4X and VD4X PT for ZX0.2- Material supplement	HB 605 HB 611 BA 509
	Operating instructions and directions for components, e.g.	
	<ul style="list-style-type: none">- Surge arresters- Current and voltage transformers- Protection and control devices- Capacitive indicators- Solid insulated busbar.	



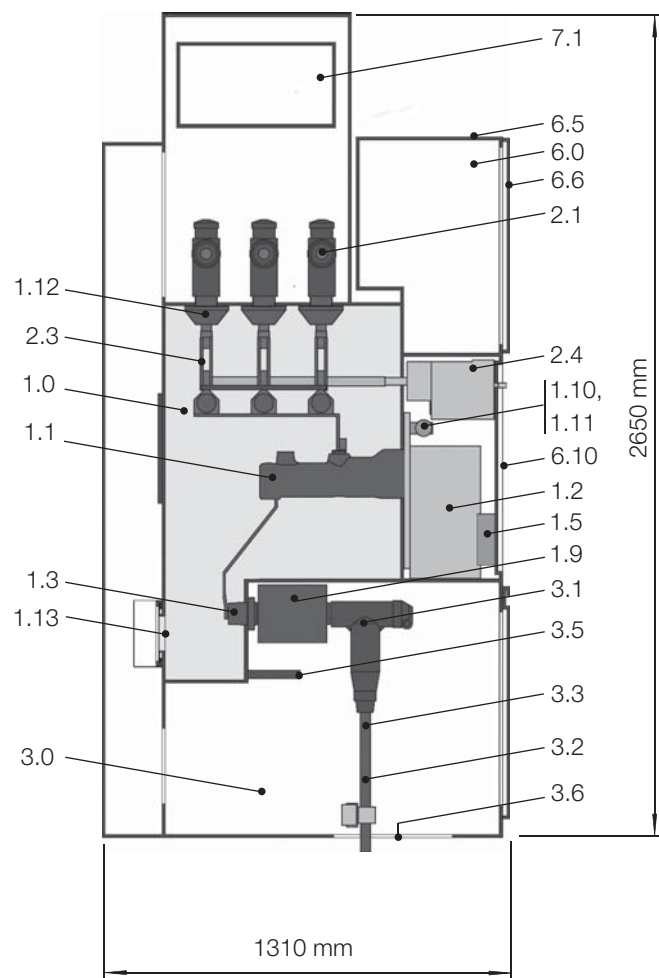
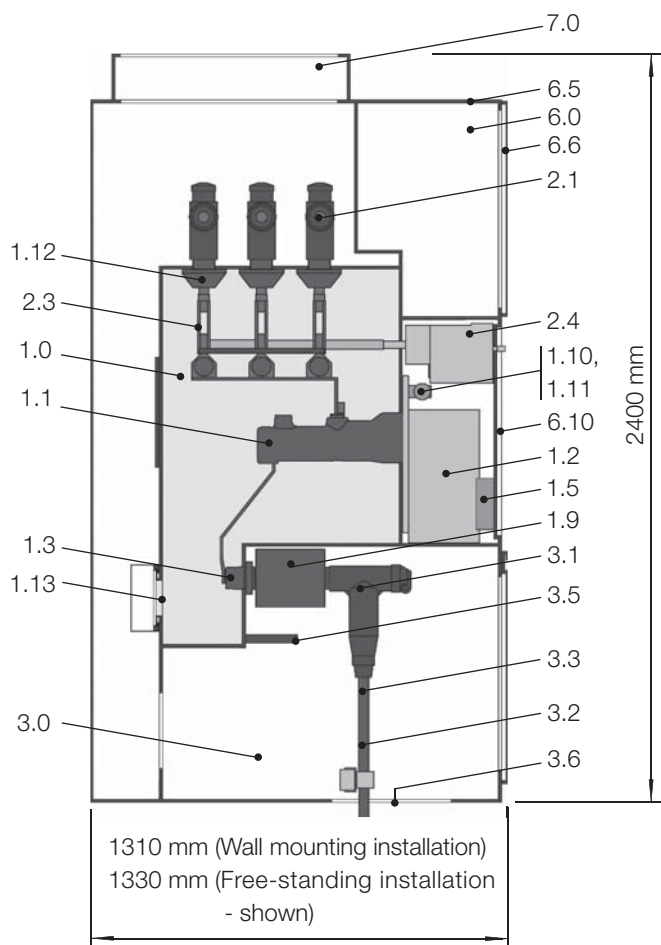
Use only chlorine-free cleansers for cleaning of the switchgear.

If you have technical questions, please contact our service staff

Power technology customer service

Call number +49 180 6222-007

Fig. 1: Circuit-breaker panel, 1250 A, panel width 600 mm, example configuration



- 1.0 Panel module
- 1.1 Circuit-breaker pole
- 1.2 Circuit-breaker operating mechanism
- 1.3 Outer cone
- 1.5 Sockets for capacitive voltage indicator system
- 1.9 Current transformer
- 1.10 Gas density sensor
- 1.11 Gas filling valve
- 1.12 Cast resin bushing to busbar
- 1.13 Pressure relief disk
- 2.1 Busbar
- 2.3 Three position disconnecter
- 2.4 Operating mechanism for three position disconnecter

- 3.0 Cable termination compartment
- 3.1 Cable connector
- 3.2 High voltage cable
- 3.3 Cable clamp
- 3.5 Main earthing bar
- 3.6 Floor plate
- 6.0 Main earthing bar
- 6.5 Secondary cable entry
- 6.6 Low voltage compartment door
- 6.10 Mechanism bay
- 7.0 Busbar cover
- 7.1 Pressure relief duct (optional, for pressure relief to the outside)

1 Despatch and storage

1.1 Condition on delivery

The panels have been routine tested to IEC 62271-200.

- In normal cases, the gas compartments have been filled with sulphur hexafluoride (SF₆) insulating gas to the rated filling pressure. When airfreighted, however, the panels are delivered with reduced pressure.
- If delivered by airfreight, increase the pressure to the rated filling pressure before installing the panels (see instruction manual HB 605 E for the procedure to be adopted).
- The individual parts of the busbars, the installation material and accessories and the documentation are packaged separately from the panels.



Busbars for 2500 A are supported on spacers in the packaging. When the busbars are removed from the packaging, do not lay them on their silicone surfaces. As the copper is very heavy, the silicone can be damaged even if the components are incorrectly stored for a short period only. Always use the spacers supplied for storage.

Tall low voltage compartments are delivered separately and have to be installed at site on completion of panel assembly (see section 2.3.3). In such cases, panel assembly without the low voltage compartment is to be performed as described in section 2.3.

1.2 Delivery

Check the consignment for completeness and freedom from damage. Document any transport damage found on the waybill and inform us of it immediately. Take photographs of the damage.

1.3 Packaging

The panels have been prepared for transport by the agreed method and for the desired duration of any interim storage required. Details of the length of preservation and the storage location (indoors or outdoors) can be found in the order documents. If the panels are packaged, they are mounted on a pallet and secured to prevent them from slipping.

The possible packaging methods are as follows:

- No packaging
- Packaged in plastic sheeting
- Packaged in plastic sheeting and surrounded by protective cardboard
- Heat sealed in plastic sheeting with drying agent enclosed
- Packaged in aluminium foil in transport crate with drying agent enclosed

1.4 Handling

- Panels with a width of 600 mm, 900 mm and 1200 mm are delivered separate. Panels with a width of 450 mm are delivered as transport units consisting of maximum 3 panels.
- Always handle the panels in the upright position.
- Take account of the weight of the transport units when selecting the handling equipment.



Due to the high centre of gravity of the panels, there is a risk that the transport units may tip over! Take all precautions to protect personnel and the materials transported. Due to the high tilting danger transportation of panels with a width of 450 mm is only permitted in any case with transport units of minimal 2 panels as delivered.

Only ever handle the panels by

- fork lift truck,
- trolley jack,
- crane, or
- hydraulic lift trolley.

1.4.1 Handling by fork lift truck or trolley jack

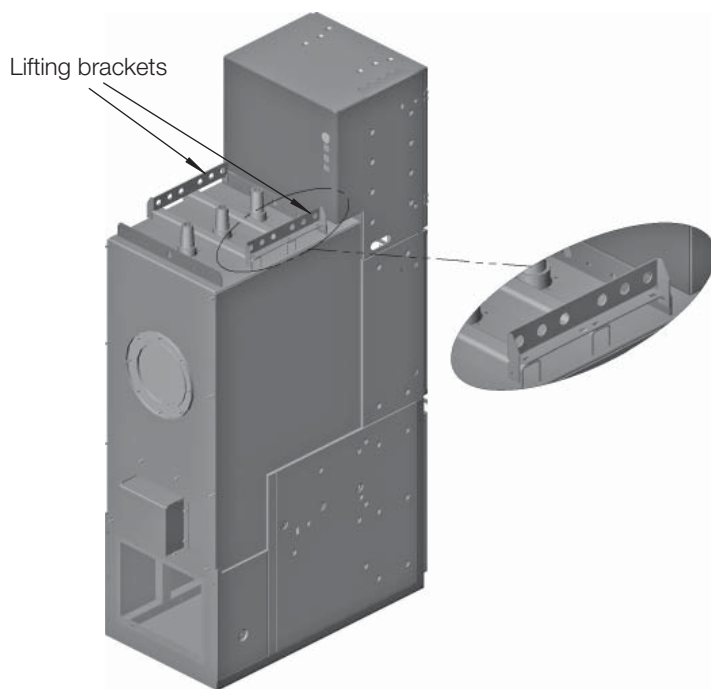


The panels must be standing on a pallet. The pallet must rest fully on the forks of the truck or jack. The high centre of gravity means there is a high risk of tipping. Avoid jerky motions.

1.4.2 Handling by crane

- As shown in figure 1.4.2.1, fasten one lifting bracket each to the left and right of the front roof section of the panel module, using two M 8 x 35 cheese-head screws with dished washers in each case.
- Attach suspension ropes of a sufficient load bearing capacity (see section 11, Technical data, for the panel weights) and sufficient length to the lifting brackets using shackles. Thread the suspension ropes through the cutouts in the rope guides. The ABB scope of supply does not include suspension ropes and shackles.

Fig. 1.4.2.1: Preparing a panel for handling by crane



1.4.3 Handling by hydraulic lift trolley

Attach hydraulic lift trolleys of sufficient capacity to the front and rear of the panel in accordance with the manufacturer's instructions (fig. 1.4.3.1).



The high centre of gravity means there is a high risk of tipping. Avoid jerky motions!

Fig. 1.4.3.1: Handling by hydraulic lift trolley



1.5 Intermediate storage

- Store the panels in the upright position.
- Do not stack the panels.
- Protect the transport units from damage.

The conditions for optimum intermediate storage without packaging or with basic packaging are as follows:

- The storeroom must comply with the normal operating conditions for a switchgear installation (see IEC 62271-1).
- Cover the unpackaged panels with protective sheeting, remembering to preserve sufficient air circulation.
- Prevent condensation on the panels by partially opening the packaging and heating the storeroom accordingly.


The conditions for optimum intermediate storage with packaging and preservation are as follows:

- Check the packaging for damage.
- Store the transport units in a dry place protected from the weather.
- Contact us if
 - the storage life of the preservation is exceeded,
 - the packaging with preservation is damaged.

2 Installation of the switchgear at site

2.1 Fundamental notes on installation work

2.1.1 Safety notes



In order to prevent accidents (especially hand injuries!), extreme care is to be exercised during all work on the operating mechanism with the mechanism bay covers removed.


In order to ensure correct function, the spiral spring in the energy store of the circuit-breaker operating mechanism is permanently subjected to a basic pre-tension which is independent of the charging and discharging processes during switching. This spring energy can be suddenly released if work is performed incorrectly in the area of the stored energy spring!

2.1.2 General site requirements

At the start of installation, the switchgear room at site must be complete and fitted with lighting and power for the installation work. It must also be lockable, dry, and with good ventilation facilities. All necessary provisions such as openings, ducts, etc. for laying of the power cables must already be in place. Compliance with the conditions for indoor switchgear to IEC 62271-1 must be ensured.

2.1.3 Tightening torques

Use DIN screws of tensile class 8.8. Use the tightening torques stated in table 2.3.2.1. The tightening torques apply to unlubricated screw connections.



Please consult the manufacturer's installation instructions for the tightening torques of cable connectors and surge arresters.

Table 2.3.2.1: Tightening torques		
	M 8	M 10
Nut on studbolt	12,5	
Steel screw in pulling nut	18 - 24	
Other screws of tensile class 8.8	26	50

2.1.4 Handling sulphur hexafluoride (SF₆)

No gas work is required during installation.



We recommend that gas work should only be performed by personnel trained in the handling of SF₆. Gas may only be extracted by certified personnel. See manual HB 605 "Use of SF₆ insulating gas" for details on handling SF₆.

- If there is a concrete floor a foundation frame is required. Standard foundation frames supplied by ABB must be embedded in the floor topping.
- Two versions of the standard foundation frame are available. Frames with a width of 600 mm are used for panel widths 600 mm, 2 x 900 mm and 1200 mm. For 450 mm wide panels, a further version with a corresponding width is available (see figure 2.2.1).



Maintain the following evenness and straightness tolerances when installing the foundation frame or a raised false floor:

- Evenness tolerance: $\pm 1 \text{ mm / m}$
- Straightness tolerance: Max. 1 mm / m, but max. 2 mm for the entire length



Consult the order documents for the position of the foundation bars in the switchgear room.



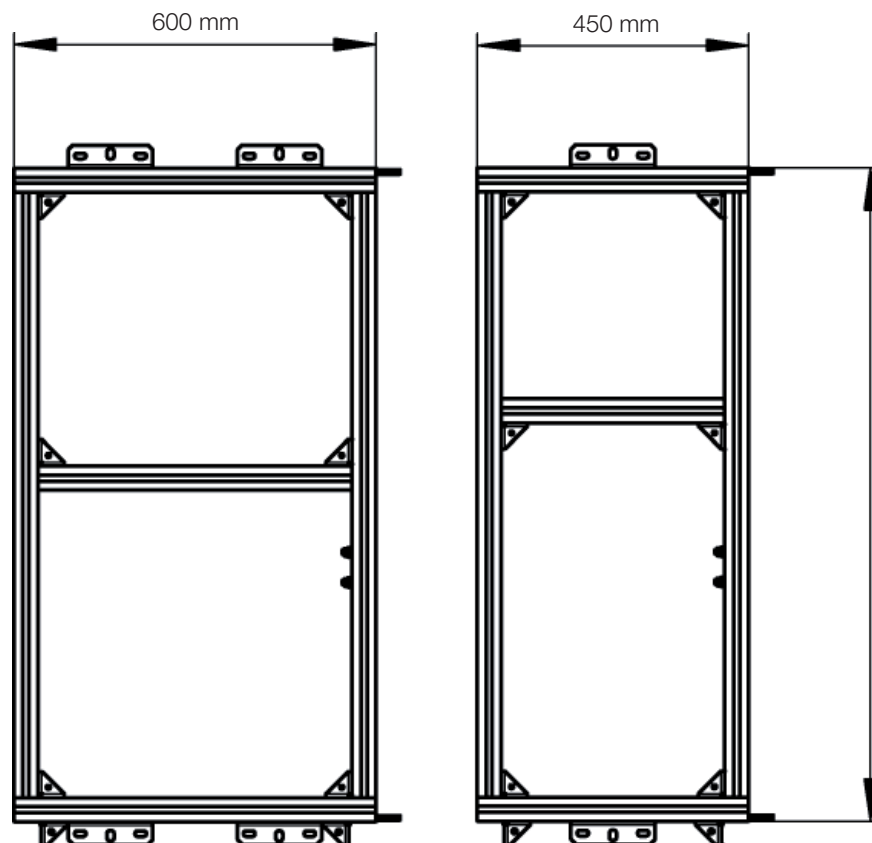
The slabs of the raised false floor must be fastened to the supporting frame.

If no standard ABB foundation frames are used, observe the relevant construction and laying drawings for the special frames.

2.2 Foundation frames

- When a raised false floor is used, load-bearing sections of the floor frame serve as supports for the panels. No additional foundation frame is necessary.

Fig. 2.2.1: Foundation frames, top view



2.2.1 Installation of the standard foundation frame

Standard foundation frames are delivered to site completely pre-assembled.

Installation principle:

The foundation frames are bolted together at the front and rear. Vertical alignment is effected by jacking screws. Brackets are used to fasten the frames to the floor. The foundation frames are finally embedded in the floor topping to provide their load bearing capacity.

Detailed description of installation

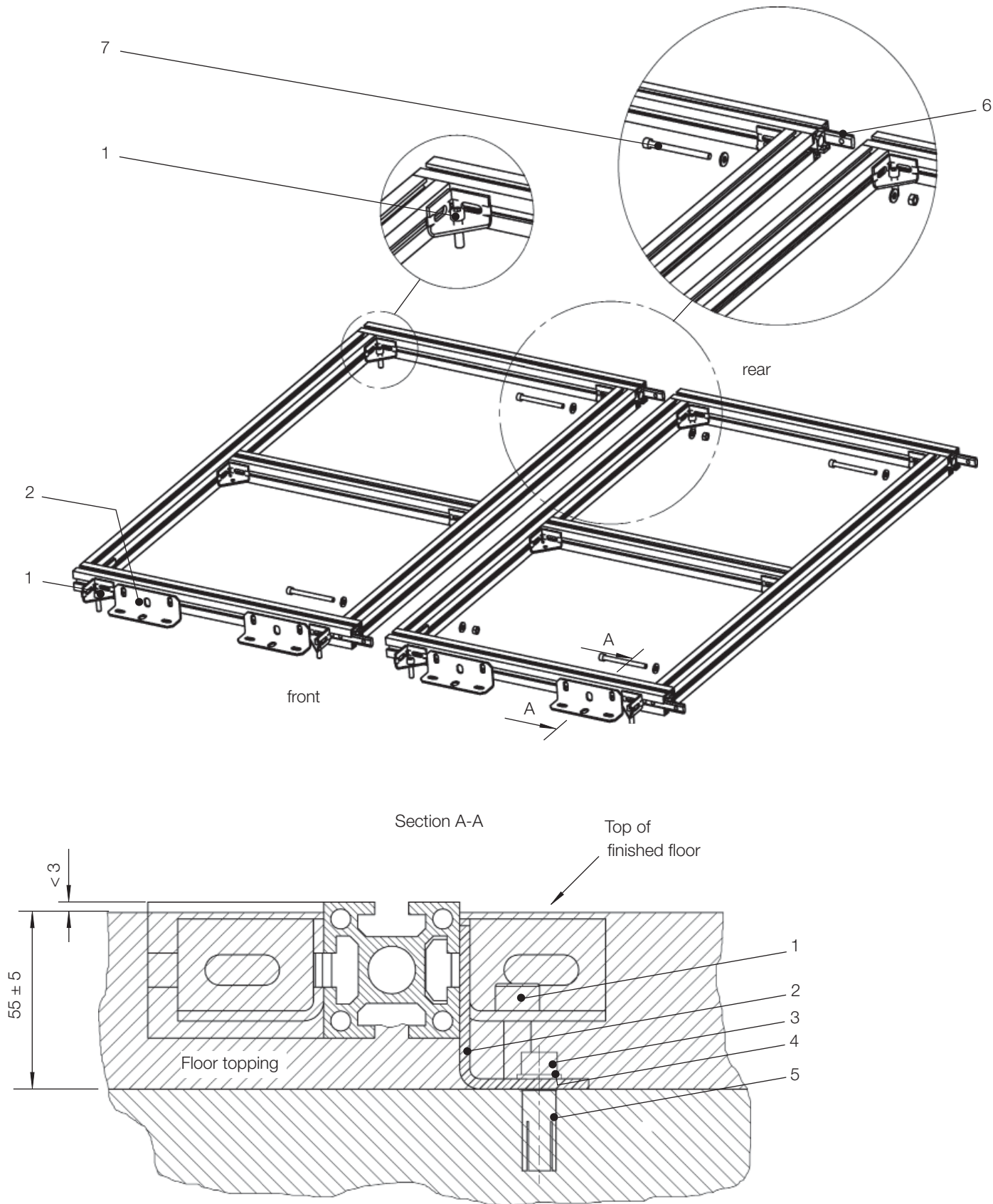
(Fig. 2.2.1.1)

- Position the foundation frame sections in the correct locations on the concrete floor.
- Align the foundation frame vertically with the four screws (1), taking account of any deviation in floor level in the direction of the foundation frames which are still to be laid.
- Fasten the brackets (2) of the foundation frame to the floor, using one knock-in anchor (5) and one screw (3) with dished washer (4) for each bracket.
- Slide one slot rod (6) into the front slot of the front section and one into the rear slot of the rear section. Fasten the slot rods in position by inserting the grub screws
- Place the following foundation frame in the correct position on the floor, allowing the inserted slot rods to slide into the sections of the frame to be installed. Bolt the foundation frames together with two M 8 x 100 cheese head screws (7) and nuts and washers. Tighten the grub screws in the slot rods.
- Align the foundation frame vertically as described above and fasten it to the floor.
- Install the following foundation frames in the same way.
- Earth the completely assembled frame. Further details on this can be found in the order documents.



When applying the floor topping, carefully fill under the foundation frame with topping material.

Fig. 2.2.1.1: Installation of the floor frame



2.3 Assembly of the switchgear

2.3.1 Preparatory work

2.3.1.1 Checking the SF₆ pressure in the gas compartment

Each panel contains a gas compartment and is fitted with a filling connector. The filling connector is located in the operating mechanism bay behind the operator controls on the panel.

Check the gas pressure in each gas compartment with a temperature-compensated pressure gauge (see list of tools) before aligning and connecting the panels, as follows:

- Dismantle the covers on the mechanism bays by removing the screws marked in Fig. 2.3.1.1.1.

Fig. 2.3.1.1.1: Screws for fastening of the cover

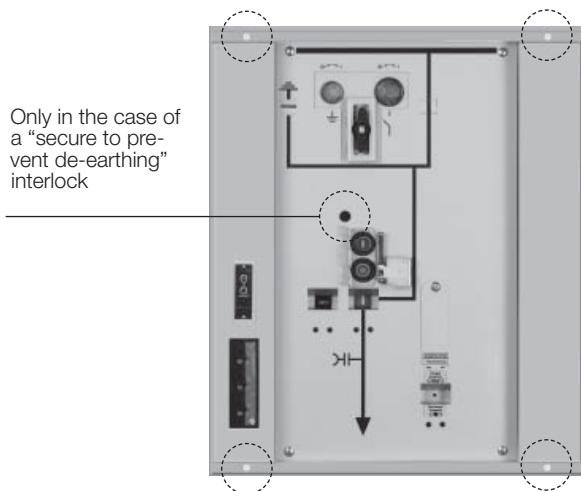
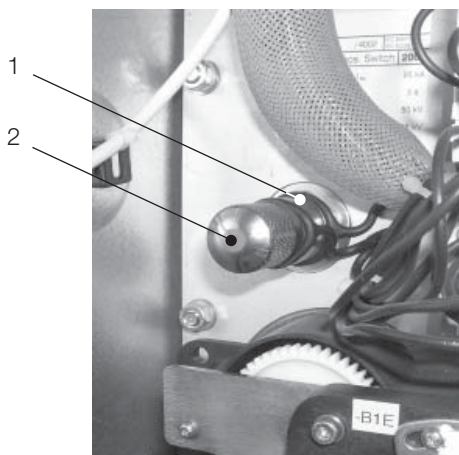


Fig. 2.3.1.1.2: Filling connector (1) with protective cap (2) in mechanism bay



- Remove the protective cap (2) from the filling connector (1) by turning it counter-clockwise (Fig. 2.3.1.1.2).



Do not press the valve pin (3) (Fig. 2.3.1.1.3) in, as otherwise gas will flow out of the valve.

- While pulling the locking ring (4) outwards, press the coupling of the pressure gauge (5) (Fig. 2.3.1.1.4) into the filling connector.

- Check the reading on the scale of the temperature-compensated pressure gauge.



The reading must be in the green area of the instrument's scale. If it is not, or if the site altitude is greater than 1000 m, please contact us.

- Remove the temperature-compensated pressure gauge by pulling out the locking ring on the filling connector.
- Screw the protective cap onto the filling connector.

Fig. 2.3.1.1.3: Filling connector (1) with valve pin (3)

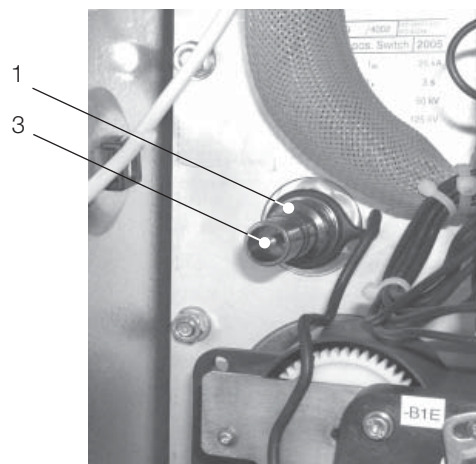


Fig. 2.3.1.1.4: Filling connector with temperature-compensated pressure gauge (5) and locking ring (4)



2.3.1.2 Greasing the foundation bars

When a standard foundation frame supplied by ABB is used, remove the protective film. Grease the top surfaces of the foundation frame or raised false floor beams. This facilitates erection and alignment of the panels.

2.3.1.3 Preparing the panels

- Remove the covers from the cable termination compartments on all panels.

Fitting the studbolts for the solid-insulated busbars

- The studbolts are part of the busbar supply. Use original studbolts only.
- For 1250 A cast resin bushings, use M16 / M12 studbolts, and for 2500 A cast resin bushings use M16 / M16 studbolts.
- Screw the studbolts into the cast resin bushings on the panels until the stop is reached (fig. 2.3.1.3.1). Tighten the studbolts with a torque wrench. The torque for 1250 A cast resin bushings is 10 Nm, and for 2500 A cast resin bushings 30 Nm.
- Measure the length of the studbolts projecting from the cast resin bushings. See figure 2.3.1.3.2 for the specified dimensions.

Fig. 2.3.1.3.1: Cast resin bushing

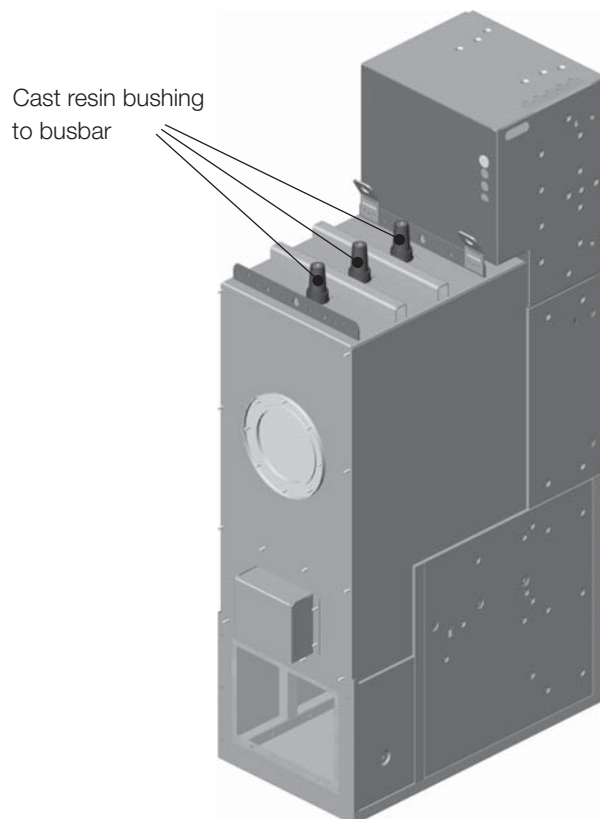
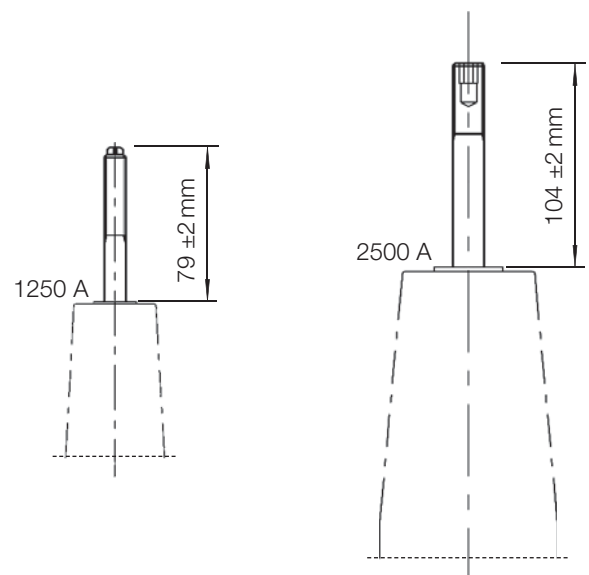


Fig. 2.3.1.3.2: Cast resin bushings with studbolts: Specified dimensions for assembled studbolts



2.3.2 Erection of the panels

- Set up the furthest panel precisely at the specified position.
- Use four fastening points for panels of 450 mm and 600 mm width, six for panels of 900 mm width, and eight for panels of 1200 mm width (fig. 2.3.2.1).

When the standard foundation frame is used:

- Insert M 8 T-nuts through the holes in the floor plates into the slots in the foundation frame sections. Join the floor plates using washers (1 x washer 8.5 x 30 x 3 and 1 x dished washer 8) and M 8 x 16 cheese head screws to the previously positioned T-nuts (Fig. 2.3.2.1 and Fig. 2.3.2.2).

When a special foundation frame or raised false floor is used:



Fasten the panels in accordance with the instruction documents supplied.

Fig. 2.3.2.1: Fastening points for panels of various widths

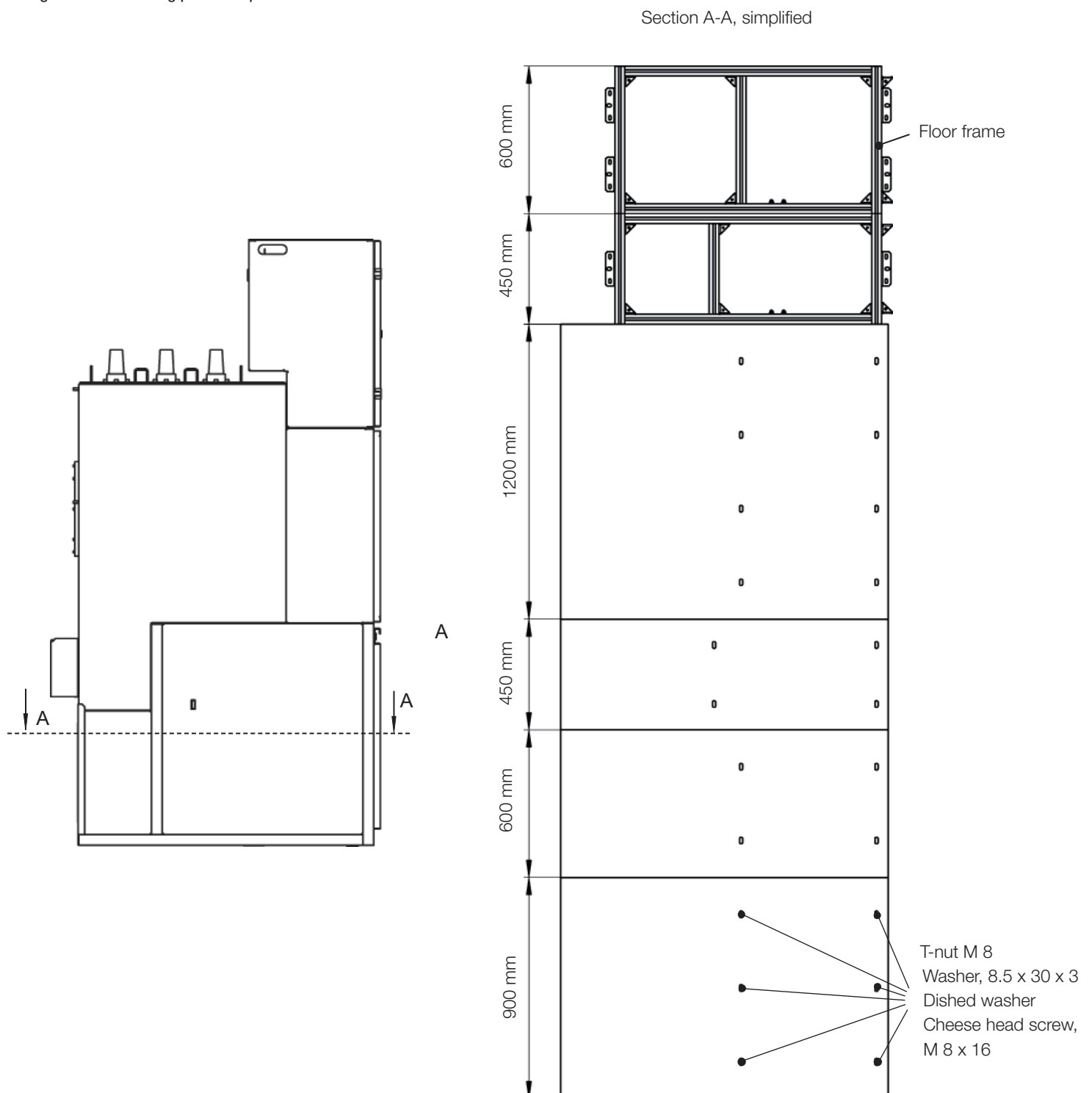
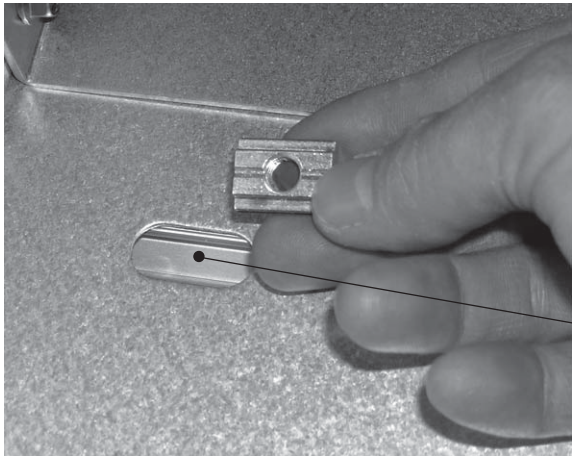
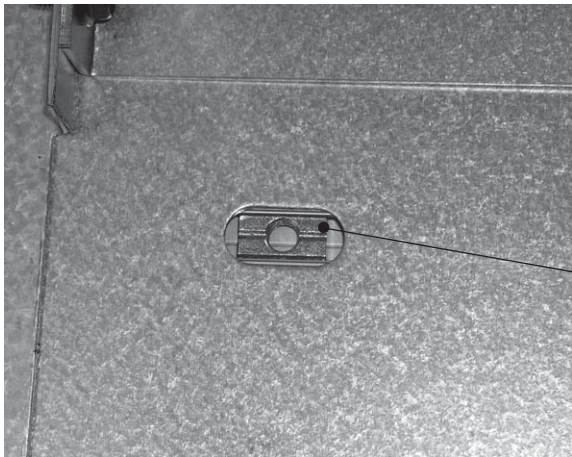


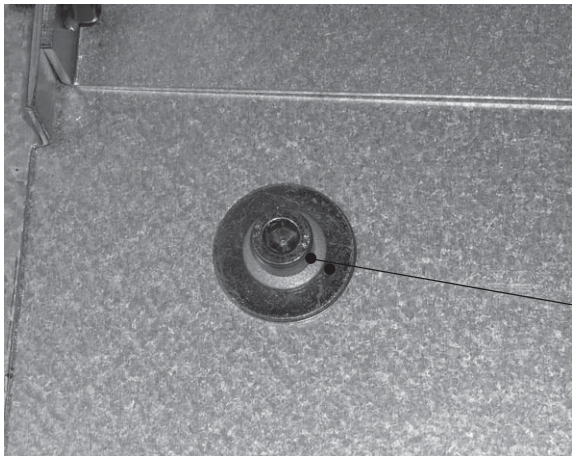
Fig. 2.3.2.2: Fastening the panel to the foundation frame



Slot in the foundation frame section



T-nut, M 8



Fastening of the panel to the foundation frame

- Carefully slide the panel to be installed up to the panel which is already in place.



Apply drawing or pressing tools to a large area on the panel directly above the floor (for instance by using a wooden beam between the tool and the panel) so as to avoid damage to the panel.

- Check the position of the panel and align the panel to the precise dimensions if necessary.
- Fasten the low voltage compartments, the operating mechanism bays and the cable termination compartments of the two panels together at the points provided (fig. 2.3.2.3) using screws and nuts.

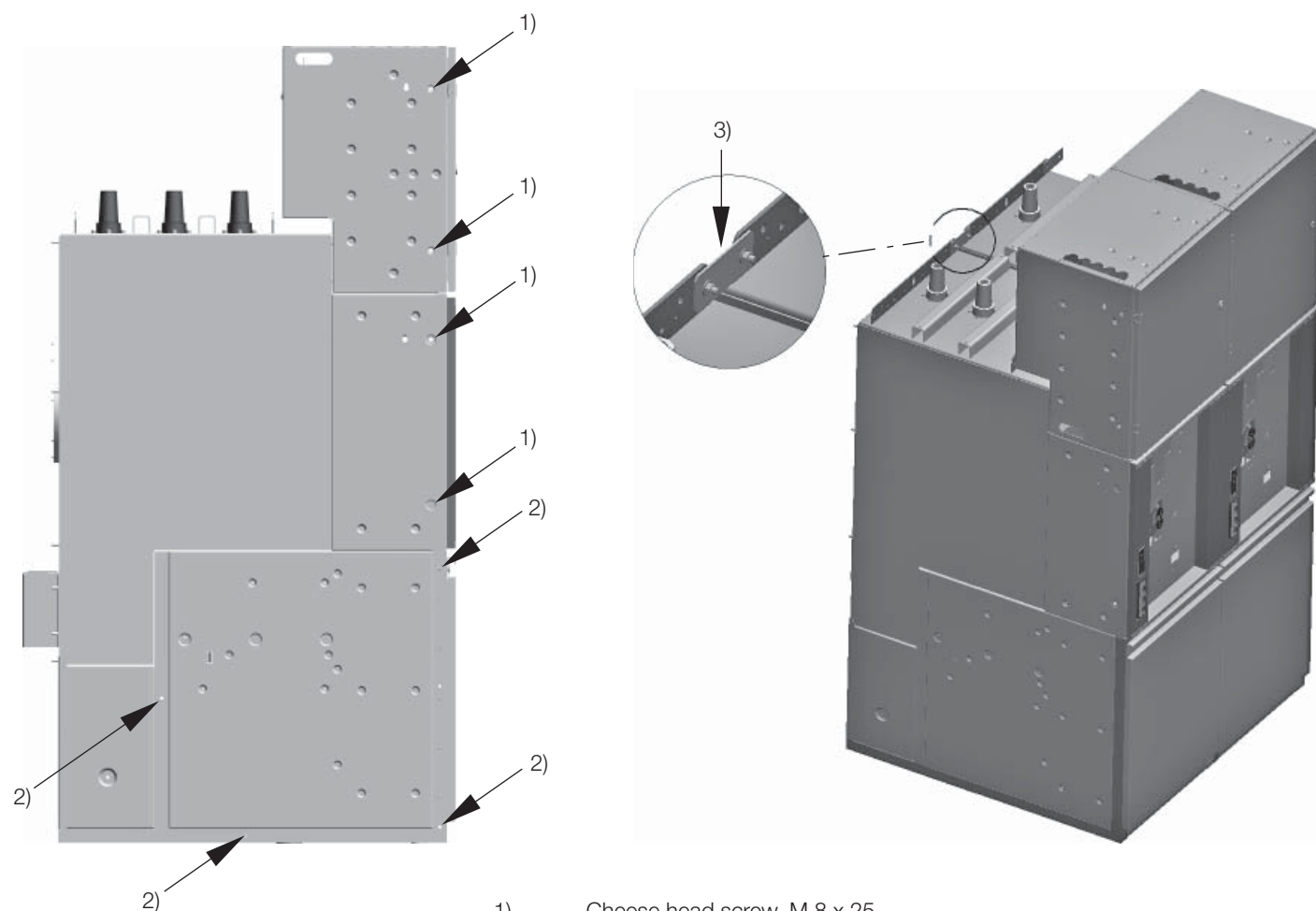
- Fit the coupling link at the rear of the panels.

- Fasten the panel to the foundation frame as described above.

- Measure the centre to centre distances L of the adjacent cast resin bushings (fig. 2.3.2.4) for all three phases. The specified dimensions for distance L can be found in tables 2.3.2.1 and 2.3.2.2.

- If the measured dimension L deviates from that specified, correct the position of the panel.

Fig. 2.3.2.3: Fastening points for panel to panel bolting



- 1) Cheese head screw, M 8 x 25
Nut, M 8
2 x dished washer, 8
- 2) Cheese head screw, M 8 x 100
Nut, M 8
2 x dished washer, 8
- 3) Coupling link
Cheese head screw, M 8 x 30
Nut, M 8
2 x dished washer, 8

Fig. 2.3.2.4: Distance L to be measured between the cast resin bushings of adjacent panels

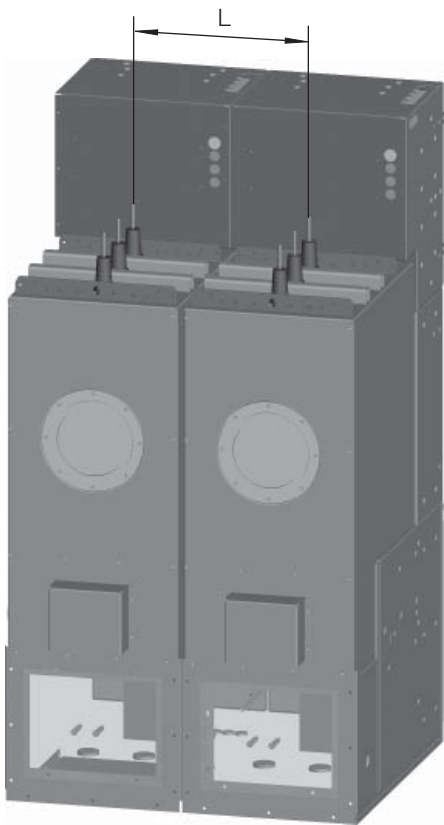


Table 2.3.2.1: Specified dimensions for distance L, busbars up to 1250

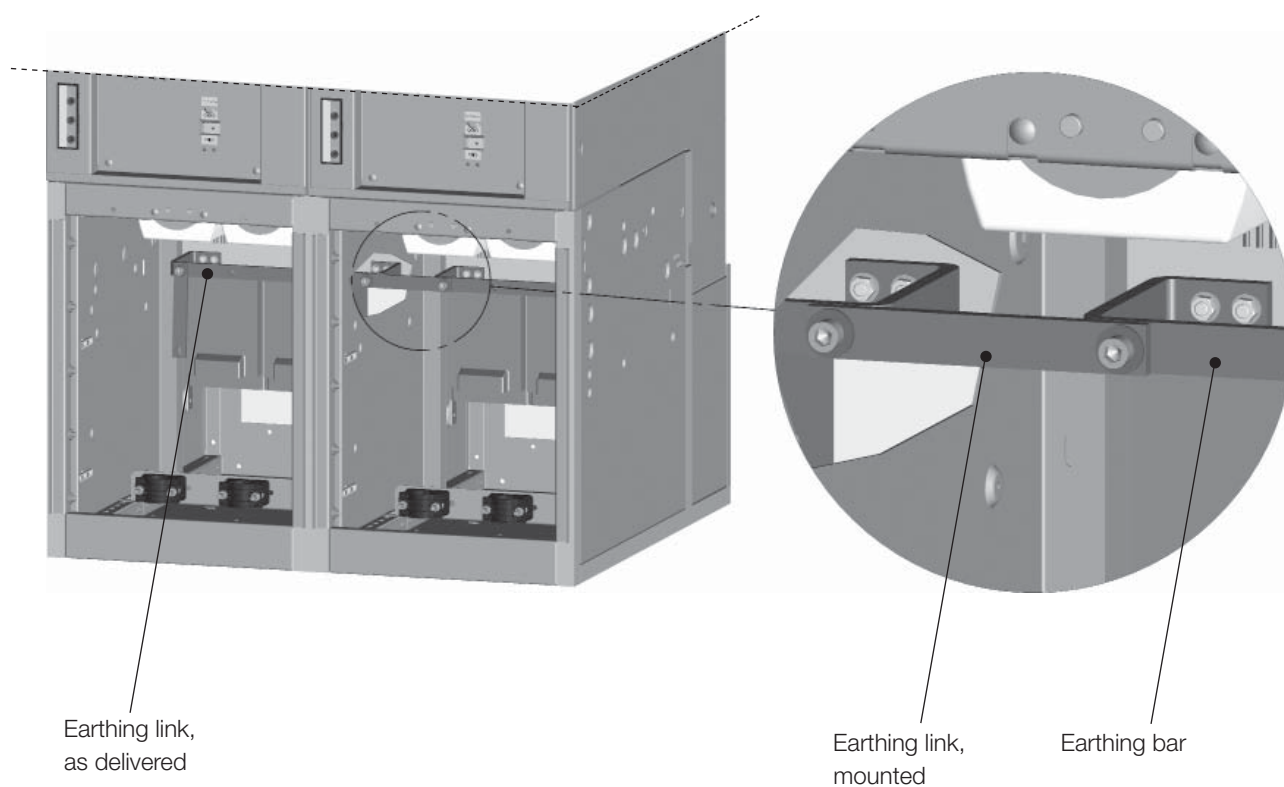
Panel widths of the adjacent panels [mm]	Specified dimension for L in figure 2.2.2.4 [mm]
450 - 450	450
450 - 600 450 - 600 (Transferpanel)	485
600 - 450	565
600 (Transferpanel) - 450	395
600 (Transferfeld) - 600	430
600 - 600	600

Table 2.3.2.2: Specified dimensions for distance L, busbars up to 2500 A

Panel widths of the adjacent panels [mm]			Specified dimension for L in figure 2.2.2.4 [mm]
450 - 600			485 ⁺² ₋₀
450 - 900			635 ⁺² ₋₀
450 - 1200			785 ⁺² ₋₀
600 - 450			565 ⁺² ₋₀
600 - 600			600 ⁺² ₋₀
900 - 450			715 ⁺² ₋₀
1200 - 450			865 ⁺² ₋₀
600 - 900	900 - 600		750 ⁺² ₋₀
900 - 900	1200 - 600	600 - 1200	900 ⁺² ₋₀
900 - 1200	1200 - 900		1050 ⁺² ₋₀
1200 - 1200			1200 ⁺² ₋₀

- Install the further panels in the manner described.
- Guide the control cables for the panel to panel connections through the opening in the low voltage compartment of the relevant adjacent panel. Fit the control wiring plugs into the corresponding connector sockets as shown in the circuit diagram.
- Connect the earthing bars of the panels together (figure 2.3.2.5) by dismantling the earthing link fitted at the works for transport, guiding it through the opening to the adjacent panel and tightening the screws with the specified torque.

Fig. 2.3.2.5: View into the cable termination compartment: Installation of the earthing bar



2.3.3 Installation of tall low voltage compartments

The sequence of installation work (e.g. busbar installation before installation of the low voltage compartment) is to be determined to suit the individual situation (e.g. free-standing or wall-mounted installation).

We recommend that installation be performed by a team of three fitters.

We recommend that installation be performed by a team of three fitters.

The points for fastening of the low voltage compartment to the panel are shown in figure 2.3.3.2.

Fig. 2.3.3.1: Side view of the panel with low voltage compartment

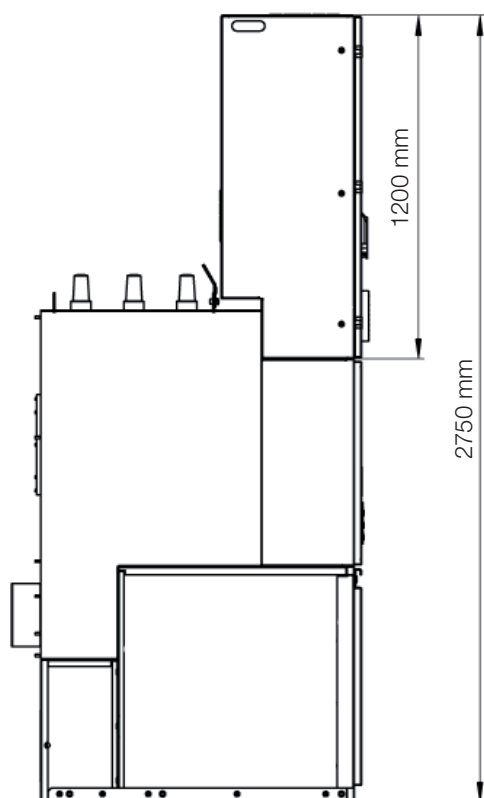
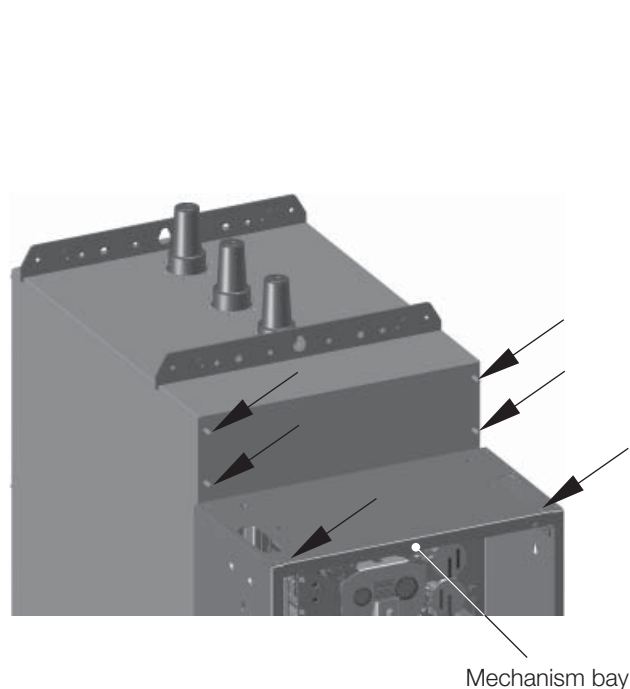


Fig. 2.3.3.2: Fastening points for the low voltage compartment

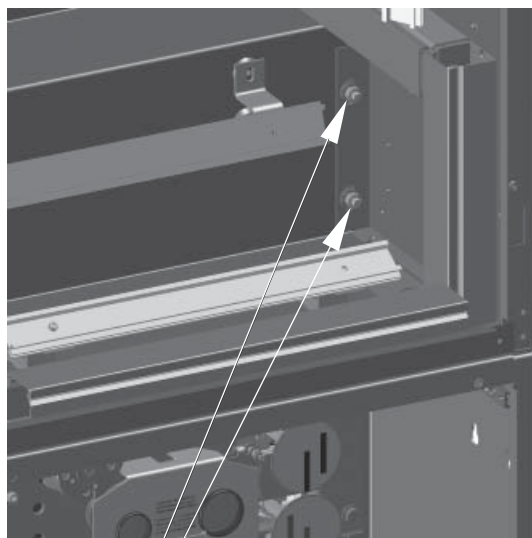


- Lift the low voltage compartment with suitable lifting gear (see figure 2.3.3.3).
- Set the low voltage compartment down on the mechanism bay and screw it tight at the points shown in figures 2.3.3.2 and 2.3.3.4, observing the specified tightening torques.

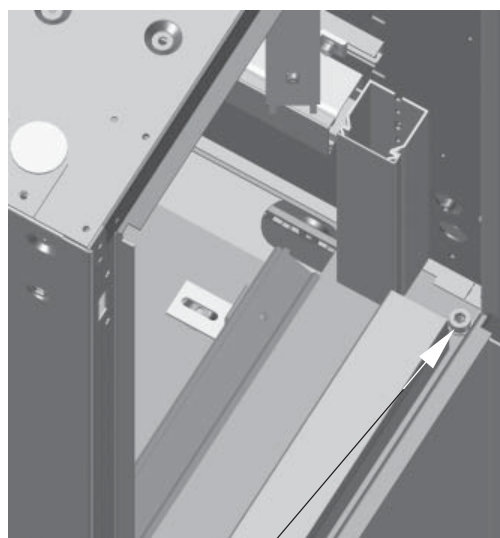
Fig. 2.3.3.3: Examples of lifting the low voltage compartment



Fig. 2.3.3.4: Fasteners (shown on the right only)



4 x Nut M8
4 x Dished washer 8



2 x Cheese head screw M 8 x 25
2 x Nut M 8
2 x Washer A 10,5
4 x Dished washer 8

- Bolt the adjacent low voltage compartments together as shown in figure 2.3.3.5.
- Guide the plugs of the relevant cable harnesses through the opening provided in the low voltage compartment (figure 2.3.3.6).
- Insert the plugs into the sockets provided.

Fig. 2.3.3.5: Bolting adjacent low voltage compartments together

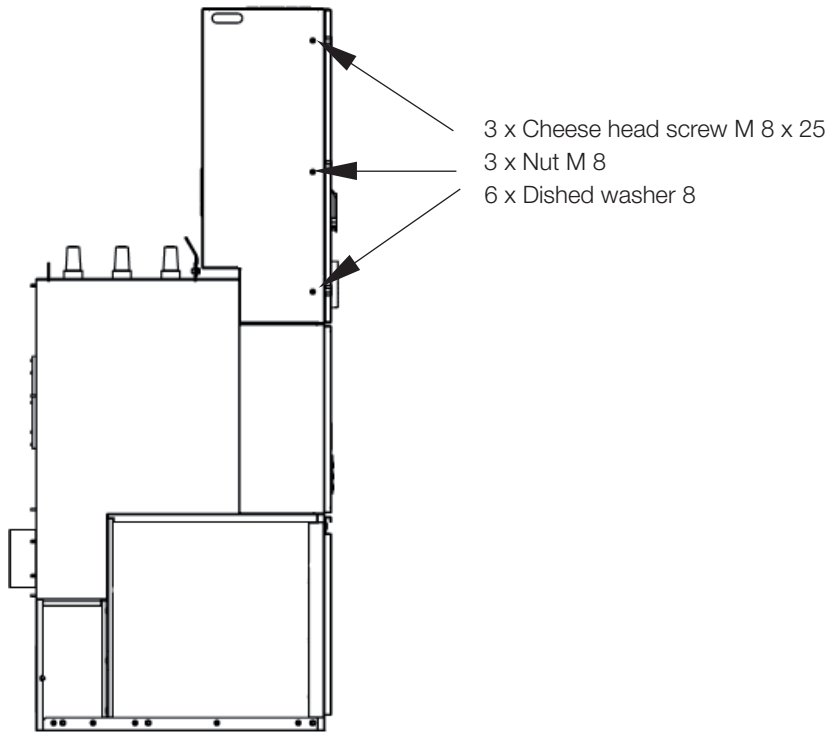


Fig. 2.3.3.6: Opening for the cable harness in the side wall of the low voltage compartment



2.3.4 Installation of the busbar

2.3.4.1 General notes on busbar installation

The individual parts of the busbar adapters (connections between the busbar sections of each panel) are supplied packaged for all three phases. Parts lists are enclosed with the material.

See section 8 for the part numbers of the adapters and the required lengths of the busbars for the adjacent panels.

End adapters are used at the ends of the switchgear system and on sectionaliser, riser and transfer panels. Cross adapters are to be installed in the busbar run.

The packaging for the busbar adapters contains assembly paste. Use only this assembly paste to grease the busbar components.

If it is intended to fit current transformers in the busbar run, please note that the current transformers are to be installed during fitting of the busbars (see section 2.3.3.6):

Storage of the busbars



Busbars for 2500 A are supported on spacers in the packaging. When the busbars are removed from the packaging, do not lay them on their silicone surfaces. As the copper is very heavy, the silicone can be damaged even if the components are incorrectly stored for a short period only. Always use the spacers supplied for storage.

Checking the silicone surfaces of the components



Only remove the relevant component from its protective packaging immediately before assembly.



Check the silicone insulating part for damage prior to installation.



If you note any damage on the silicone insulating part, only use the component after this has been agreed with our service department.

The silicone surface must be free of

- gas bubbles,
- scoring,
- damage,
- abrasions,
- foreign bodies.

Cleaning soiled silicone surfaces

Components removed from the packaging can as a rule be installed directly without cleaning. If cleaning should nevertheless be necessary, clean the components immediately before installation as follows:

- Remove surplus or dirty grease from the silicone part with a soft, clean, non-fraying cloth.



Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

- Clean the silicone insulating part when required with intensive cleaner M.X.T. 60 forte and a soft, non-fraying cloth.
- Only moisten the cloth slightly with intensive cleaner. Apply only moderate pressure when cleaning the insulating parts of busbar connections. Do not wipe from the black areas towards the light insulating surfaces. By adopting this procedure you avoid transferring black, conductive material onto the light, insulating area.
- After cleaning with intensive cleaner M.X.T. 60 forte, wipe the silicone insulating part with a dry cloth.



As the cleaner causes the silicone to swell slightly, it then has to dry for approx. 15 minutes in the air.

Checking the copper ends of the busbars

- Inspect the copper ends for oxidation and discoloration.

Cleaning the copper ends of the busbars

- In the case of oxidation or the presence of discoloration, clean the copper ends immediately before installation with a clean non-woven cloth. Inspect and clean the silicone surfaces of the busbars as described above.

Checking the cast resin bushings

- Inspect the cast resin bushings for damage. If damage to a cast resin bushing is found, please contact our service department.

Cleaning the cast resin bushings

- Remove surplus or dirty grease from the silicone part with a soft, clean, non-fraying cloth.



Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

- Clean the cast resin bushing with the cleaning agent and a soft, clean, non-fraying cloth. Only lightly moisten the cloth with intensive cleaner.
- After cleaning with intensive cleaner M.X.T. 60 forte, wipe the silicone insulating part with a dry cloth.

2.3.4.2 Installation of the busbar for busbar currents up to 1250 A

(Fig. 2.3.4.2.1)

The studbolts (8) have been fitted as described in section 2.3.1.3. The insertion depth of the studbolts and the centre to centre distances have been checked in accordance with table 2.3.2.1.

- Check the adapter (2) and clean it if necessary as described above.
- Bolt the earthing cable to the adapter as shown in Detail “Z”.
- Coat the area of the two contact shells (9) and the adapter (2) shown as “A” lightly and evenly with assembly paste. Fit the contact shells together, with contact piece (1) in the case of an end adapter, and slide the complete components through the greased busbar opening up to the centre of the adapter. Align the set of contact shells in such a way that the bores are in line to accommodate the studbolt.
- Check and clean the copper ends and the silicone area “C” of the busbar (4) as described above.
- Evenly coat the silicone area “C” with assembly paste. Insert the busbar up to the centre of the adapter. The black conductive coating of the busbar must be covered by the adapter.
- Check the cast resin bushing (6) and clean it if necessary as described above.
- Evenly coat area “B” of the cast resin bushing and area “B” of the adapter (2) with assembly paste. Slide the adapter onto the cast resin bushing. Fit a washer (10) to the studbolt and turn the nut (11) onto the studbolt. As long as the nut has not been tightened, the busbar can be moved in the adapter, so that the next adapter and the corresponding part of the busbar can be slid together onto the next cast resin bushing after the preparation described above.
- Install the following adapters and busbar sections in the manner described.
- Tighten all the nuts (11) using a socket insert which is at least 80 mm long at a torque of 50 Nm.



Note on installation of the insulating plugs:

If the pick-off for capacitive indication of the busbar voltage is to be installed on the panel concerned, use insulating plugs marked “MP” (see section 2.3.4.5). These insulating plugs contain the capacitive pick-off.

- Check and clean the areas of the adapter and insulating plug (12) marked “D”. Evenly coat the areas with assembly paste. Press the insulating plug together with a clean cable tie (to allow the air to escape) into the adapter. Lightly fasten the insulating plug. Withdraw the cable tie. Release the insulating plug by approximately 1.5 turns. Screw the insulating plug tight with a torque of 30 Nm.
- Fit the insulating plugs to all the adapters in the manner described.
- Press covering caps (5) onto all the adapters.
- Remove surplus grease from the busbar components and from the cast resin bushings with a non-fraying cloth.



Open adapters (end adapter without busbar or cross adapter with busbar on one side) have no dielectric strength and are therefore impermissible.

1 Contact piece
2 End adapter
3 Cross adapter
4 Busbar
5 Covering cap
6 Cast resin bushing
7 Conductive layer
8 Studbolt
9 Contact shell

10 Dished washer
11 Nut
12 Insulating plug
13 Cable tie
14 Stop nut
15 Washer
16 Earthing cable
17 Screw
18 Earthing cable lug

10 Nm
19 50 Nm
19 30 Nm

"B" "D" "A" "C" "Z"

1250 A

Detail "Z"
Erdungsanbindung
Earthing connection

2.3.4.3 Installation of the busbar for busbar currents up to 2500 A

(Fig. 2.3.4.3.1)

The studbolts (8) have been fitted as described in section 2.3.1.3. The insertion depth of the studbolts and the centre to centre distances have been checked in accordance with table 2.3.2.2.

In this busbar design, different end and cross adapters are required to fit the cast resin bushings on the panel (up to 1250 A or up to 2500 A). A list of the part numbers can be found in section 8.

- Check the adapter (2) and clean it if necessary as described above.
- Bolt the earthing cable to the adapter as shown in Detail “Z”.
- Check the cast resin bushing (6) and clean it if necessary as described above.
- Slide the two contact shells (9) onto the studbolt (8). In the case of an end adapter, insert a contact piece (1) between the contact shells.
- Coat the areas of the cast resin bushing, the contact shells (9) and the adapter (2) shown as “B” lightly and evenly with assembly paste. Slide the adapter onto the cast resin bushing (6).
- Check and clean the copper ends and the silicone area “C” of the busbar (4) as described above.
- Evenly coat the silicone area “C” with assembly paste. Lift the adapter slightly away from the cast resin bushing to create play between the contact shells, and insert the busbar up to the centre of the adapter. The black conductive coating of the busbar must be covered by the adapter.
- Fit a washer (10) to the studbolt and turn the nut (11) onto the studbolt. As long as the nut has not been tightened, the busbar can be moved in the adapter, so that the next adapter and the corresponding part of the busbar can be slid together onto the next cast resin bushing after the preparation described above.
- Install the following adapters and busbar sections in the manner described.
- Tighten all the nuts (11) using a socket insert which is at least 80 mm long at a torque of 70 Nm.

- Check and clean the areas of the adapter and insulating plug (12) marked “D”. Evenly coat the areas with assembly paste. Press the insulating plug together with a clean cable tie (to allow the air to escape) into the adapter. Lightly fasten the insulating plug. Withdraw the cable tie. Release the insulating plug by approximately 1.5 turns. Screw the insulating plug tight with a torque of 30 Nm.
- Fit the insulating plugs to all the adapters in the manner described.
- Press covering caps (5) onto all the adapters.
- Connect the earthing cables of all adapters to the enclosure of the relevant panel.
- Remove surplus grease from the busbar components and from the cast resin bushings with a non-fraying cloth.



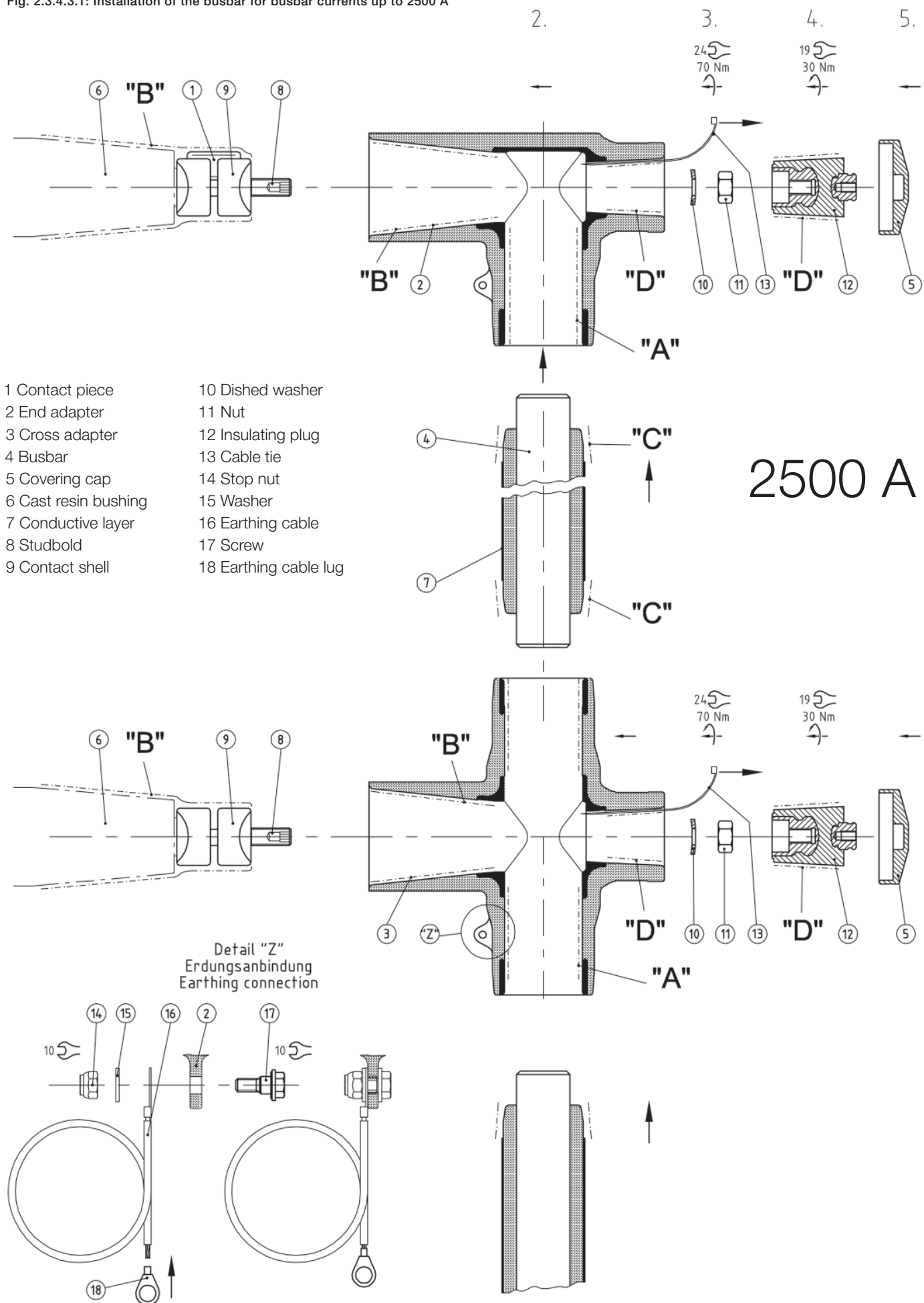
Open adapters (end adapter without busbar or cross adapter with busbar on one side) have no dielectric strength and are therefore impermissible.



Note on installation of the insulating plugs:

If the pick-off for capacitive indication of the busbar voltage is to be installed on the panel concerned, use insulating plugs marked “MP” (see section 2.3.4.5). These insulating plugs contain the capacitive pick-off.

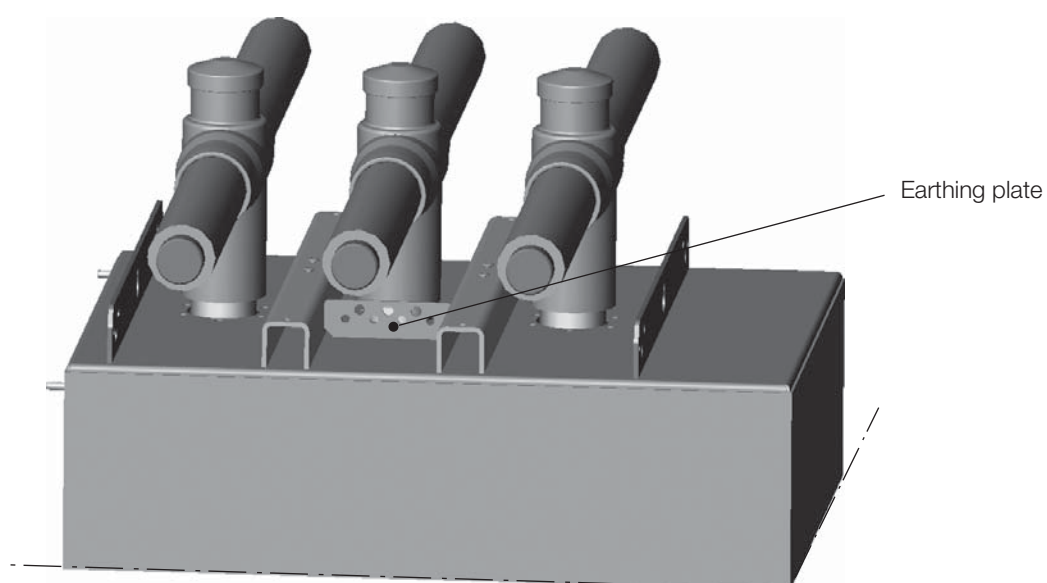
Fig. 2.3.4.3.1: Installation of the busbar for busbar currents up to 2500 A



2.3.4.4 Earthing of the busbar adapters

Connect the earthing cables previously connected to the adapters (detail “Z”, part 16 in figure 2.3.4.2.1 or figure 2.3.4.3.1) to the earthing plate shown in figure 2.3.4.4.1 between the sections on the panel modules.

Fig.: 2.3.4.4.1: Earthing of the adapters



2.3.4.5 Mounting of the capacitive indicator on the busbar

The following components are required for connection of the capacitive indicator to the busbar (fig. 2.3.4.5.1): Insulating plug with identification marking "MP", tab terminal with male thread and lock nut, cap, covering cap for end or cross adapter, made-up cable and fastening materials.

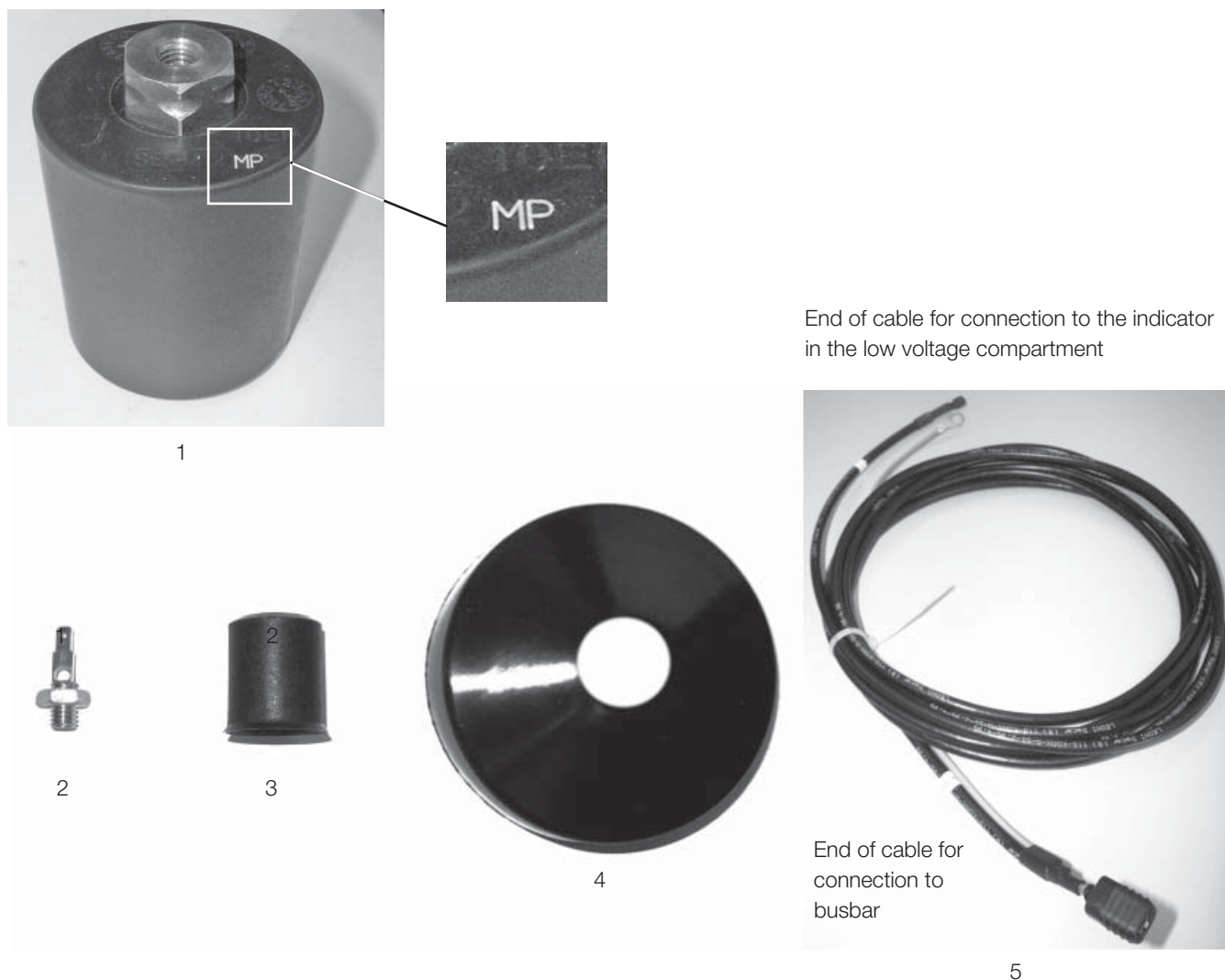
The insulating plugs are usually installed in the course of fitting the busbars (section 2.3.4).



The length of the cable is relevant to the function of the indicator. The cable must therefore not be shortened or lengthened or otherwise modified..

The made-up cables are connected to the indicator unit at the works, and are rolled up at the rear of the low voltage compartment. The further components are packaged separately and supplied with the site material.

Fig. 2.3.4.5.1: Components for connection of the capacitive indicator to the busbar for one phase



- 1 Insulating plug with identification marking "MP"
- 2 Tab terminal with male thread and lock nut
- 3 Protection cap
- 4 Covering cap for end or cross adapter
- 5 Made-up cable

Remove the covering caps from the end or cross adapters of the relevant panel.



Check whether the insulating plugs are marked "MP". If this is not the case, the insulating plugs have to be exchanged.

Screw the tab terminals with male threads into the insulating plugs on the busbars (figure 2.3.4.2.1 or figure 2.3.4.3.1) of the relevant panel. Lock the thread with the flat nut supplied (see figure 2.3.4.5.2).

Lead the cable through the opening in the covering cap for the end or cross adapter (4 in figure 2.3.4.5.1) and through the hole in the protection cap (3). Connect the plug on the cable to the tab terminal in the insulating plug (figure 2.3.4.5.2). Press protection cap (3) onto the terminal and the covering cap onto the end or cross adapter. Connect the earthing conductor of the cable to one of the two connecting brackets on the reinforcement section

of the enclosure (figure 2.3.4.5.3) using an M6 x 10 self-tapping screw, a contact washer and a dished washer.

Connect the cables for the other two phases in the same way. Fasten the cables to the appropriate plates with cable ties and adhesive pads.



Check the function of the capacitive indicator, for instance in the course of high voltage testing.

Fig 2.3.4.5.2: Tab terminal with male thread screwed into in insulating plug.

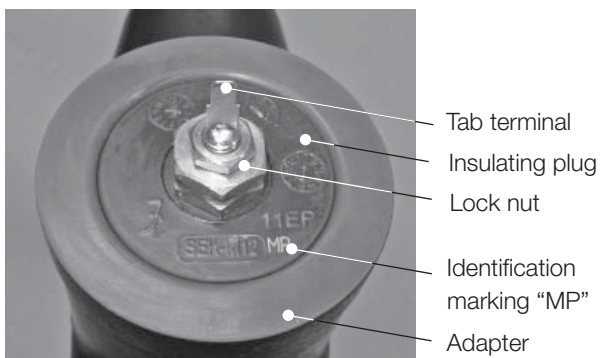
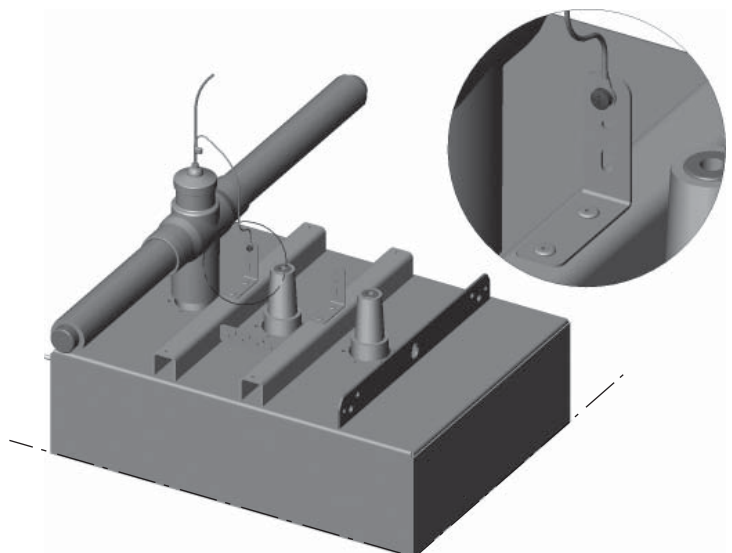


Fig 2.3.4.5.3: Connection of the earthing cable to the enclosure.



2.3.4.6 Installation of the busbar current transformers

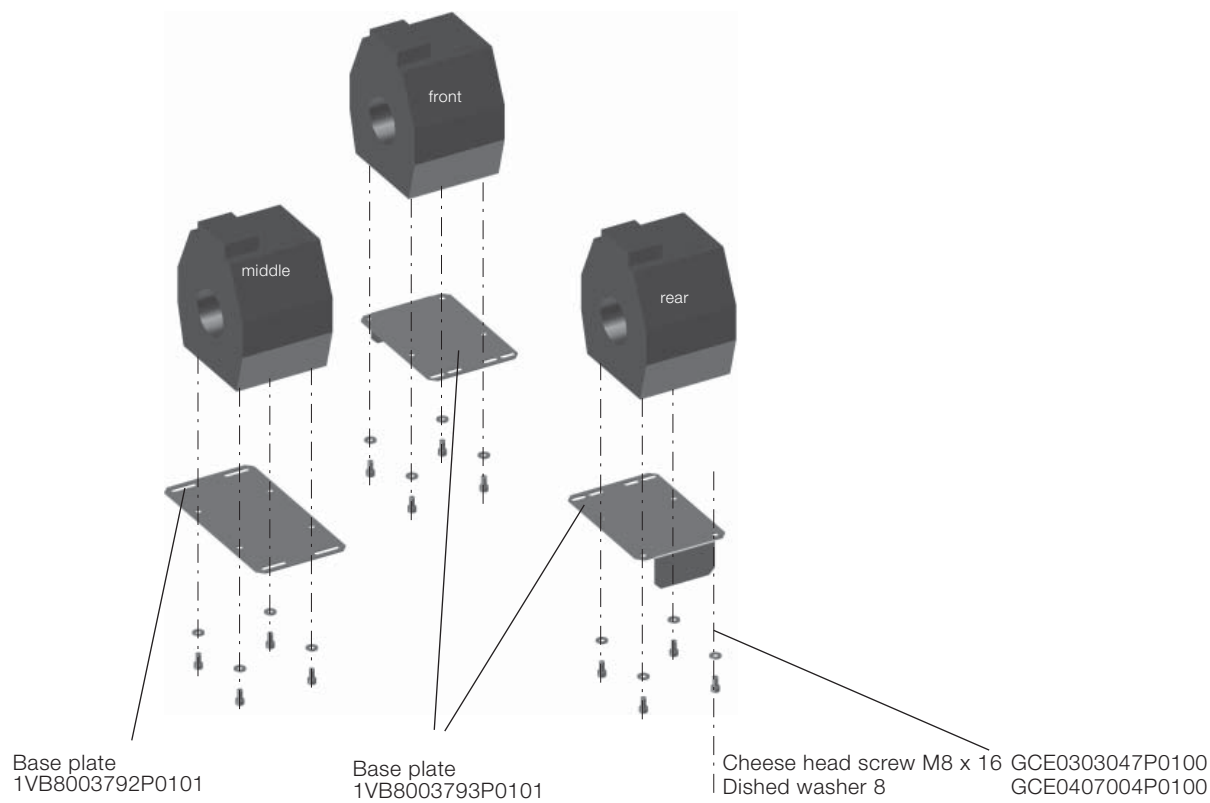
Table 2.3.4.6.1 shows the sections to be consulted in relation to the busbar current and the widths of the panels on which the current transformers are installed.

Table 2.3.4.6.1: Relevant sections depending on the busbar current and panel widths			
Max. busbar current / A	Panel width, left	Panel width, right	Section
1250	600	450, 600, 600 (transfer panel)	2.3.4.6.1
	600	600, 900, 1200	2.3.4.6.2
	450	900, 1200	2.3.4.6.3
	900	450, 600, 1200	
	1200	450, 600, 900, 1200	

2.3.4.6.1 Installation of the busbar current transformers, variant 1

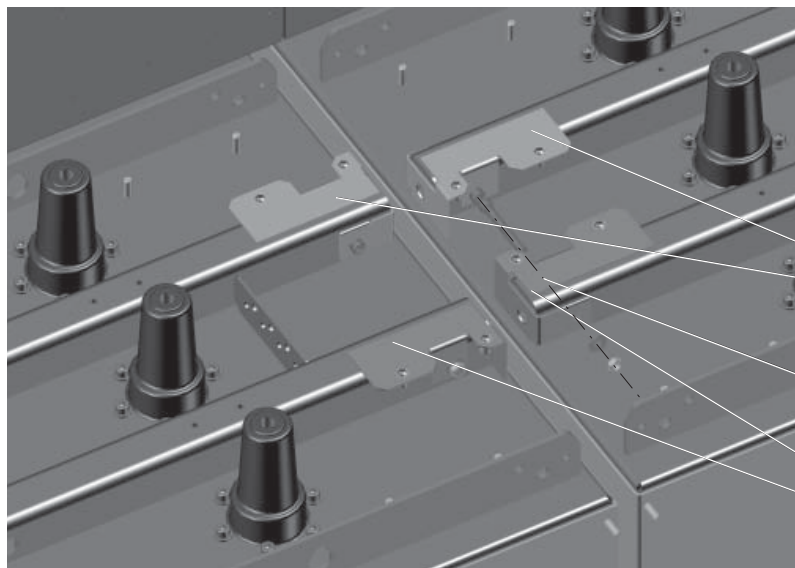
- Screw the base plates to the current transformers as shown in figure 2.3.4.6.1.1.

Fig. 2.3.4.6.1.1: Screwing the base plates to the current transformers



- Screw the mounting plates to the sections of the relevant panel modules as shown in figure 2.3.4.6.1.2.

Fig. 2.3.4.6.1.2: Screwing the mounting plates to the sections of the panel modules



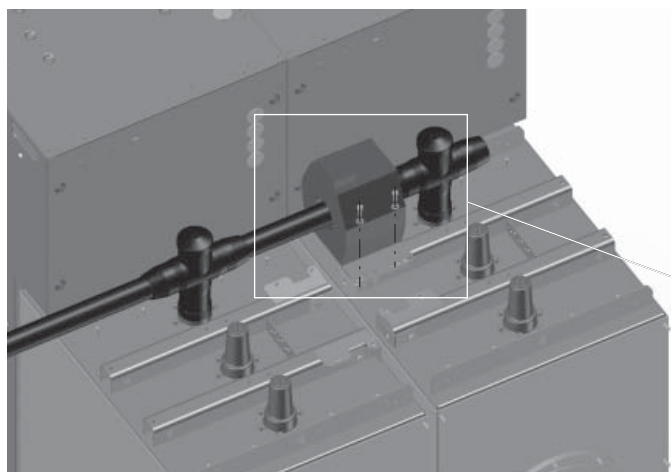
Mounting plate
1VB8003791P0102

Cheese head screw M8 x 65 GCE0303059P0100
Dished washer 8 GCE0407004P0100
Nut 8 GCE0352411P0100

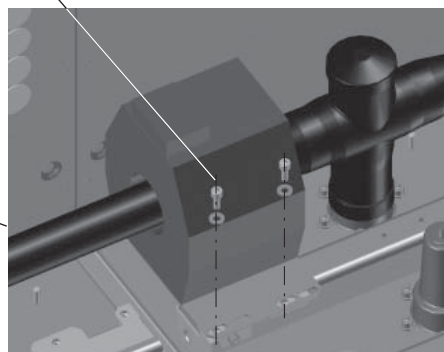
Mounting plate
1VB8003791P0101

- During installation of the busbars, guide the busbar through the aperture in the current transformer. Avoid damage to the conductive layer of the busbar.
- On completion of busbar installation, screw the base plates of the current transformers to the previously fitted mounting plates as shown in figure 2.3.4.6.1.3.

Fig. 2.3.4.6.1.3: Installing the current transformer

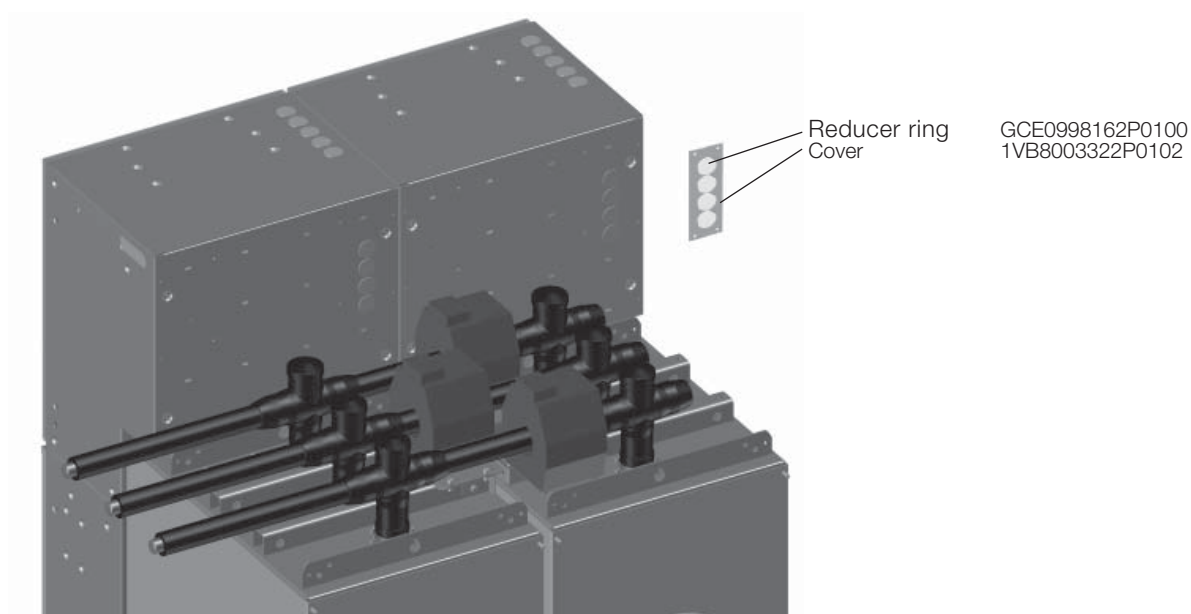


Cheese head screw M8 x 20 GCE0303049P0100
Dished washer 8 GCE0407004P0100



- Follow the same procedure to install the further transformers.
- If the transformer is fitted with a terminal board, wire this up as shown in the circuit diagram.
- Slide the reducer rings over the transformer leads. During assembly of the busbar cover or pressure relief duct, route the transformer leads through the opening in the relevant plate behind the low voltage compartment. The opening is sealed off by a cover (see figure 2.3.4.6.1.4).

Fig. 2.3.4.6.1.4: Installing the further current transformers

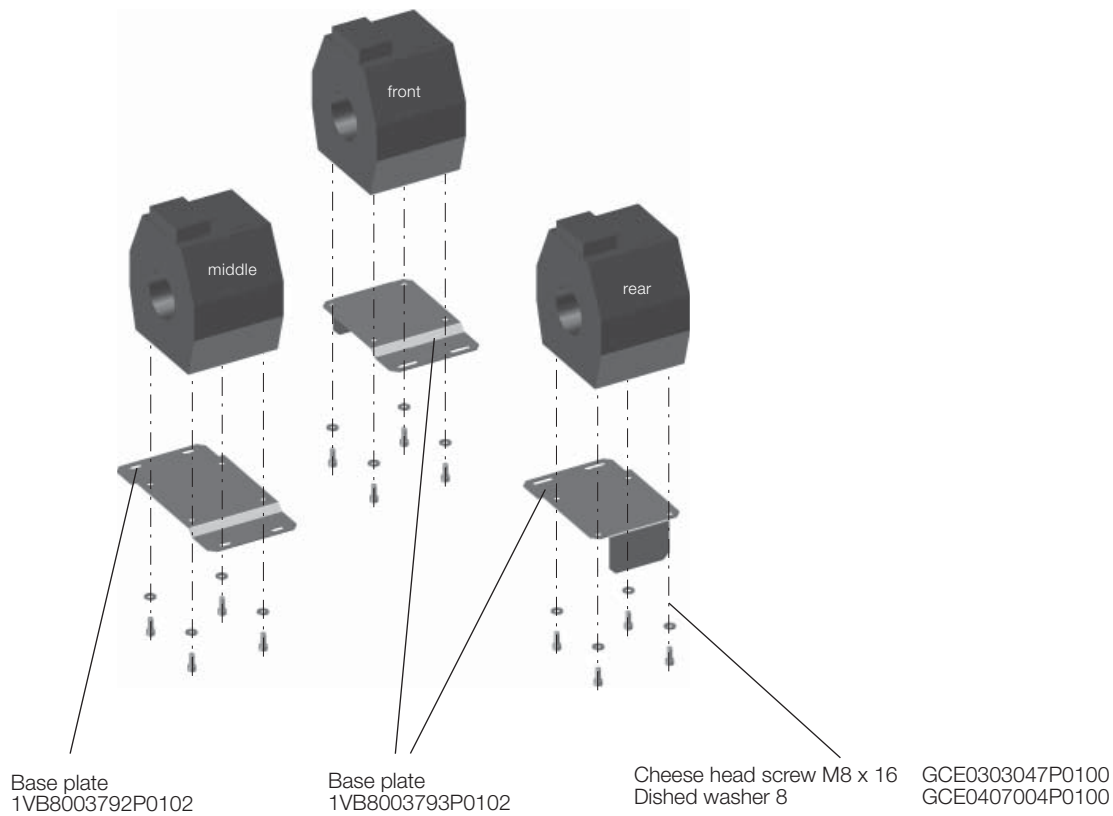


2.3.4.6.2 Installation of the busbar current transformers, variant 2

The illustrations in this section show two panels of 600 mm width. Installation is to take place accordingly for other panel widths in the right-hand position.

- Screw the base plates to the current transformers as shown in figure 2.3.4.6.2.1.

Fig. 2.3.4.6.2.1: Screwing the base plates to the current transformers



- Screw the mounting plates to the sections of the relevant panel modules as shown in figure 2.3.4.6.2.2. The distance (dimension a) of the mounting plates depends on the widths and the positions of the adjacent panels (see table 2.3.4.6.2.1).

Fig. 2.3.4.6.2.2: Screwing the mounting plates to the sections of the panel modules

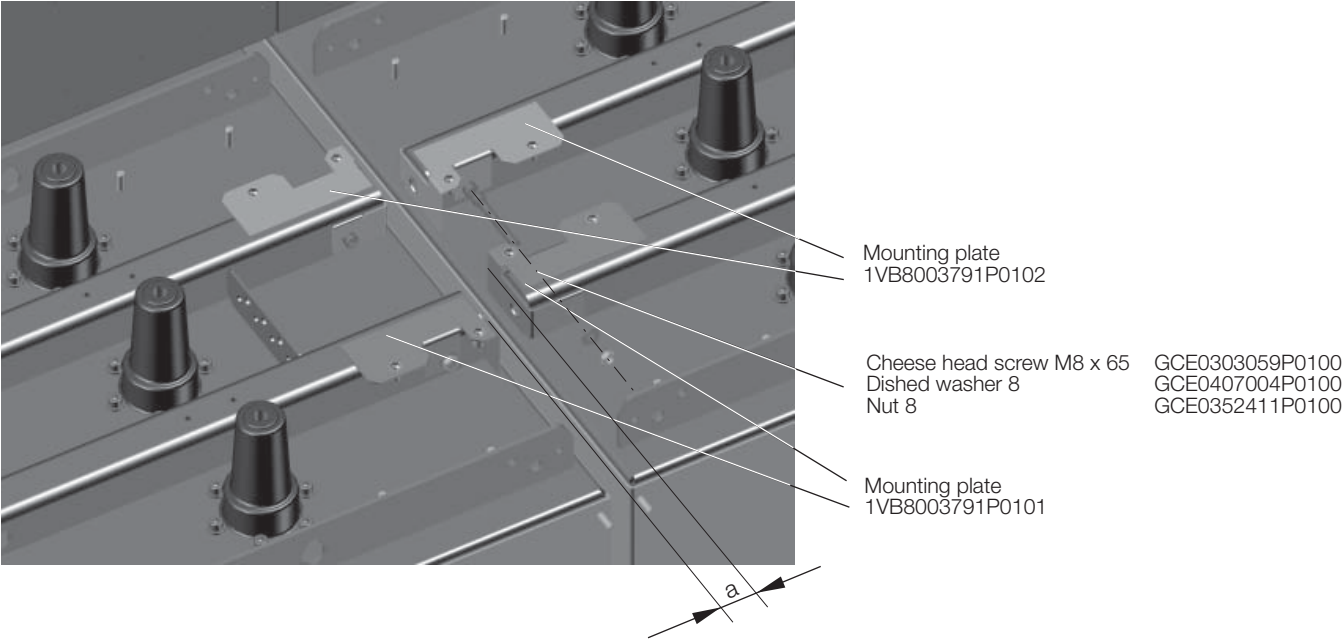
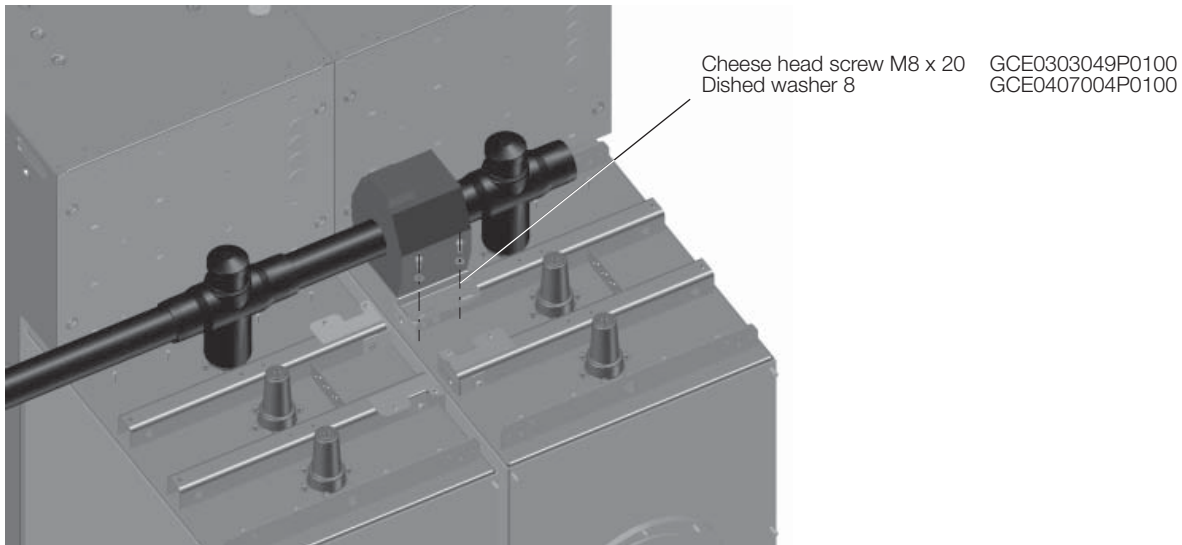


Table 2.3.4.6.2.1: Dimension a in figure 2.3.4.6.2.2 in relation to the width of the right-hand panel		
Panel width, left	Panel width, right	Dimension a / mm
600	600	25
600	900	80
600	1200	231

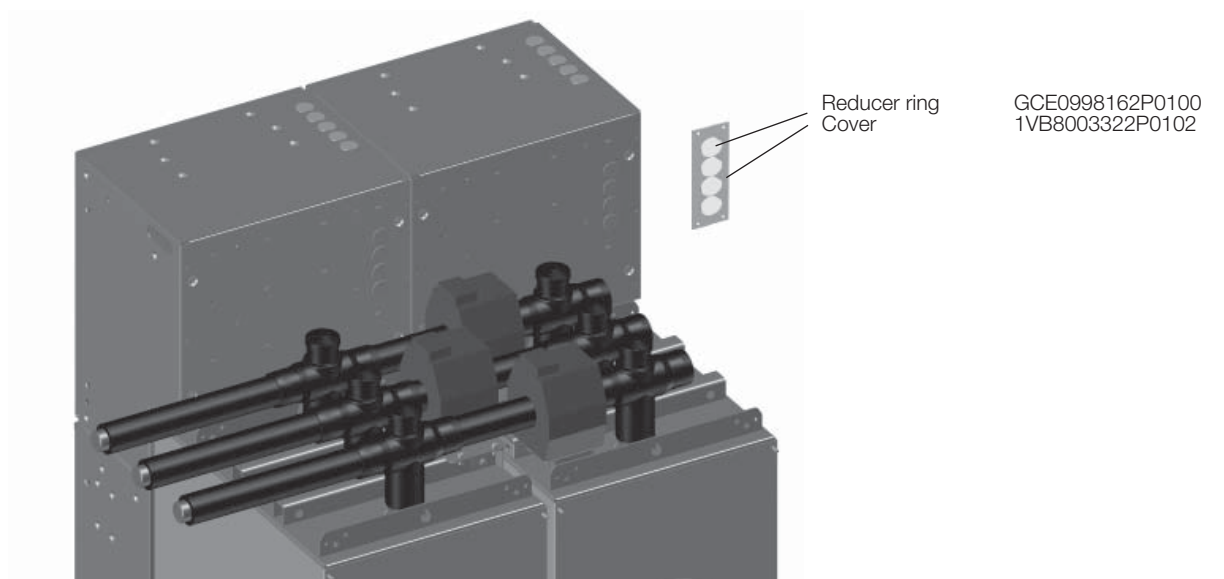
- During installation of the busbars, guide the busbar through the aperture in the current transformer. Avoid damage to the conductive layer of the busbar.
- On completion of busbar installation, screw the base plates of the current transformers to the previously fitted mounting plates as shown in figure 2.3.4.6.2.3.

Fig. 2.3.4.6.2.3: Installing the current transformer



- Follow the same procedure to install the further transformers.
- If the transformers are fitted with a terminal board, wire these up as shown in the circuit diagram.
- Slide the reducer rings over the transformer leads. During assembly of the busbar cover or pressure relief duct, route the transformer leads through the opening in the relevant plate behind the low voltage compartment. The opening is sealed off by a cover (see figure 2.3.4.6.2.4).

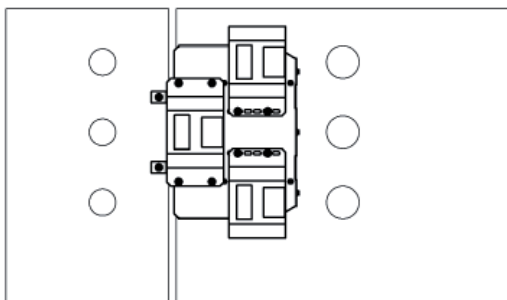
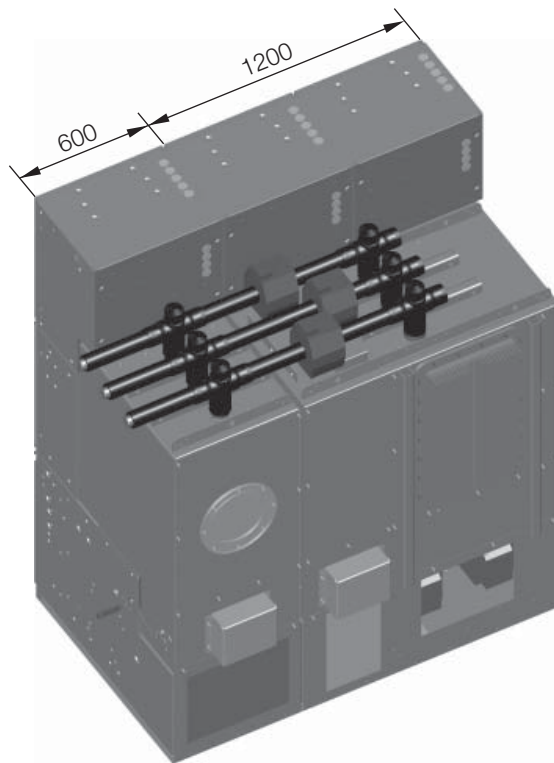
Fig. 2.3.4.6.2.4: Installing the further current transformers



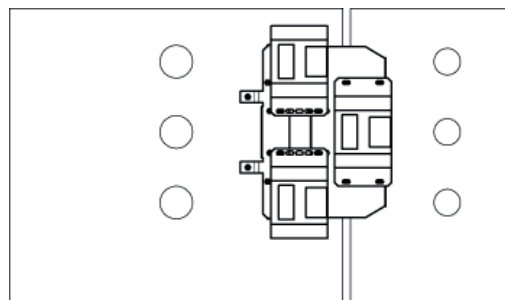
2.3.4.6.3 Installation of the busbar current transformers, variant 3

Figure 2.3.4.6.3.1 shows a 3D view of a completely installed current transformer set in a 1200 mm wide panel with a 600 mm wide panel positioned to the right. The figure also shows the positions of the current transformer sets on the panels which are important for their function, as plan views in relation to the relevant panel widths.

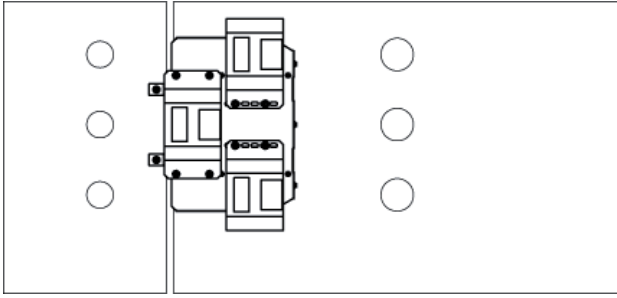
Fig. 2.3.4.6.3.1: Position of the current transformer set



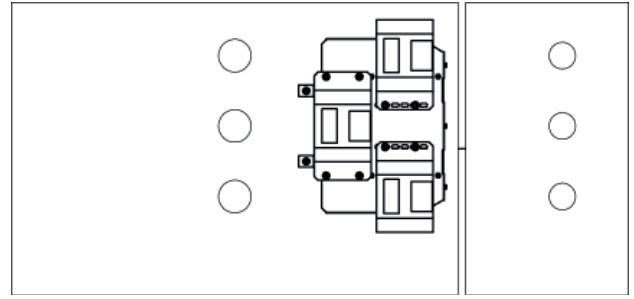
Panel widths: left 450 mm, right 900 mm



Panel widths: left 900 mm, right 450 mm,
600 mm or 1200 mm



Panel widths: left 450 mm, right 1200 mm

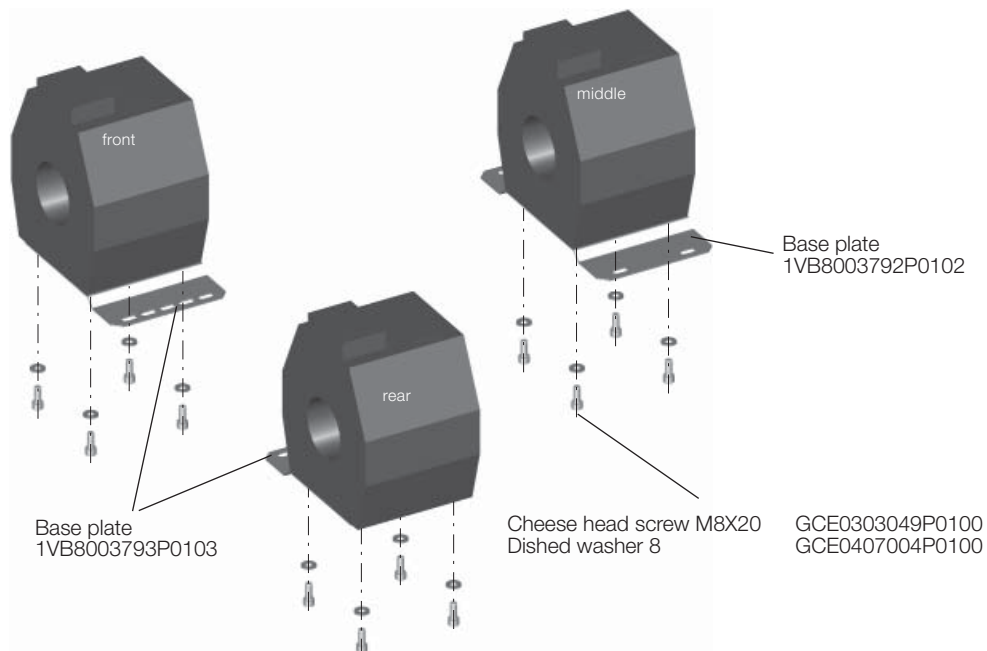


Panel widths: left 1200 mm, right 450 mm, 600 mm or 1200 mm

The further illustrations in this section refer to the installation of current transformers on a panel with a width of 1200 mm, with an adjacent panel to the right with a width of 600 mm. Installation is to take place accordingly for other panel widths in accordance with table 2.3.4.6.1.

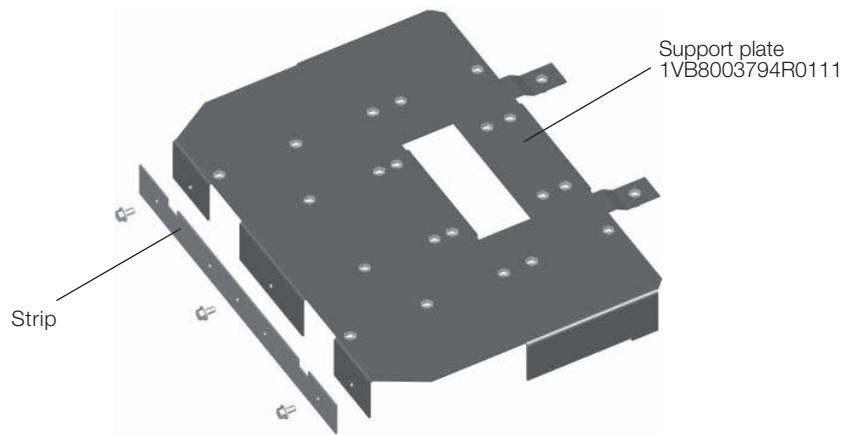
- Screw the base plates to the current transformers as shown in figure 2.3.4.6.3.2.

Fig. 2.3.4.6.3.2: Screwing the base plates to the current transformers



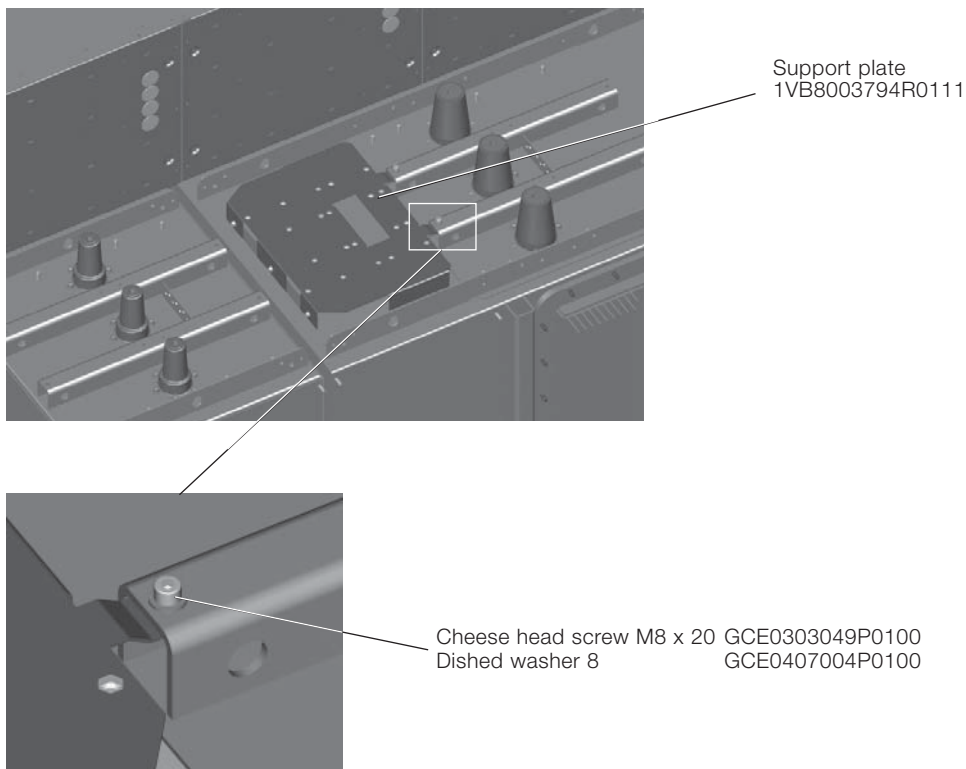
- If the relevant left-hand panel is 900 mm wide and the right-hand panel 600 mm wide, remove the strip from the support plate as shown in figure 2.3.4.6.3.2. In all other cases, the strip must remain on the support plate.

Fig. 2.3.4.6.3.2: Removing the strip from the support plate (only when the left-hand panel is 900 mm wide and the right-hand panel 600 mm wide)



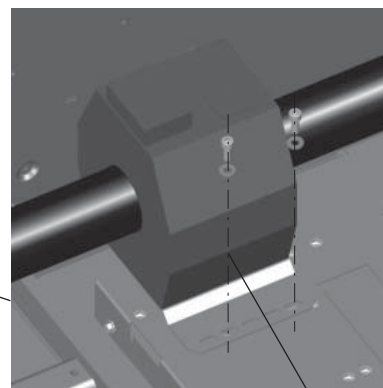
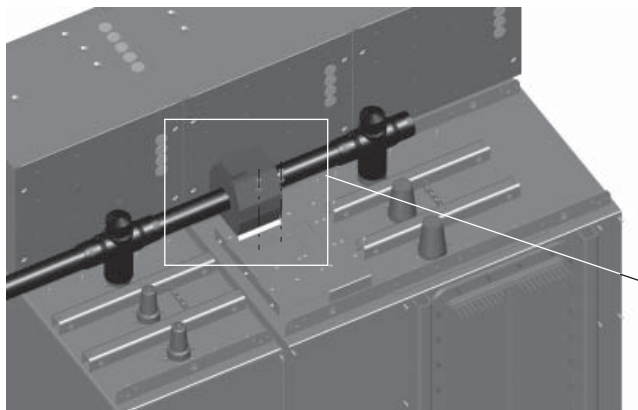
- Screw the support plate to the sections of the relevant panel module at two points as shown in figure 2.3.4.6.3.3.

Fig. 2.3.4.6.3.3: Screwing the support plate to the sections of the panel module



- During installation of the busbars, guide the busbar through the aperture in the current transformer. Avoid damage to the conductive layer of the busbar.
- On completion of busbar installation, screw the base plate of the current transformer to the previously fitted support plate as shown in figure 2.3.4.6.3.4.

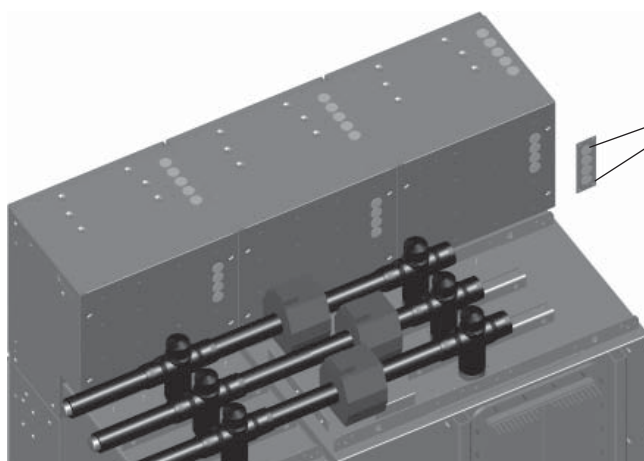
Fig. 2.3.4.6.3.4: Installing the current transformer



Cheese head screw M8X20 GCE0303049P0100
Dished washer 8 GCE0407004P0100

- Follow the same procedure to install the further transformers.
- If the transformers are fitted with a terminal board, wire these up as shown in the circuit diagram.
- Slide the reducer rings over the transformer leads. During assembly of the busbar cover or pressure relief duct, route the transformer leads through the opening in the relevant plate behind the low voltage compartment. The opening is sealed off by a cover (see figure 2.3.4.6.3.5).

Fig. 2.3.4.6.3.5: Installing the further current transformers



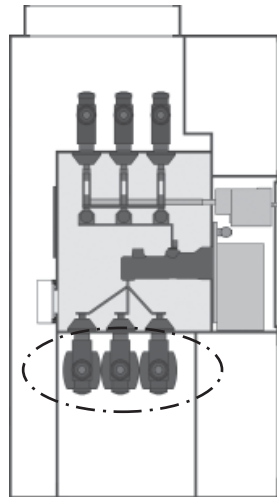
Reducer ring
Cover

GCE0998162P0100
1VB8003322P0102

2.3.4.7 Installation of the busbar and current transformers between a sectionaliser and riser

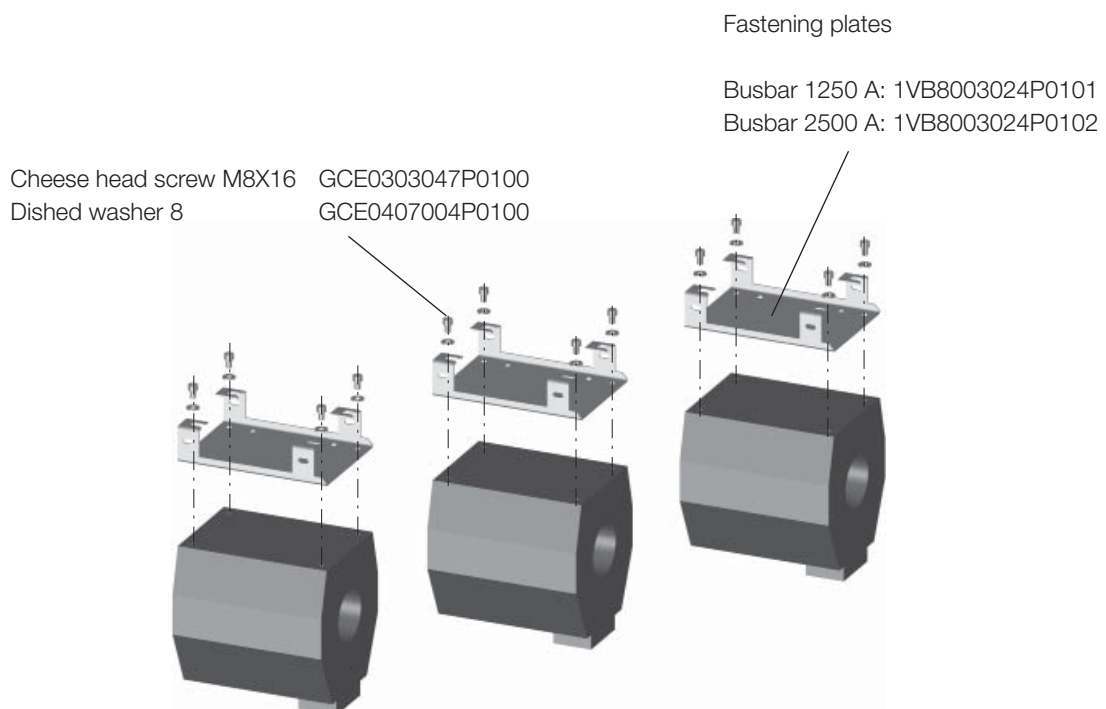
The illustrations in this section refer to sectionaliser and riser panels with a width of 600 mm (1250 A). The current transformers are installed similarly in panels with a width of 900 mm (> 1250 A).

Fig. 2.3.4.7.1: Sectional view of sectionaliser panel, width 600 mm (1250 A), with current transformers between the sectionaliser and riser



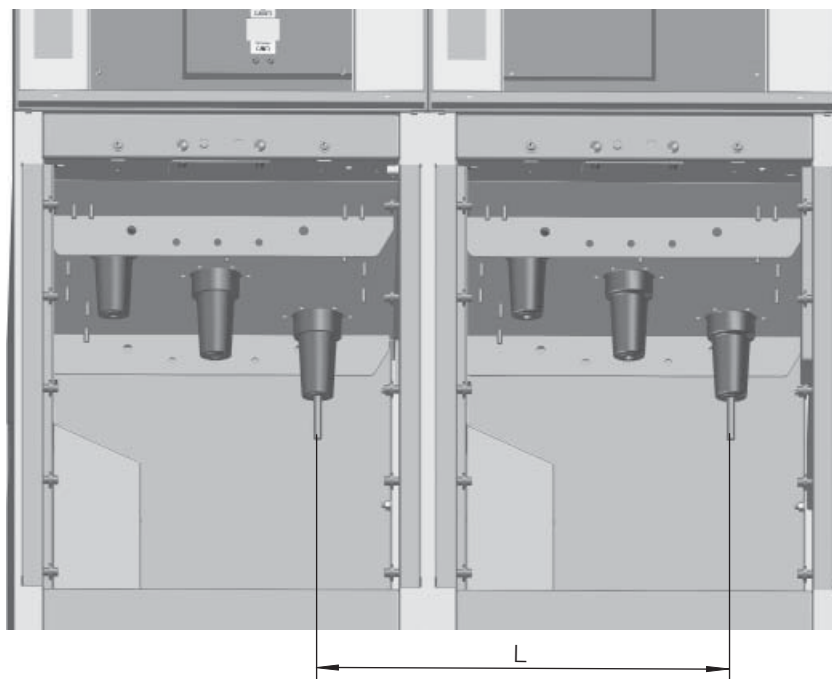
- We recommend completely dismantling the main earthing bar in both the panels.
- Screw the fastening plates to the current transformers as shown in figure 2.3.4.7.2.

Fig. 2.3.4.7.2: Screwing the fastening plates to the current transformers



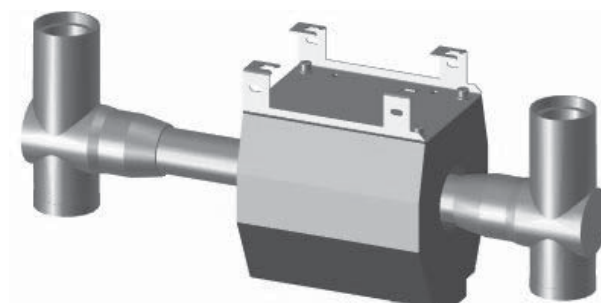
- Start installation with the rear bar.
- Fit the two bushings concerned with studbolts as described in section 2.3.1.3 (see figure 2.3.4.7.3).
- The specified dimensions for distance L between the bolts (see figure 2.3.4.7.3) can be found in tables 2.3.2.1 and 2.3.2.2. Observe the dimensions in in figure 2.3.1.3.2.

Fig. 2.3.4.7.3: View into the termination compartments from the front: Prepared bushings



- Insert the bars through the current transformers outside the panels.
- In the further course of installation, observe the general notes on busbar installation in section 2.3.3.1 with regard to inspection and cleaning of soiled silicone parts, busbars and cast resin bushings and the use of assembly paste.
- Prepare the two end adapters with covering caps and insulating plugs as shown in figure 2.3.4.2.1.
- Fit the end adapters to the busbar (figure 2.3.4.7.4).

Fig. 2.3.4.7.4: Prepared busbar with current transformer



- Move the preassembled unit into the termination area, below the prepared bushings. Ensure that the external conductive layers of the busbar and adapter are not damaged.
- Lift the preassembled unit, plug the adapters onto the bushings and hang the current transformer's fastening plate on the studbolts provided. The nuts on the studbolts hold the transformer in position. Fit the washers and nuts onto the studbolts in the bushings (see figure 2.3.4.2.1 or figure 2.3.4.3.1, items 10 + 11). The nuts hold the bar in position. Tighten the nuts for the bar and those for the current transformer's fastening plate to the specified torque.
- Fit the insulating plugs and the covering caps as described in section 2.3.4.1. Earth the adapter by fastening one end of the earthing lead to the adapter and the other end to a suitable point on the enclosure.

Fig. 2.3.4.7.5: Busbar fitted to the rear bushings

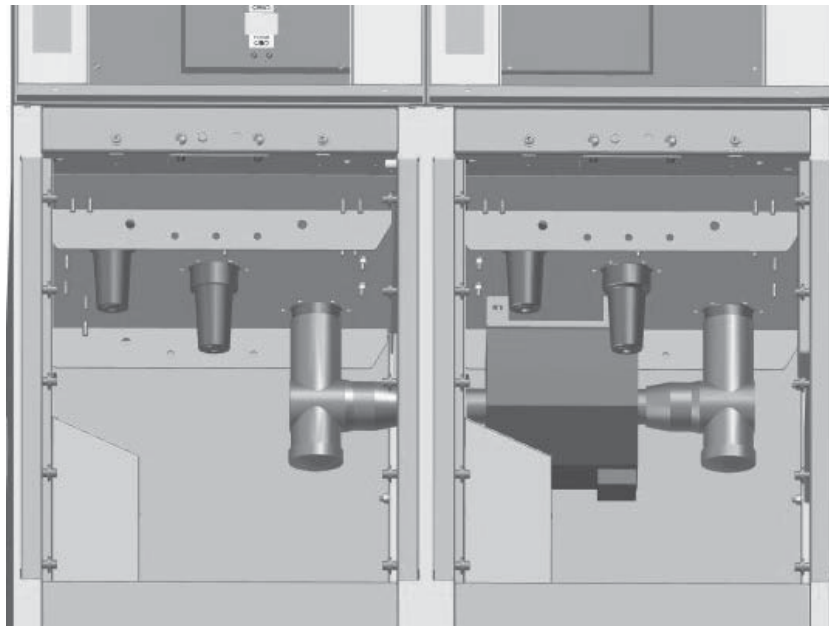
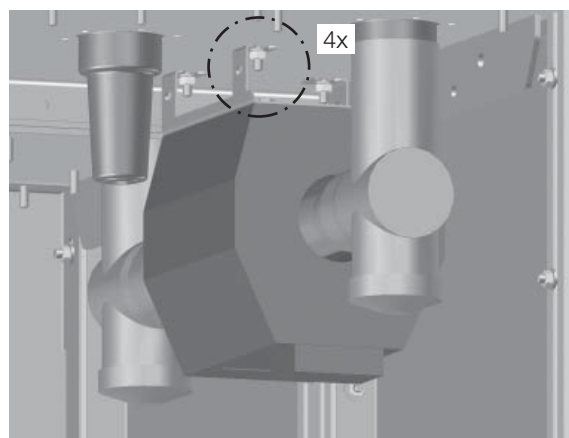
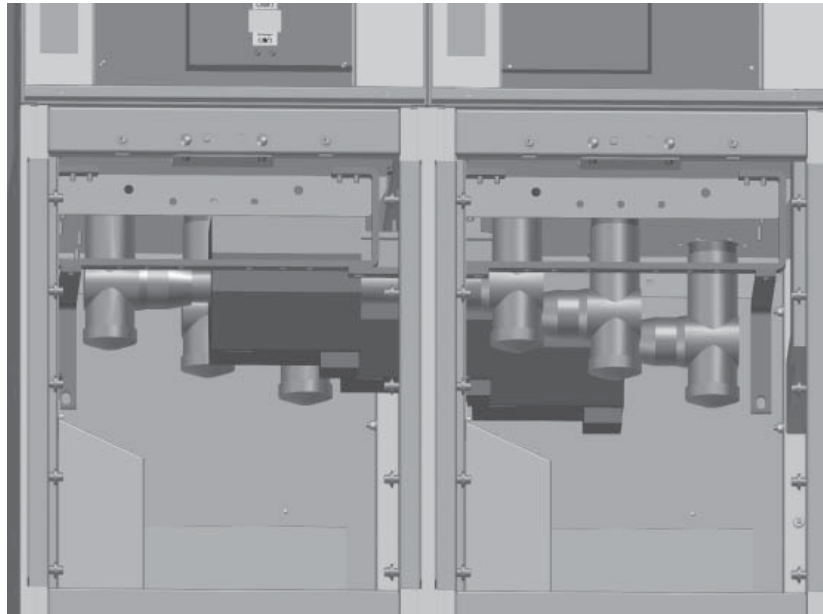


Fig. 2.3.4.7.6: Current transformer fastenings below the enclosure



- Install the further busbars in the manner described above.
- Refit the main earthing bar and the connections between the main earthing bar and the adjacent panels.

Fig. 2.3.4.7.7: Completely assembled arrangement



2.3.4.8 Installation of the busbar voltage transformers



The weight of a voltage transformer can be over 30 kg. Use suitable lifting gear (e.g. a mobile gantry crane) to install the voltage transformers for busbar measurement (type 3). We recommend having installation performed by two fitters. Observe the relevant accident prevention regulations in the country of installation.

The busbar voltage transformers are to be installed after installation of the busbars and before the busbar covers are fitted.

Perform high voltage testing of the busbars before installing the voltage transformers.

Before installing the voltage transformers, remove the insulating plugs (part 12 in figure 2.3.4.2.1 or 2.3.4.3.1) from the relevant end or cross adapters.

Two types of voltage transformer are used:

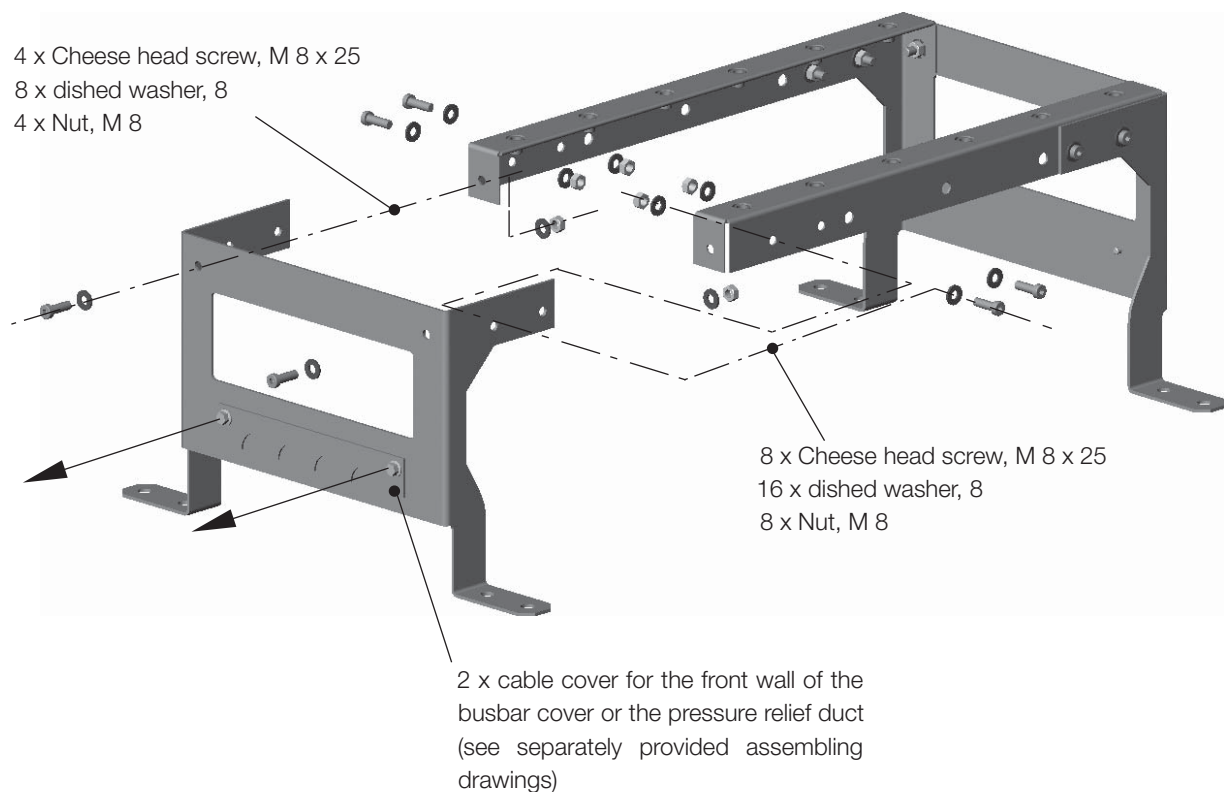
- Type 1: For rated voltages up to 24 kV
- Type 2: For rated voltages greater than 24 kV and up to 36 kV

The two types are installed in different ways, which are described separately in the following two sections

2.3.4.8.1 Installation of the busbar voltage transformers, type 1

Bolt the four individual parts of the voltage transformer frame together (figure 2.3.4.8.1.1). Remove the cable covers for the front wall of the busbar cover and store the two parts for later use.

Fig. 2.3.4.8.1.1: Screwing the individual parts of the voltage transformer frame



Position of the frame on the roof plate of the panel

Use the bores in the feet of the frame to fasten it as shown in figure 2.3.4.8.1.2, Position A when the panel with the voltage transformers is a left-hand end panel or a right-hand sectionaliser or riser panel. In all other cases use Position B.

Bolt the frame to the roof plate of the panel module as shown in figure 2.3.4.8.1.2.



Check the transformer for damage prior to installation.



If you note any damage on the transformer, only use the component after this has been agreed with our service department.

– The surface of the cone must be free of

- gas bubbles,
- scoring,
- damage,
- abrasions,
- foreign bodies.

Cleaning of soiled cone surfaces

Clean the cone of the transformer immediately prior to installation as follows:

- Remove surplus or dirty grease from the cone surface with a soft, clean, non-fraying cloth.



Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

- Clean the surface of the cone with the cleaning agent and a soft, clean, non-fraying cloth.
- After cleaning with intensive cleaner M.X.T. 60 forte, wipe the surface of the cone with a dry cloth.

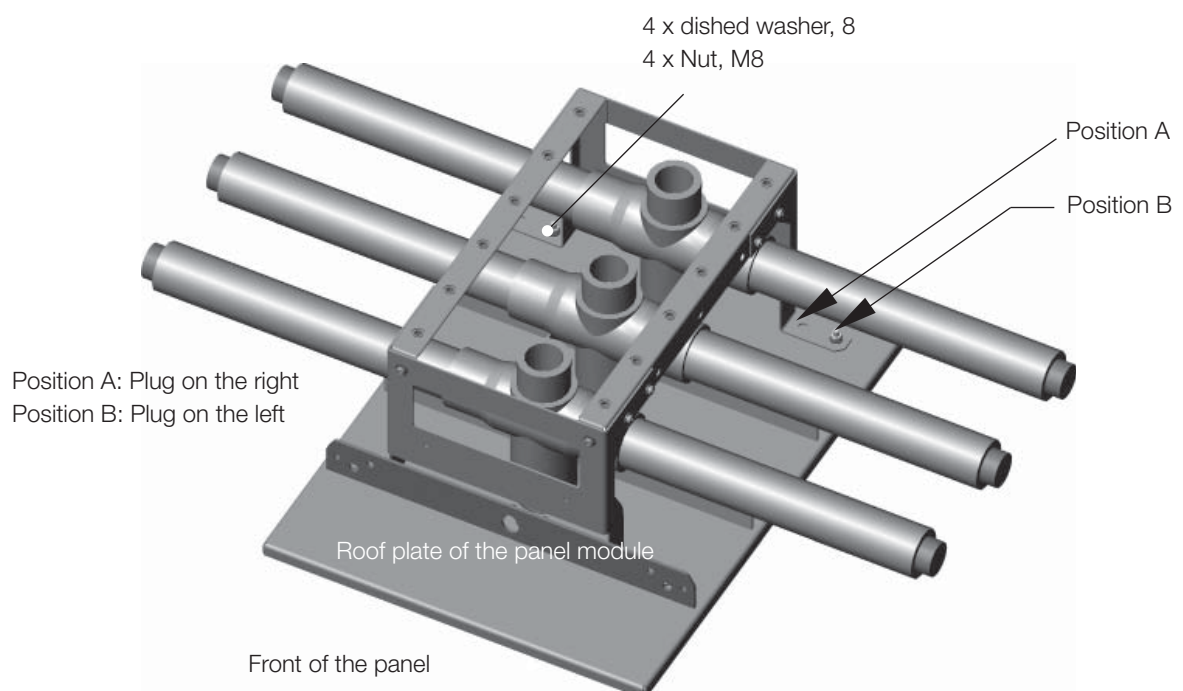
Cleaning the busbar adapters



Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

- Clean the silicone surface with the cleaning agent and a soft, clean, non-fraying cloth.
- Only moisten the cloth slightly with intensive cleaner. Apply only moderate pressure when cleaning the silicone surfaces.
- After cleaning with intensive cleaner M.X.T. 60 forte, wipe the silicone surface with a dry cloth.

Fig. 2.3.4.8.1.2: Installation of the frame



Greasing the cones

- Grease the cone of the transformer and the cone of the adapter lightly, evenly and completely with assembly paste (part number 1VB0000207P0100).

Installing the voltage transformers

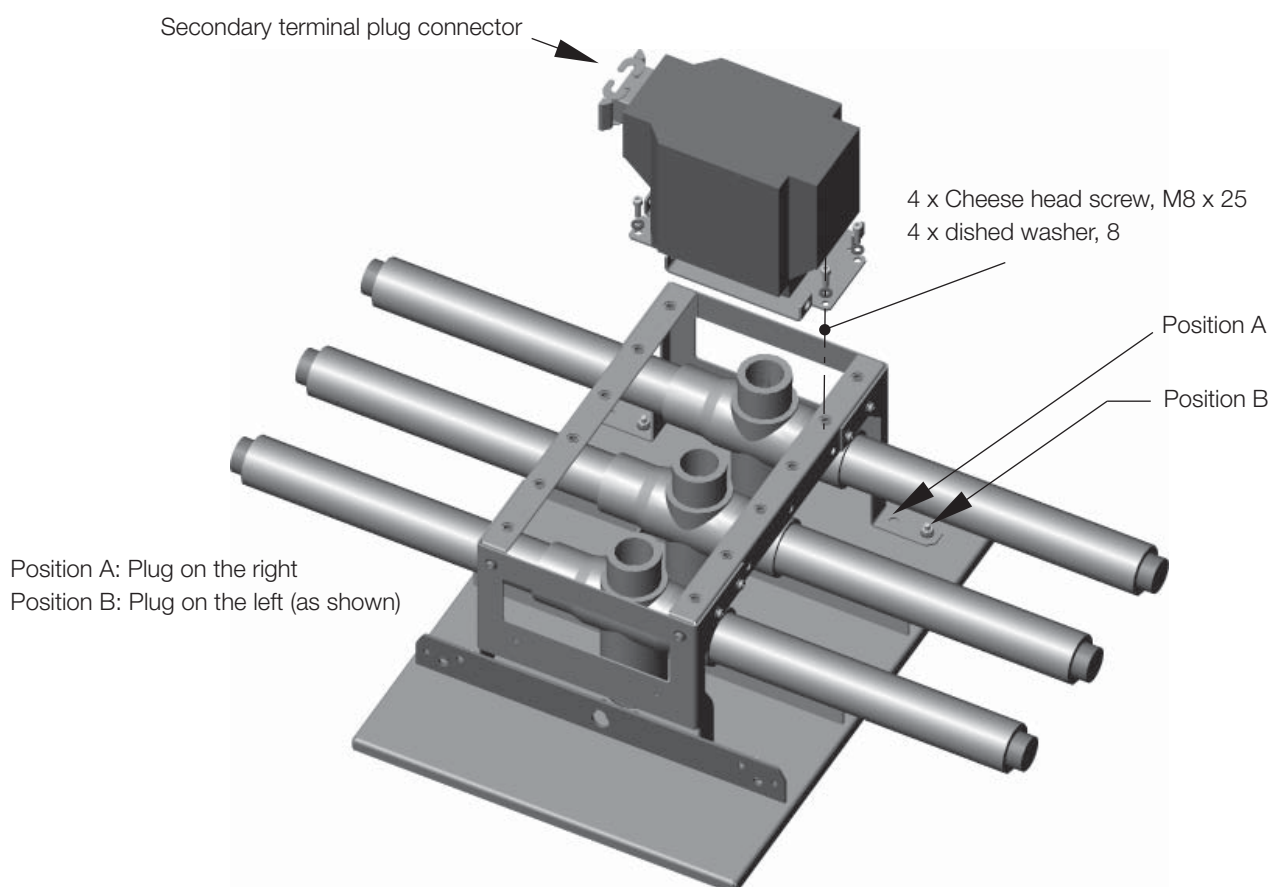
Use the eyebolts supplied for lifting of the voltage transformer. Screw the eyebolts into the threads in the cast resin body of the voltage transformer and lift it using a suitable hoist.

On installation of the frame as shown in figure 2.3.4.8.1.2, Position B, the secondary terminals of the transformer are located on the left (as in figure 2.3.4.8.1.3). When the frame is installed as shown in figure 2.3.4.8.1.2, Position A, the secondary terminals of the transformer are located on the right.

Position the voltage transformer above the corresponding busbar adapter. Lower the voltage transformer slowly and evenly, guiding the silicone insulating part of the transformer into the cone of the busbar adapter.

Bolt the base plate of the voltage transformer to the frame as shown in figure 2.3.4.8.1.3.

Fig. 2.3.4.8.1.3: Mounting a voltage transformer

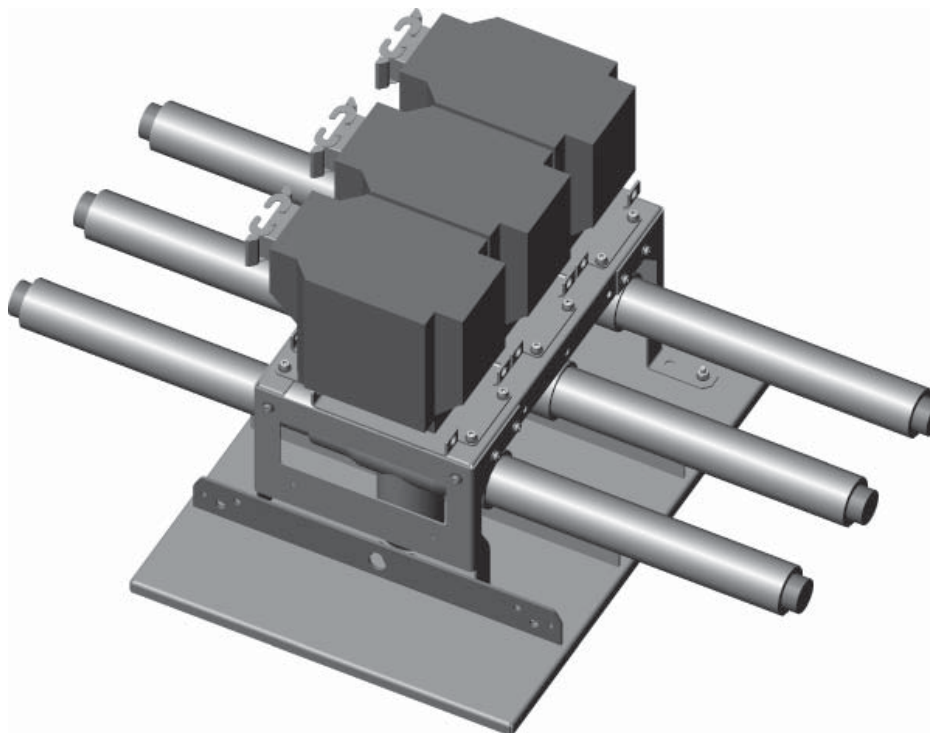


Install the voltage transformers for the other two phases in the same manner. Observe the position of the transformers in figure 2.3.4.8.1.4.

When the front wall of the busbar covers or the front wall of the pressure relief duct have been fitted (see next section), guide the cable harnesses with the instrument transformer secondary wiring and plugs from the low voltage compartment through the opening provided in the front plate of the busbar cover or in the front plate of the pressure relief duct, and close off the opening with the cable cover from figure 2.3.4.8.1.1.

Connect the plugs on the instrument transformer secondary wiring with the connectors on the transformers as shown in the circuit diagram.

Fig. 2.3.4.8.1.4: Three-phase voltage transformer set installed
(Example with secondary terminals on the left)

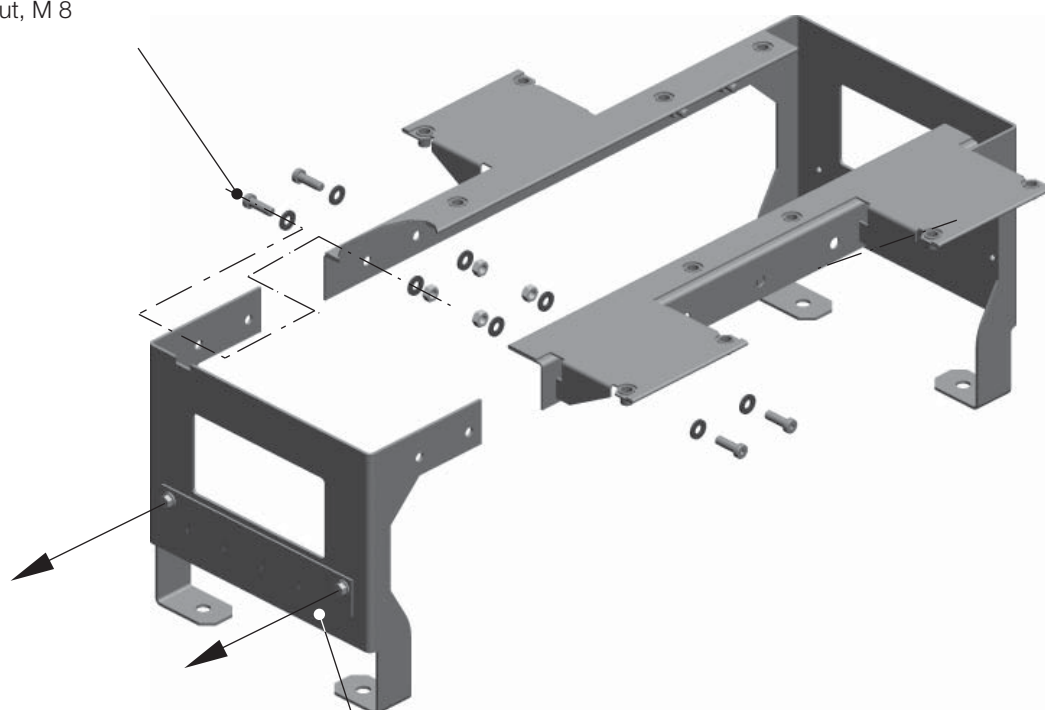


2.3.4.8.2 Installation of the busbar voltage transformers, type 2

Bolt the four individual parts of the voltage transformer frame together (figure 2.3.4.8.2.1). Remove the cable covers for the front wall of the busbar cover and store the two parts for later use.

Fig. 2.3.4.8.2.1: Screwing the individual parts of the voltage transformer frame

8 x Cheese head screw, M 8 x 25
16 x dished washer, 8
8 x Nut, M 8



2 x cable cover for the front wall of the
busbar cover or the pressure relief duct
(see separately provided assembling
drawings)

Bolt the frame to the roof plate of the panel module as shown in figure 2.3.4.8.2.2.



Check the transformer for damage prior to installation.



If you note any damage on the transformer, only use the component after this has been agreed with our service department.

- The surface of the cone must be free of
 - gas bubbles,
 - scoring,
 - damage,
 - abrasions,
 - foreign bodies.

Cleaning of soiled cone surfaces

Clean the cone of the transformer immediately prior to installation as follows:

- Remove surplus or dirty grease from the cone surface with a soft, clean, non-fraying cloth.



Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

- Clean the surface of the cone with the cleaning agent and a soft, clean, non-fraying cloth.
- After cleaning with intensive cleaner M.X.T. 60 forte, wipe the surface of the cone with a dry cloth.

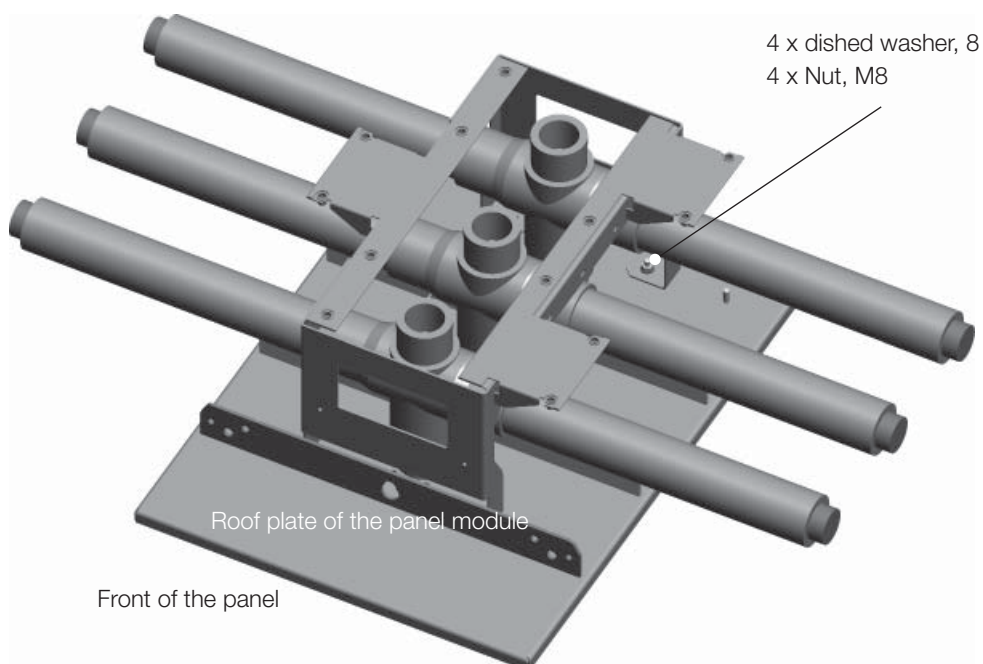
Cleaning the busbar adapters



Only use intensive cleaner M.X.T. 60 forte as the cleaning agent.

- Clean the silicone surface with the cleaning agent and a soft, clean, non-fraying cloth.
- Only moisten the cloth slightly with intensive cleaner. Apply only moderate pressure when cleaning the silicone surfaces.
- After cleaning with intensive cleaner M.X.T. 60 forte, wipe the silicone surface with a dry cloth.

Fig. 2.3.4.8.2.2: Installation of the frame



Greasing the cones

- Grease the cone of the transformer and the cone of the adapter lightly, evenly and completely with assembly paste (part number 1VB0000207P0100).

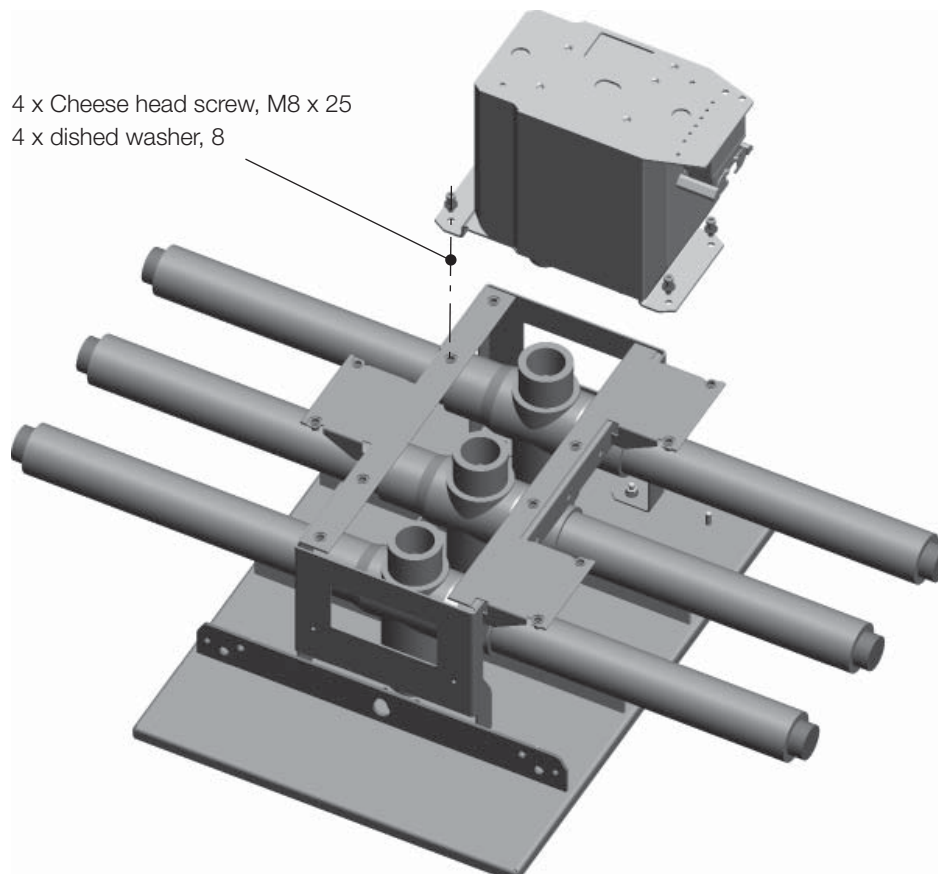
Installing the voltage transformers

Use the eyebolts supplied for lifting of the voltage transformer. Screw the eyebolts into the threads in the cast resin body of the voltage transformer and lift it using a suitable hoist.

Position the voltage transformer above the corresponding busbar adapter. Lower the voltage transformer slowly and evenly, guiding the silicone insulating part of the transformer into the cone of the busbar adapter.

Bolt the base plate of the voltage transformer to the frame as shown in figure 2.3.4.8.2.3.

Fig. 2.3.4.8.2.3: Mounting a voltage transformer

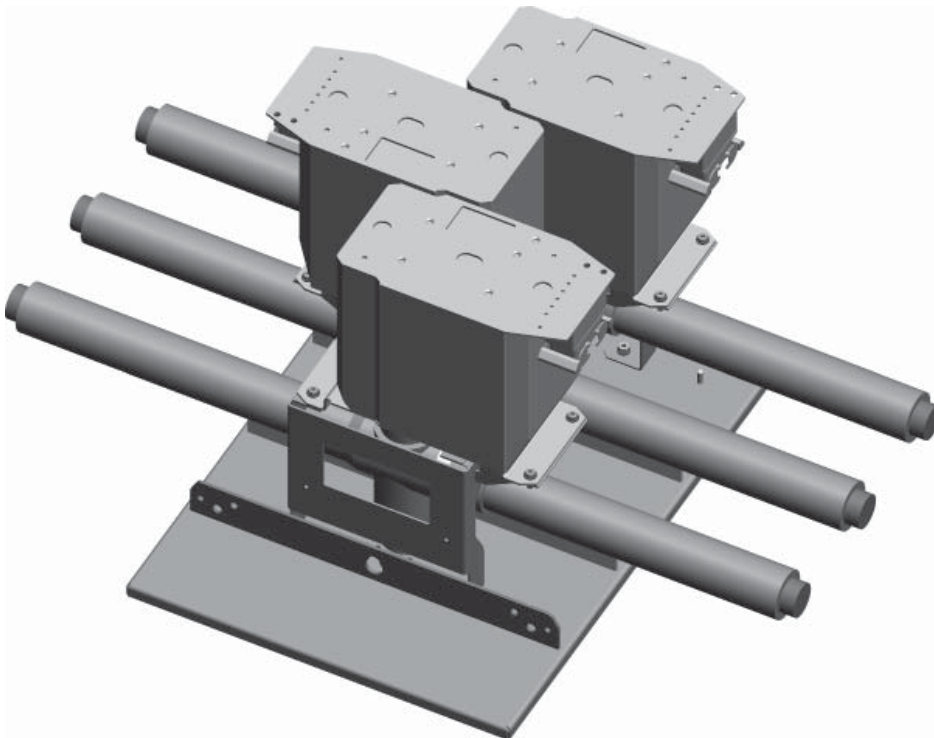


Install the voltage transformers for the other two phases in the same manner. Observe the position of the transformers in figure 2.3.4.8.2.4.

When the busbar covers have been fitted (see next section), guide the cable harnesses with the instrument transformer secondary wiring and plugs from the low voltage compartment through the opening provided in the front plate of the busbar cover, and close off the opening with the cable cover from figure 2.3.4.8.2.1.

Connect the plugs on the instrument transformer secondary wiring with the connectors on the transformers as shown in the circuit diagram.

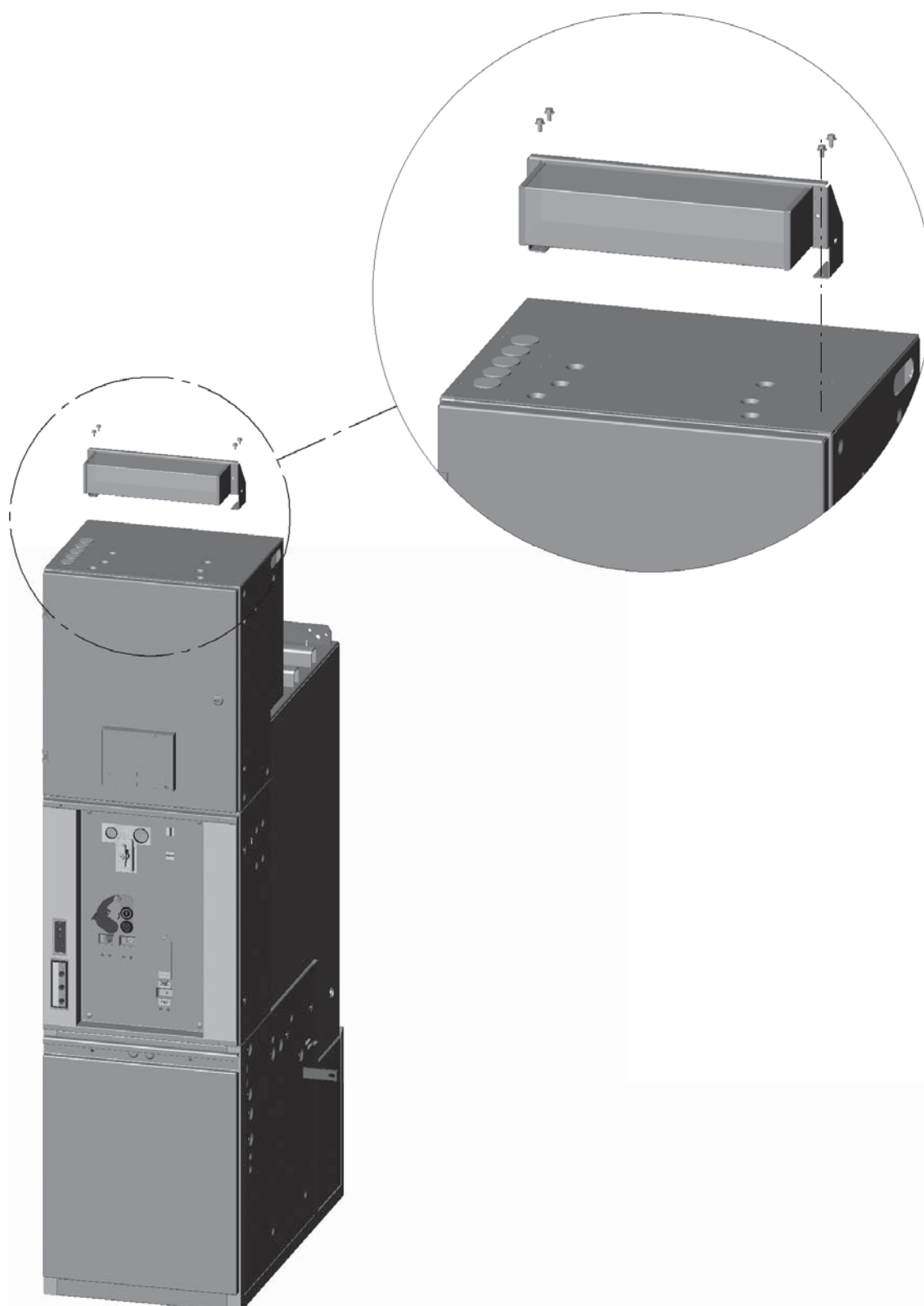
Fig. 2.3.4.8.2.4: Three-phase voltage transformer set installed



2.3.5 Installation of the damping resistor

Fasten the damping resistor, if available, to the roof plate of the relevant panel with the aid of four M6 x 12 self-tapping screws as shown in figure 2.3.5.1. Connect the resistor using the prepared wiring.

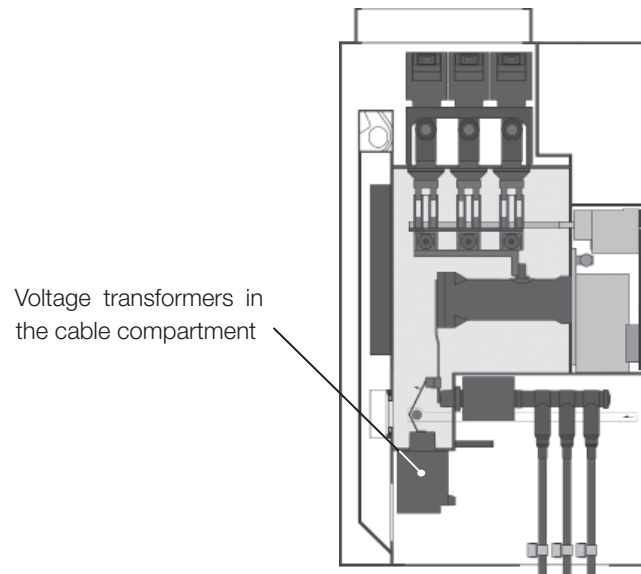
Fig. 2.3.5.1: Installation of the damping resistor



2.3.6 Installation of voltage transformers in the cable compartment

As a rule, voltage transformers in the cable compartment (Fig. 2.3.6.1) are supplied fitted and ready for operation. In individual cases, voltage transformers may also be supplied loose. Please contact ABB for installation information. If the transformers are fitted with a terminal board, wire the transformers after installation according to chapter 2.3.6.1.

Fig. 2.3.6.1: Voltage transformers in the cable compartment



2.3.6.1 Wiring of the voltage transformers

The voltage transformers are fitted with terminal boards. The possible configurations of terminal boards can be found in figure 2.3.6.1.1 and table 2.3.6.1.1.

Fig. 2.3.6.1.1: Possible terminal board configurations



Table 2.3.6.1.1: Possible terminal board configurations

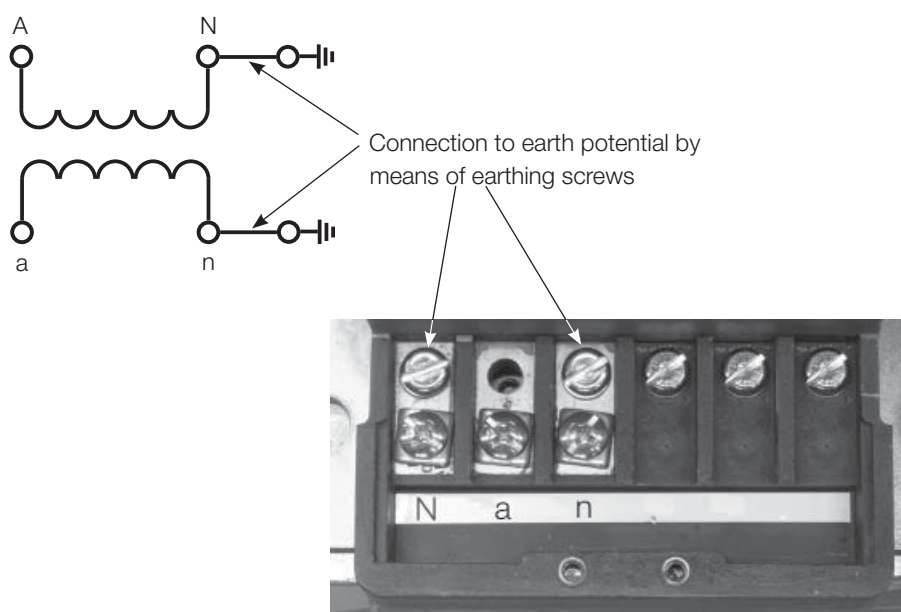
Windings			Terminal					
Number	Tap	e-n winding	1	2	3	4	5	6
1			N	a	n			
1		•	N	a	n	da	dn	
1	•		N	a1	a2	n		
1	•	•	N	a1	a2	n	da	dn
2			N	1a	1n	2a	2n	
2		•	1a	1n	2a	2n	da	dn
2	•		1a1	1a2	1n	2a1	2a2	2n

In a voltage transformer version with 2 windings plus tap or 2 windings plus e-n winding, "N" is implemented at the base plate of the voltage transformer.

Earthing of terminals on the voltage transformer terminal board using earthing screws

Connections to earth potential can be established by means of earthing screws on the terminals of the terminal board. Figure 2.3.6.1.2 illustrates this using the example of a voltage transformer with one secondary winding.

Fig. 2.3.6.1.2: Earthing of terminals using earthing screws



Wiring the voltage transformers

The cable harnesses for wiring of the transformers are prepared at the works and wired to the low voltage compartment. Wire the transformers as follows.



Wire the secondary terminals and the earthing of the voltage transformers in accordance with the circuit diagrams.

Check that all terminal screws including the earthing screws are tightly fastened.

Releasing the earthing screw on the 'N' terminal leads to potentially lethal high voltage at the terminal when the voltage transformer is in operation!

Releasing the earthing screw on the 'N' terminal is only permissible for test purposes on voltage transformers with de-energized primary!

Always use the original earthing screws!

Earthing of e-n windings

If the e-n windings of the voltage transformers are damped with a resistor, the windings connected in an open delta are to be earthed **at one point**. The circuit can be earthed

- in the low voltage compartment (figure 2.3.6.1.3) or
- on the terminal block of a voltage transformer (figure 2.3.6.1.4).

Perform measurements to ascertain which earthing method applies to your system.

Fig. 2.3.6.1.3: Earthing of the circuit in the low voltage compartment

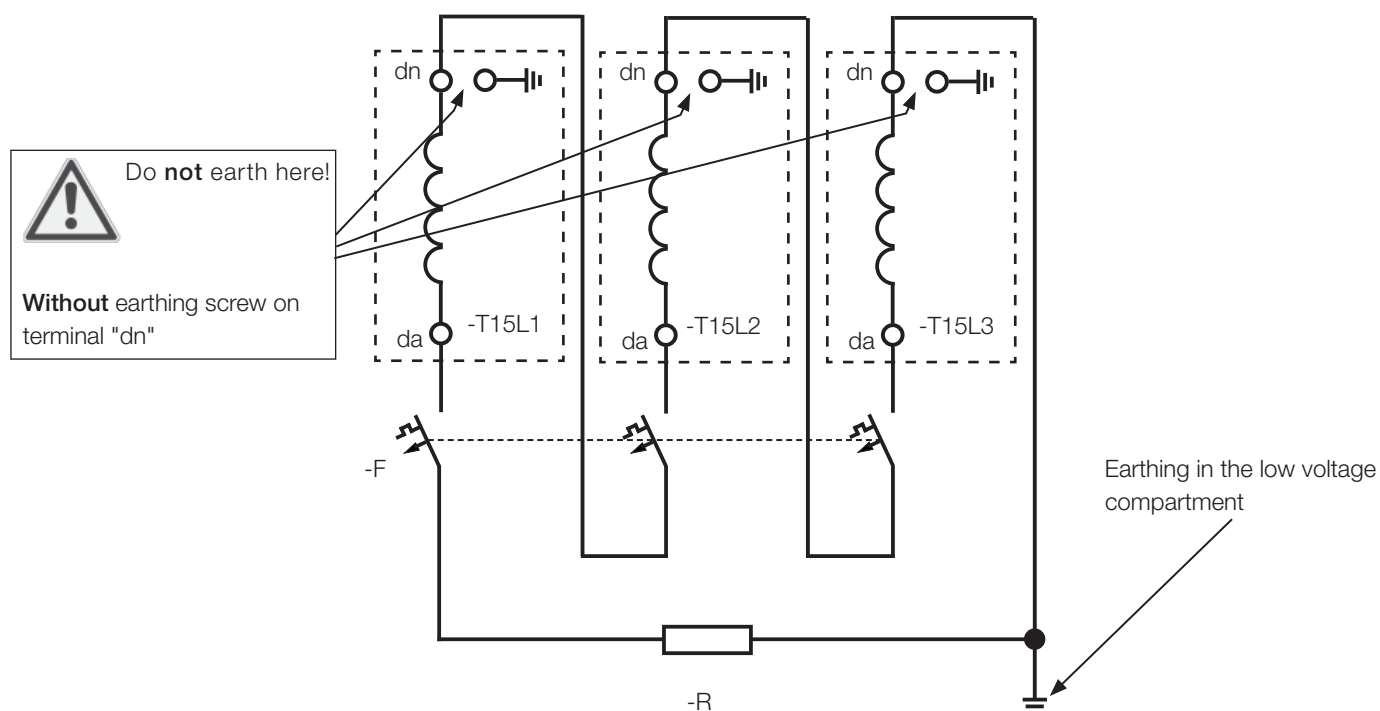
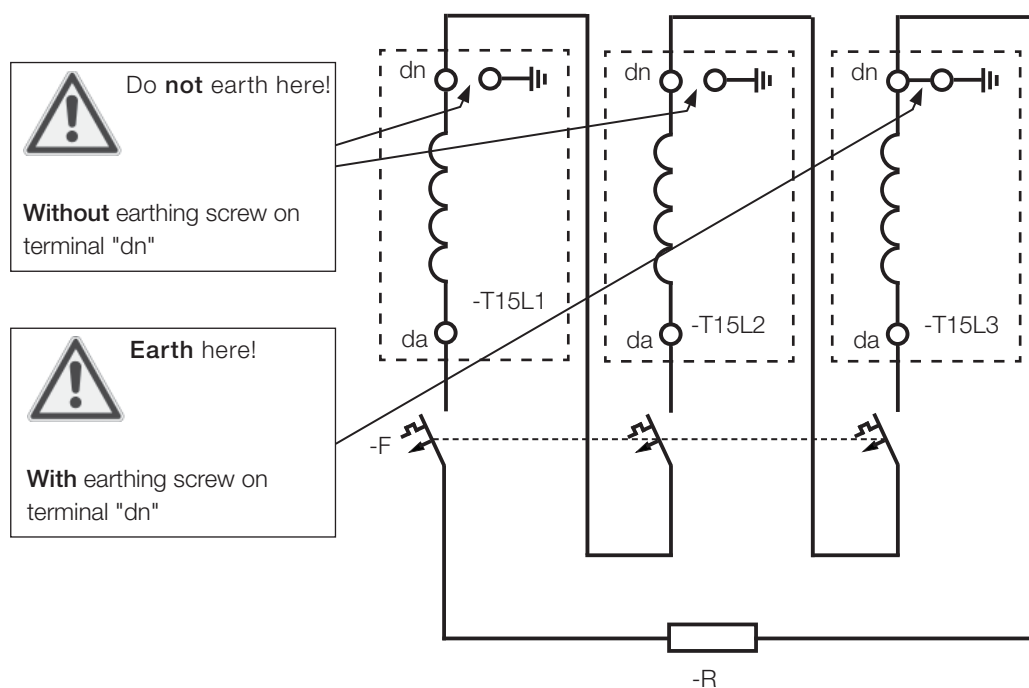


Fig. 2.3.6.1.4: Earthing the circuit on the terminal board of a transformer





Remove the earthing screws of the e-n windings from the terminal boards of the voltage transformers in accordance with the circuit diagrams (figure 2.3.6.1.5) or earth the e-n windings using the earthing screw (figure 2.3.6.1.6).

Earth the circuit at one point only.

Fig. 2.3.6.1.5: View of the terminal board of a voltage transformer with e-n winding: Earthing screw (arrow) in isolated position (no earthing)

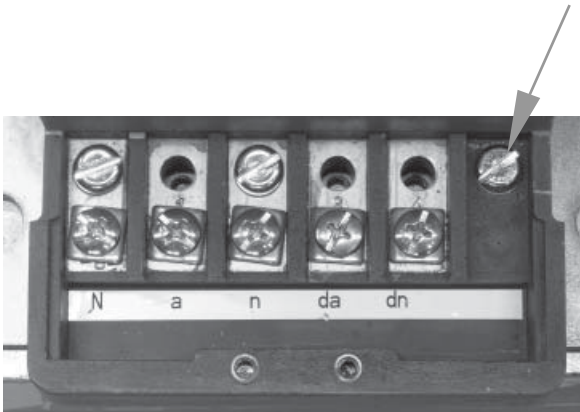
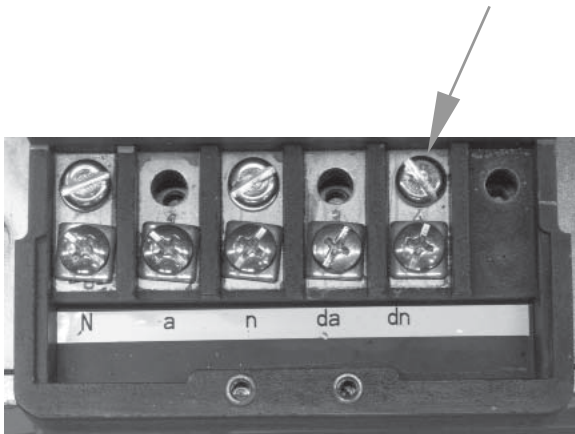



Fig. 2.3.6.1.6: View of the terminal board of a voltage transformer with e-n winding: Earthing screw (arrow) in earthing position (dn terminal earthed)



Checking the wiring



Finally, check the earthing system of the voltage transformer wiring in accordance with table 2.3.6.1.2.

Table 2.3.6.1.2: Earthing of terminals on the voltage transformer terminal board

Windings			Terminals						
Number	Tap	e-n winding							
1			N	a	n				
1		•	N	a	n	da	dn		
1	•		N	a1	a2	n			
1	•	•	N	a1	a2	n	da	dn	
2			N	1a	1n	2a	2n		
2		•	1a	1n	2a	2n	da	dn	
2	•		1a1	1a2	1n	2a1	2a2	2n	

N

The terminal must be earthed via the earthing screw!

n

Earthing of the terminal in accordance with the circuit diagram!

dn

Earthing screw fitted in accordance with the circuit diagram and figure 2.3.6.1.3 or 2.3.6.1.4!

When 2 windings plus a tap or 2 windings plus e-n winding, are used, "N" is implemented by the works at the base plate of the voltage transformer.

2.3.7 Fitting the cover plates

Fit the rear cover plate (for free-standing installation), the busbar cover and the end covers as shown in the installation drawings supplied with the switchgear.

2.4 Connection of cables and wiring

2.4.1 Control cables and wiring

- Establish the panel to panel connections of the control wiring. The panel to panel connections are of the plug-in type.

Earth the cable screen for the external control cables in accordance with the accepted EMC (electromagnetic compatibility) rules.



External control cables should be screened.



The lengths of the external control cables should not exceed 200 m. With greater lengths, use for example interposing relays or optical fibre cables.

- The cable entry for external control cables and wiring is located in the roof plate of the low voltage compartment or in the floor plate of the cable termination compartment.

Cable entry in the roof plate of the low voltage compartment

- Route the external control cables and wiring through the roof plate using reducer rings and connect them as shown in the circuit diagram.

Cable entry in the floor plate of the cable termination compartment

- Dismantle the left-hand secondary cable duct in the cable termination compartment. Using reducer rings, route the external control cables and wiring through the opening between the cable termination compartment and the operating mechanism bay, and through the opening between the operating mechanism bay and the low voltage compartment, and connect them as shown in the circuit diagram.

2.4.2 High voltage cables

The high voltage cables are installed after completion of the high voltage test on the busbar.

- Dismantle the floor plates of the cable termination compartments. Remove the cable bushings from the floor plates.
- Lay the high voltage cables to the panels in accordance with the project planning.



Ensure that the phase positions of the cables are correct!

- Slide the cable bushings onto the cables.
- Connect the cable connectors to the cables in accordance with the manufacturer's instructions.

Checking the outer cones



Check the outer cones for damage. If there is damage to the outer cones, please contact our service department.

Cleaning the outer cones

Remove any surplus or dirty grease or soiling from the outer cones with a soft, clean, non-fraying cloth. Use intensive cleaner M.X.T. 60 forte for cleaning if necessary.

Fitting the cable connectors

- Connect the cable connectors to the relevant outer cones in accordance with the manufacturer's instructions.
- Connect the earthing conductors of the cable screens to the earthing bar in the panel.
If window-type current transformers are used, route the earthing conductors of the cable screen back through the current transformers and connect the earthing conductor to the earthing bar in the panel.



The earthing conductors of the cable screens should always be routed to the earthing bar in the shortest possible distance.



Observe the tightening torques for screw connections given in the cable connector manufacturer's instructions.

- Use a diagonal cutter to break out the required cable openings in the floor plates.
- Press the cable bushings into the openings in the floor plates.
- Refit the floor plates and covers on the panels.

2.5 Connecting the main earthing bar

- Connect the main earthing bar to the station earth.



Details of the cross section and the number of connections can be found in the earthing diagram (not included in ABB's scope of supply).

- Establish the earthing connections in accordance with IEC 61936 and IEC 62271-1 from the points of view of touch voltage, short-circuit capability and electromagnetic compatibility (EMC).

2.6 Concluding installation work

- Remove all tools and other foreign bodies from the switchgear.
- Refit any cladding, covers, cable ducts, etc. removed during the installation work.



Use only chlorine-free cleansers for cleaning of the switchgear.

- Clean the outsides of the panels where necessary.
- Touch up any damage to paintwork with a suitable paint.
- Check that the switchgear room is in proper condition for operation and establish that condition if necessary.

3 Commissioning

3.1 Conditions for commissioning of the switchgear

The conditions for commissioning of the switchgear are as follows:

- Supply voltage is available.
- There are no active SF₆ gas pressure alarms.
- Visual examination and sample checks on installation in accordance with this document have been performed.
- External control cables and wiring have been installed.
- Testing of the specified protection data of the secondary equipment has been successfully performed.
- Protection testing has been passed.
- Testing of all mechanical and electrical functions of the switching devices and corresponding operating mechanism has been successfully performed.
- Testing of the panel and switchgear interlocks has been successfully performed.
- Several trial switching operations (without service voltage) on all switching devices have been successfully performed.
- Switch positions are correctly displayed on the panels and – if necessary – in the control room.
- If remote control systems are fitted, these have been successfully tested.
- Unused outer cones have been closed off and insulated.
- High voltage testing of the busbar at 100 % of rated short duration power frequency withstand voltage U_d to IEC 62271-200 has been successfully completed.
- The high voltage cables have been installed (after high voltage testing of the busbar).
- All cladding and covers have been fitted.
- The following accessories have been handed over to the operators:
 - This manual
 - The corresponding documents and order documents
 - Double bit key or barrel lock key for opening and closing of the low voltage compartment door.
 - Levers and cranks for operation of the operating mechanisms (see list of accessories).
 - Earthing set (optional)
 - Plug-in indicator unit for capacitive indication – if necessary (see section 5.1).
 - Phase comparator in the case of more than one incoming feeder (optional).
 - A work instruction for handling of SF₆ (an example can be found in instruction manual HB 605) is displayed in the switchgear room.
- The operators have been instructed in the theory and practice of operation of the switchgear and are familiar with all details of operation.

3.2 Energizing the system

- Please consult section 4 for procedures for operating the devices. Also observe section 3.1.
- Switch all circuit-breakers off.
- Switch all three position disconnectors off.
- Switch all three position switch-disconnectors off.

Connecting the incoming feeder panels

- Switch the three position disconnector in the incoming feeder panel to the “Disconnecter ON” position.
- Switch the circuit-breaker in the incoming feeder panel “ON”.
- The busbar is then at operating voltage.



Before connecting further incoming feeder panels, ensure that the phase angle of the panels is identical (section 5.2).

Connecting the outgoing feeder panels (loads) when these are circuit-breaker panels

- Switch the three position disconnector in the outgoing feeder panel to the “Disconnecter ON” position.
- Switch the circuit-breaker in the outgoing feeder panel “ON”.
- The loads are then switched on.

Connecting the outgoing feeder panels (loads) when these are switch-disconnector panels with fuses

- Switch the three position switch-disconnector in the outgoing feeder panel to the “Switch-disconnector ON” position.
- The loads are then switched on.

Switch the further loads on as described.

The switchgear is in operation.

4 Operation

General notes

- All activities in connection with operation of the switchgear require compliance with EN 50110 standard or relevant national regulations regarding the operation of electrical installations.
- Always make sure that switching operations have been completed before performing the next switching operation.

Optional interlocking of the cable termination compartment cover

The cover on the cable termination compartment can only be removed when the outgoing feeder of the relevant panel is earthed (earthing switch and circuit-breaker ON).

In the case of a panel with 1200 mm width, remove the left-hand cover first. Deblock the right-hand cover by pressing slide 1 in figure 4.1 to the left. Press slide 2 upwards to lock slide 1 in position (figure 4.2). Remove the right-hand cover.

Press slide 2 downwards to activate the interlock.

Fig. 4.1: Deblocking of the right-hand cover on a panel of 1200 mm width

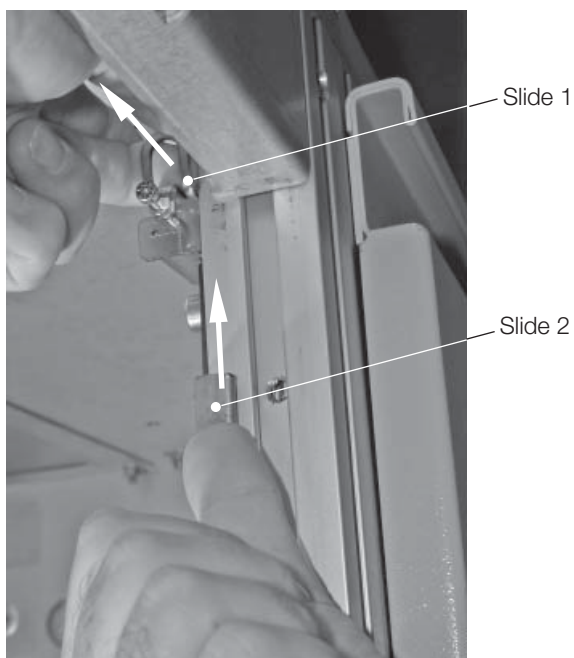


Fig 4.2: Limit position of the slides with deblocked right-hand cover on a panel of 1200 mm width



4.1 Panels with circuit-breakers and three position disconnectors

The three switching positions of the three position disconnector, “connecting”, “disconnecting” and “preparing for earthing” are clearly defined by the mechanical structure of the switch. Connecting and disconnecting the operating current and earthing are performed exclusively by the circuit-breaker (Fig. 4.1.1 and Fig. 4.1.2). Fig. 4.1.3 to Fig. 4.1.8 show the switching sequence for earthing of a busbar section using the sectionaliser and riser, on the basis of an example switchgear installation.

In order to avoid maloperation, the operating mechanisms are mechanically or electrically interlocked, and as an option also electrically interlocked between different panels.

- The three position disconnector (disconnecter and earthing switch function) can only be operated when the circuit-breaker is open. The earthing switch can only be operated when the disconnector is open. The disconnector can only be operated when the earthing switch is open.



See the order documents for the conditions of optional panel to panel interlocks.

4.1.1 Notes on earthing of a feeder panel or system section



When feeder panels or section of the system has been earthed by operating the earthing switch and circuit-breaker (figures 4.1.1, and 4.1.3 to 4.1.8), secure it to prevent cancellation of earthing as follows:

Switch the mcbs ¹⁾ for the circuit-breaker release circuit and for the motor-operated mechanism of the three position switch in the relevant panel off.

Lock the low voltage compartment door or where appropriate the mechanical OFF button for the circuit-breaker.

Affix a sign to the panel to indicate that earthing has been performed.

Fig. 4.1.1: Earthing a feeder and cancelling the earthing

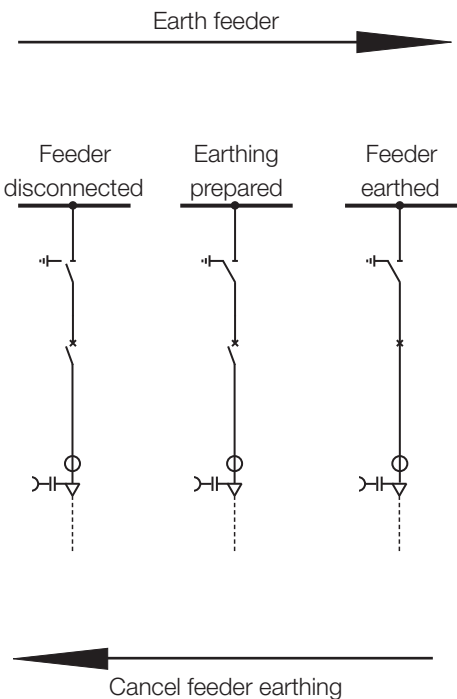


Fig. 4.1.2: Connecting and disconnecting a feeder panel

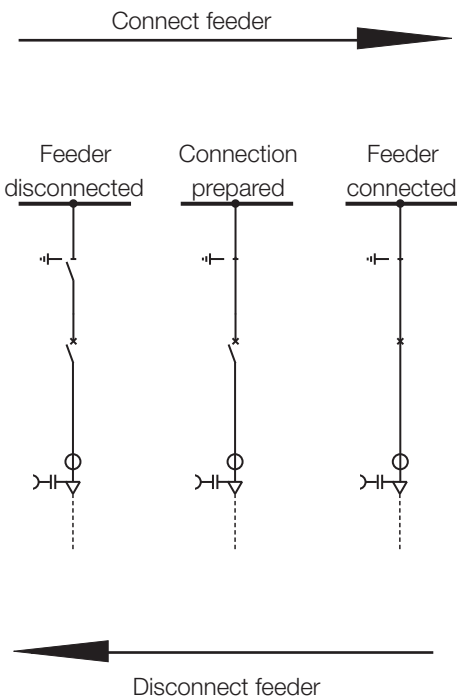


Fig. 4.1.3: Example switchgear, consisting of two busbar sections, in operation

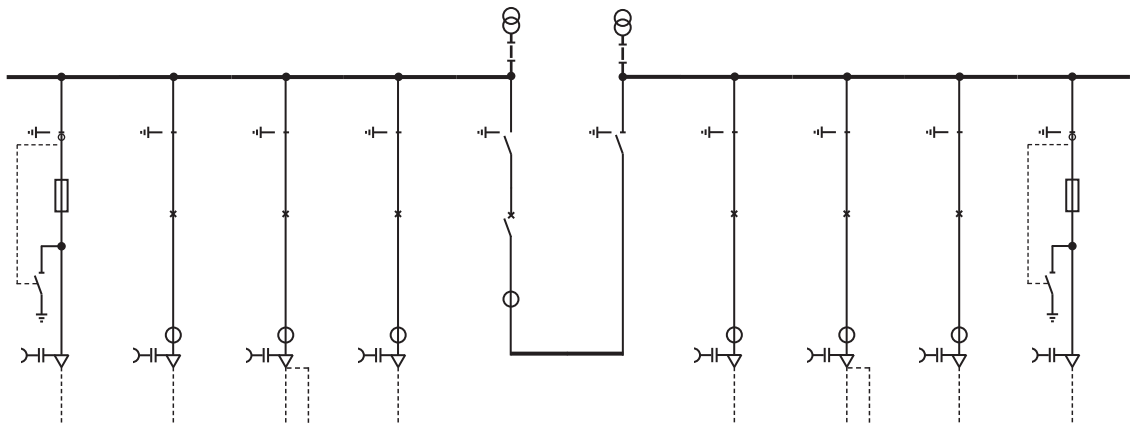


Fig. 4.1.4: Opening the circuit-breakers in the feeder panels in the area of the busbar section to be earthed

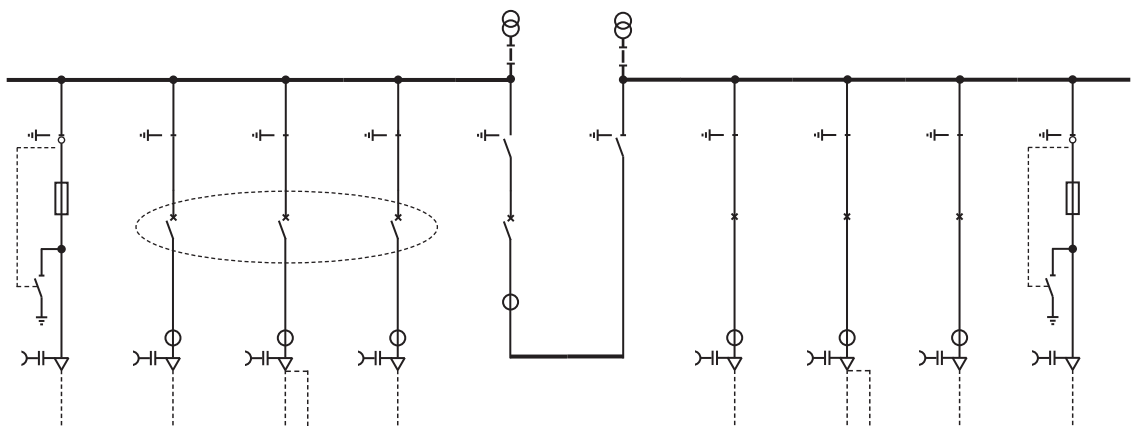


Fig. 4.1.5: Opening the disconnectors and switch-disconnectors in the feeder panels in the area of the busbar section to be earthed

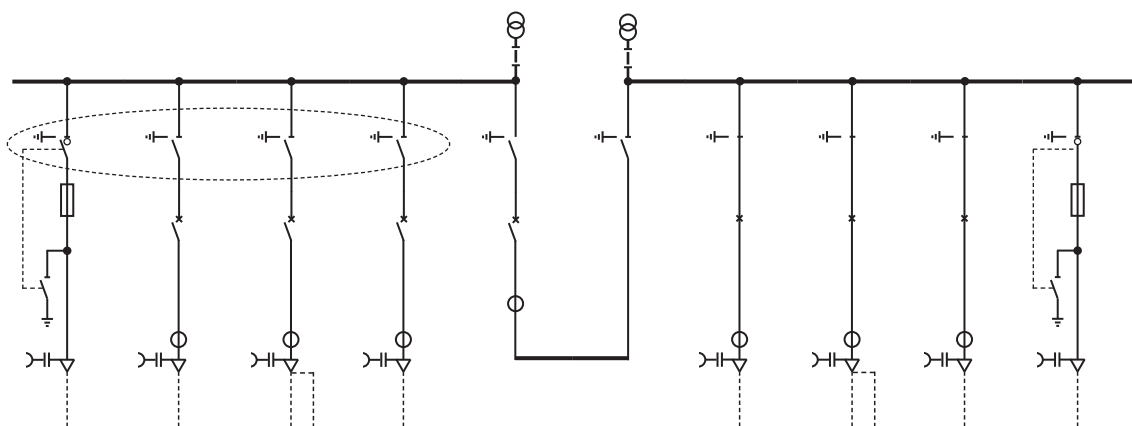


Fig. 4.1.6: Closing the disconnecter in the sectionaliser

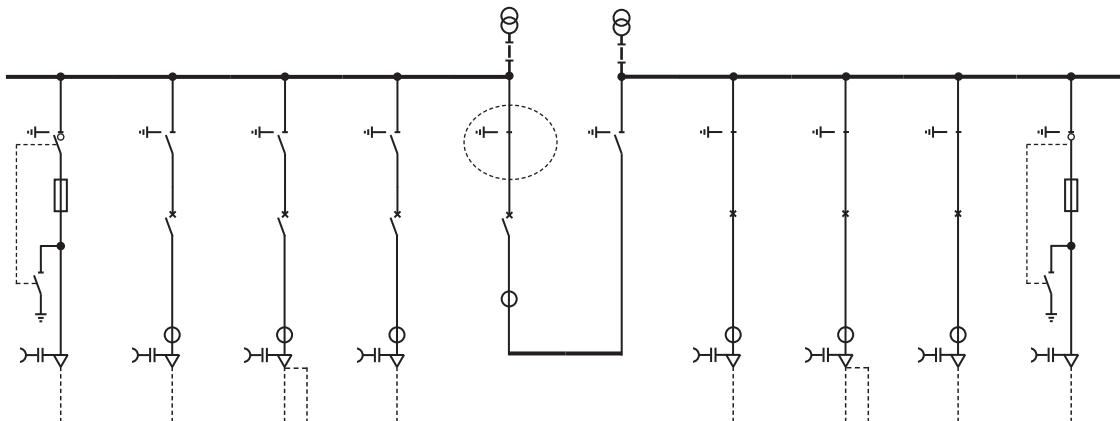


Fig. 4.1.7: Closing the earthing switch in the riser panel

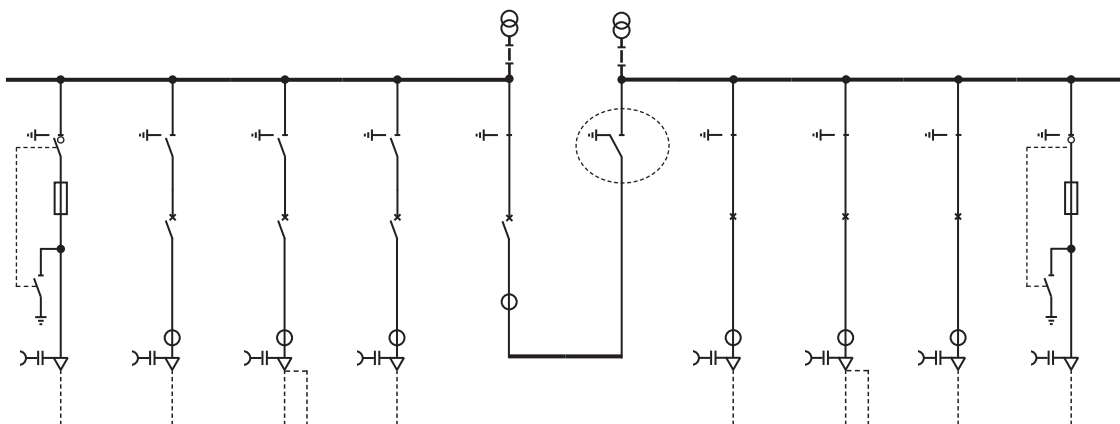
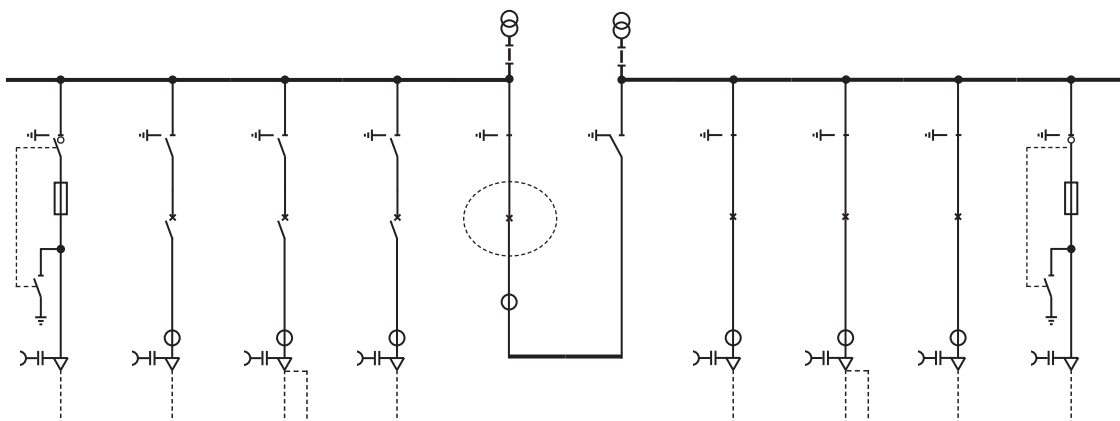


Fig. 4.1.8: Closing the circuit-breaker in the sectionaliser, left hand busbar earthed



4.1.2 Operation of the circuit-breaker

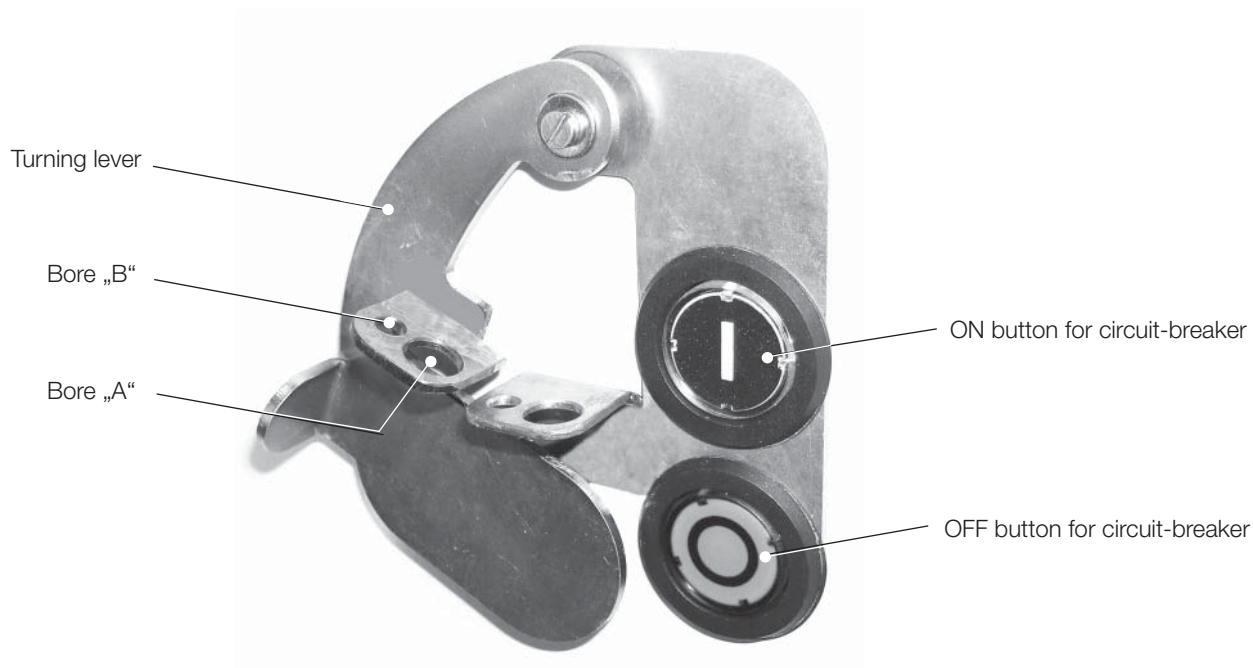
Depending on the version of the switchgear system, the circuit-breaker can be operated remotely (from the control room) or locally. At the panel, the circuit-breaker operating mechanism can be operated manually, or electrically if electrical controls (e.g. the human-machine interface of a control device) are fitted.

Note on “securing to prevent cancellation of earthing” interlock



The interlock has two different bores for U-locks. Use only U-locks with a shackle diameter of 10 mm for bores “A” in figure 4.1.2.1, and only U-locks with a shackle diameter of 5 mm for bores “B”.

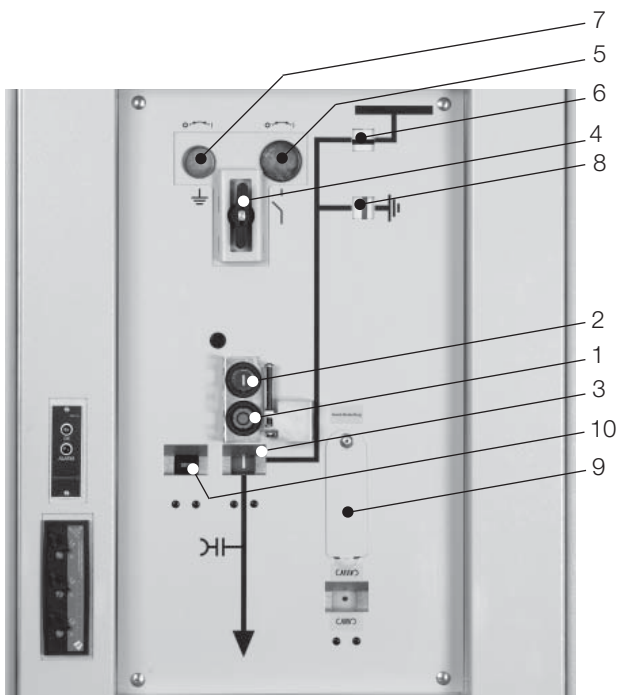
Fig. 4.1.2.1: “Securing to prevent cancellation of earthing” interlock in the deblocked condition



4.1.2.1 Manual operation of the circuit-breaker

- Mechanical switch position indication is effected by graphical symbols (3 in Fig. 4.1.2.1.1) in the cover of the operator control area.
- Cancel any blocking of the relevant pushbutton by removing the padlock or by releasing a lock switch with a key.
- In order to change the switching condition of the circuit-breaker, press the mechanical OFF button (1) or the mechanical ON button (2).

Fig. 4.1.2.1.1: Indicators and controls for the circuit-breaker and three position switch operating mechanisms ¹⁾



- | | |
|----|---|
| 1 | OFF button for circuit-breaker |
| 2 | ON button for circuit-breaker |
| 3 | Switch position indicator for circuit-breaker |
| 4 | Selector lever |
| 5 | Opening for disconnecter operation |
| 6 | Switch position indicator for disconnecter |
| 7 | Opening for earthing switch operation |
| 8 | Switch position indicator for earthing switch |
| 9 | Cover on the receptacle for manual charging of the stored-energy spring |
| 10 | Mechanical operating cycle counter |

¹⁾ Alternatively the mimic diagram and the position of the earthing switch indicator deviates from the illustration. This takes no effect to the operation and the function of the mechanisms.

4.1.2.2 Emergency manual operation of the circuit-breaker

On failure of the supply voltage, the circuit-breaker can be opened at any time by pressing the mechanical OFF button. Closing of the circuit-breaker with the mechanical ON button is dependent on the stored-energy spring mechanism being charged. The condition of the stored-energy spring mechanism is displayed mechanically (10 in Fig. 4.1.2.2.1).

On failure of the supply voltage or the stored-energy spring charging motor for the circuit-breaker operating mechanism, the charging process can be performed or completed manually.

The receptacle for the charging lever for the stored-energy spring in panels of widths 600, 900 and 1200 mm is covered by a rotating flap (figure 4.1.2.5.2), and in panels of 450 mm width by a slide.

Manual charging of the stored-energy spring

Depending on the version, swing the flap to the side or move the slide upwards. Fit the charging lever (11) into the receptacle (12)

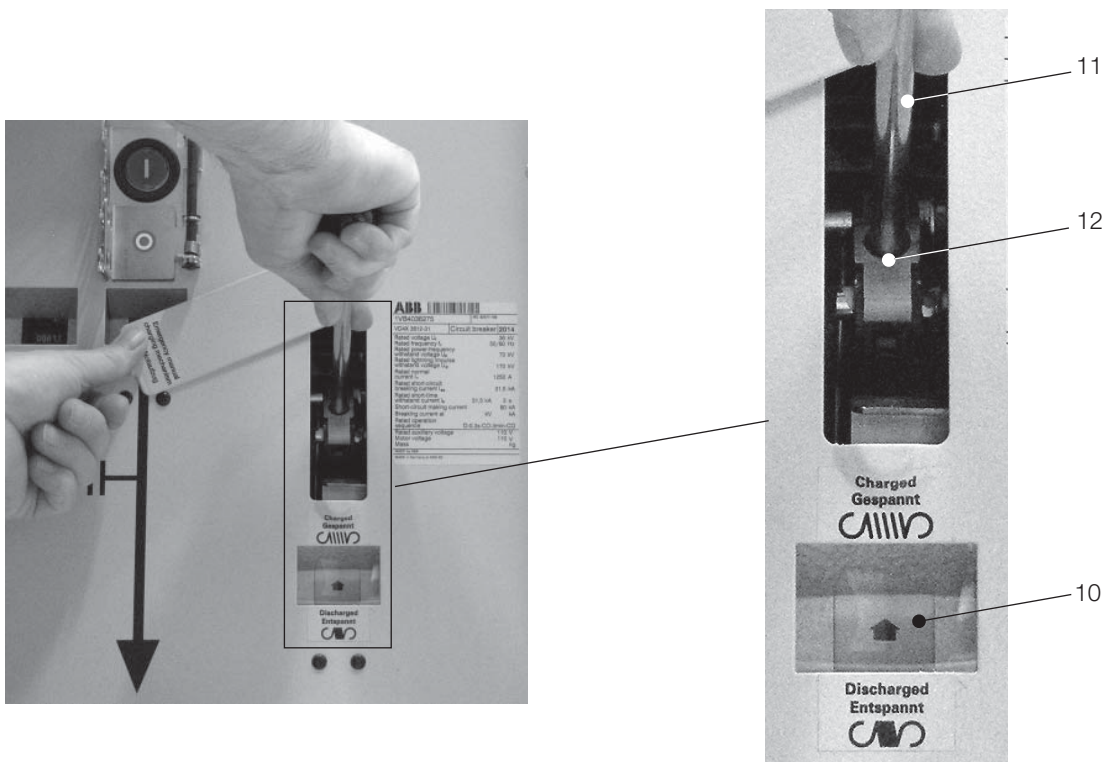
and pump for approx. 25 strokes until the charged condition (10) is indicated.

When the charged condition is reached, the charging mechanism is disengaged, and no further movements of the charging lever can be made.

Circuit-breaker operating mechanism fitted with optional blocking magnet -RLE1

The blocking magnet -RLE1 blocks the mechanical ON button of the circuit-breaker in certain situations. This interlock is active on failure of the supply voltage. Deblocking of the blocking magnet requires work inside the circuit-breaker operating mechanism, and may only be performed by qualified personnel. Contact the ABB Service Department if necessary.

Fig. 4.1.2.2.1: Manual charging of the stored-energy spring



- 10 Condition indicator for the stored energy spring
- 11 Charging lever
- 12 Receptacle for charging lever

4.1.3 Operation of the three position disconnecter

Depending on the version of the switchgear system, the three position disconnecter can be operated remotely (from the control room) or locally. At the panel, the three position disconnecter operating mechanism can be operated manually, or electrically if a motor and electrical controls (e.g. the human-machine interface of a control device) are fitted.

4.1.3.1 Operation of the three position disconnecter (manual mechanism)

Turning the selector lever (4) moves a sliding cover to release the opening (5 or 7) for the operating lever of the disconnecter or earthing switch. The operating lever for the earthing switch (figure 4.1.3.1.1) has a hexagon socket and is marked red, and the operating lever for the disconnecter (figure 4.1.3.1.2) has a splined socket and is marked black.

The selector lever can only be turned when the circuit-breaker is switched off. Turning the selector lever in the direction for earthing switch operation is only possible when the disconnecter is switched off, and turning in the direction for disconnecter operation is only possible when the earthing switch is switched off.

- The selector lever can be blocked by a padlock. To fit the padlock, press the selector lever towards the cover.
- Mechanical switch position indication is effected by graphical symbols (6 and 8) in the low voltage compartment door.



Always perform all switching operations up to the stop.

If the stop is not reached by the manual switching motion, it is possible to remove the operating lever but the selector lever is not returned to its vertical initial position and the relevant opening (5 or 7) is not closed off. The circuit-breaker is blocked.

- When the operating lever is turned, increased force can be felt after approx. 30°, and this has to be overcome to reach the limit position (stop).

Fig. 4.1.3.1.1: Operating lever with hexagon and red handle for operation of the earthing switch

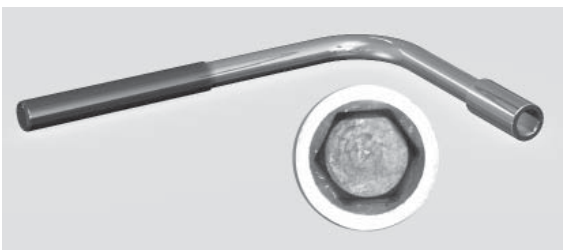


Fig. 4.1.3.1.2: Operating lever with splines and black handle for operation of the disconnecter



Operation of the disconnecter

- Turn the selector lever (4 in Fig. 4.1.2.1.3) counterclockwise and hold it fast.
- Insert the operating lever through the released opening (5) onto the splined shaft.

Disconnector OFF ⇒ ON

- Turn the operating lever clockwise until the stop is reached ($< 90^\circ$).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Disconnector ON ⇒ OFF

- Turn the operating lever counter-clockwise until the stop is reached ($< 90^\circ$).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Operation of the earthing switch

- Turn the selector lever (4 in Fig. 4.1.3.1.3) clockwise and hold it fast.
- Insert the operating lever through the released opening (7) onto the hexagon.

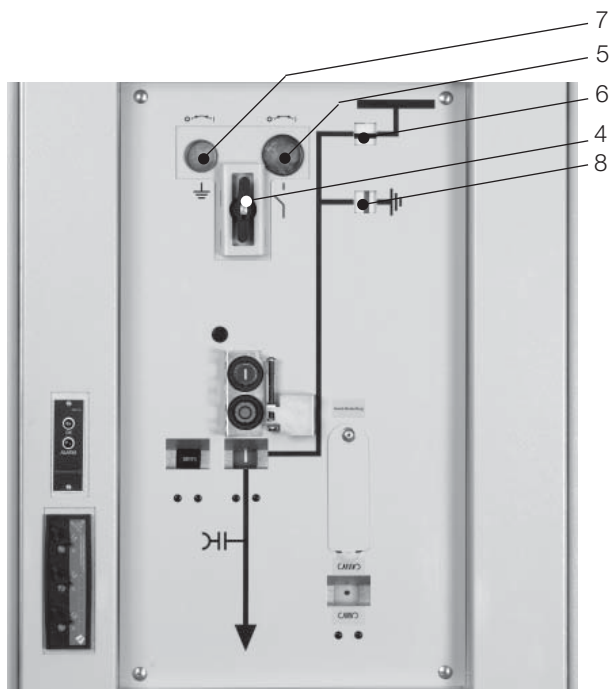
Earthing switch OFF ⇒ ON

- Turn the operating lever clockwise until the stop is reached ($< 70^\circ$).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Earthing switch ON ⇒ OFF

- Turn the operating lever counter-clockwise until the stop is reached ($< 70^\circ$).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Fig. 4.1.3.1.3: Operation of the three position disconnector ¹⁾



- 4 Selector lever
- 5 Opening for disconnector operation
- 6 Switch position indicator for disconnector
- 7 Opening for earthing switch operation
- 8 Switch position indicator for earthing switch

¹⁾ Alternatively the mimic diagram and the position of the earthing switch indicator deviates from the illustration. This takes no effect to the operation and the function of the mechanisms.

4.1.3.2 Operation of the three position disconnecter (motor operated mechanism)

The motor-operated three position disconnecter operating mechanism is in principle identical to the manual mechanism, but additionally has a drive motor. The three position disconnecter can thus be operated by the motor, or also manually as an alternative.

The three position disconnecter is mechanically blocked when the circuit-breaker is closed. Operation of the earthing switch is only possible when the disconnecter is open, and vice versa.

Motor operation

Motor operation of the three position disconnecter is possible when electrical controls (e.g. the operator controls of a control unit) are fitted on the panel. Operate the corresponding controls to switch the three position disconnecter on and off. The switch position is indicated on the display of the control unit and mechanically on the operating mechanisms

Manual operation

Operation of the disconnecter

- Turn the selector lever (4 in Fig. 4.1.3.1.3) counterclockwise and hold it fast.
- Insert the operating lever through the released opening (5) onto the splined shaft.

Disconnecter OFF ⇒ ON

- Turn the operating lever slowly in the clockwise direction, applying force, through approx. 20° and then in the counter-clockwise direction through approx. 20° to disengage the motor from the mechanism.
- Turn the operating lever clockwise until the stop is reached. (< 90°).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Disconnecter ON ⇒ OFF

- Turn the operating lever slowly in the counter-clockwise direction, applying force, through approx. 20° and then in the clockwise direction through approx. 20° to disengage the motor from the mechanism.

- Turn the operating lever counter-clockwise until the stop is reached (< 90°).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Operation of the earthing switch

- Turn the selector lever (4 in Fig. 4.1.2.1.3) clockwise and hold it fast.
- Insert the operating lever through the released opening (7) onto the hexagon.

Earthing switch OFF ⇒ ON

- Turn the operating lever slowly in the clockwise direction, applying force, through approx. 20° and then in the counter-clockwise direction through approx. 20° to disengage the motor from the mechanism.
- Turn the operating lever clockwise until the stop is reached (< 70°).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

Earthing switch ON ⇒ OFF

- Turn the operating lever slowly in the counter-clockwise direction, applying force, through approx. 20° and then in the clockwise direction through approx. 20° to disengage the motor from the mechanism.
- Turn the operating lever counter-clockwise until the stop is reached (< 70°).
- Withdraw the operating lever.
- Turn the selector lever into the vertical position without using force.

4.1.3.3 Emergency operation of the three position disconnecter (motor operated mechanism)

If the mechanism motor becomes defective or the auxiliary power fails when the three position disconnecter is in an intermediate position, manual operation is only possible by performing work on the operating mechanism. This work may only be performed by qualified personnel. In such a case, please inform our service department.

If the three position disconnecter is not in an intermediate position on failure of the auxiliary voltage, the operating mechanism can still be operated as described in 4.1.3.1 even without the auxiliary power. When blocking magnets are used for the selector lever, the mechanism can only be deblocked by qualified personnel. In such a case, please contact the ABB Service Department.

4.2 Panels with three position switch-disconnectors and HRC fuses

- The three switching positions of the three position switch-disconnector, “connecting”, “disconnecting” and “earthing” are clearly defined by the mechanical structure of the switch.
- Blowing of a fuse results in automatic tripping of the switch-disconnector.
- The current switch position is indicated mechanically by graphical symbols (7) in the cover of the operator control area (figure 4.2.1).
- The switch disconnector is always manually operated.
- Both earthing switches (upstream and downstream from the fuses) are operated in parallel.
- The operating mechanism can be secured with a padlock on the selector slide (6).



Consult the order documents for the conditions of any interlock.

4.2.1 Notes on earthing of an outgoing feeder or system section

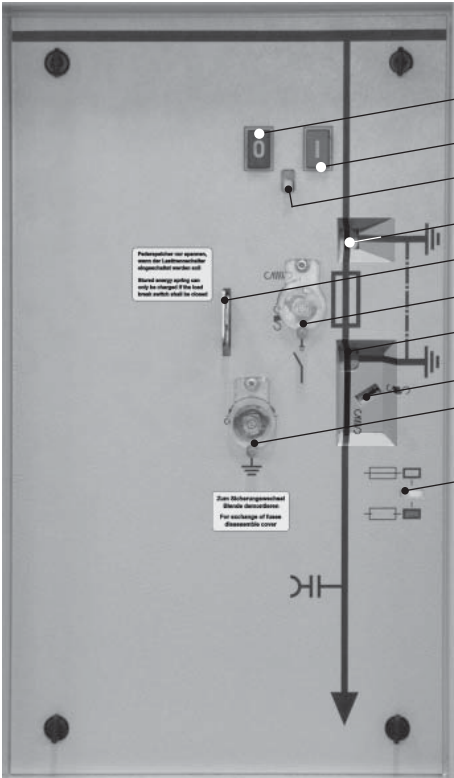


When the outgoing feeder or section of the system has been earthed, secure it to prevent cancellation of earthing as follows:

Secure the selector slide with a padlock.

Affix a sign to the panel to indicate that earthing has been performed.

Fig. 4.2.1: Three position switch-disconnector operating mechanism



- 1 Mechanical OFF button for the switch-disconnector
- 2 Mechanical ON button for the switch-disconnector
- 3 Charging shaft for the switch-disconnector’s stored-energy spring
- 4 Condition indicator for the stored energy spring
- 5 Slide to release the charging shaft
- 6 Selector slide
- 7 Switch position indicator
- 8 “fuse blown” indicator
- 9 Shaft for earthing switch operation

4.2.2 Operation of the three position switch-disconnector with fuses

Operation of the switch is performed with the aid of an operating lever. Three different operating levers can be supplied:

- Operating lever for the charging shaft of the stored-energy spring and for the actuating shaft of the earthing switches (figure 4.2.2.1)
- Coded operating lever with black marking on the shaft for charging of the stored-energy spring (figure 4.2.2.2)
- Coded operating lever with red marking on the shaft for operation of the earthing switch (figure 4.2.2.3)

Fig. 4.2.2.1: Operating lever without coding

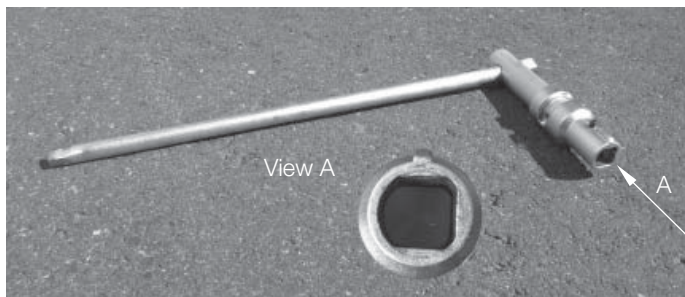


Fig. 4.2.2.2: Receptacle for the coded operating lever for operation of the stored energy spring charging shaft

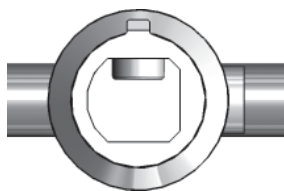
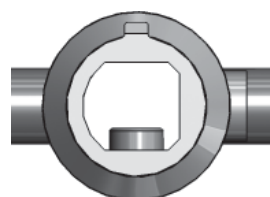


Fig. 4.2.2.3: Receptacle for the coded operating lever for operation of the earthing switch (colour marking on the face of the shaft)



Operation of the earthing switch

- Remove any padlock fitted from the selector slide.
- Press the selector slide upwards and fit the operating lever onto the shaft for earthing switch operation (figure. 4.2.2.4 and 4.2.2.5).

Earthing switch OFF ⇒ ON

- Turn the operating lever approx. 180° clockwise.
- Withdraw the operating lever.

Earthing switch ON ⇒ OFF

- Turn the operating lever approx. 180° counter-clockwise.
- Withdraw the operating lever.

Fig. 4.2.2.4: Fitting the operating lever onto the shaft for earthing switch operation



Fig. 4.2.2.5: Operation of the earthing switch



Operation of the switch disconnecter

- Remove any padlock fitted from the selector slide.
- Closing the switch-disconnector requires the stored-energy spring to be charged. Check the condition of the stored-energy spring at the charging condition indicator (figure 4.2.2.6).



The closing switch disconnecter procedure starts with charging the stored-energy spring.

- Opening of the switch-disconnector is possible without charging the stored-energy spring.

Charging the stored-energy spring



Only charge the stored-energy spring when the switch-disconnector is to be closed.

- Press the slide to release the charging shaft upwards and fit the operating lever onto the charging shaft (figure 4.2.2.7).
- Charge the stored-energy spring by turning the operating lever clockwise through approx. 90° until the stop is reached.
- Remove the operating lever.

Switch-disconnector OFF ⇒ ON

- Press the mechanical ON button.

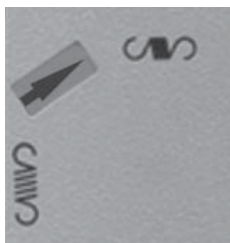
Switch-disconnector ON ⇒ OFF

- Press the mechanical OFF button.

Fig. 4.2.2.6: Condition indicator for the stored energy spring



Indication of spring charged



Indication of spring discharged

Fig. 4.2.2.7: Fitting the operating lever onto the charging shaft




4.2.3 Replacement of HRC fuses

Blowing of a fuse is indicated mechanically (Fig. 4.2.3.1).

Blowing of a fuse results in automatic tripping of the switch-disconnector. The switch position indicator shows the OFF position of the switch-disconnector.

Conditions for replacement of a fuse:

- 
- Earth the outgoing feeder of the relevant panel as described in section 4.1.

 - Comply with the safety regulations to EN 50110.
 - Secure the working area as described in section 4 and EN 50110 standard.

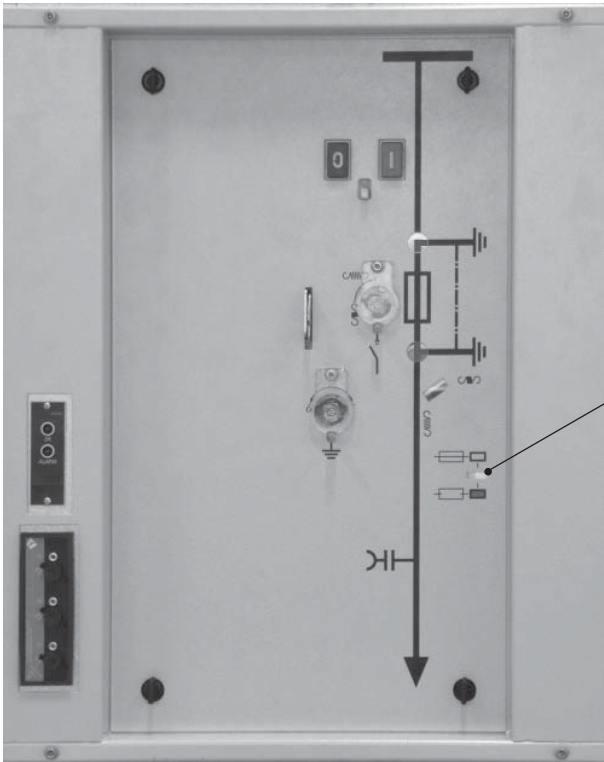


Always replace all three fuses in a panel, even if only one or two fuses have blown.



Use fuses from ABB or from Siba in accordance with tables 4.2.3.1 and 4.2.3.2. The fuse boxes are designed for a maximum fuse length of 442 mm and a maximum fuse diameter of 67 mm. Use adapters for smaller dimensions (see list of accessories).

Fig. 4.2.3.1: Fuse blown indication



Fuse blown:
Red indicator in the sight window

Fig. 4.2.3.2: Length adapter (1) and adapter for fuse diameter 53 mm (2)

1

2



Replacing fuses

- Remove the cover from the operating mechanism bay by releasing the plastic catches at the corners of the cover.
- Release the twist lock fastener (Fig. 4.2.3.3) and push the slide in front of the flap upwards. The fuse flap then automatically swings out (Fig. 4.2.3.4).
- Draw the lid with the fuse to be replaced out of the box (Fig. 4.2.3.5). Turning and gently shaking the lid makes it easier to withdraw it.
- Remove the lid with the fitted fuse.
- Loosen the clamping band and remove the fuse from the lid.

Fig. 4.2.3.3: Opening the fuse flap - 1

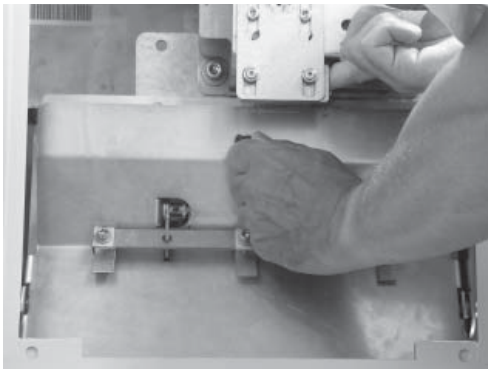


Fig. 4.2.3.5: Removing the lid with the fuse

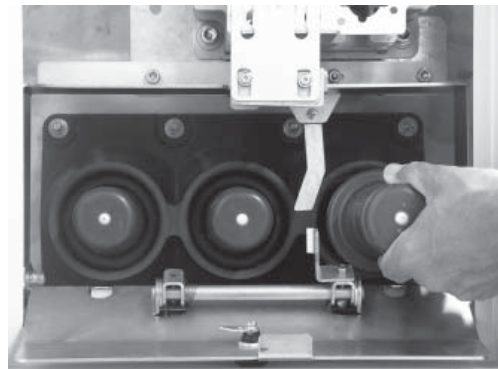
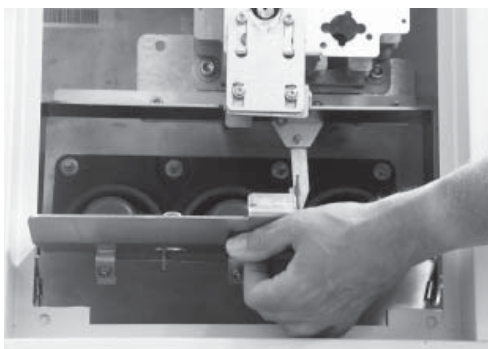


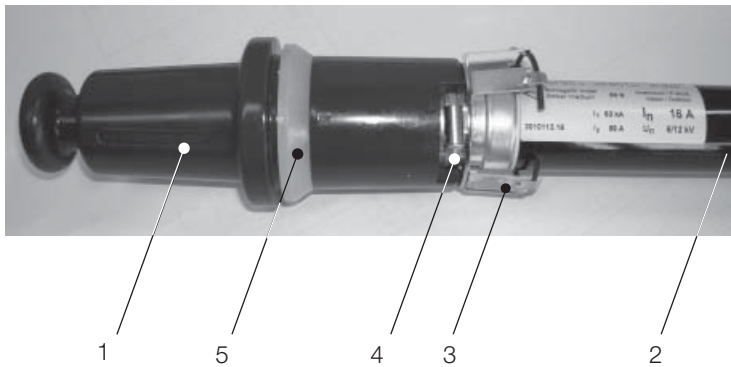
Fig. 4.2.3.4: Opening the fuse flap - 2



- Clean the sealing collar (Fig. 4.2.3.6) on the lid with M.X.T. 60 forte intensive cleaner.
- Insert the new HRC fuse into the lid with the striker pin pointing towards the lid.
- Tighten the clamping band (Fig. 4.2.3.7). Ensure when doing so that the contact fingers of the ring contact are not deformed.
- Slide the fuse into the fuse box up to the stop.
- Replace the other fuses in the same manner.
- Swing the fuse flap upwards and fasten it with the twist lock fastener.
- Fit the cover on the operator control area and lock it in place with the plastic catches.

Fig. 4.2.3.7: Tightening the clamping band

Fig. 4.2.3.6: Lid with fuse fitted



- | | |
|---|---------------------|
| 1 | Lid |
| 2 | Fuse |
| 3 | Ring contact |
| 4 | Clamping band screw |
| 5 | Sealing collar |



Table 4.2.3.1: Selection table for HV HRC fuses. manufacturer ABB

Operating voltage	Transformer capacity	Short-circuit voltage U_k	Rated transformer current	Type	Rated current of HRC fuse	
					min. [A]	max. [A]
6 ... 7.2	50	4	4.8	CEF-TCU	16	16
	75	4	7.2	CEF-TCU	16	16
	100	4	9.6	CEF-TCU	20	20
	125	4	12.0	CEF-TCU	20	20
	160	4	15.4	CEF-TCU	25	31.5
	200	4	19.2	CEF-TCU	31.5	40
	250	4	24.1	CEF-TCU	40	40
	315	4	30.3	CEF-TCU	50	63
	400	4	38.5	CEF-TCU	63	63
10 ... 12	50	4	2.9	CEF-TCU	10	10
	75	4	4.3	CEF-TCU	10	10
	100	4	5.8	CEF-TCU	16	16
	125	4	7.2	CEF-TCU	16	16
	160	4	9.2	CEF-TCU	20	20
	200	4	11.5	CEF-TCU	20	25
	250	4	14.4	CEF-TCU	25	31.5
	315	4	18.2	CEF-TCU	31.5	40
	400	4	23.1	CEF-TCU	40	40
	400	6	23.1	CEF-S-TCU	50	50
	500	4	28.9	CEF-TCU	50	50
	630	4	36.4	CEF-TCU	63	63
13.8	75	4	3.1	CEF-TCU	10	10
	100	4	4.2	CEF-TCU	10	10
	125	4	5.2	CEF-TCU	16	16
	160	4	6.7	CEF-TCU	16	16
	200	4	8.4	CEF-TCU	16	16
	250	4	10.5	CEF-TCU	20	20
	315	4	13.2	CEF-TCU	25	31.5
	400	4	16.7	CEF-TCU	31.5	40
	400	6	16.7	CEF-S-TCU	40	40
	500	4	20.9	CEF-TCU	40	40
15 ... 17.5	75	4	2.9	CEF-TCU	10	10
	100	4	3.8	CEF-TCU	10	10
	125	4	4.8	CEF-TCU	16	16
	160	4	6.2	CEF-TCU	16	16
	200	4	7.7	CEF-TCU	16	16
	250	4	9.6	CEF-TCU	20	20
	315	4	12.1	CEF-TCU	20	25
	400	4	15.4	CEF-TCU	31.5	31.5
	500	4	19.2	CEF-TCU	31.5	40
	500	6	19.2	CEF-TCU	31.5	31.5
	630	4	24.2	CEF-TCU	40	40
	630	6	24.2	CEF-TCU	40	40
24	100	4	2.9	CEF-TCU	10	10
	125	4	3.6	CEF-TCU	10	10
	160	4	4.6	CEF-TCU	10	10
	200	4	5.8	CEF-TCU	16	16
	250	4	7.2	CEF-TCU	16	20
	315	4	9.1	CEF-TCU	20	20
	400	4	11.5	CEF-TCU	20	25
	500	4	14.4	CEF-TCU	25	25
	630	4	18.2	CEF-TCU	40	40
	630	6	18.2	CEF-S-TCU	40	40

Table 4.2.3.2: Selection table for HV HRC fuses (U_r up to 13.8 kV). manufacturer Siba

Operating voltage	Transformer capacity	Short-circuit voltage u _k	Rated transformer current	Type	Rated current of HRC fuse	
					min. [A]	max. [A]
[kV]	[kVA]	[%]	[A]			
6 ... 7.2	50	4	4.8	HHD-B	16	16
	75	4	7.2	HHD-B	16	20
	100	4	9.6	HHD-B	20	25
	125	4	12.0	HHD-B	20	31.5
	160	4	15.4	HHD-B	31.5	40
	200	4	19.2	HHD-B	40	50
	250	4	24.1	HHD-B	40	50
	315	4	30.3	HHD-B	50	63
	400	4	38.5	HHD-B	63	63
	400	6	38.5	HHD-B	63	63
	500	4	48.1	HHD-B	80	80
	500	6	48.1	HHD-BSSK	100	100
10 ... 12	50	4	2.9	HHD-B	10	10
	75	4	4.3	HHD-B	10	10
	100	4	5.8	HHD-B	16	16
	125	4	7.2	HHD-B	16	16
	160	4	9.2	HHD-B	20	25
	200	4	11.5	HHD-B	20	31.5
	250	4	14.4	HHD-B	25	40
	315	4	18.2	HHD-B	31.5	50
	400	4	23.1	HHD-B	40	50
	400	6	23.1	HHD-B	40	40
	500	4	28.9	HHD-B	50	63
	500	6	28.9	HHD-B	50	50
	630	4	36.4	HHD-B	63	63
	630	6	36.4	HHD-BSSK	80	80
	800	6	46.2	HHD-BSSK	80	80
	1000	6	57.7	HHD-BSSK	100	100
13.8	75	4	3.1	HHD-B	10	10
	100	4	4.2	HHD-B	10	10
	125	4	5.2	HHD-B	16	16
	160	4	6.7	HHD-B	16	16
	200	4	8.4	HHD-B	20	20
	250	4	10.5	HHD-B	20	25
	315	4	13.2	HHD-B	25	31.5
	400	4	16.7	HHD-B	31.5	40
	400	6	16.7	HHD-B	31.5	31.5
	500	4	20.9	HHD-B	40	50
	630	4	26.4	HHD-B	50	63
	800	6	33.5	HHD-BSSK	63	63

Table 4.2.3.2: Selection table for HV HRC fuses (U_r from 15 to 24 kV). manufacturer Siba

Operating voltage	Transformer capacity	Short-circuit voltage u_k	Rated transformer current	Type	Rated current of HRC fuse	
					min. [A]	max. [A]
[kV]	[kVA]	[%]	[A]			
15 ... 17.5	75	4	2.9	HHD-B	10	10
	100	4	3.8	HHD-B	10	10
	125	4	4.8	HHD-B	16	16
	160	4	6.2	HHD-B	16	16
	200	4	7.7	HHD-B	20	20
	250	4	9.6	HHD-B	20	25
	315	4	12.1	HHD-B	20	31.5
	400	4	15.4	HHD-B	31.5	40
	500	4	19.2	HHD-B	40	50
	630	4	24.2	HHD-B	40	63
	630	6	24.2	HHD-B	40	40
	800	6	30.8	HHD-BSSK	63	63
	1000	6	38.5	HHD-BSSK	80	80
20 ... 24	100	4	2.9	HHD-B	10	10
	125	4	3.6	HHD-B	10	10
	160	4	4.6	HHD-B	10	16
	200	4	5.8	HHD-B	16	16
	250	4	7.2	HHD-B	16	16
	315	4	9.1	HHD-B	20	25
	400	4	11.5	HHD-B	20	31.5
	400	6	11.5	HHD-B	20	20
	500	4	14.4	HHD-B	25	40
	500	6	14.4	HHD-B	25	25
	630	4	18.2	HHD-B	31.5	50
	630	6	18.2	HHD-B	31.5	31.5
	800	6	23.1	HHD-B	40	40
	1000	6	28.9	HHD-B	50	50
	1250	6	36.1	HHD-BSSK	63	63

4.3 Gas monitoring with density sensors

The high voltage compartments must have sufficient SF₆ pressure during operation. (Please consult the table entitled “Technical data” in section 10 for the pressure levels.) The SF₆ insulating gas pressure is monitored during operation by density sensors (temperature-compensated pressure sensors).

If the gas pressure falls below the alarm level, a signal to top up the insulating gas is issued. The signal appears at a warning lamp (figure 4.3.1) in the operator control area, or on a panel control unit.

When systems are isolated for a relatively long period the auxiliary power supply should be maintained to monitor the insulating gas density.

Fig. 4.3.1: Signal lamp for gas density



4.4 Operation of the isolating device for voltage transformers



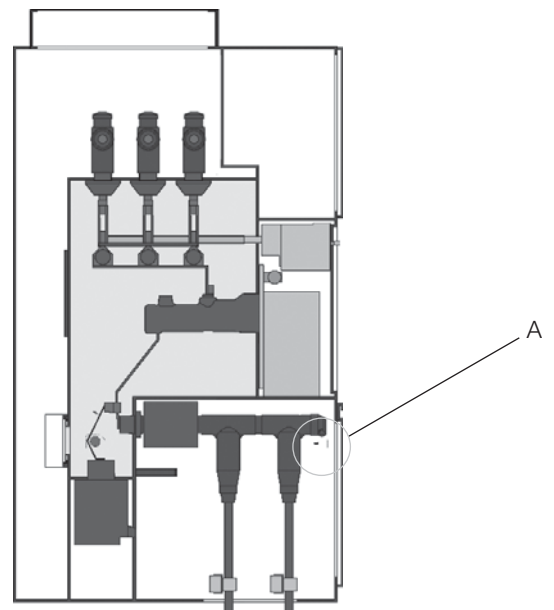
Isolate the relevant switchgear section before connecting or disconnecting voltage transformers.

- Comply with the safety regulations to EN 50110.
- Check the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs ¹⁾ of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.

The operating mechanism for the voltage transformer isolating device is located in the cable termination compartment on the right-hand side wall (figure 4.4.1).

Dismantle the cover on the cable termination compartment. This is done by removing the two screws above the cover and pulling the cover upwards.

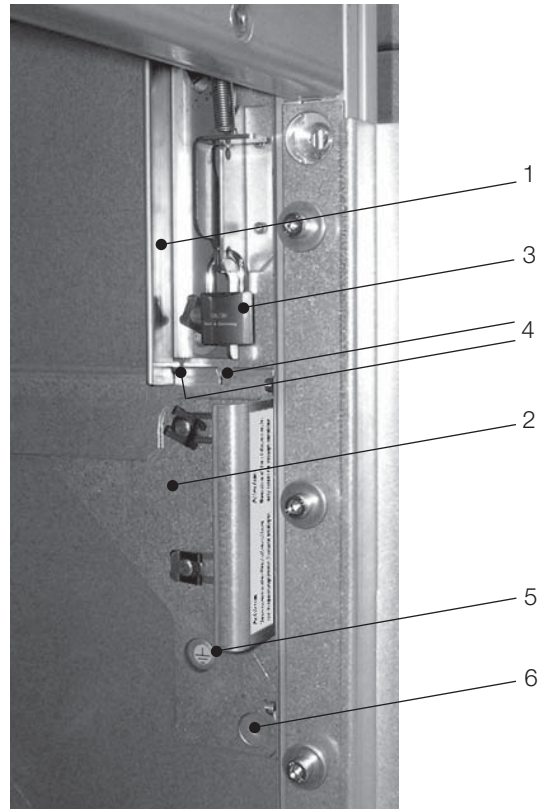
Fig. 4.4.1: A) Location of the controls for the voltage transformer isolating device (example configurations)



¹⁾ mcb: miniature circuit-breaker

The controls and indicators for the voltage transformer isolating device are shown in figure 4.4.2. Check the switch position indicator (5 and 6). The isolating device can be secured with a padlock (3). Remove the padlock before operating the device.

Fig. 4.4.2: Controls and displays for the voltage transformer isolating device



- | | |
|---|--|
| 1 | Locking plate |
| 2 | Actuating plate |
| 3 | Padlock (optional) |
| 4 | Latching slot |
| 5 | Switch position indicator, "voltage transformer earthed" |
| 6 | Opening for switch position indicator, "voltage transformer connected" |

Isolating and earthing the voltage transformers

To isolate and earth the voltage transformers, slide the locking plate (1) upwards and pull the actuating plate (2) to the front until the stop is reached. Allow the locking plate to slide into the appropriate latching slot (4) in the actuating plate (figure 4.4.3).



When the locking plate engages in the latching slot of the actuating plate, the dielectric strength of the isolating device is ensured.

Secure the isolating device with a padlock.

Connecting the voltage transformers

To connect the voltage transformers, slide the locking plate (1) upwards and pull the actuating plate (2) to the rear until the stop is reached. Allow the locking plate to slide into the appropriate latching slot (4) in the actuating plate (figure 4.4.3).



When the locking plate engages in the latching slot of the actuating plate, the current carrying capacity of the isolating device is ensured.

Secure the isolating device with a padlock.

Fig. 4.4.3: Operation of the voltage transformer isolating device



5.1 Testing for the off-circuit condition

The off-circuit condition on the cable side is tested by means of the capacitive voltage indicator (pick-off on the outer cone). Three systems can be used:

- LRM-system,
- KVDS-system, or
- CAVIN-system.



Observe the instruction manual for the system used.

- Check the function of the equipment immediately before use. The optical display must be clearly visible!
- The sockets of the capacitive indicator system must never be short-circuited, except during voltage testing on the switchgear.

Testing for the off-circuit condition is performed with a plug-in display unit (design to IEC 61243-5) at the three pairs of measuring sockets (figure 5.1.1.1).



Perform repeat tests on the system in accordance with IEC 61243-5, for instance with interface tester KSP. Observe the instructions for the interface tester.

5.1.2 KVDS- und CAVIN-systems

Testing for the off-circuit condition is performed with the display on the unit (figure 5.1.2.1 and 5.1.2.2). No separate display unit is required.

Fig. 5.1.1.1: LRM system with display unit

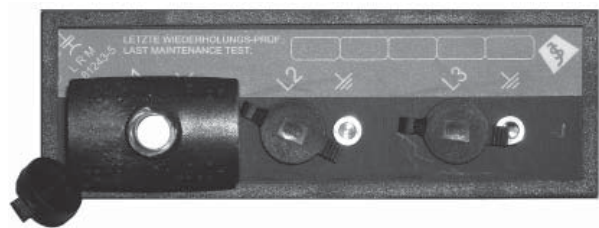


Fig. 5.1.2.1: KVDS-system



Fig. 5.1.2.2: CAVIN-system



5.2 Testing for the in-phase condition

Testing for the in-phase condition, e.g. when there is more than one incoming feeder, can be performed with a suitable phase comparator at the measuring sockets of the capacitive voltage indication system.

The phase comparator must comply with IEC 61243-5 and correspond to the technical design of the indicator system used.



Observe the instruction manual for the phase comparator.

5.3 High voltage tests

Direct access to the conductors via the fitted cable connectors is available for the performance of high voltage tests. The test voltage is applied through suitable test sets for the outer cone connector system used.

5.3.1 Cable tests with dc



Do not exceed the maximum test voltages and the maximum test duration as specified in IEC 60502-2.



Comply with the safety regulations to EN 50110.

- Isolate the switchgear section to be tested in accordance with section 4.
- Test the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs ¹⁾ of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.

- Dismantle the cover on the relevant cable termination compartment.



Isolate all voltage transformers inside the switchgear section to be tested by operating the isolating device (see chapter 4.4).



Dismantle any surge arresters in the relevant outgoing feeder.



Short-circuit the sockets for the capacitive indicator system in the relevant switchgear section using the short-circuiting plug.

- Fit the high voltage testing set in accordance with the manufacturer's instructions.
- Establish the test circuit in accordance with the manufacturers directions for the test apparatus.
- De-earth the switchgear section to be tested before switching the test voltage on.
- Perform the cable test in accordance with the manufacturer's directions for the test apparatus.
- Earth the switchgear section after completion of parts of the test and on conclusion of testing.
- Remove the high voltage testing set.
- Refit any dismantled surge arresters.
- Close off free outer cones with insulating blanking plugs in accordance with the manufacturers instructions.
- Remove the short-circuiting plugs from the capacitive indicator.
- Reconnect the voltage transformers by operating the isolating device (see section 4.4)
- Refit the cover on the cable termination compartment.

¹⁾ mcb: miniature circuit-breaker

5.3.2 Voltage test of the main circuit

Perform a voltage test on the busbar after installation. We recommend feeding in the test voltage via an incoming or outgoing feeder panel. Use high voltage testing sets for the outer cones.

The test voltage can also be applied directly to the busbars. In this case, special test plugs for connection to the busbar adapters of any panel are required.



In the course of testing, the test voltage is applied in sequence to every conductor in the main circuit, with the other conductor earthed. Testing should be performed with at least 80 % of the rated short-duration power frequency withstand voltage (U_D) as stated on the type plate. Testing with 100 % of the rated short-duration power frequency withstand voltage as stated on the type plate is possible. Comply with the test conditions as set out in IEC 62271-200.



Comply with the safety regulations to EN 50110.

- Isolate the switchgear section to be tested in accordance with section 4.
- Test the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs ¹⁾ of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.



If there are isolatable voltage transformers or sockets for these within the section of the system to be tested, use the isolating device to isolate them (see section 4.4).



Remove the busbar voltage transformers within the section of the system to be tested, and close off all cross and end adapters with the insulating plugs provided (see section 2.2.3).

- Remove any surge arresters fitted in the section of the system to be tested in accordance with the manufacturer's instructions.
- Short-circuit the sockets for the capacitive indicator system in the relevant switchgear section using the short-circuiting plug

- Connect the test transformer to the test plug or test cable and earth the other two phases of the test system.
- Connect the second terminal of the test transformer to system earth.
- Close the switch-disconnector and the circuit-breaker in the panel through which the test voltage is to be applied. Open the switch-disconnectors and circuit-breakers in all the other panels. If the test voltage is applied via the busbar, open all circuit-breakers and switch-disconnectors.
- Perform the high voltage test.
- Earth the system section on completion of individual tests and on conclusion of testing.
- Remove the high voltage testing sets
- Fit any surge arresters and voltage transformers required.
- Close off free outer cones with insulating blanking plugs in accordance with the manufacturer's instructions.
- Cancel any isolation of voltage transformers.
- Remove the short-circuiting plugs from the capacitive indicator.

¹⁾ mcb: miniature circuit-breaker

5.4 Secondary protection testing



Comply with the safety regulations to EN 50110.

- Isolate the feeder panel to be tested in accordance with section 4.
- Test the switchgear section for the off-circuit condition as described in section 5.1
- Earth the outgoing feeder and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs ¹⁾ of the relevant operating mechanisms off in order to prevent the outgoing feeder being energized by remote control.



Voltage may only be applied to the OFF release coil of the circuit-breaker (shunt release OFF) for a period of 1000 ms. If this time is exceeded the coil will burn out. For this reason, the protection testing system must be shut down by the OFF command, or the shunt release OFF must be disconnected.



If the circuit-breaker is also to be tested, please note that earthing via the circuit-breaker is cancelled when the breaker is opened. Otherwise, disconnect the release coil before testing.



Note that when the voltage signals from the voltage transformers in the panel to be tested are used by other panels, the signals are not available during the work. This can lead to impairments of function in the other panels.

- Establish the test circuit in accordance with the protection tester manufacturer's directions and perform the test.

¹⁾ mcb: miniature circuit-breaker

5.5 Protection testing by primary current injection

Direct access to the conductors for performance of protection tests by primary current injection is possible via the fitted cable connectors. The test current is applied via suitable testing sets for the cable connector system used.



Comply with the safety regulations to EN 50110.

- Isolate the relevant switchgear section in accordance with section 4.
- Test the switchgear section for the off-circuit condition as described in section 5.1.
- Earth the switchgear section and secure the working area in accordance with section 4 and EN 50110 standard.
- Switch the mcbs ¹⁾ of the relevant operating mechanisms off in order to prevent the switchgear section being energized by remote control.

- Observe the example of primary side test circuits in figure 5.5.1.



If the circuit-breaker is also to be tested, please note that earthing via the circuit-breaker is cancelled when the breaker is opened. Otherwise, disconnect the release coil before testing.

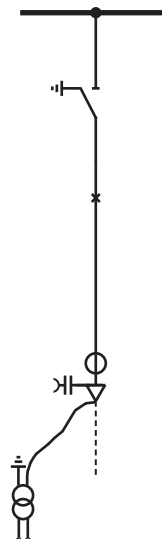


Note that when the voltage signals from the voltage transformers in the panel to be tested are used by other panels, the signals are not available during the work. This can lead to impairments of function in the other panels.



Do not exceed the maximum values for the current testing plug (see the section on accessories).

Fig. 5.5.1: Test circuit



Test transformer

- Dismantle the cover on the cable termination compartment of the relevant panel.
- Fit the testing set in accordance with the manufacturer's instructions.
- Establish the test configuration in accordance with the manufacturer's instructions for the protection testing equipment and perform the protection test.
- Earth the switchgear section after completion of the test.
- Remove the testing set.
- Refit the insulating ends of the cable connectors in accordance with the manufacturer's instructions.
- Refit the cover on the cable termination compartment.

6 Service

6.1 Inspection and maintenance of the switchgear

- Check that the switchgear room and the switchgear are in proper condition for the intended use at regular intervals.
- Check primarily for dirt, corrosion and moisture.



If you find that the switchgear is not in the proper condition, take appropriate action, e.g. cleaning of the switchgear, removal of corrosion or rectification of the cause of the moisture.

6.2 Maintenance of the switching devices and their operating mechanisms

Please consult the relevant directions and instruction manuals for the actions and intervals required.

All parts in SF₆ are maintenance-free.

The manually operated three position disconnecter and the manually operated three position switch-disconnector are maintenance-free within 1000 operating cycles; the motor-operated three position disconnecter is maintenance-free within 2000 operating cycles.

7 Actions at the end of the service life

ABB can be appointed to decommission and dismantle the switchgear. The switchgear is then professionally dismantled by ABB and the SF₆, which is normally reusable, removed before the switchgear is broken down into its remaining components.

Further notes on decommissioning at the end of the switchgear's service life can be found in materials supplement BA 509.

8 Overview of the busbar parts and assemblies

Three different busbar versions are available:

- 1250 A, up to 24 kV, conductor diameter 32 mm,
- 1250 A, up to 36 kV, conductor diameter 32 mm,
- 2500 A, up to 36 kV, conductor diameter 50 mm.

The busbars are supplied ready to assemble in the lengths required. End adapters and cross adapters can each be supplied in four versions:

- Busbar and outgoing feeder 1250 A, up to 24 kV
- Busbar and outgoing feeder 1250 A, up to 36 kV
- Busbar 2500 A and outgoing feeder 1250A, up to 36 kV
- Busbar and outgoing feeder 2500 A, up to 36 kV

End adapters and cross adapters are supplied packaged in sets (3 pcs. each) with all the necessary individual parts and the assembly paste. A list of the individual parts is supplied with the delivery. The assemblies for the end and cross adapters and the busbars are marked with the relevant part numbers. The following lists are intended to provide you with an overview of the end adapters, cross adapters and busbars to be used for the relevant application.

8.1 Busbar 1250 A

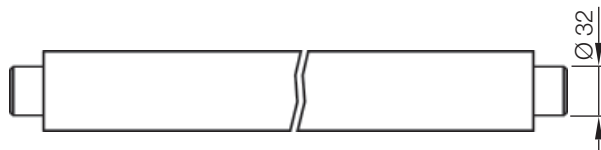


Table 8.2.1: Busbars for a busbar current of up to 1250 A

Rated voltage [kV]	Designation	Widths of the panels to be connected [mm]	Length [mm]	Quantity	Supplier's part number	ABB part number
24	SS 1250 A 436	450 - 450	436	1 piece	2645069	1VB8001281R1141
	SS 1250 A 471	450 - 600 450 - 600 (Transferpanel)	471	1 piece	2660150	1VB8001281R1142
	SS 1250 A 551	600 - 450	551	1 piece	2660135	1VB8001281R1143
	SS 1250 A 381	600 (Transferpanel) - 450	381	1 piece	On request	1VB8001281R1144
	SS 1250 A 416	600 (Transferpanel) - 600	416	1 piece	2645056	1VB8001281R1101
	SS 1250 A 586	600 - 600	586	1 piece	2645016	1VB8001281R1102
36	SS 1250 A 586	600 - 600	586	1 piece	2645116	1VB8001281R3102

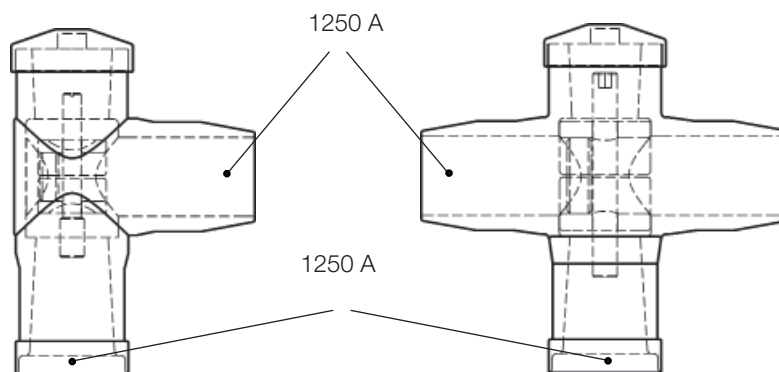


Table 8.1.2: End and cross adapter assemblies for a busbar current of up to 1250 A

Rated voltage [kV]	Designation	Quantity	Supplier's part number	ABB part number
24	End adapter 1250 A	1 set (3 pcs.)	2612972	1VB8001283R1112
	Cross adapter 1250 A	1 set (3 pcs.)	2612973	1VB8001283R1111
36	End adapter 1250 A	1 set (3 pcs.)	2621932	1VB8001283R3112
	Cross adapter 1250 A	1 set (3 pcs.)	2621933	1VB8001283R3111

8.2 Busbar 2500 A

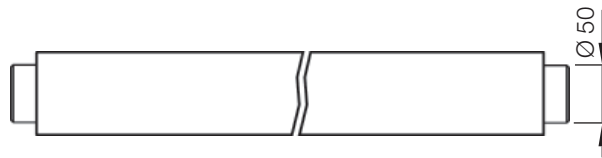


Table 8.2.1: Busbars for a busbar current of up to 2500 A

Designition	Widths of the panels to be connected [mm]			Length [mm]	Quantity	Supplier's part number	ABB part number
SS 2500 A 432	450 - 450			432	1 Stück	2648432	1VB8001281R0131
SS 2500 A 467	450 - 600			467	1 Stück	On request	1VB8001281R0132
SS 2500 A 617	450 - 900			617	1 Stück	On request	1VB8001281R0134
SS 2500 A 767	450 - 1200			767	1 Stück	On request	1VB8001281R0136
SS 2500 A 547	600 - 450			547	1 Stück	2648440	1VB8001281R0133
SS 2500 A 582	600 - 600			582	1 Stück	2648401	1VB8001281R0102
SS 2500 A 697	900 - 450			697	1 Stück	On request	1VB8001281R0135
SS 2500 A 847	1200 - 450			847	1 Stück	On request	1VB8001281R0137
SS 2500 A 732	600 - 900	900 - 600		732	1 Stück	2648307	1VB8001281R0103
SS 2500 A 882	900 - 900	1200 - 600	600 - 1200	882	1 Stück	2648302	1VB8001281R0104
SS 2500 A 1032	900 - 1200	1200 - 900		1032	1 Stück	2648305	1VB8001281R0105
SS 2500 A 1182	1200 - 1200			1182	1 Stück	2648304	1VB8001281R0106

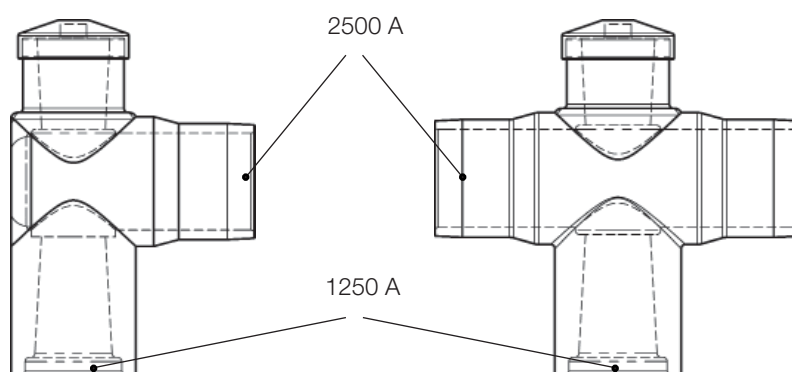


Table 8.2.2: End and cross adapter assemblies for a busbar current of up to 2500 A / feeder current 1250 A

Designation	Panel width [mm]	Quantity	Supplier's part number	ABB part number
End adapter 1250 A / 2500 A	600	1 set (3 pcs.)	2652688	1VB8001283R0112
Cross adapter 1250 A / 2500 A	600 Not in sectionaliser and riser	1 set (3 pcs.)	2652689	1VB8001283R0111

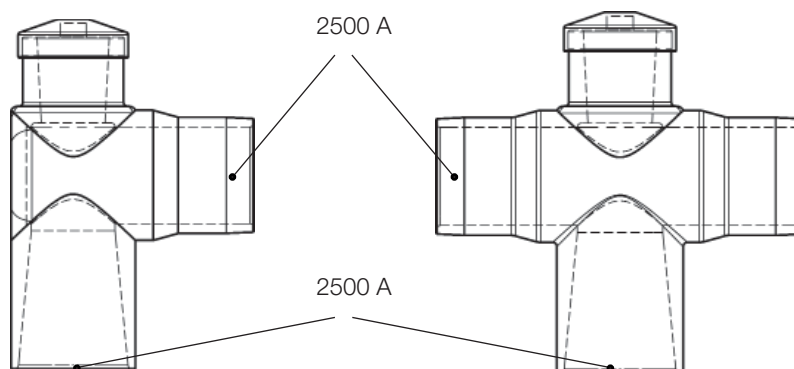


Table 8.2.3: End and cross adapter assemblies for a busbar current of up to 2500 A / feeder current 2500 A

Designation	Panel width [mm]	Quantity	Supplier's part number	ABB part number
End adapter 2500 A / 2500 A	900 1200	1 set (3 pcs.)	2612988	1VB8001283R0114
Crossadapter 2500 A / 2500 A	1200	1 set (3 pcs.)	2612989	1VB8001283R0113

9 List of tools

The tools required for assembly of the switchgear system are detailed in the list below. Tools are not part of the ABB scope of supply.

All the tools listed must comply with the safety regulations of the country concerned.

- 1 Temperature-compensated pressure gauge with coupling, for systems up to 24 kV, not for panels with switch-disconnector and fuses (ABB part number: GCE0905091P0101, figure 2.3.1.1.4)
- 1 Temperature-compensated pressure gauge with coupling, for systems with a rated voltage over 24 kV and up to 36 kV and for panels with switch-disconnector and fuses (up to 24 kV) (ABB part number: GCE0905091P0102, figure 2.3.1.1.4)
- 1 Set of open-ended spanners, 8 to 19 mm AF
- 1 Set of ring spanners, 8 to 19 mm AF
- 1 Ratchet, 3/8", with extensions and 8 to 19 mm AF socket keys and 4 to 10 mm Allen key inserts
- 1 Ratchet, 1/2", with extensions and 10 to 19 mm AF socket keys and 4 to 10 mm Allen key inserts
- 1 Socket insert 1/2", 19 mm AF, min. 82 mm long (for busbar installation, busbar current 1250 A)
- 1 Socket insert 1/2", 24 mm AF, min. 82 mm long (for busbar installation, busbar current 2500 A)
- 1 Set of screwdrivers for slotted and cross-head screws, sizes 1 to 3
- 1 Set of electrician's pliers (end cutting nipper, pointed pliers, flat end pliers, stripping tongs)
- 1 Rubber mallet
- 1 Set of fitter's hammers
- 1 Leveller
- 1 Plumb bob
- 1 Guide string
- 1 Scribing iron
- 1 Punch
- 1 Tri-square
- 1 Tape measure
- 1 Calliper gauge
- 1 Continuity tester
- 1 Multimeter (voltage, current and resistance)
- 1 Torque wrench, 0 – 40 Nm, calibrated
- 1 Torque wrench, 15 – 100 Nm, calibrated
- 1 Extension cable, 230 V, 15 m long 1 Cable drum, 230 V / 16 A, 50 m
- 1 Angle grinder, small
- 1 Hand-held drill, chuck up to 13 mm
- 1 Hammer drill
- 1 Welding machine + accessories
- 1 Set of steel drill bits, 1 to 13 mm
- 1 Set of concrete drill bits, 6 to 12 mm
- 1 Steps, 8 rung
- 2 Trolley jacks (recommended capacity 2 t) or
- 2 Hydraulic lift trolleys (recommended capacity 3.5 t per pair)
- 4 Lifting ropes, 0.75 m, recommended capacity 1 t
- 4 Lifting ropes, 1.5 m, recommended capacity 1 t
- 4 Shackles, capacity 1 t
- 2 Pinch bars
- 5 Handling tubes
- 2 Chain hoists, 0.25 t including chain
- 1 Site lighting
- 1 Torch
- 1 Hand-held lamp
- 1 Vacuum cleaner
- Several wooden planks
- Several wooden beams
- Soft, non-fraying cleaning cloth, household cleaner, chlorine-free

10

Working materials, auxiliary materials and accessories

Working materials, auxiliary materials and accessories are included in the scope of supply as contracted.

10.1

Working materials

ABB part number

SF ₆ insulating gas	
Pressure-liquefied gas in steel cylinders,	
Capacity: 5 kg	GCE0990258P0102
Capacity: 40 kg	GCE0990253P0102
Quality to IEC 60376	



Observe sample instruction manual included in manual
HB 605 E

As a rule, the panel modules are filled with insulating gas at the works. For this reason, no gas cylinders are supplied with the switchgear. Gas cylinders are not normally part of the ABB scope of supply.

In the case of airfreight, the panel modules are filled at the works to a reduced insulating gas pressure, and therefore they have to be topped up with SF₆ at site. In this case SF₆ in cylinders is required. Further information on the handling of SF₆ can be found in instruction manual HB 605/E.

If extreme temperatures ≥ 50 °C during the storage, transport or temporary storage in the open air of the SF₆ cylinders with exposure to sunlight cannot be ruled out, please provide in your order for a reduced filling factor of 0.75 kg/l for safety reasons.

10.2

Auxiliary materials

Lubricant: Isoflex Topas NB 52,	
Capacity 1 kg	GCE0007249P0100
Assembly paste for silicone insulating parts,	
Capacity 40 g	1VB0000207P0100
Cleaning agent for silicone insulating parts, cast resin bushings, outer cones and fuse sealing collars	
Intensive cleaner M.X.T. 60 forte, capacity 1 l	1VB0000240P0100
Paint, standard colour RAL 7035	
Can, capacity 1 kg	GCE9014060R0103

10.3 Accessories

	ABB part number
<u>Accessories for manual charging of the stored energy spring of the circuit-breaker</u>	
Charging lever for VD4 X operating mechanism	GCE9477394R0101
<u>Accessories for manual operation of the three position disconnecter</u>	
Operating lever for earthing switch (Fig. 4.1.3.1.1)	1VB8002443R0102
Operating lever for disconnecter (Fig. 4.1.3.1.2)	1VB8002443R0101
<u>Accessories for operation of the three position switch-disconnector with fuse</u>	
Operating lever without coding (Fig. 4.2.2.1)	1VB8004061R0101
Operating lever with coding for operation of the earthing switches (Fig. 4.2.2.3)	1VB8004062R0101
Operating lever with coding for operation of the charging shaft (Fig. 4.2.2.2)	1VB8004062R0102
<u>Accessories for HRC fuses</u>	
Length adapter for fuse length 292 mm and diameter 53 mm (Fig. 4.2.3.2)	GCE9015980R0101
Adapter for fuse diameter 53 mm (Fig. 4.2.3.2)	GCE9015982R0101
Fuse links (manufacturer Siba): HRC fuse links for indoor switchgear with striker pin 80 N and temperature limiter, nominal dimension "e": 442 mm (or 292 mm with adapter) nominal dimension "d": 67 mm (or 53 mm with adapter)	On request, depending on rated voltage and rated current
<u>Accessories for capacitive indicator, system LRM</u>	
Display unit (Abb. 5.1.1.1)	GCE0931333P0101
Interface tester	GCE0900052P0102
Short-circuiting plug	GCE0909005P0101
<u>Other accessories</u>	
Double bit key for barrel lock in panel door	GCE0990108P0100
Wall mounting for accessories	GCE9016025P0101
Wall mounting for three HRC fuses	GCE9016382P0102
Adapter for DILO filling truck	1VB8000532R0101

11 Technical data

The technical data of the switchgear can be found on the name plate. The name plate of the panel is located at the top on the right-hand side wall of the opened low voltage compartment. Further name plates are located in the immediate vicinity of the devices they describe.

Table 11.1: Technical data of the panels						
Rated voltage / maximum operating voltage	U _r	kV	12	17.5	24	36 ¹⁾
Rated power-frequency withstand voltage	U _d	kV	28	38	50	70 ¹⁾
Rated lightning impulse withstand voltage	U _p	kV	75	95	125	170 ¹⁾
Rated frequency ²⁾	f _r	Hz	50			
Rated normal current of busbars	I _r	A	...1250, ... 2500			
Rated normal current	I _r	A	... 630 (Panel width 450 mm)			
			... 630, ... 1250 (Panel width 600 mm)			
			... 1600, ... 2000, ... 2500 (Panel width 900 mm and 1200 mm)			
Rated short-time withstand current	I _k	kA	... 25 (Panel width 450 mm)			
			... 31.5 (Panel width 600 mm, 900 mm and 1200 mm)			
Rated peak withstand current	I _p	kA	... 63 (Panel width 450 mm)			
			... 80 (Panel width 600 mm, 900 mm and 1200 mm)			
Rated duration of short-circuit	t _k	s	...3			
Insulating gas system ^{3) 4)}						
Alarm level for insulation	p _{ae}	kPa ⁵⁾	120 ⁶⁾			
Rated filling level for insulation	p _{re}	kPa	130 ⁷⁾			
Minimum functional level for operation ⁸⁾	p _{mm}	kPa	140			
Rated filling level for switch ⁸⁾	p _{sw}	kPa	150			
Degree of protection for parts under high voltage			IP65			
Degree of protection of the low voltage compartment and mechanism bay ⁹⁾			IP3X			

¹⁾ Except for panels with switch-disconnector and transfer panels, Panel with a width of 450 mm

²⁾ Rated current for 60 Hz on request

³⁾ Insulating gas: SF₆ (sulphur hexafluoride)

⁴⁾ All pressures stated are absolute values relative to 20 °C

⁵⁾ 100 kPa = 1 bar

⁶⁾ Three position switch-disconnector: 140 kPa

⁷⁾ Three position switch-disconnector: 150 kPa

⁸⁾ Applies to switch-disconnectors only

⁹⁾ Higher degrees of protection on request

11.2: Operating conditions		
Ambient temperature, maximum	°C	+40
Ambient temperature, maximum 24 h average ¹⁾	°C	+35
Ambient temperature, minimum	°C	-5
Site altitude ²⁾	m	...1000
Average humidity measured over 24 h ³⁾	%	≤ 95
Average relative humidity in one month ³⁾	%	≤ 90
Ambient air		Ambient air not significantly contaminated by dust, smoke, corrosive or flammable gases or salts.

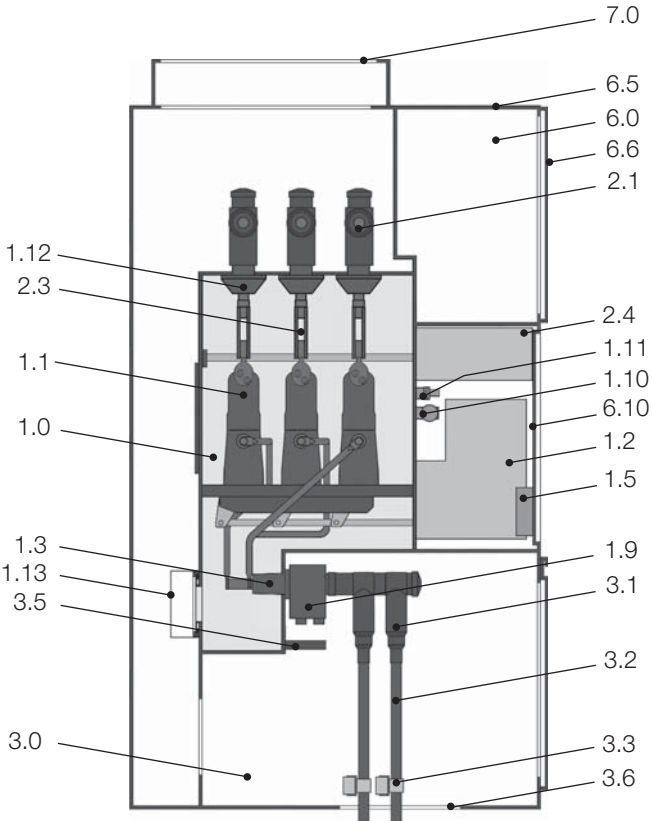
Table 11.3: Panel weights			
Panel type	Panel width [mm]	Rated normal current [A]	Weight, max. [kg]
Panel with three-position switch-disconnector and fuses	600	Depends on fuses	600
Feeder panel	450	630	450
Feeder panel	600	1250	900
Sectionaliser panel	600	1250	900
Riser panel	600	1250	700
Transfer panel	600	1000 (1250)	800
Incomer panel	1200	2500	2200
Sectionaliser panel	900	2500	1600
Riser panel	900	2500	1200

¹⁾ Higher ambient temperature on request

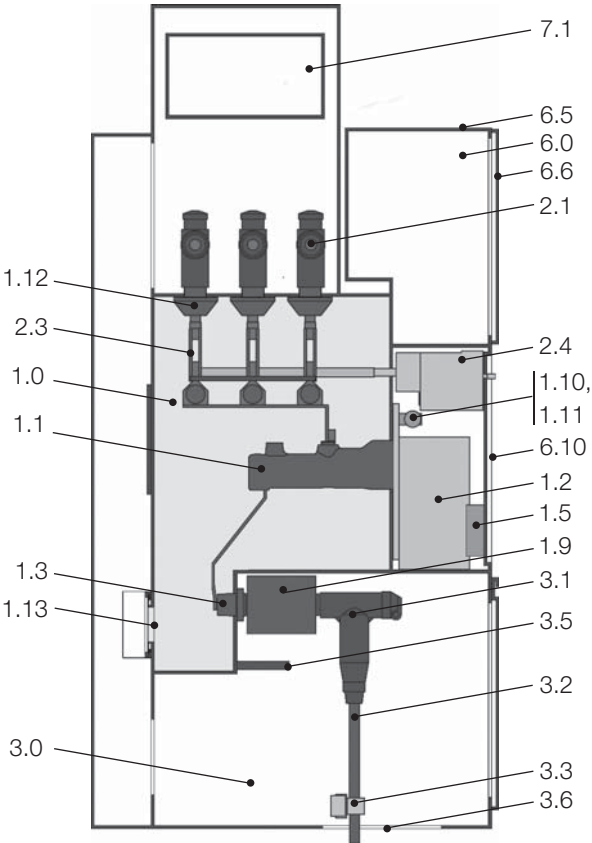
²⁾ Greater site altitudes on request

³⁾ Take suitable action to prevent condensation in the low voltage compartment.

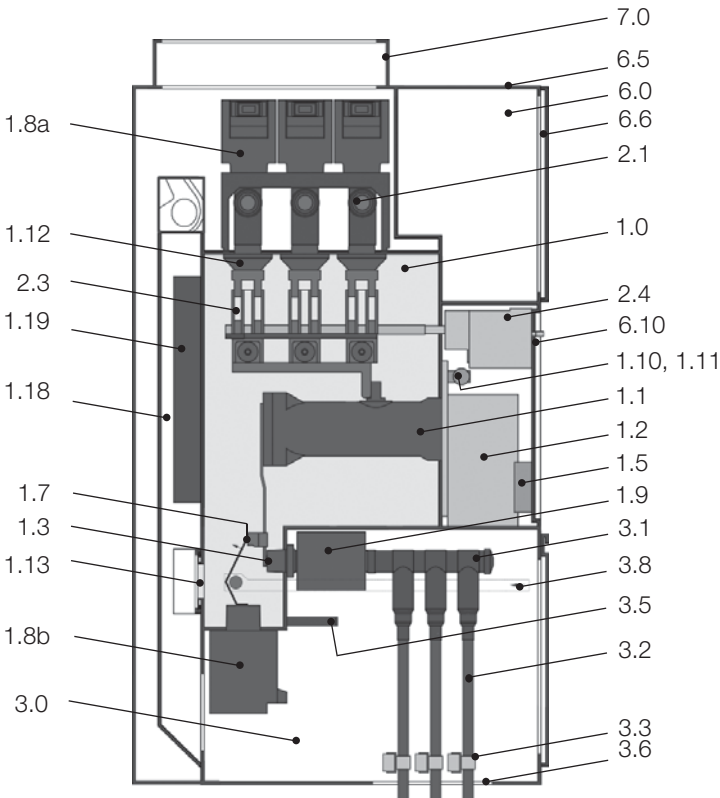
Feeder panel, 630 A, example configuration

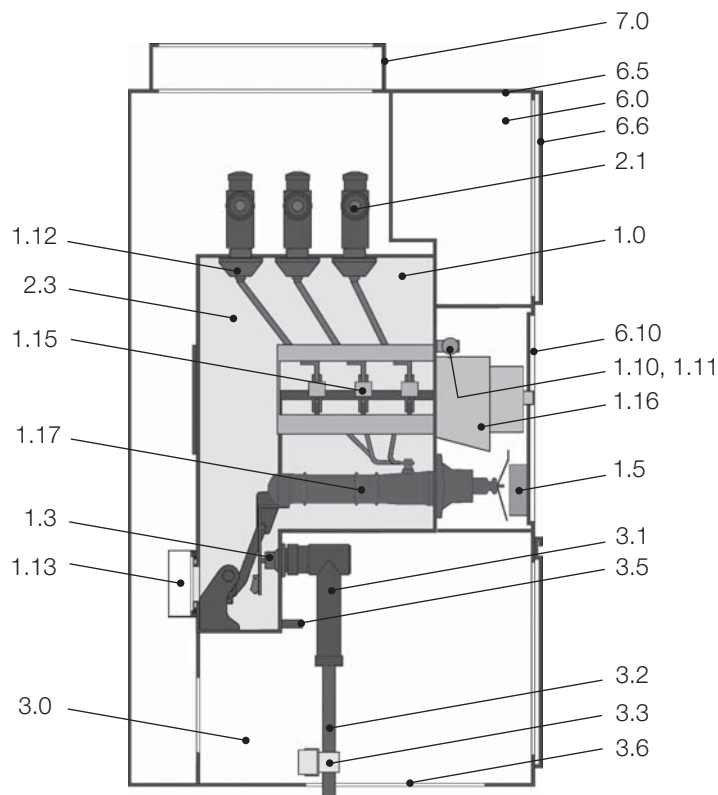


Feeder panel, 1250 A, example configuration



Incomer panel, 2000 A, example configuration





1.0	Panel module	2.1	Busbar
1.1	Circuit-breaker pole	2.3	Three position disconnector
1.2	Circuit-breaker operating mechanism	2.4	Three position disconnector mechanism
1.3	Outer cone	3.0	Cable compartment
1.5	Measuring sockets for capacitive voltage indicator system	3.1	Cable connector
1.7	Isolating system for voltage transformer	3.2	High voltage cable
1.8a	Voltage transformer for busbar measurement (optional)	3.3	Cable fastener
1.8b	Voltage transformer for feeder measurement (optional)	3.5	Main earthing bar
1.9	Current transformer	3.6	Floor plate
1.10	Gas density sensor	3.8	Mechanism for the voltage transformer isolating device (optional)
1.11	Filling valve	6.0	Low voltage compartment
1.12	Cast resin bushing to busbar	6.5	Secondary cable entry
1.13	Pressure relief disk	6.6	Low voltage compartment door
1.15	Three position switch disconnector	6.10	Mechanism bay
1.16	Three position switch disconnector mechanism	7.0	Busbar cover
1.17	Fuse box	7.1	Pressure relief duct
1.18	Heat sink		



Insulating Gas SF₆

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