ZS1

Air-insulated medium voltage switchgear, 12 kV/17.5 kV
Instruction manual BA 372/04 E

Your safety first – **always!**

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

- Only install switchgear and/or switchboards in enclosed rooms suitable for electrical equipment.
- Ensure that installation, operation and maintenance are carried out by specialist electricians only.
- Comply in full with the legally recognized standards (DIN VDE / IEC), the connection conditions of the local electrical utility and the applicable safety at work regulations.
- Observe the relevant information in the instruction manual for all actions involving switchgear and switchboards.
- ⚠ Danger!

  Pay special attention to the hazard notes in the instruction manual marked with this warning symbol.
- Make sure that under operation condition of the switchgear or switchboard the specified data are not exceeded.
- Keep the instruction manual accessible to all persons concerned with installation, operation and maintenance.
- The user's personnel are to act responsibly in all matters affecting safety at work and the correct handling of the switchgear.

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

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1 Summary

1.1 General

The metal-clad, three-pole air-insulated panels without disconnectors from type ZS1 for rated voltage of 12 kV and 17.5 kV are factory-assembled, type-tested indoor panels. They are designed as withdrawable switchgear and fitted with single busbar systems. The withdrawable breaker parts are preferably fitted with vacuum circuit-breaker

Details of the technical design and configuration of the switchgear, such as technical data, detailed equipment lists, comprehensive circuit documentation etc., can be found in the relevant order documents.

1.2 Standards and specifications

ZS1 switchgear comply with the standards and specifications for factory-assembled and type tested high voltage switchgear in VDE 0670, and the relevant IEC publications 60298 and 60694.

In addition, in accordance with IEC 60529, the panels have degrees of protection

- IP 4X (up to IP 55 possible) for the enclosure
- IP 2X for the partitioning.

All other relevant VDE specifications, especially DIN VDE 0101, VDE 0105 and DIN VDE 0141, the corresponding IEC publications, the national or local workplace safety regulations and the safety regulations for production materials are to be followed during erection and operation of this equipment. In addition, the order-related data and instructions from ABB are to be observed.

1.3 Operating conditions

1.3.1 Normal operating conditions

The switchgear are basically suitable for normal operating conditions for indoor switchgear and controlgear in accordance with VDE 0670, Part 1000 (IEC Publication 60694). The following limit values, among others, apply:

- Ambient temperature:
  - Maximum + 40 °C
  - Maximum 24 h average + 35 °C
  - Minimum (according to "minus 5 indoor class" – 5 °C
- Humidity:

  VDE 0670 Part 6 amends the contents of VDE 0670 Part 1000 with respect to humidity as follows: With indoor installation, it is assumed that the humidity within the enclosure can reach high values, but without condensation normally appearing on the installed equipment. Condensation can be prevented by appropriate design of the station building or switchgear room.
- Site altitude:
  - The maximum site altitude is up to 1000 m above sea level.

1.3.2 Special operating conditions

Special operating conditions must be agreed by the manufacturer and operator according to VDE 0670 Teil 1000. The ZS1-switchgear provides opportunities to comply, for example, with the following special operating conditions

- Increased ambient:
  Conductors and switching devices to be designed for a higher rated current.
- Increased humidity:
  Heaters to be installed in the panels.
- Sites altitudes above 1000 m:
  Design panels for higher insulation level in consideration of the altitude factor k according to figure 1/1.

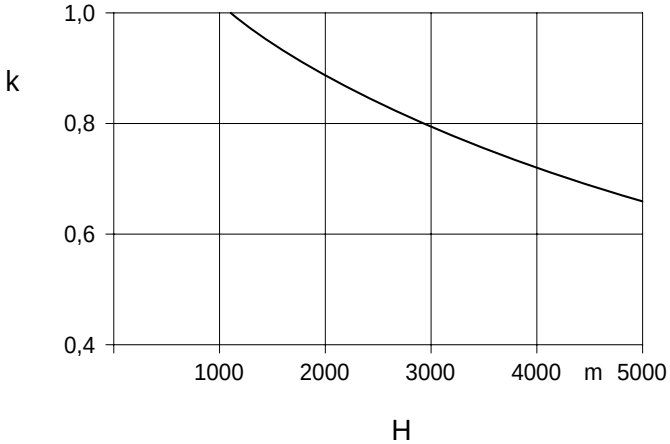


Figure 1/1: Curve for determination of the altitude factor k in relation to the altitude H

(Sourcee: ABB switchgear manual, 9th Edition, 1992)

2 Technical data

2.1 **Electrical data**

Rated voltage	kV	12	17.5
Max. operating voltage	kV	12	13.8
Rated power frequency withstand voltage	kV	28	38
Rated lightning impulse withstand voltage	kV	75	95
Isolation		VDE/IEC List 2	VDE/IEC List 2
Rated frequency	Hz	50/60	50/60
Rated current of the busbars		... 4000	... 4000
Rated current of the tee-offs:			
• Circuit-breaker	A	... 4000	... 4000
• Switch-disconnector	A	... 1250	... 1250
Rated impulse current of the main conductor	kA	... 125	... 100
Rated short-circuit breaking current of the circuit-breaker	kA	... 50	... 40
Rated short-time current [2] 3s	kA	... 50	... 40
Auxiliary voltage	V	DC[1] 60, 110, 120; AC 110, 220	

[1] Special DC voltage on request.
[2] Take the short-circuit withstand capability of the instrument transformers into account separately.

For data on the individual switching devices, see ABB switchgear handbook or the instruction manual for the switching device concerned, as listed under 7.1.

2.2 **Resistance to internal arc faults**

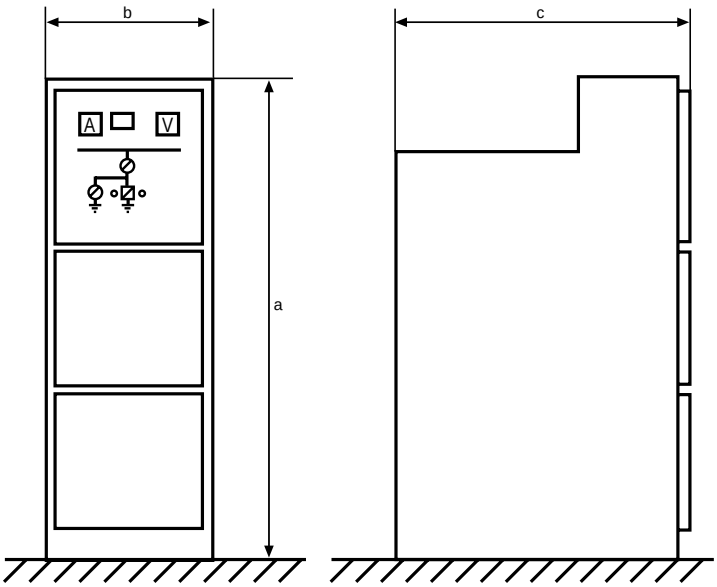
The resistance to internal arcing faults is 50 kA 1s. Criteria 1 to 6 of PEHLA Directive No. 4 (in conjunction with VDE 0670 part 6 and IEC 60298) are fulfilled. Depending on the configuration of the panels and/or the switchroom conditions (e.g. low ceiling height), additional measures may be necessary to ensure compliance with criterion 5.

2.3 Dimensions and weights

Rated voltage		kV	12	17.5
Height[2]	Dimension a	mm	2200	2200
Width	Dimension b			
• Tee-off current up to 1250 A (up to 31.5 kA)		mm	650	650
• Tee-off current up to 1250 A (above 31.5 kA)		mm	800	800
• Tee-off current 1600 A		mm	800/1000	800/1000
• Tee-off current above 1600 A		mm	1000	1000
Depth	Dimension c	mm	1300[1]	1300[1]

[1] 1350 mm for rated tee-off currents of 4000 A

[2] Height of the control cabinet is 705 mm



The minimum ceiling height in the switchroom is 3000 mm. Further details of the switchroom design can be found in figures 5/1 to 5/4.

Weights:

Feeder panel (including withdrawable circuit-breaker part)

	Weight kg	
Rated current A	Rated short-time current …31,5 kA	…50 kA
…1250	800	850
1600	850	850
2000	1200	1200
2500	1200	1200
3150	1200	1200
4000	1400	1400

3 Panel design and equipment

3.1 Basic structure and variants

(Figures 3/1 to 3/5)

The basis for the ZS1 panel is the incoming/ outgoing feeder panel with vacuum circuit-breaker using insertion technology. It is divided into busbar compartment A, circuit-breaker compartment B, cable compartment C and the control cabinet for the secondary equipment D. Apart from this, there are variants for all operating needs. The pictures 3/ 1 to 3/5 show possible configurations of a panel including electrical equipment.

For a busbar sectionalizing, two panels are necessary, the coupling panel with the withdrawable circuit-breaker part and a bus riser panel (optional with busbar metering and earthing). When setting up the switchgear in two rows, the busbar sectionalizing can be combined with a bar connection between the two sets of switchgear. In equipment without busbar sectionalizing, a direct bar connection between the busbars will be established.

With ZS1 panels it is possible to set up a double busbar installation in accordance with the two breaker method. This duplex arrangement is possible both with back to back or front to front positioning.

Apart from this, panels with fixed-mounted switch-disconnectors of type C3 (e.g. for feed to a station service transformer) are provided.

Depending on rated short-time current and the ceiling height of the circuit-breaker compartment, a pressure relief duct on the panel would perhaps be required.

Further details about the installation and equipping of the switchgear can be obtained from the order documents.

3.2 Enclosure and partitioning

(Figure 3/5)

Enclosure and internal partitioning of the panels are of high quality aluminium-zinc coated steel sheets, 2 mm thick. The three high voltage compartments (busbar compartment circuit-breaker compartment and cabel connection compartment) are equipped with top-mounted, secured pressure relief flaps. These open in the case of overpressure due to an internal arc fault.

The front of the panel is closed off by pressure resistant doors which open to an angle of almost 180°. Cable and circuit-breaker compartments have their own doors equipped with sight glasses made of security glass. Neighbouring panels are partitioned from one another by the side walls of each panel and the air cushion which remains between these walls as a result of the design when the panels are joined together.

In the case of the duplex version with a rated short-time current of up to 31,5 kA a swivelling lever cap is used instead of the three screw caps. The door of the control cabinet has a catch fastener lock.

The enclosure is completed by top-mounted pressure-relief flaps which are, according to the rated tee-off conductor current, made of sheet steel 49.2 or expanded metal 49.1 and below by means of the floor-covering 17 made of sheet steel which cannot be magnetized. The pressure-relief flaps are secured with steel screws on one longitudinal side and on the other longitudinal side with plastic screws. In the case of internal overpressure, the plastic screws are the point of rupture.

Part of the internal partitioning are the busbars-rear wall 9.3, the intermediate wall 9, the mounting plate 12 with the shutters 12.1. and the horizontal partition 20. The internal partitioning makes it possible to have safe access to the circuit-breaker and cable compartment even when the busbars are live.

The control cabinet for the secondary equipment is completely protected from the high voltage area due to its steel-sheet casing.

On the front side, cover plates ensure a good appearance and are mechanically and thermically arc fault proof in case of such an event in the end panel.

Doors and rear walls as well as the cover plates are thoroughly cleaned and treated against corrosion before receiving a high-quality double coating of paint. The finishing coat is in the standard colour RAL 7035 (special colours by agreement). The stoving procedure completes the work and imparts a notable insensitivity to impacts and corrosion.

3.2.1 Ventilation of the panels

(Figures 3/1, 3/5, 3/9)

For the purpose of ventilation in cases of certain rated currents in the busbar and tee-off bars, openings in the outer enclosure are necessary.

For incoming air to the circuit-breaker compartment, the horizontal partition is provided with air-vents 20.2. The degree of protection IP4X and safety in case of releases of hot gas caused by an arc fault are provided by the flap 20.3 in the raised false floor. In the case of outgoing air, the presssure relief flaps are provided made of expanded metal instead of clad metal sheets. The form and size of the vents in the expanded metal provide the degree of protection IP4X.

In the panel for tee-off rated current 4000 A, cross-current blowers are installed for cooling purposes.

3.3 Compartments in the panels

3.3.1 Busbar compartment

(Figures 3/5, 3/6, 5/8, 5/9, 5/11 and 5/12)

The busbars 3 have a D-shaped cross-section made of copper or aluminium and are laid in sections from panel to panel. According to the current rating, single or double configuration is used. They are held by the flat tee-off conductor 2 and the busbar bushings 29 and/or 29.4. No special connecting clamps are needed.

Busbars and tee-off conductors are insulated by means of shrink-on sleeves. The bolt connections in the busbar system are normally covered by insulating covers 58, so that the entire configuration is completely free of arc fault points of origin.

In conjunction with bushing plates 28 (or 28.2) and 29 and/or 29.4, panel by panel partitioning is possible.

In switchgear with a short-time current more than 25 kA this partitioning may also be necessary for reasons of stability.

3.3.2 Circuit-breaker compartment

(Figures 3/5, 3/7, 3/10 and 3/19)

The circuit-breaker compartment contains all the necessary equipment for the mutual functioning of the withdrawable breaker part and the panel. It is, as the busbar compartment, metally partitioned on all sides.

The isolating tulips 5 together with the fixed isolated contacts are in the mounting plate 12. Also included are the metal shutters 12.1 which cover the insertion openings. The shutters are opened by means of the actuating bars 13.16 of the withdrawable breaker part using lever 38 when inserting into the service position and are closed when it is removed. In the test/disconnected position of the withdrawable part, a partitioning by separation is established in the main circuit current. The connection of the control wiring which must be established for test purposes need not be interrupted when in the test/disconnected position.

The socket 10.1 for the control wiring is fixed-mounted in the circuit-breaker compartment.

3.3.3 Withdrawable parts

(Figures 3/7, 3/8, 3/10, 3/11 and 3/21)

1. Withdrawable circuit-breaker parts

   The withdrawable circuit-breaker forms a complete module consisting of the circuit-breaker type VD4, the withdrawable assembly 13.15, the isolated contact arm 4.2 with the contact system 4.3 and the control wiring plug 10.2.

   The withdrawable assembly 13.15 and the circuit-breaker are coupled via a multipole control-wiring plug connection 10.3.

   The withdrawable assembly establishes the mechanical connection between the panel and the circuit-breaker. The fixed part is connected to the panel by forking, form-coded on both sides. The movable part with the circuit-breaker is moved manually or by a motor by way of a spindle, between the service or test disconnected positions with the front doors closed. Service and test disconnected positions are exactly registered by means of auxiliary switches, which register the final position reached and the angular position of the spindle.

   The earthing connection between the withdrawable part and the panel is established by its rollers and the travel rails 41 which are bolted into the panel. The surfaces of all the parts of the earthing circuit are zink-galvanized.

   Withdrawable parts of the same design are mutually interchangeable. In the case of the withdrawable parts having the same dimensions, but different equipping of the circuit-breaker, the codification of the control wiring plug prevents non-permitted connections between the withdrawable part and the panel.

2. Other withdrawable parts

   In place of the circuit-breaker, the withdrawable part can also be fitted to act as a „disconnecting device“ with a fixed current-bridge in VD4 pole-casing, with a SF6 circuit-breaker or vacuum contactor (both fabricated by ABB Sace).

   The withdrawable part 95 is used in the metering panel with a voltage transformer 95.1 with or without HRC fuses as required. At the point of contact of the movable contact-arms or the HRC fuse cartridges and the voltage transformer, dielectrically dense cast-resin tubes have been used.

3.3.4 Cable compartment

(Figures 3/1, 3/4, 3/5, 3/12, 3/13)

The cable compartment contains current transformer 7, voltage transformer 8 and earthing switch 6 in each case according to the individual operating requirements.

The cable compartment is constructed for the installation of three current transformers. Should all three current transformers not be required, dummies will be installed instead with the same installation and connection procedures.

The fixed-mounted voltage transformers are connected on the primary side with flexible, completely insulated wirings which are inserted into the transformers.

In certain circumstances it is possible to use removable voltage transformers. They can be equipped with HRC fuses as in the metering panel.

The earthing switch type EK6 can be used either with manual or motor-operated mechanism. Its switching position will be indicated by means of the auxiliary switch both mechanically and electrically.

In the 650 mm wide panel, it is possible (according to choice) to prepare for up to three parallel three-core cables if required. In the standard version, the intended equipping is a plastic cable with single cable core protection. Intended maximum cross-section is 240 mm^2 with push-on sealing ends.

In the 800 mm or 1000 mm wide panel up to six parallel plastic cables can be connected also with single cable core protection and push-on sealing ends with a cross section of maximum 500 mm^2.

An alternative could be the 650 mm wide panel socket-contacts with inner cones for connection to the cable plugs. Customer wishes regarding the connections to bars or special cable or sealing-end types must be considered during the order-planning phase.

In place of the three cable cores, three surge arrestors can be fixed-mounted. An alternative would be, under certain conditions, to have these in a withdrawable form.

In the Duplex version, the cable compartment is modified as follows:

- In the back to back version, the connection between the two panels consists of flat copper bars.
- In the front to front version it consists of made-up plastic insulated cables or insulated busbar capacitance grading device, depending on the current.

3.3.5 Control cabinet

(Figures 3/1, 3/5, 3/14 and 3/15)

The control cabinet is for all matters of control and protection suitable for both conventional or modern control technology.

Apart from the usual case, a control cabinet of 705 mm in height, there is also a 1100 mm high version for especially comprehensive secondary technology, which has a panel height of 2595 mm.

If the secondary devices are not intended for door installation, they are mounted on perforated metal sheet 37.3. This is stored folded-up to enable any subsequent changes to the wiring. In the lower part of the control cabinet, three rows of terminal strips are on the swivelling terminal strips holder 37.4 and below these, auxiliary switch 10.4 for the control wiring plug is easily accessible.

For doors in which devices with higher voltage than that of low-voltage protection are installed, a secure and complete protection conductor connection must be established. The corrosion protected hinge of the control cabinet corresponds to these requirements (DIN VDE 0660 part 500). Protection against contact to clamps and devices corresponds to VGB 4.

Secondary wiring internal to the panel is in a duct on the right side of the panel. The left side of the panel is for the external wiring. The ducts are covered with steel sheet metal 43. At the side of the control cabinet are holes for sliding in the ring conductors.

Detailed information about the secondary technology and to the relevant material used in each case can be obtained from the secondary check-list pertaining to the order and the handbook (switching book).

3.4 Interlocks/protection against maloperation

3.4.1 Panel internal interlocking

(Figures 3/5 and 3/8)

To prevent dangerous situations and maloperation, a series of interlocks exist to protect both personnel and equipment.:

- The withdrawable part can only be moved from the test/disconnected position (and back) when the circuit-breaker and earthing switch are off (i.e., the switch must be off beforehand.) In the in-between position, the switch is mechanically interlocked, in the case of circuit-breakers with electrical release, the interlock is also electrical.
- The circuit-breaker can only be switched on when the withdrawable part is in the test or service position. In the in-between position, the switch is mechanically interlocked, in circuit-breakers with electrical release there is an electrical interlock too.
- In panels with digital control technology, prevention of maloperation of the switch basically takes place by means of the panel's software.
- In the service or test positions, the circuit-breaker can only be switched off manually when no control voltage is applied and cannot be closed (electromechanical interlock).

- Connecting and disconnecting of the control wiring 10.2 is only possible in the test/ disconnected position of the withdrawable part.
- Switch-disconnector and the earthing switch integrated therein are normally mechanically interlocked from each other and in each case only one of the two can be switched on.
- The earthing switch 6 can only be switched on if the withdrawable part is in the test/disconnected position or outside of the panel (mechanical interlock[1]).
- If the earthing switch is on, the withdrawable part cannot be moved from the test/disconnected position to the service position (mechanical interlock).
- Details of other possible interlocks e.g. in connection with a blocking magnet on the withdrawable part and/or earthing switch drive, can be obtained from the relevant order documents.

3.4.2 Interlocks between panels

(Figure 3/1)

- The busbar earthing switch can only be on when all withdrawable parts in the busbar section, which must be earthed, are in the test/disconnected position (electromechanical[2] interlock).
- When the busbar earthing switch is on, the withdrawable part in the earthed busbar section cannot be moved from the test/disconnected position to the service position (electromechanical[2] interlock).

3.4.3 Locking devices

(Figures 3/7, 3/17, 3/18 and 6/16)

- The shutters 12.1 can be secured independently of each other with padlocks when the withdrawable circuit-breaker part has been removed.
- Access to the drive-shaft of the earthing switch can be restricted with a padlock.
- Access to the circuit-breaker compartment and the cable compartment as well as to the withdrawable part controls can be restricted with a padlock.

3.5 **VD4 circuit-breaker run on-block**

In case of any irregularity in the area of the inner control mechanism and of the charging function of the stored-energy spring mechanism, the run-on block disables the immediately subsequent switching operation.

This is a protective measure to prevent damage to the circuit-breaker.

Release of the run-on block is described in instruction manual BA 383/E.

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[1] The mechanical interlock is replaced by a blocking magnet in the case of a duplex configuration.

In the case of a motor drive, the mechanical interlock or the blocking magnet is replaced by electrical interlock of the earthing switch. The **emergency** manual switch is **not** locked!

[2] The blocking magnet is not installed in the case of a motor drive; busbar earthing switches or the withdrawable parts are electrically locked. The **emergency** manual switch is **not** locked!

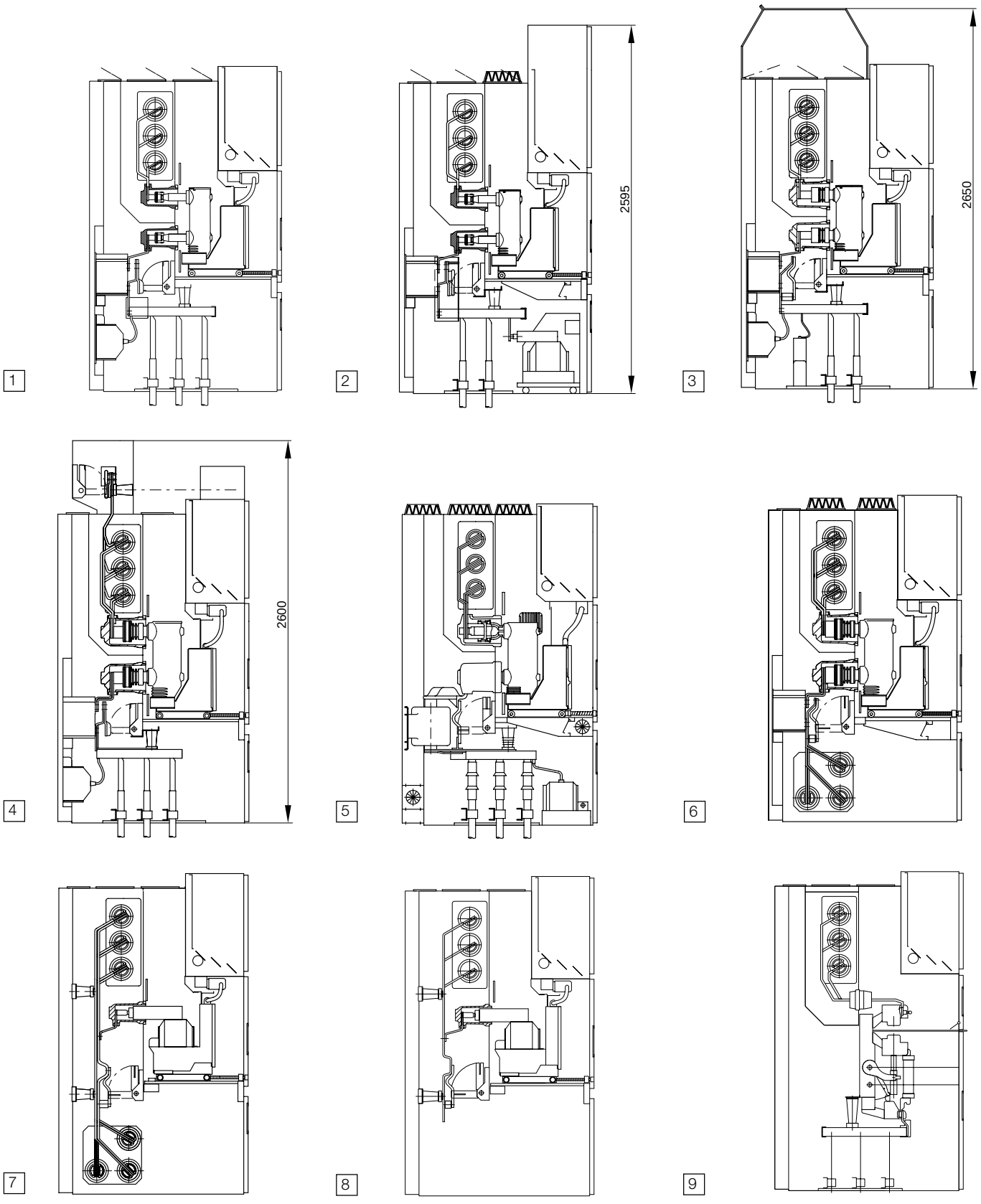


Figure 3/1: Panel variations

1 *Outgoing feeder 12 kV, 1000 A, 31.5 kA with firmly connected voltage transformers*
2 *Outgoing feeder 13,8 kV, 1250 A, 31,5 kA with removable voltage transformers and 1100 mm high control cabinet*
3 *Outgoing feeder 12 kV, 1250 A, 40 kA with firmly connected voltage transformers, surge arrestors and pressure relief duct*
4 *Incoming feeder 12 kV, 2000 A, 31,5 kA with busbar earthing switch in top mounted box*
5 *Incoming feeder 12 kV, 4000 A, 40 kA with insulated busbar capacitance grading device*
6 *Busbar sectionalizing 12 kV, 2500 A, 40 kA with earthing switch*
7 *Bus riser 12 kV, 2500 A, with withdrawable metering unit and earthing switch*
8 *Busbar metering 12 kV, 40 kA, with withdrawable metering unit and busbar earthing switch*
9 *Outgoing feeder 12 kV, 630 A, with switch-disconnector and fuses*

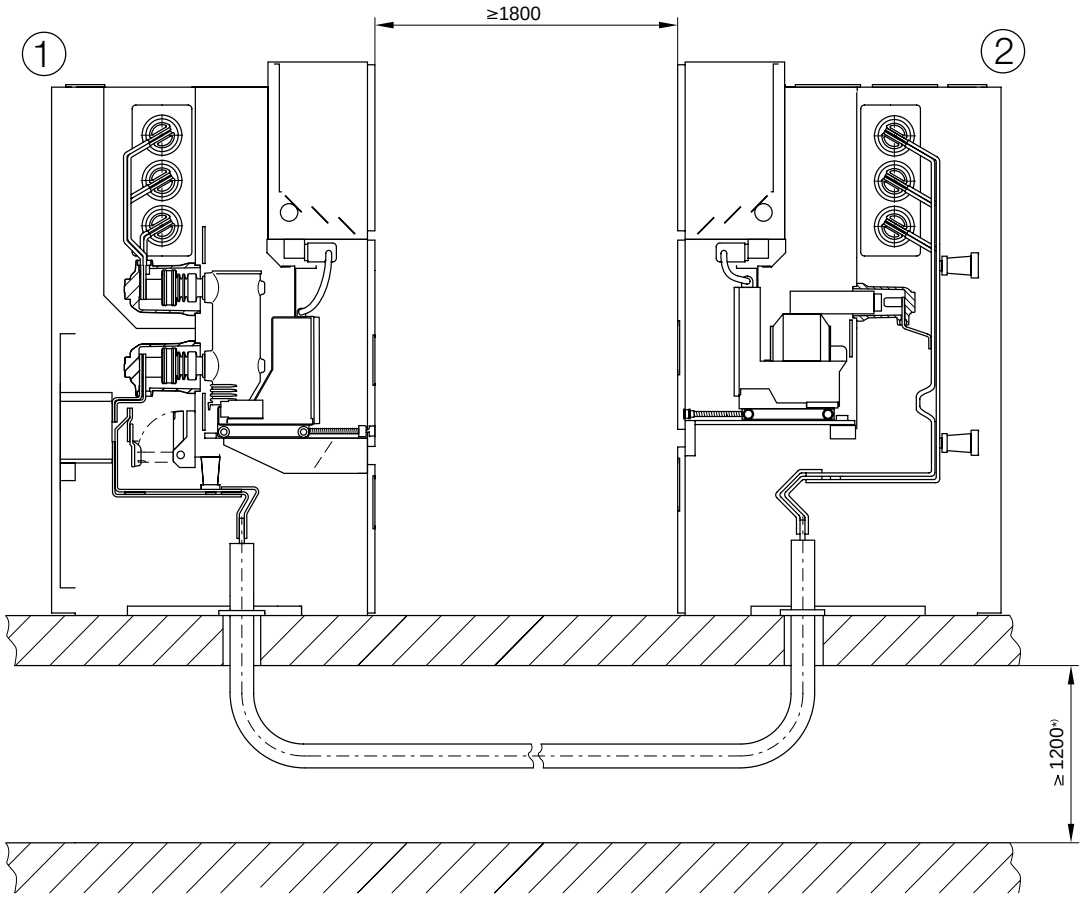
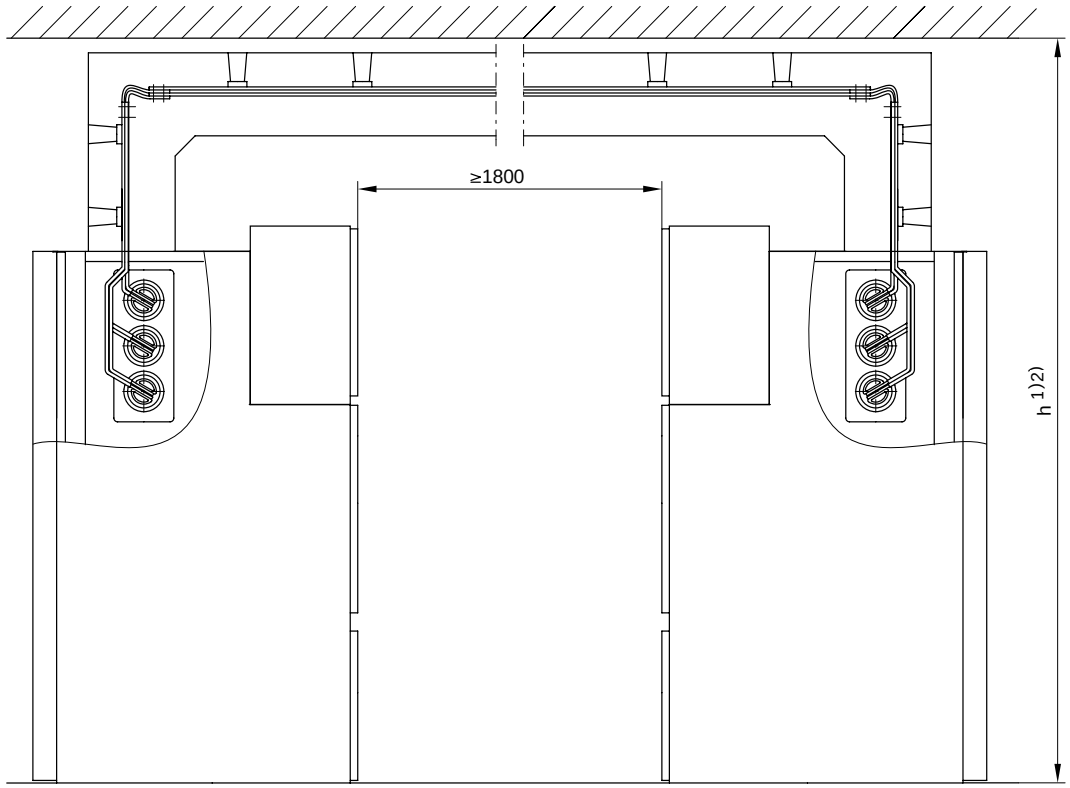


Figure 3/2: Erection of the ZS1 switchgear in two rows

**) Make allowance for the floor thickness*

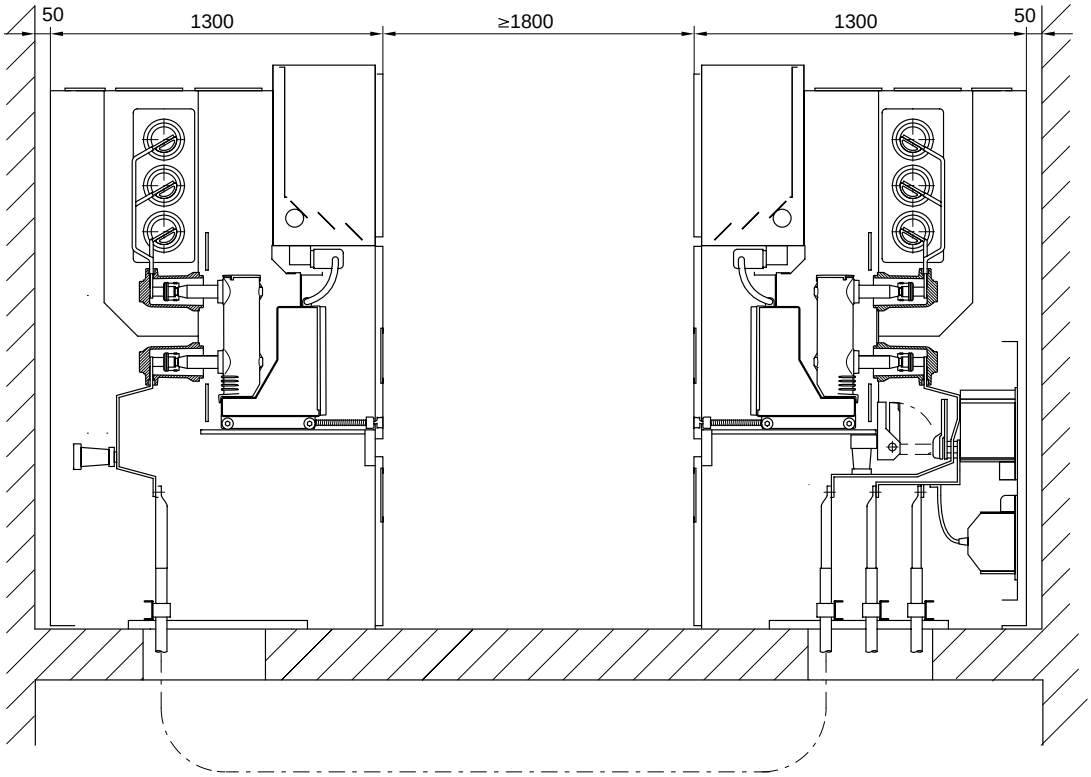
Busbar sectionalizing connection with insulated busbar capacitance grading device
① Busbar sectionalizing 2500 A
② Bus riser panel with withdrawable metering unit



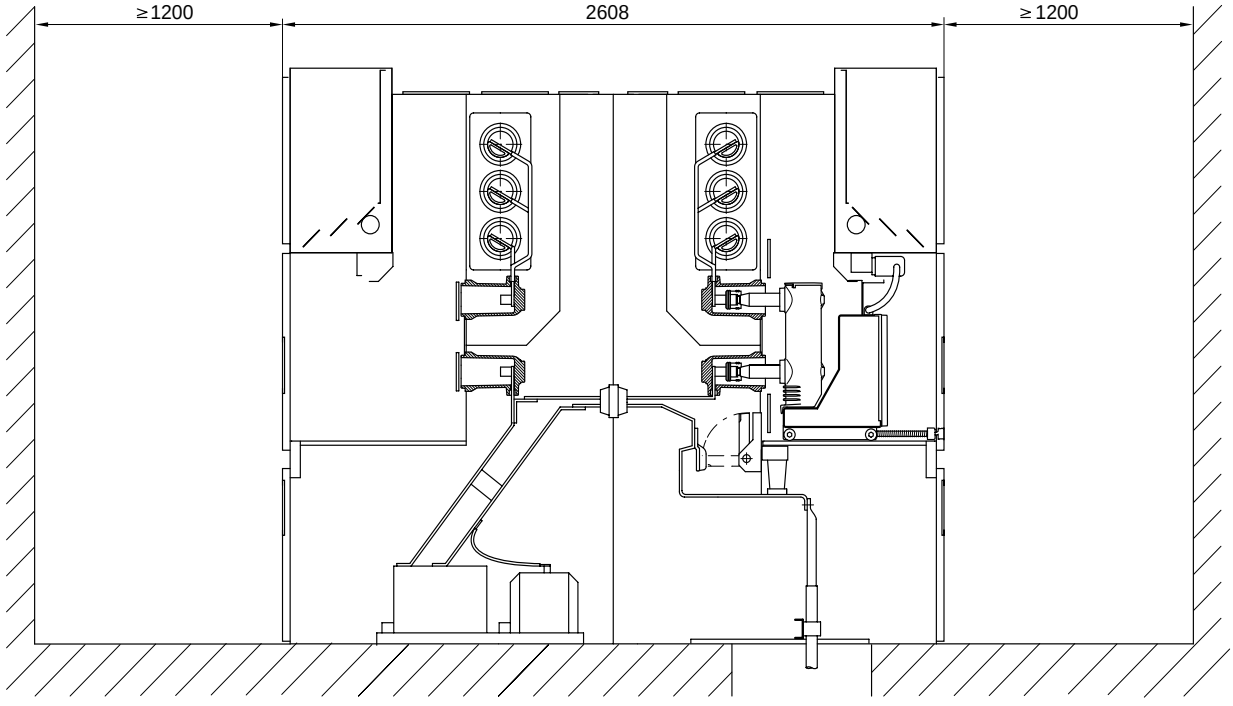
1) Dimension dependent on switchroom volume and short-circuit current.
2) Minimum dimensions are specified by the manufacturer.

Figure 3/3: Erection of the ZS1 switchgear in two rows,

Connection of the busbars in a bar duct



a) Installation front to front



b) Installation back to back

Figure 3/4: ZS1 Duplex switchgear 12 kV, 1000 A, 31,5 kA
Double busbar switchgear according to the two-breaker method

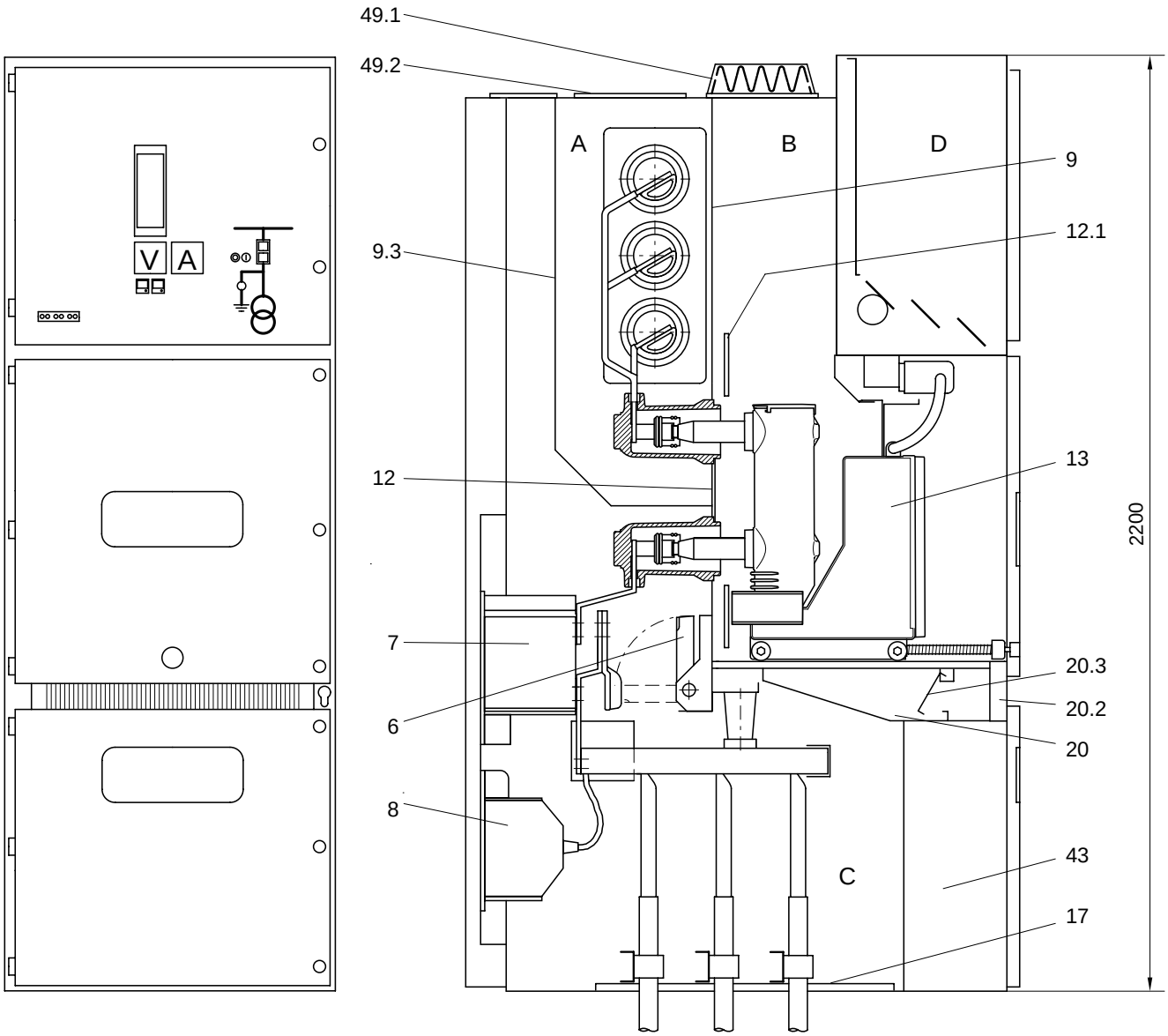


Figure 3/5: ZS1 Feeder panel 12 kV, 1250 A, 31.5 kA

A Busbar compartment
B Circuit-breaker compartment
C Cable compartment
D Control cabinet

6 Earthing switch
7 Current transformer
8 Voltage transformer
9 Intermediate wall
9.3 Busbar rear wall
12 Mounting plate
12.1 Shutter
13 Withdrawable circuit-breaker part
17 Floor covering
20 Horizontal partition
20.2 Air vents
20.3 Flap
43 Duct cover
49.1 Pressure relief flap,expanded metal
49.2 Pressure relief flap, steel sheet

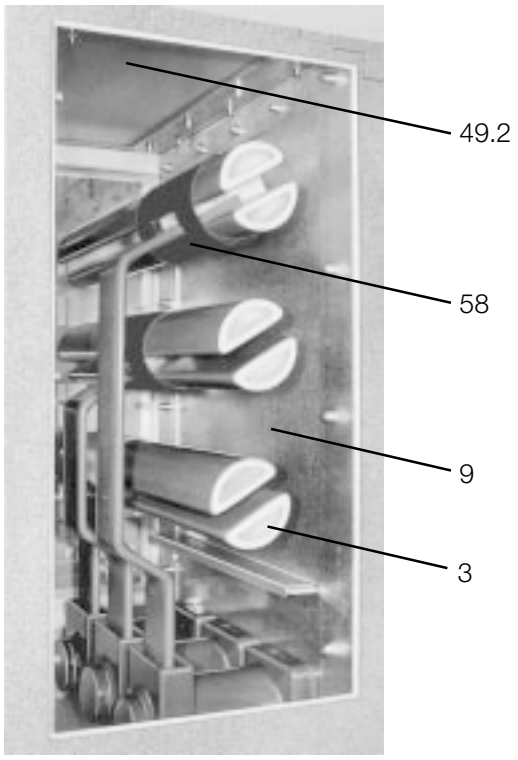


Figure 3/6: Busbar compartment, busbar system without partitioning

3 Busbar
9 Intermediate wall
49.2 Pressure relief flap
58 Insulating cover

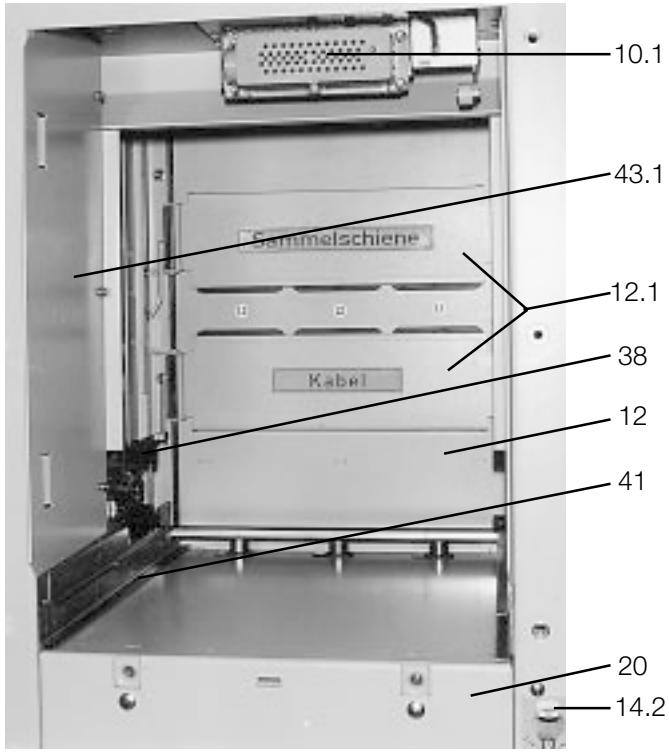


Figure 3/7: Circuit-breaker compartment, without withdrawable part

10.1 Socket for control wiring
12 Mounting plate
12.1 Shutters
14.2 Slide in front of the earthing switch manual operating mechanism
20 Horizontal partition
38 Lever for operating the shutters
41 Travel rail
43.1 Lateral covering of the external control wiring

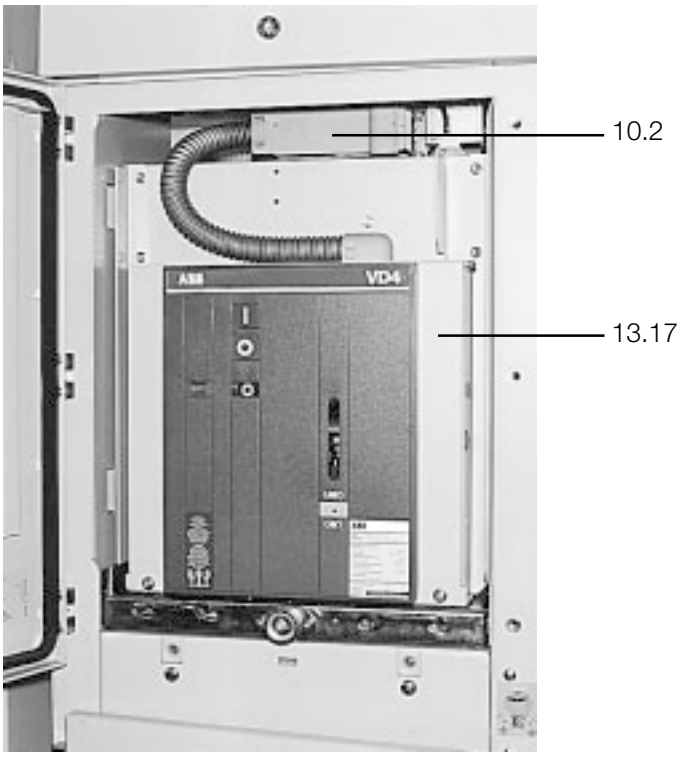


Figure 3/8: Circuit-breaker compartment with withdrawable part 1250 A in disconnected position

10.2 Control wiring plug
13.17 Front plate

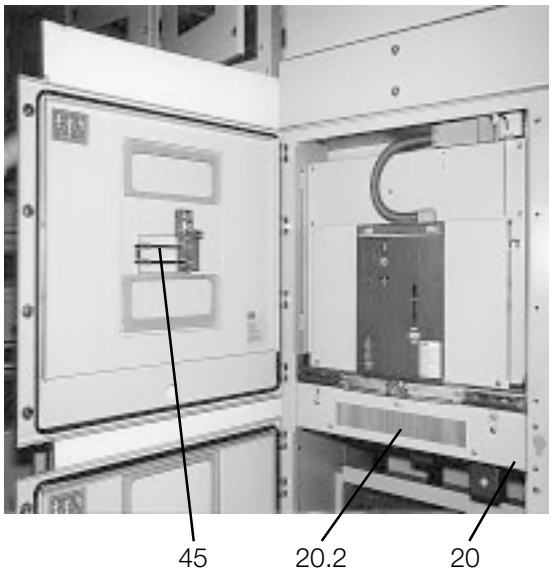


Figure 3/9: Circuit-breaker compartment with withdrawable part 2500 A in disconnected position

20 Horizontal partition with ventilation wall
20.2 Air vents
45 Mechanical circuit-breaker operation

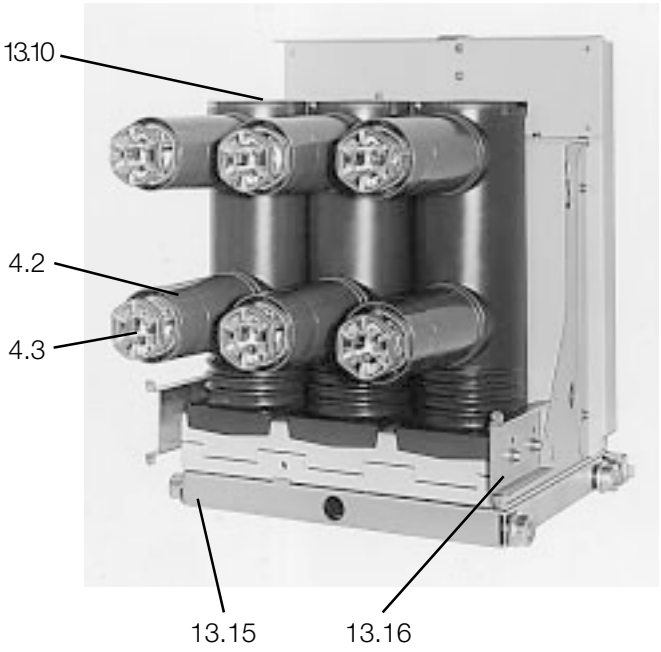


Figure 3/10: Withdrawable part with circuit-breaker 1250 A

4.2 Insulated contact arms
4.3 Contact system
13.10 Pole tube cap
13.15 Withdrawable assembly
13.16 Actuating bar

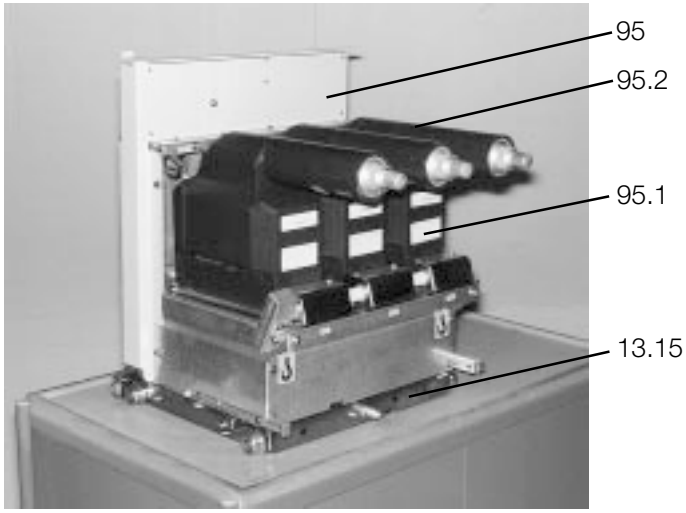


Figure 3/11: Withdrawable part with metering unit

13.15 Withdrawable assembly
95 Withdrawable metering unit
95.1 Voltage transformer
95.2 Cast-resin tube

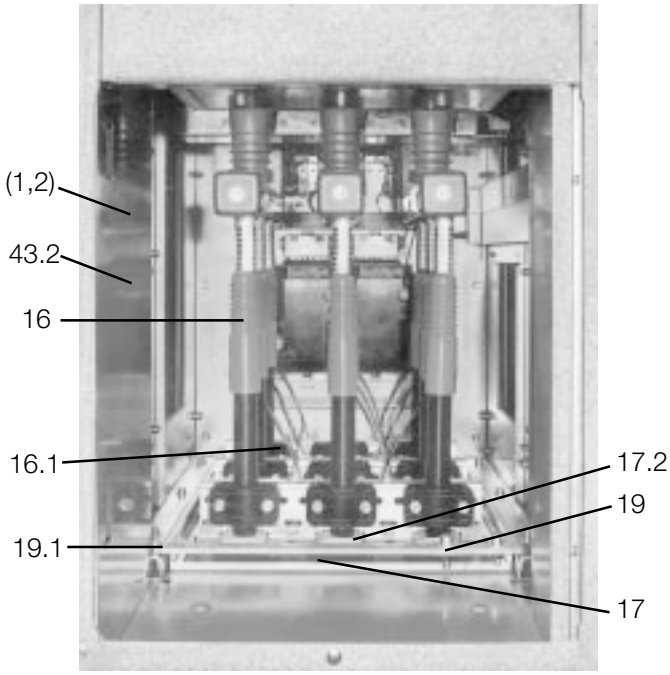


Figure 3/12: Cable compartment, width of panel 650 mm, with earthing switch, voltage transformer and three parallel single-conductor plastic cables.

(1.2) Control cable duct
16 Cable sealing ends
16.1 Cable screen
17 Floor covering
17.2 Reducer ring
19 Main earthing bar
19.1 Connecting link
43.2 Lateral covering of the external control wiring

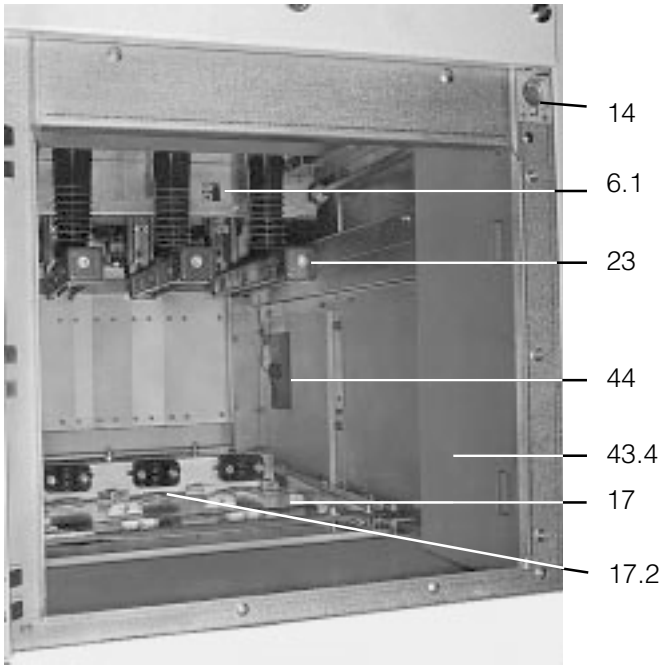


Figure 3/13: Cable compartment, panel width 1000 mm, with connecting bars for six parallel cabels

6.1 Position indicator of the earthing switch
14 Manual mechanism of the earthing switch
17 Floor covering
17.2 Reducer ring
23 Cable connecting bar
43.4 Lateral covering of the internal control wiring
44 Heating plate

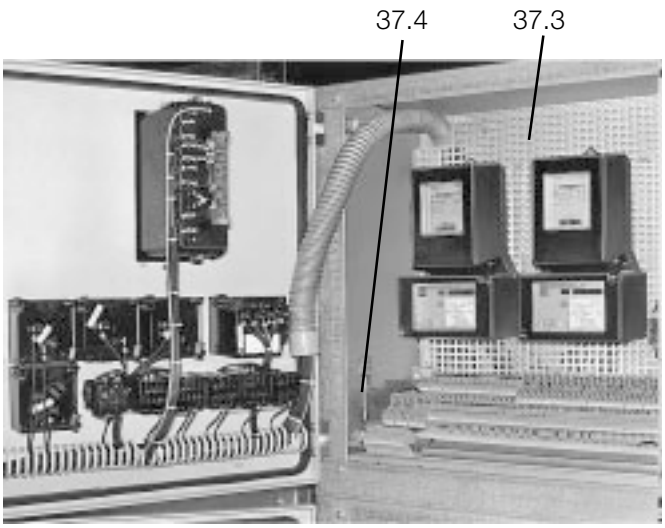


Figure 3/14: Control cabinet

37.3 Perforated sheet
37.4 Terminal-strip holder

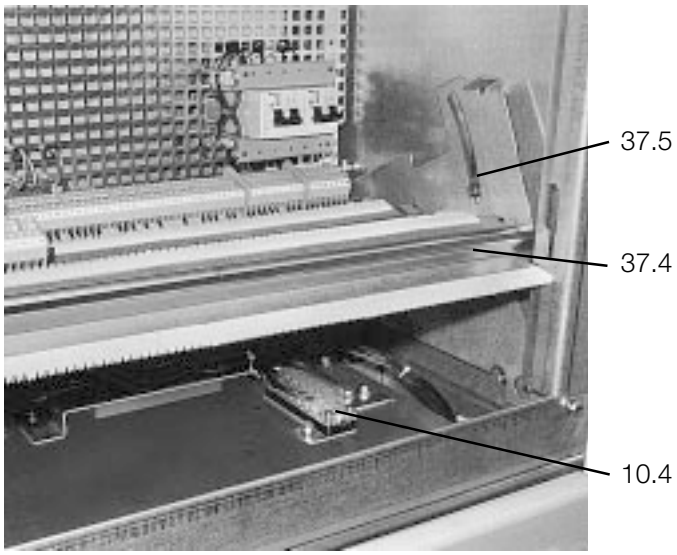


Figure 3/15: Control cabinet, terminal-strip holder swung upwards

10.4 Auxiliary switch for control wiring plug
37.4 Terminal-strip holder
37.5 Screw for terminal-strip holder

Figure 3/16: Mechanical plug interlock

10.1 Socket
10.2 Plug
32 Interlock lever

Figure 3/17: Lock for earthing switch manual mechanism.

14.9 Padlock

Figure 3/18: Lock for the circuit-breaker and cable compartment

14.9 Padlock

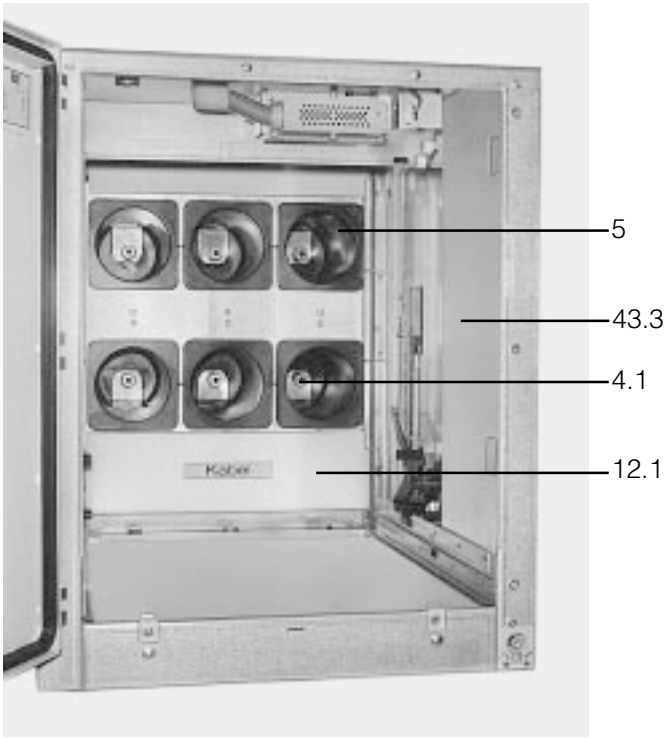


Figure 3/19: View of the circuit-breaker compartment with the withdrawable part removed and the shutters open

4.1 Contact pin
5 Isolating tulip
12.1 Shutter
43.3 Duct covering of the internal control wiring (above)

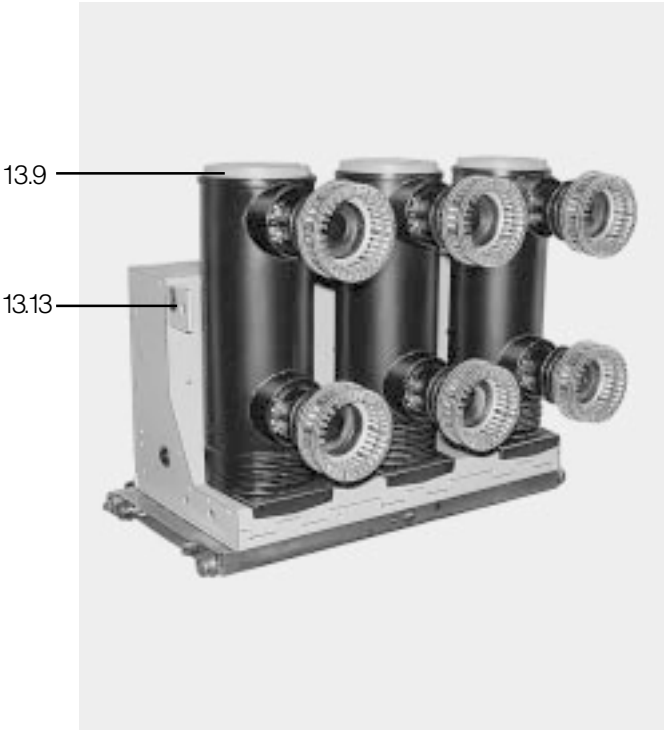


Figure 3/20: Pole side of a withdrawable part with circuit-breaker of the high current type VD4

13.9 Protective cap used during transport (remove before putting into service)
13.13 Lifting lug (remove before putting into service)

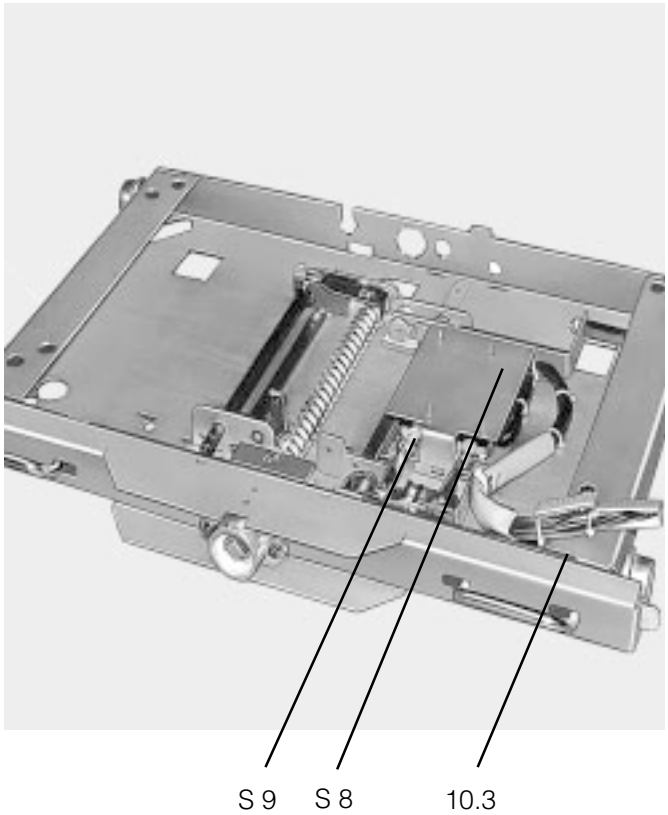


Figure 3/21: Withdrawable assembly for the withdrawable part with auxiliary switches

S8 Test position indicator
S9 Service position indicator
10.3 Control wiring plug connection for the withdrawable assembly

4 Despatch and storage

4.1 Condition on delivery

At the time of despatch, the ZS1 panels are factory-assembled, the withdrawable parts inserted into the service position and the doors closed.

The factory-assembled panels are checked at the works for completeness in terms of the order and simultaneously subjected to routine testing (normally without AC voltage testing of the busbars) to VDE 0670 part 6 or IEC publication 60298, and thus tested for correct structure and function.

The busbars are not assembled. The busbar material, fasteners and accesssories are packed separately.

4.2 Packaging

According to the kind of transport and country of destination, the panels remain unpackaged or are welded in foil and packed in seaworthy crates. To protect against moisture, a drying agent is provided:

- Panels with basic packaging or without packaging.
- Panels with seaworthy packaging or similar (including packaging for containerized shipments):
  - Sealed in polythene sheeting,
  - Transport drying agent bags included,
  - Moisture indicator included,
  - When aluminium composite sheeting is used, a sight window is fitted for checking.
- Observe the directions for use of the drying agent bags to DIN55 473. The following applies:
  - Coloured indicator blue: contents dry,
  - Coloured indicator pink: contents moist (relative humidity above 40%).

4.3 Transport

(Figure 4/1)

The transport units normally comprise individual panels, and in exceptional cases small groups of panels or panels assembled back to back. The panels are each fitted with four lifting lugs.

Transport panels upright. Take account of the high centre of gravity. Only ever carry out loading operations when it has been ensured that all precautionary measures to protect personnel and materials have been taken and using a

- crane,
- fork-lift truck and/or
- manual trolley jack.

Loading by crane:

- Fit lifting ropes of appropriate load capacity with shackles (opening width above 30 mm, fastening bore diameter 30 mm)
- Maintain an angle of at least 60° from the horizontal for the ropes leading to the crane hook.

4.4 Delivery

The responsibilities of the consignee when the switchgear arrives at site include, but are not limited to, the following:

- Checking the consignment for completeness and freedom from damage (e.g. also for moisture and ist detrimental effects). in cases of doubt, the packaging must be opened and then properly resealed, fitting new drying agent bags, when intermediate storage is necessary.
- If any short quantities, defects or transport damages are noted:
  - To be documented on the respective shipping document.
  - Notify the relevant carrier or forwarding agent immediately in accordance with the relevant liability regulations .

Note:

Always take photographs to document any major damage.

4.5 Intermediate storage

Optimum intermediate storage as far as this is necessary at all – without detrimental consequences depends on compliance with a number of minimum conditions for the panels and assembly materials

1. Panels with basic packaging or without packaging:
   - A dry well-ventilated store room with a climate in accordance with IEC 60694.
   - The room temperature must not fall below -5° C.
   - There must not be any other unfavourable environmental influences.

- Store the panels upright.
- Do not stack panels.
- Panels with basic packaging:
  - Open the packaging, at least partially.
- Panels without packaging:
  - Loosely cover with protective sheeting.
  - Ensure that there is sufficient air circulation.
- Check regularly for any condensation until the start of installation.

2. Panels with seaworthy or similar packaging with internal protective sheeting:
   - Store the transport units:
     - protected from the weather,
     - in a dry place,
     - safe from damage.
   - Check the packaging for damage.
   - Check the drying agent (see also section 4.2):
     - on arrival of the consignment,
     - later at regular intervals.
   - When the maximum storage period, starting from the date of packaging, has been exceeded:
     - the protective function of the packaging can no longer be guaranteed,
     - take suitable action if intermediate storage is to continue.

Note:

Do not walk on the roof of the panels (rupture points in pressure relief devices)!

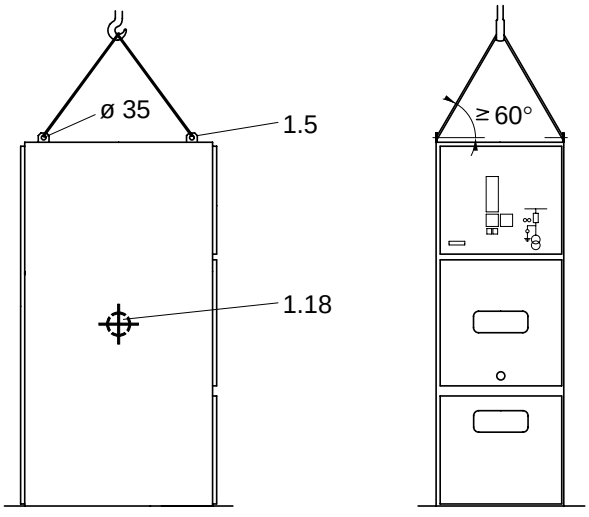


Figure 4/1: Handling by crane

1.5 Lifting lug
1.18 Marking on the centre of gravity

5 Erection of the switchgear on site

In the interests of the best possible erection sequence, and in order not to endanger the high quality standard of the ZS1 switchgear, local erection should only be carried out, or at least responsibly managed and supervised, by specially trained skilled personnel.

5.1 Site requirements

On commencement of installation at site, the switchroom must be completely finished, provided with lighting and site electricity supply, lockable, dry and with facilities for ventilation. All the necessary preparations such as wall openings, ducts, etc. for laying of the power and control cables up to the switchgear must already be complete. Where panels have top-mounted structures for earthing switches or instrument transformers, it must be ensured that the ceiling height is sufficient for the opening travel of the pressure relief flaps.

The ceiling height is also to be checked when there is a top-mounted pressure relief duct.

Compliance with the conditions for indoor switchgear to VDE 0670 part 1000/IEC 60694, including the conditions for the „minus 5 indoor“ temperature class must be ensured.

5.2 Foundations

(Figures 5/1 to 5/5)

The switchgear is preferably to be erected on a foundation frame set into the switchroom floor or on a raised false floor.

The guideline structural data listed below facilitate a rough calculation of the space required and preliminary planning of the room design for a switchgear project. When the final construction documents are compiled, the binding data supplied by ABB Calor Emag must always be taken into account!

The stipulations of DIN 43 661 are also to be complied with when the foundation is laid. This particularly applies to the evenness and straightness tolerances of the switchgear.

Note:

The construction data for the ceiling openings for incoming conductors do not aply to trunking bars without earthed coatings. Broader ceiling openings are required in such cases.

Dimension chart of structural data

(See also figures 5/1 to 5/4)

Panel dimensions	[mm]	Width	650	800	1000	
		Depth	1300	1300	1300	1350
Minimum dimensions in the switching room	[mm]	Door height [1]	2400	2400	2400	2400
		Door width	850	1000	1200	1200
		Aisle width [2]	1350	1500	1700	1700
		Assembly opening in ceiling:				
		• Width	1000	1000	1200	1200
		• Length	1500	1500	1500	1500

[1] Upright transport of panels with a height of 2200 mm.
[2] Pay attention to VDE 0101

5.2.1 Foundation frame on concrete floor

(Figures 5/1, 5/2 and 5/5)

The foundation frame, consisting of one or more parts depending on the size of the switchgear, can be supplied with the switchgear by ABB; it is usually laid by site personnel and should if possible be aligned and inspected under the supervision of a ABB specialist.

Installation of the foundation frame:

- If the foundation frame consists of several parts 60.1/60.2, connect these together at the prepared joint locations using links 60.3 and bolts (foundation frame bag group) in the specified sequence and so as to achieve a level surface.
- Place the foundation frame precisely in the specified position on the concrete floor in accordance with the installation drawing.
- Enter jacking screws 60.8 and place steel strips 60.4 below them.
- Carefully align the foundation frame horizontally along the entire surface and to the correct height by screwing the jacking screws down by an appropiate amount and using a levelling instrument. The top edge of the foundation frame should be 2 mm above the finished floor surface. This facilitates erection and alignment of the panels. In some cases, this means that the material thickness of an addtional floor covering to be fitted later must be taken into account separately. Tolerances for laying of the frame to DIN 43 661, version A:
  - Evenness tolerance:

    Deviation max. ± 1 mm within a measured length of 1 m,
  - Straightness tolerance:

    Deviation max. 1 mm per metre, but no more than 2 mm for the entire length of the frame.
- Slide brackets 60.5 against the frame at two points - for each 3 m of frame length -, secure them to the concrete floor with dowels 60.6 and bolts 60.7, and weld them to the frame. The set position of the frame on the concrete floor must not be altered during this operation!
- Weld the foundation frame parts together. Grind projecting parts and weld seams on the top of the frame flat.
- Make the necessary preparations for perfect earthing of the foundation frame with 30 x 4 mm galvanized steel strip. Two connections are necessary for long switchgear.
- When the screed is applied, carefully backfill the foundation frame, leaving no gaps.

  The upper edge of the screed must be up to 3 mm below the upper edge of the frame. Take account of the thickness of any additional floor covering.
- The foundation frame must not be subjected to any injurous impacts or pressures, particularly during the installation phase.

If these conditions are not fulfilled, problems during assembly of the switchgear and possibly with movement of the withdrawable parts and opening and closing of the doors cannot be ruled out.

5.2.2 Raised false floor

(Figures 5/3 and 5/4)

Procure the raised false floor locally from a suitable supplier (ABB can arrange if necessary). It must meet all the specific requirements of the switchgear. No additional intermediate frame is required.

5.3 Erection of the panels

(Figures 3/5 to 3/9, 3/12, 3/13, 3/19, 5/6, 5/8 and 5/9)

For local erection of the ZS1 switchgear bolts of tensile strength class 8.8 are supplied in all cases. The following table contains the recommended rated tightening torques. These rated tightening torques also apply to bolts of tensile strength class 10.9, which are used in exceptional cases.

	Recommemded tightening torque[1)2)] Nm	
	Lubricant[3)]	
Thread	without	Oil or grease
M 6	10.5	4.5
M 8	26	10
M 10	50	20
M 12	86	40
M 16	200	80

1) The rated tightening torques for fasteners without lubrication are based on a coefficient of friction for the thread of 0.14 (the actual values are subject to an unavoidable, partly not inconsiderable, spread).

2) Rated tightening torques for fasteners with lubrication in accordance with DIN 43 673.

3) Thread and head contact surface lubricated.

Any tightening torques which deviate from those in the general table (e.g. for contact systems or devise terminals) are to be taken into account as stated in the detailed technical documentation.

It is recommended that the threads and head contact surfaces of bolts should be lightly oiled or greased, so as to achieve a precise rated tightening torque.

- Withdraw the withdrawable parts 13 out of the panels and store them in a safe place.
- Dismantle lifting lugs 1.5.
- Transport the panels to the prepared installation point in the sequence shown on the switchgear plan.

- Align the panels on the foundation frame.
- Join the panels together with fastener material from the „panel screws“bag group.
- Remove vertical intermediate wall 9 in front of the busbar compartments by releasing the fastening screws.
- Release the fastening screws and draw out horizontal partition 20 below the withdrawable part travel rails.
- Release and remove floor cover 17.
- Remove covers 43.1 and 43.3 in the circuit-breaker compartment and covers 43.2 and 43.4 in the cable compartment.
- Align the panels on the foundation frame one after another for correct position and vertical alignment (deviations of the panel edges from the vertical must not exceed 2 mm, particulary at the front) and bolt the panels together. It is advisable to start from the centre when assembling switchgear with more than ten panels.
- When bolting together panels without busbar partionings, insert a shim 27 between the panels above the busbar apertures.
- On switchgear with busbar partionings, also install and screw bushing plates 28/28.2 externally to the right or left hand panel wall.
- When the switchgear has been properly assembled, fasten the panels to the concrete floor using dowels, or weld or adequately bolt them to the foundation frame.

5.4 Installation of the busbars

(Figures 5/8 to 5/12)

- Clean all insulating parts prior to installation with a soft dry cloth.
- Install bushings 29 and/or 29.4 (for switchgear with busbar partioning only):
  - Insert bushing 29 and/or 29.4 in bushing plate 28 and/or 28.2.
  - Fasten the bushing 29 with the screw material 28.1 in bag group „panel partitions“.
- Busbar connections:

– The silver plated surfaces of the connections are to be cleaned with a metal free nonwoven cleaning cloth and thinly and evenly coated with Isoflex Topas NB 52 grease.

– The non-silver plated surfaces of the connections are either to be brushed under grease with a wire brush, preserving the grease film, or cleaned with a metal-free non-woven cleaning cloth and evenly greased with a thin coat of Isoflex Topas NB 52.

- Prepare insulating covers 58 to suit the relevant busbar and thread them onto the busbar.
- Install the busbars panel by panel. Screw on the individual busbar elements one above the other (depending on the system layout) and in line with the flat tee-off conductor 2.

  Follow the assignment of screw material 3.4 to 3.7 from the various „junction“ bag groups to the spacer plates 3.2 and 3.3.

  For tightening torque see the table in section 5.3.

  Use one dished washer for the head side and one for the nut side.
- In end panels, also install supports 58.1 with washers 58.6 and 58.7 to support the insulating covers 58.

  Also fit lid 58.5 in end panels for rated voltage 17.5 kV.
- Position insulating cover 58 over the relevant bolted joint, and slide the lid onto the cover until it clicks into place.

5.5 Installation of the top mounted boxes

Due to reasons of transport, attachments to the panels are not usually completed at our works. As far as possible however, they are pre-mounted.

5.5.1 Voltage transformer for busbar metering

(Figures 5/13 and 5/14)

- Top mounted box 79 with screwing material in the group of bags „Top mounted box for metering“ is to be mounted on the busbar compartment.
- Connecting bars 2.2 with the tee-off conductors 2 at the junction point are to be screwed together according to figure 5/14. However, if necessary, the additional spacer plate 3.2 and threaded plate 3.8 as well as the screwing material from the group of bags "top mounted box for metering" are to be used.
- Insulating cover 58 is to be brought into position as is described in section 5.4.
- Intermediate box 79.1 with the screwing material from the group of bags „top mounted box for metering“ is to be mounted on the control cabinet. The conduction tube 79.2 is to be positioned and inserted into the reducer rings 79.3.
- Secondary circuits from the voltage transformers are to be led to the terminal strips and connected according to the cable core markings and the circuit diagramm.

5.5.2 Earthing switch for busbar earthing

(Figures 5/14 to 5/17)

- Top mounted box 77 with screwing material from the group of bags „top mounted box for earthing“ is to be mounted on the busbar compartment.
- Operating mechanism box 78 with screwing material from the group of bags „top mounted box for earthing is to be mounted on the control cabinet.
- Pre-mounted single parts of the hexagonal shaft 78.1 are to be removed.

  Please pay attention to the sequence and angle of the parts!
- Hexagonal shaft from the operating mechanism box is to be pushed through into the bevel gear of the earthing switch.

  Sequence and angles of the parts are to be restored!
- Connecting bars 2.2 with the tee-off conductors 2 at the junction point are to be screwed together according to figure 5/14. However, if necessary, the additional spacer plate 3.2 and threaded plate 3.8 as well as the screwing material from the group of bags „top mounted box for earthing“ are to be used.
- Insulating cover 58 is to be brought into position as described in section 5.4.

Note:

The auxiliary switches for the earthing switch are adjusted at the works. Problem-free functioning is only guaranteed if the functioning elements on the hexagonal shaft are correctly mounted.

Due to the final installation of the earthing switch and operating mechanism at the site, it may be necessary to undertake an exact adjustment of the auxiliary switches. In this case the following is important:

- The auxiliary switch OFF 78.5 must be operated
  - before the slide 78.2 has uncovered half of the opening in front of the hexagonal shaft and
  - before the lower edge of the slide has touched the anker of the blocking magnet 78.6.
- The auxiliary switch ON 78.4 must be operated
  - before the toggle spring of the earthing switch has reached its dead point.
- The push-rod of the auxiliary switch must still have about 0,5 mm to go to the end position in the operated position.

5.6 **Pressure relief ducts**

(Figures 3/1 and 5/18)

- The pressure-relief duct is supplied dismantled in single parts. The rear wall 50.1 and the front wall 50.2 correspond, as far as length is concerned, to the appropriate panel width. They are joined together by means of the attachment strips 50.3.
- The screwing material is contained in the group of bags „pressure relief duct“. Rivet nuts are already present in the metal sheets.

Note:

The rear pressure relief flap must be mounted according to figure 5/18, detail X.

Details regarding connection to the wall and the discharge grating 50.4 for pressure relief outside of the switch room will be agreed with the customers concerend. In the case of pressure relief within the switchroom, the absorber grating 50.5, which is also supplied together with the rest of the equipment, is to be installed.

5.7 **Connection of the cables**

5.7.1 Power cables

(Figures 3/12, 3/13, 5/19 to 5/21)

1. Standard equipment:

   a) Panel width 650 mm:
   - Connection points for 9 single cores with M12 socket head bolts
   - 9 cable clamps for core diameters 36 - 52 mm
   - 3-section floor covering with reducing rings
   - M10 connection points for the earth connections of the cable screens.

   b) Panel width 800 mm:
   - Up to 1250 A corresponding to the 650 mm width panel
   - From 1600 A corresponding to the 1000 mm width panel.

   c) Panel width 1000 mm:
   - Connection points for 18 single cores with M12 and M16 socket head bolts
   - 18 cable clamps for core diameters 50-75 mm
   - 3-section floor covering with reducing rings
   - M10 connection points for the earth connections of the cable screens.

2. Method:

- Power cable is to be inserted, cut to length and stripped.
- Reducer rings 17.2 are to be adapted to the cable diameter and fitted.
- Cable sealing ends 16 are to be prepared and secured according to the manufacturer's instructions.
- Cable cores are to be connected to the prepared connection points 23 with strain relief.

  Cable core crossings are to be avoided.

Other agreed equipment is prepared at the factory, e.g. for the connection of insulated busbar capacitance grading devices. Should any particular work in the panels be necessary during erection at site, construction drawings and parts lists according to which this work can be performed are supplied with the delivery.

5.7.2 Control cables

(Figures 3/7, 3/12, 3/15 and 5/6)

- Control cables are to be inserted into the left-hand side ducts 1.2.

  For the purposes of inserting the control cables, the floor of the panel on the left-hand side has been omitted. The wiring is protected by a sheet-metal duct which extends into the control cabinet. The duct is covered laterally by 43.1 and 43.2 and is therefore closed off. In the control cabinet floor, 6 drill holes for reducer rings are intended.
- The control cable is to be stripped and secured at the top end of the duct and the cores inserted into control cabinet D after swinging the terminal-strip frame upwards.
- The control cable is to be connected to the terminal strip as shown in the wiring diagram.
- The control wiring connections are to be made to the adjacent panel using bushing 24.

5.8 Earthing of the switchgear

(Figure 3/12)

- Connect main earthing bar 19 with links 19.1 supplied in every panel.
- Protection wiring connection of the foundation frame or the erected raised false floor respectively, should be made.
- Connect the earthing conductor coming from the earth electrode, preferably via a removable bolted link for testing purposes, to the main earthing bar 19 of the switchgear.

5.9 Laying the ring circuits

The ring circuits are supplied rolled up as a bundle in the control cabinet. They are marked and fitted with ferrules at both ends. Openings are provided in the side walls of the control cabinet for these lines to be looped through from panel to panel.

5.10 Final erection work

- Check painted areas of the switchgear for possible damage, touching up where required (see also section 7.4.1).
- Check bolt connections and tighten where required, in particular all those carried out in on-site erection of the busbars and earthing system.
- The auxiliary switch for the I_{th} limitation (according to the relevant order) must if necessary, be effected via the pressure relief flaps after removing the lifting lug:
  - Auxiliary switch push-rod is to be inserted into the drill hole in the pressure relief flap.
  - Auxiliary switch holder is to be adjusted into the horizontal position (Figure 5/22).
- Clean the switchgear thoroughly.
- Remove all foreign bodies from the panels.
- Replace properly all coverings, etc., removed during erection and connection.
- In the enclosure, the openings which may remain are to be closed if they are no longer needed.
- Check the isolating contacts and interlock mechanisms for smooth motion, and regrease with Isoflex Topas NB 52 where required (see section 7.4.1).
- Withdrawable circuit-breaker parts are to be inserted and the control wirings connected.
- Panels doors are to be properly closed.

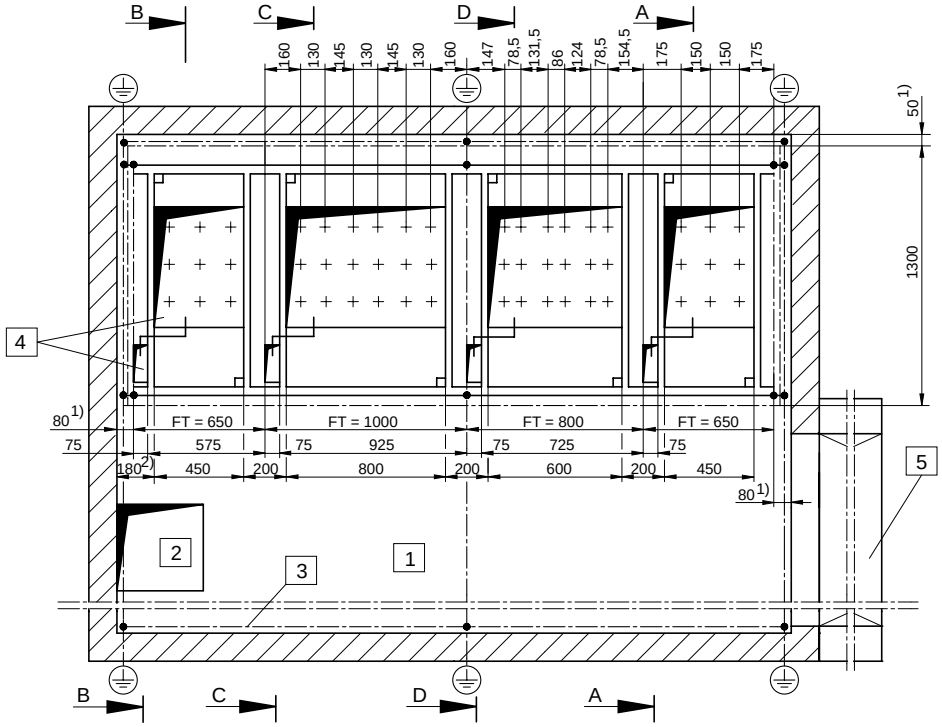


Figure 5/1a: Panels without toroidal-core current transformers

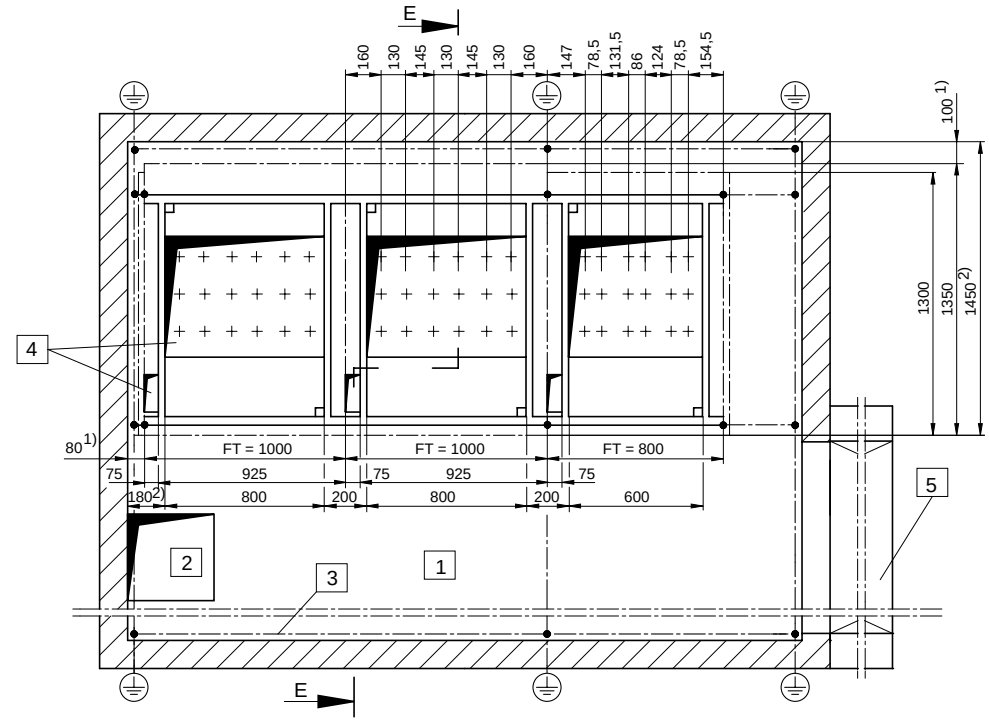


Figure 5/1b: Panels with and without toroidal-core current transformers

Figure 5/1: Guideline construction data for foundation frame on a concrete floor

See figure 5/2 for sections
FT = panel width
1) Minimum dimensions
2) When the minimum dimension1) are changing the corresponding dimension2) must be adjusted accordingly

1 *Operator aisle*
2 *Basement entrance*
3 *Main earthing bar*
4 *Instead of individual openings, continuous openings or drilled holes are possible*
5 *Platform*
6 *Control cabinet, optional*
7 *Absorber*
8 *Opening for ventilation*
9 *Height of cable basement as required*
10 *Screed, see also figure 5/5*
11 *To main earthing bar*
12 *Opening for power cable*
13 *Opening for control cable*
14 *Door*
15 *Busbar metering or busbar earthing*
16 *Wall opening for pressure relief*
17 *Pressure relief duct*
18 *Diverter*

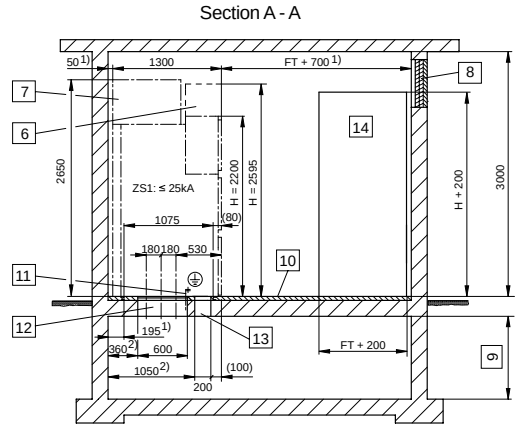


Figure 5/2a: Switchgear with pressure relief via absorber into the switchroom,
panel width: 650/800/1000 mm

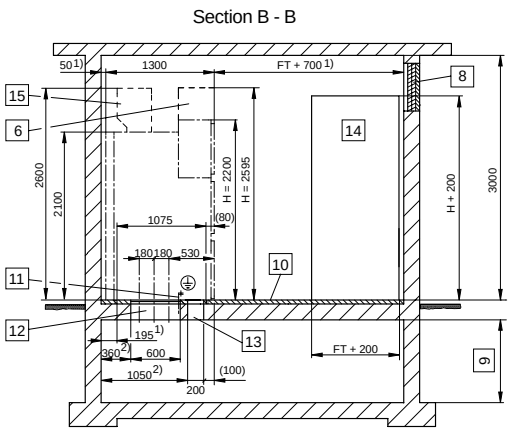


Figure 5/2b: Switchgear without pressure relief duct,
panel width: 650/800/1000 mm

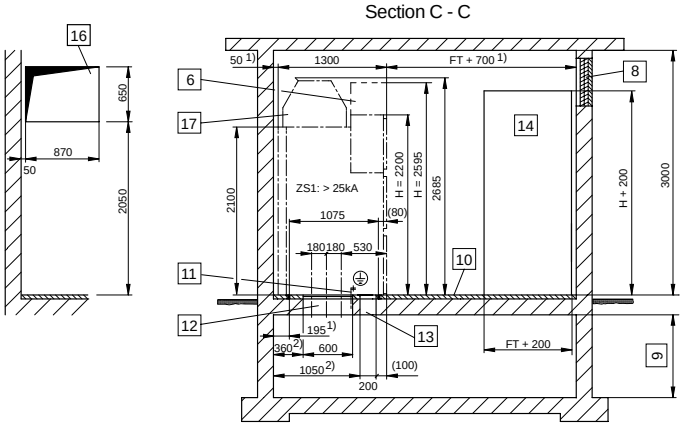


Figure 5/2c: Switchgear with pressure relief to the outside,
panel width: 800/1000 mm

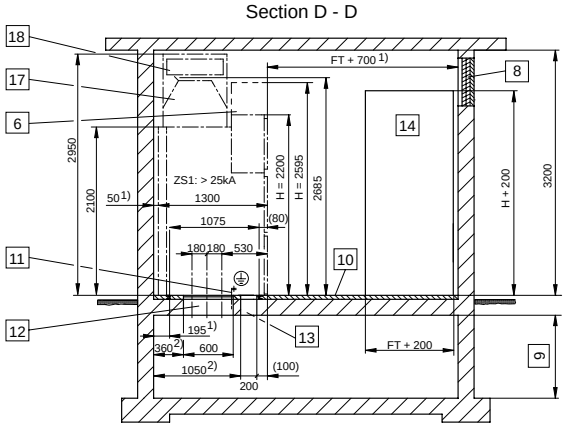


Figure 5/2d: Switchgear with pressure relief duct and diverter,
pressure relif into the switchroom,
panel width: 800/1000 mm

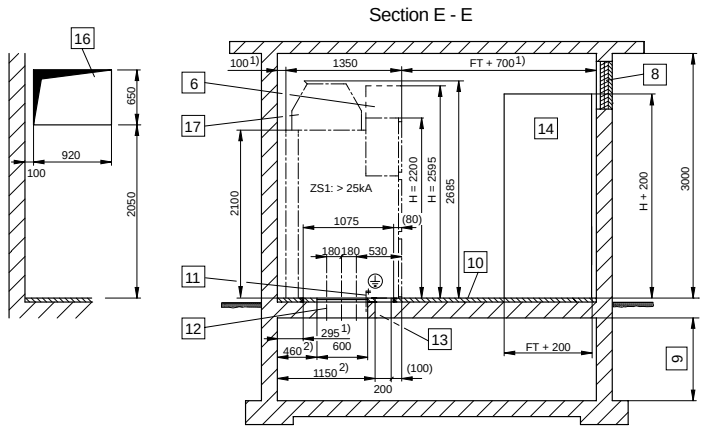


Figure 5/2e: Switchgear with pressure relief to the outside,
Switchgear with toroidal-core current transformers,
panel width: 1000 mm

Figure 5/2: Sections for figure 5/1

See figure 5/1 for legend
FT = panel width
1) Minimum dimensions
2) When minimum dimension1) are changing the corresponding dimension2) must be adjusted accordingly.

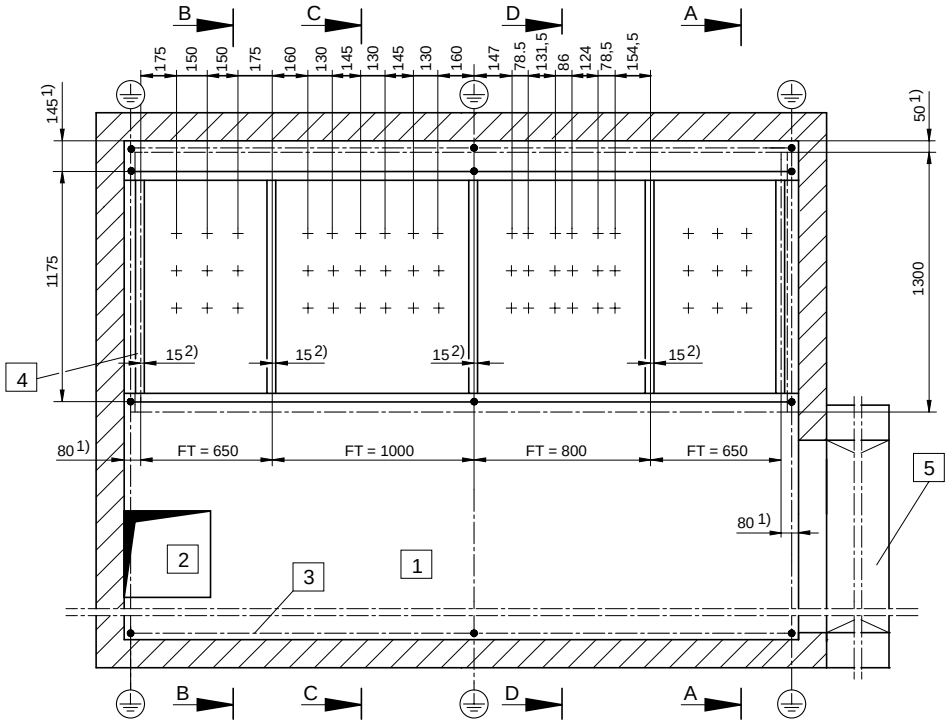


Figure 5/3a: Panels without toroidal-core current transformers

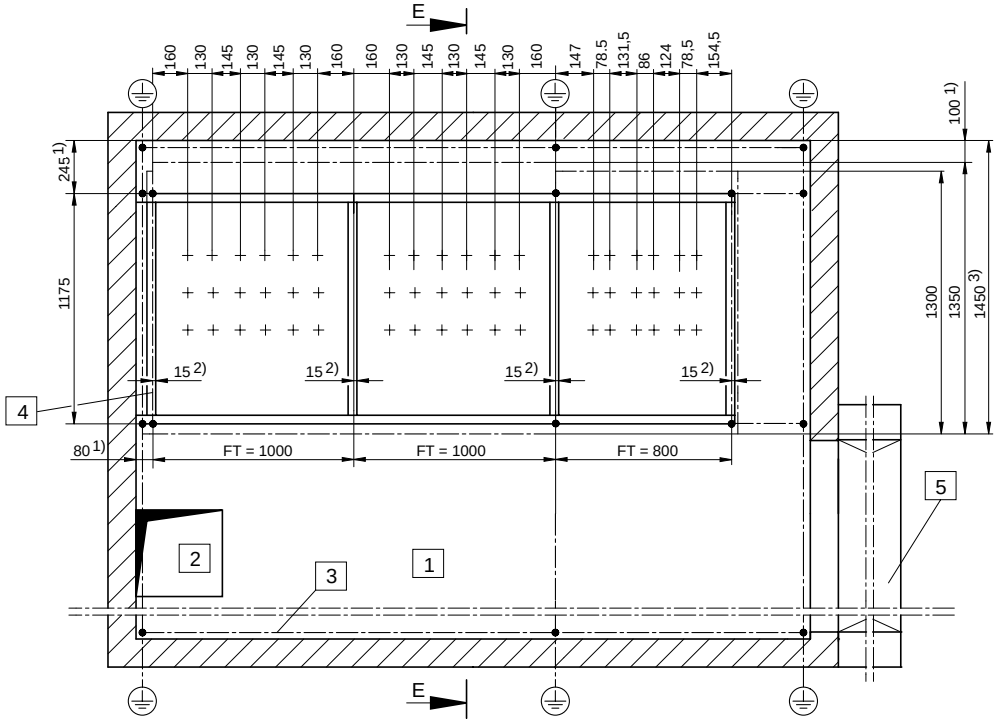


Figure 5/3b: Panels with and without toroidal-core current transformers

Figure 5/3: Guideline construction data for a raised false floor

See figure 5/4 for sections
FT = panel width
1) Minimum dimension
2) Maximum dimension
3) When the minimum dimensions1) are changing the corresponding dimensions3) must be adjusted accordingly

1 *Operating aisle*
2 *Basement entrance*
3 *Main earthing bar*
4 *Raised false floor structure, only shown in the vicinity of the switchgear*
5 *Platform*
6 *Control cabinet, optional*
7 *Absorber*
8 *Opening for ventilation*
9 *Height of cable basement as required*
10 *Covering, site supply*
11 *Raised false floor, site supply, top of false floor 0 to 3 mm above top of finished floor*
12 *Power cable*
13 *To main earthing bar*
14 *Door*
15 *Busbar metering or busbar earthing*
16 *Wall opening for pressure relief*
17 *Pressure relief duct*
18 *Diverter*

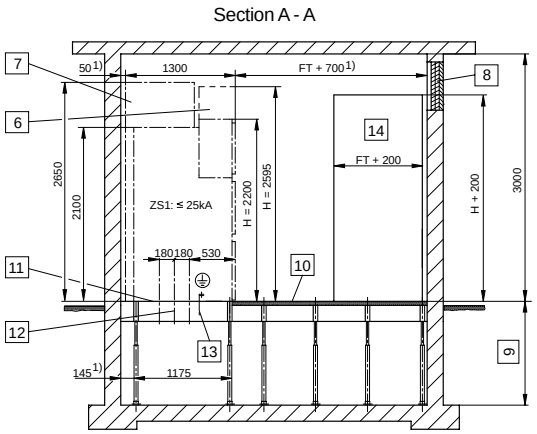


Figure 5/4a: Switchgear with pressure relief via absorber into the switchroom,
panel width 650/800/´1000 mm

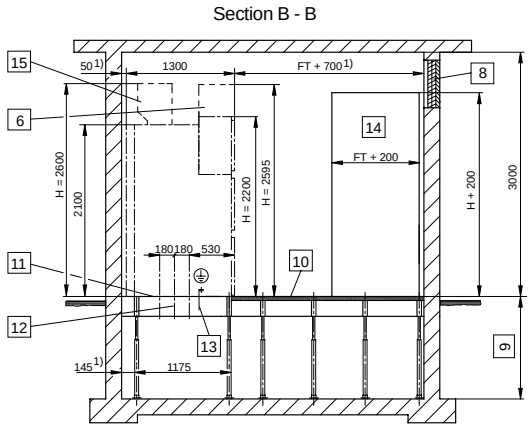


Figure 5/4b: Switchgear without pressure relief duct, panel width: 650/800/1000 mm

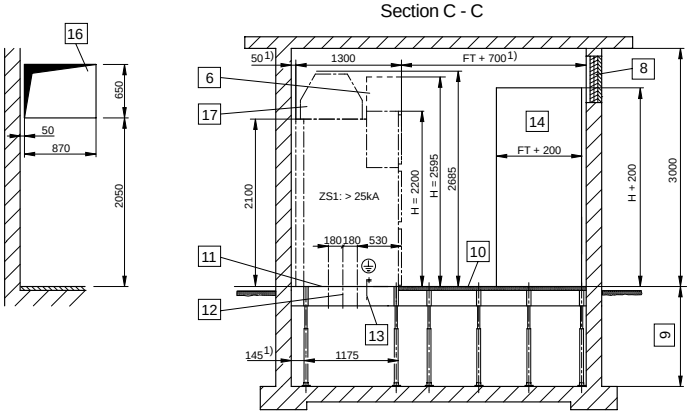


Figure 5/4c: Switchgear with pressure relief to the outside, panel width: 800/1000 mm

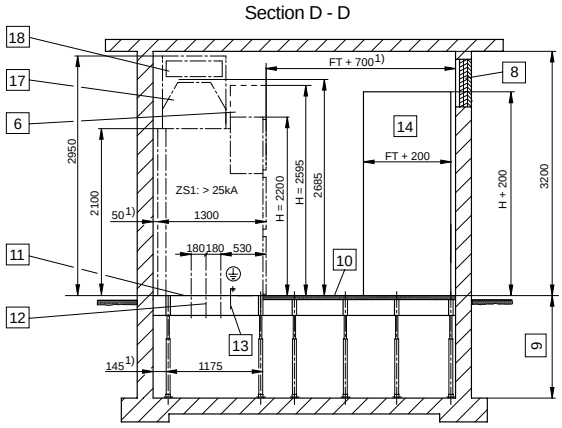


Figure 5/4d: Switchgear with pressure relif duct and diverter, pressure relief into the switchroom, panel width: 800/1000 mm

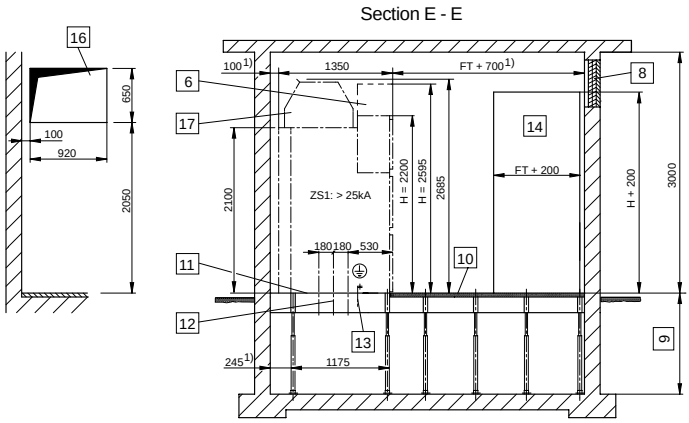
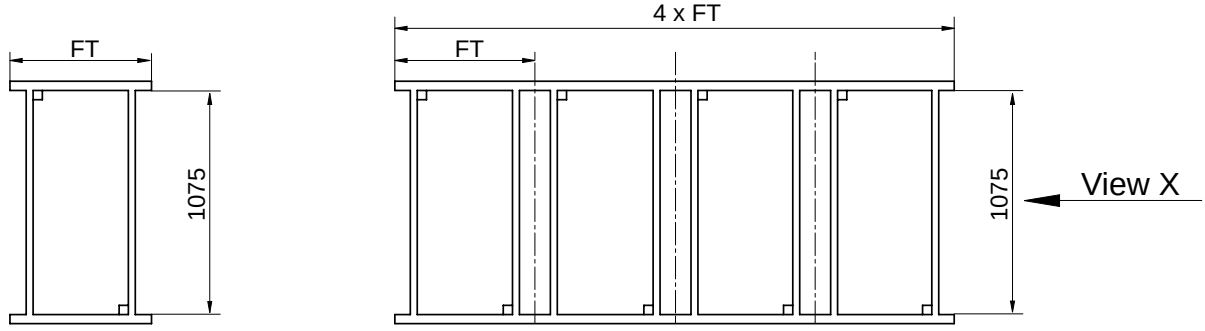


Figure 5/4e: Switchgear with pressure relief to the outside, switchgear with toroidal-core current transformers, panel width: 1000 mm

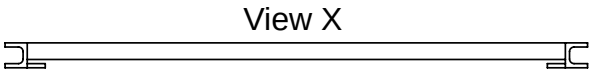
Figure 5/4: Sections for figure 5/3

See figure 5/3 for legend
FT = panel width
1) Minimum dimensions

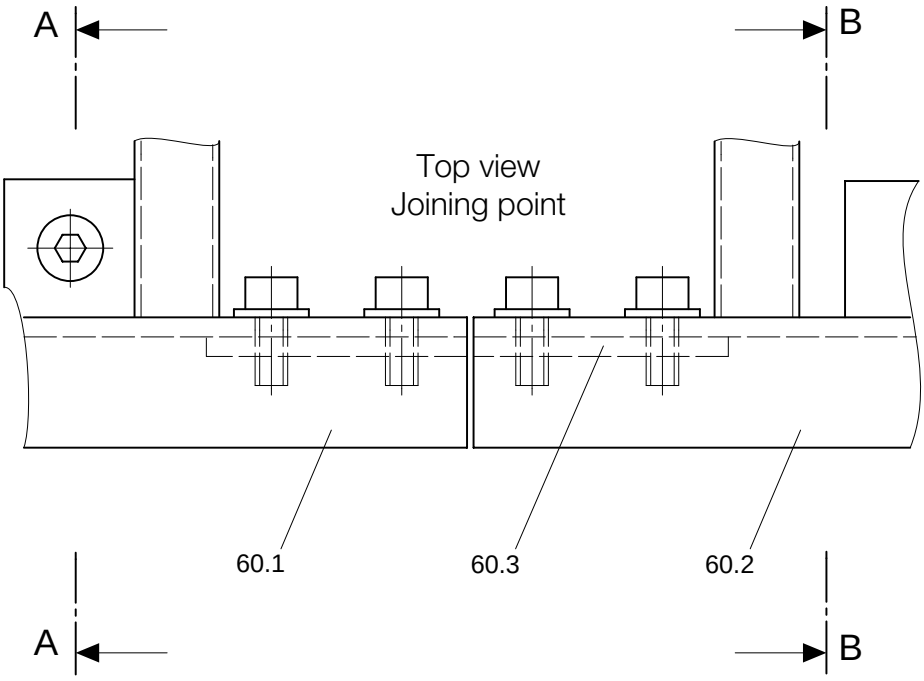


a) *Foundation frame, single panel*

b) *Foundation frame, four panels*



Panel width FT: 650 mm, 800 mm or 1000 mm



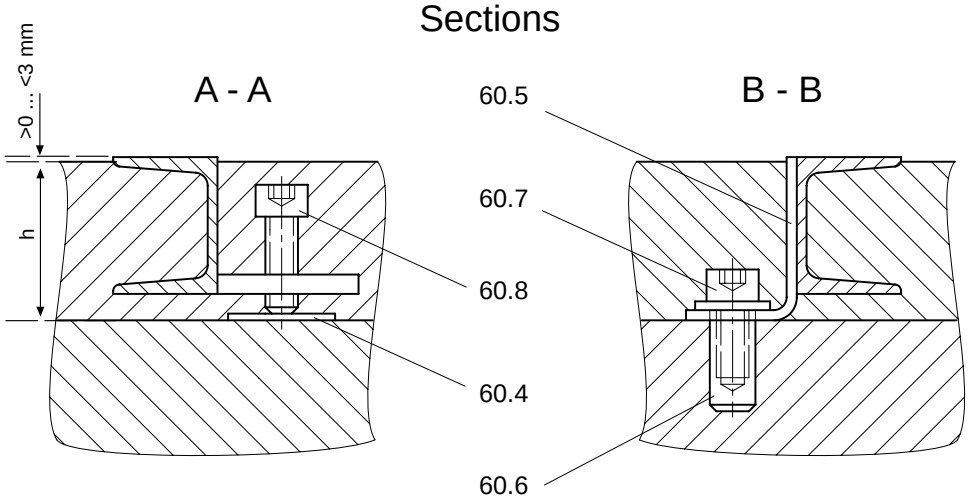


Figure 5/5: Assembly of the foundation frame

60.1 Foundation frame part
60.2 Foundation frame part
60.3 Link
60.4 Steel strip
60.5 Bracket
60.6 Dowel
60.7 Bolt M10x25
60.8 Jacking screw
h Screed height 50 to 60 mm

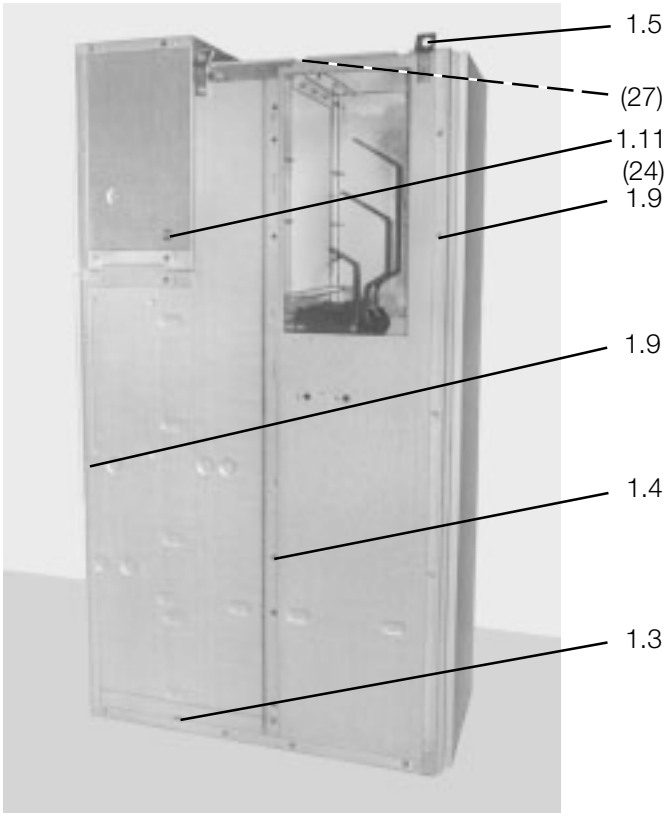


Figure 5/6: For bolting of the panels together, through holes are provided on the left-hand side and threaded bushes on the right-hand side near the front and rears edges of the side walls, and through holes on both sides in the central part of the walls.

1.3 Aperture, for the main earthing bar
1.4 Bore
1.5 Lifting lug
1.9 Threaded bush, for switchgear assembly
1.11 Bore, for control wiring bushing 24
27 Shim, to be inserted above the opening when bolting together panels without busbar partitioning

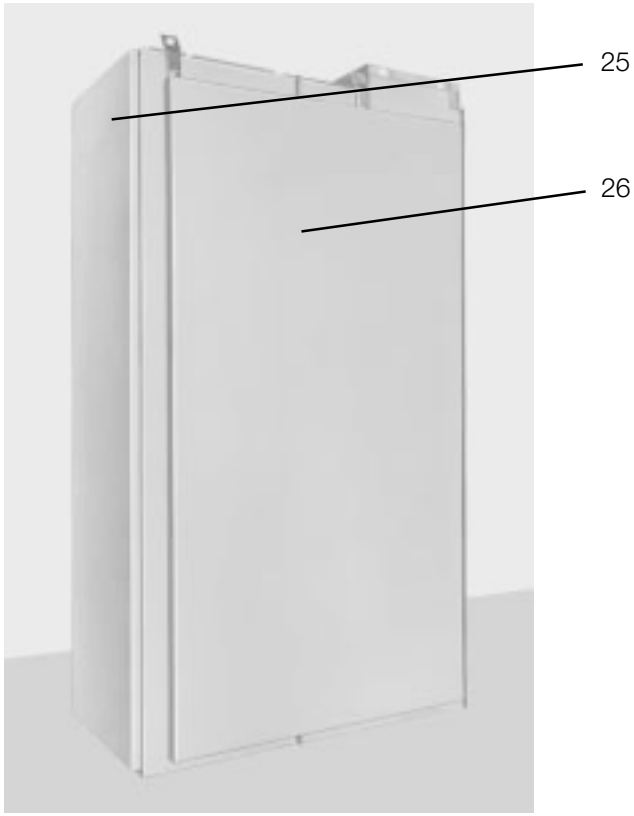
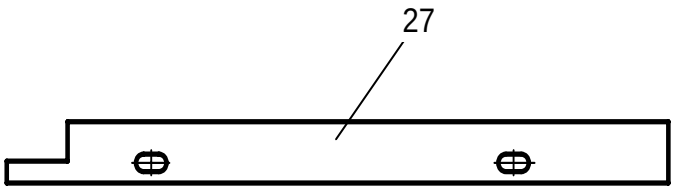
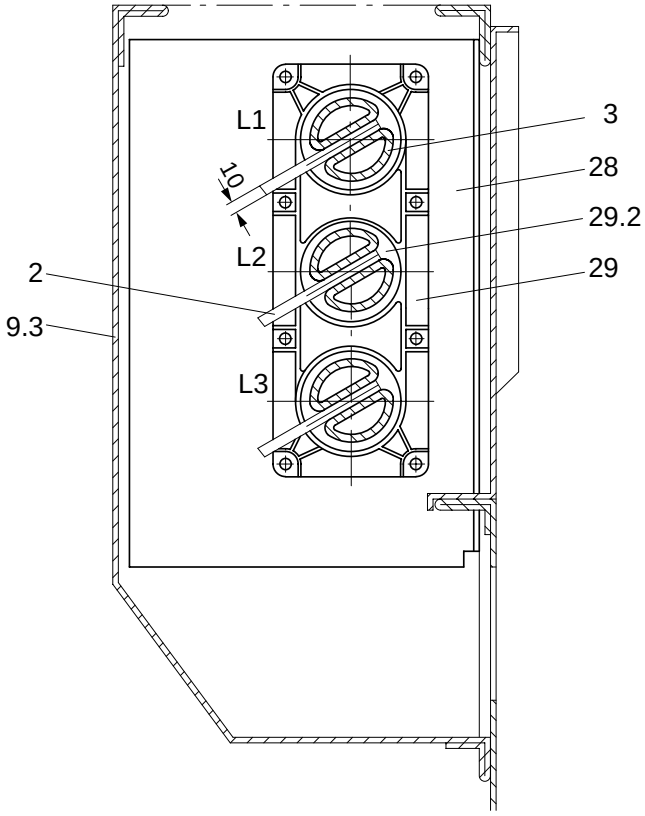


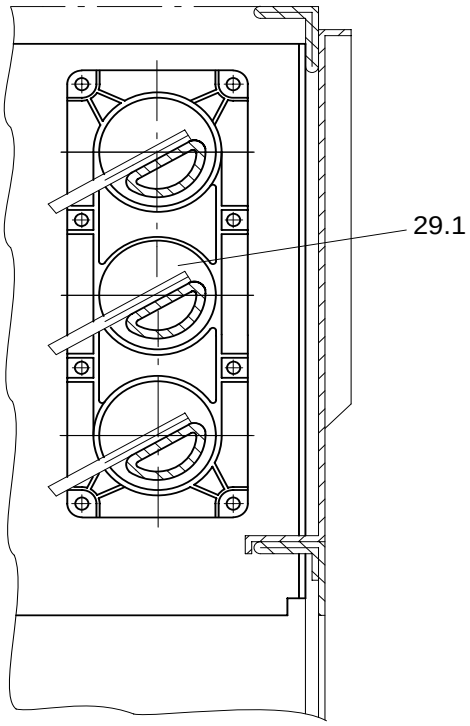
Figure 5/7: End panel of a switchgear with bolted-on cover plates and rear wall

25 Rear wall
26 Cover plate





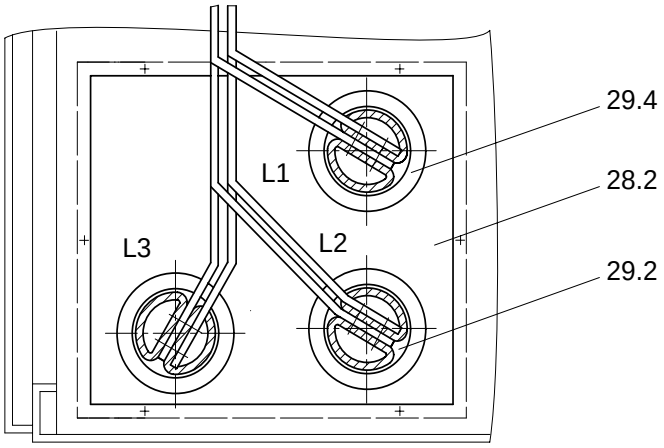
a) *Bushings with busbar supports for busbar systems with double conductor*



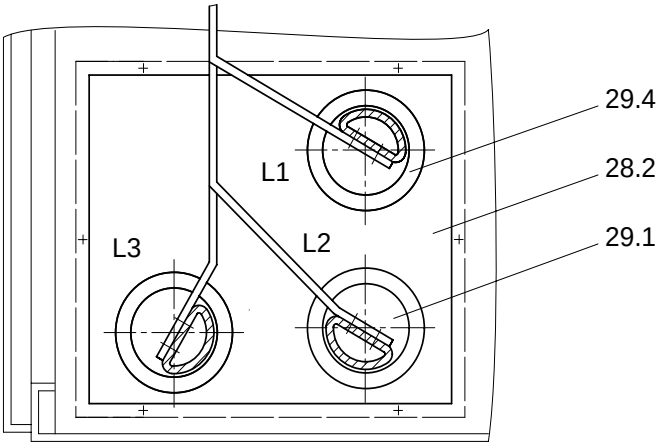
b) *Bushings with busbar supports for busbar systems with single conductor. Conductor arrangement at bottom required*

Figure 5/8: Arrangement of the bushing plate and busbar bushing on the right-hand panel side wall in bus tie panels. View of the inside

2 Tee-off conductor
3 Busbar section
9.3 Partition
28 Bushing plate
29 Busbar bushing
29.1 Busbar support for single conductor
29.2 Busbar support for double conductor



a) *Bushings with busbar supports for tie bus systems with double conductor*



b) *Bushings with busbar supports for tie bus systems with single conductor. Observe the conductor arrangement*

Figure 5/9: Arrangement of the bushing plate and busbar bushings on the right-hand panel side wall in bus tie panels. View of the inside

28.2 Bushing plate
29.1 Busbar support for single conductor
29.2 Busbar support for double conductor
29.4 Busbar bushing

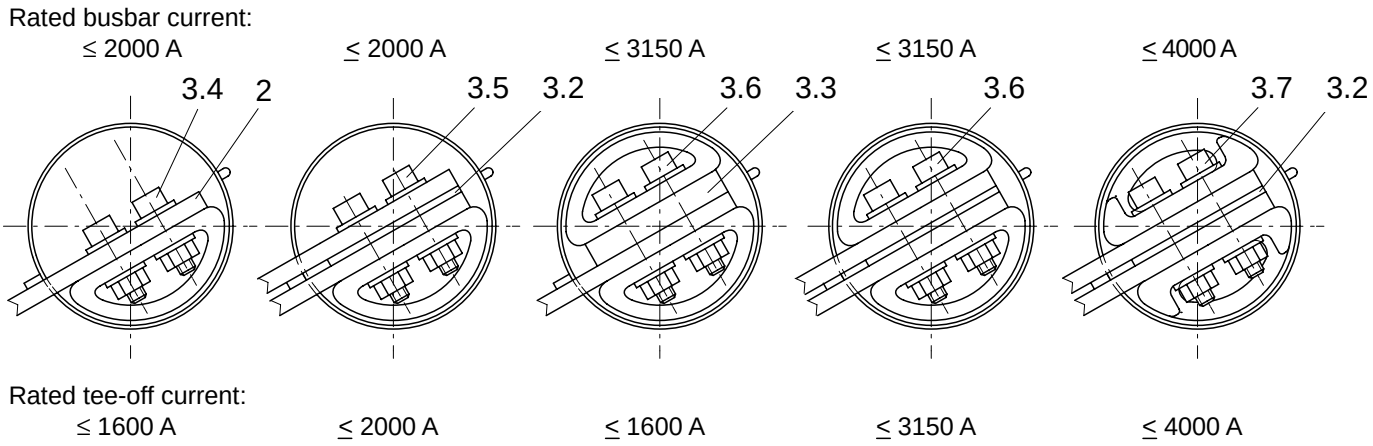


Figure 5/10: Busbar junctions

2 Tee-off conductor
3.2 Spacer plate, 5 mm thick
3.3 Spacer plate, 15 mm thick
3.4 "Junction" bag group, part number GCE 800 6131R0103
3.5 "Junction" bag group, part number GCE 800 6131R0104
3.6 "Junction" bag group, part number GCE 800 6131R0105
3.7 "Junction" bag group, part number GCE 800 6131R0106

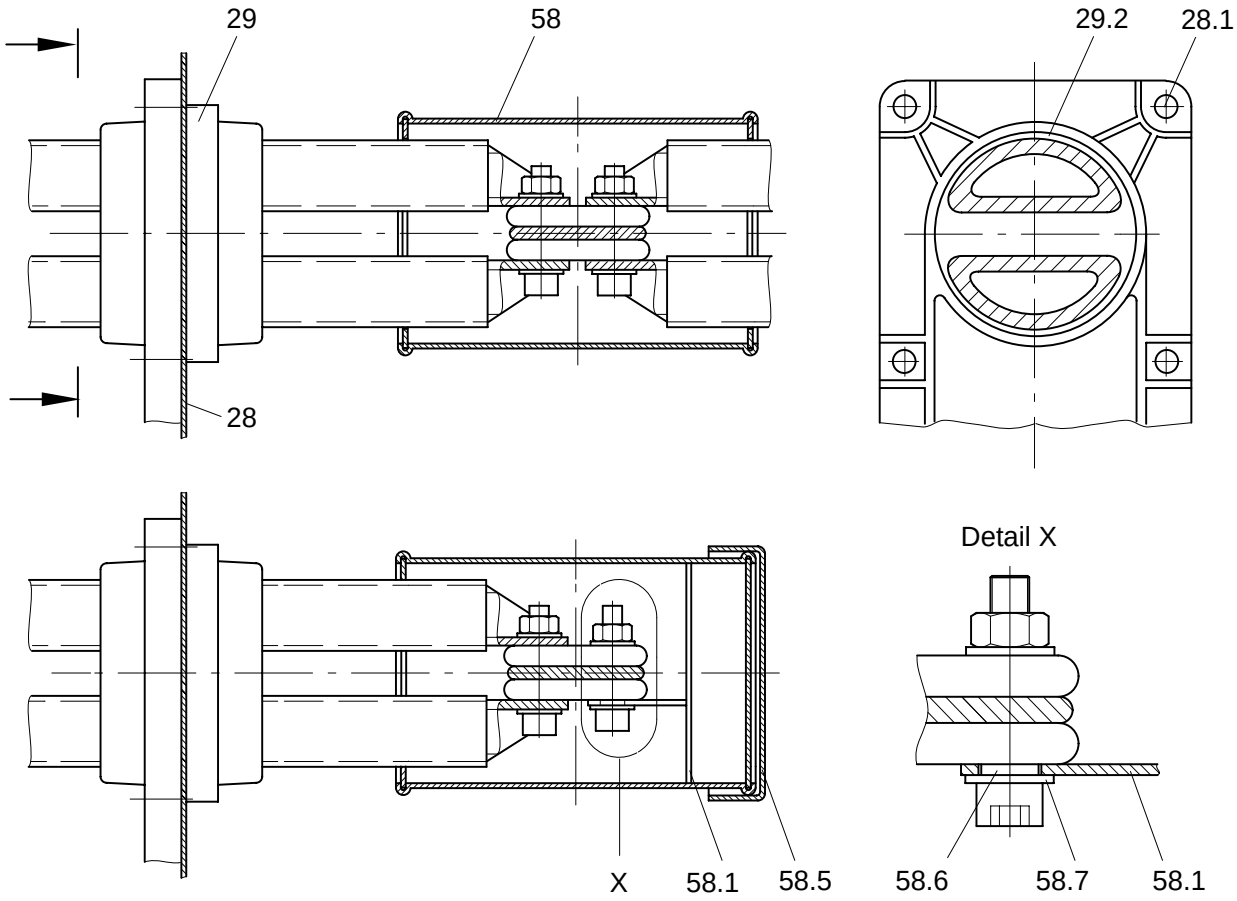


Figure 5/11: Installation of the busbars

28 Bushing plate
28.1 „Panel partitioning“ bag group
29 Busbar bushing
29.2 Busbar support for double conductor
58 Insulating cover
58.1 Support for cover
58.5 Lid (for 17.5 kV only)
58.6 Washer, DIN 125
58.7 Washer, 25 mm diameter

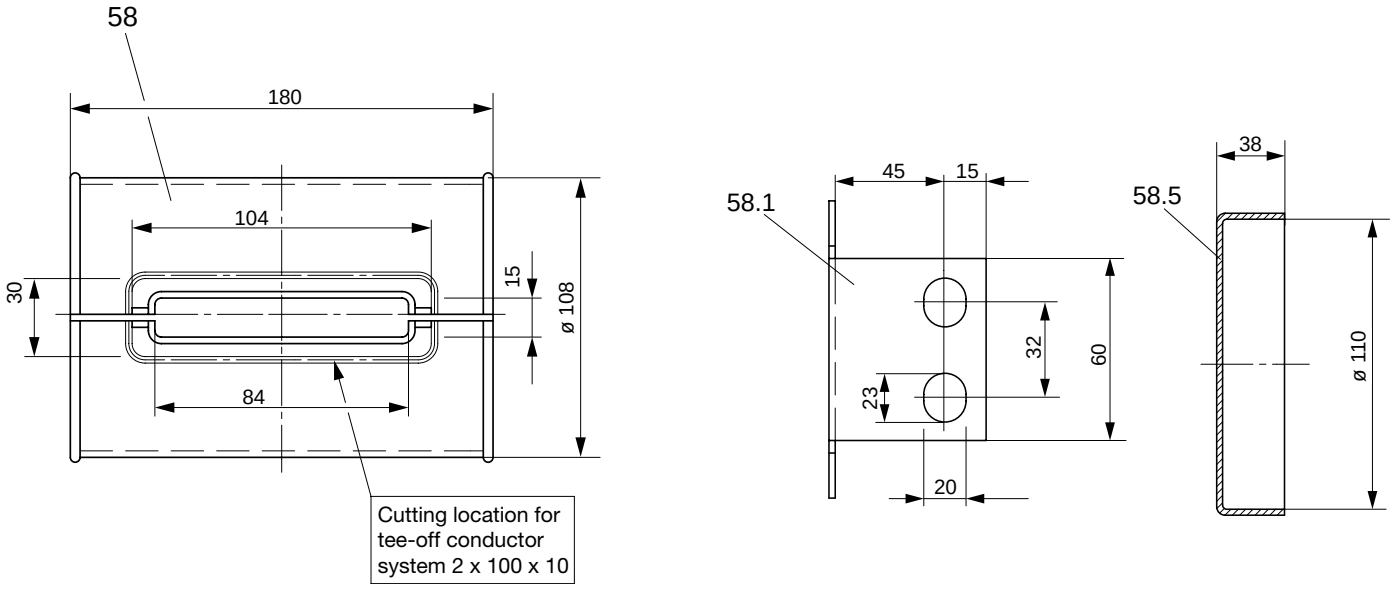


Figure 5/12: Insulating covers for busbars

58 Insulating cover
58.1 Support for cover
58.5 Lid (for 17.5 kV only)

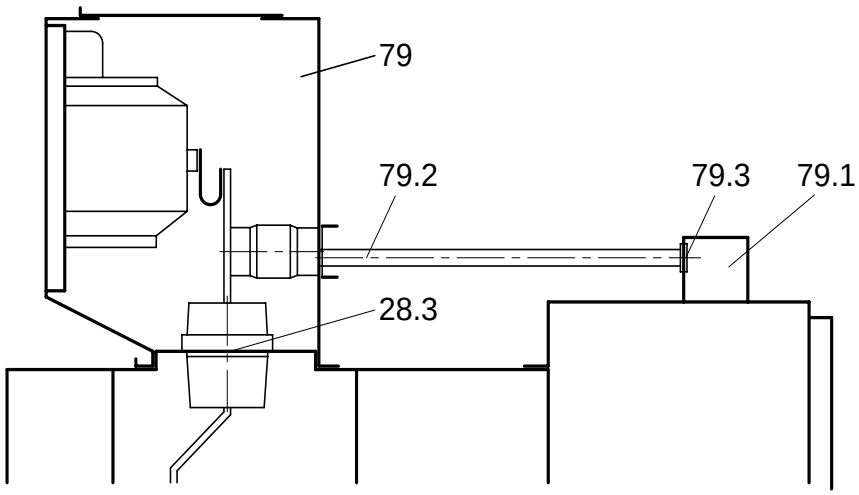


*Figure 5/13: Top mounted box with voltage transformers for busbar metering. The figure (non-standard equipment) shows the arrangement in panels **without** the busbar bushing plate 28 (observe the notes in section 5.5.1).*

28.3 Partitioning (non-standard; equipment on request)
79 Top mounted box with voltage transformer
79.1 Intermediate box
79.2 Conductor tube
79.3 Reducer ring

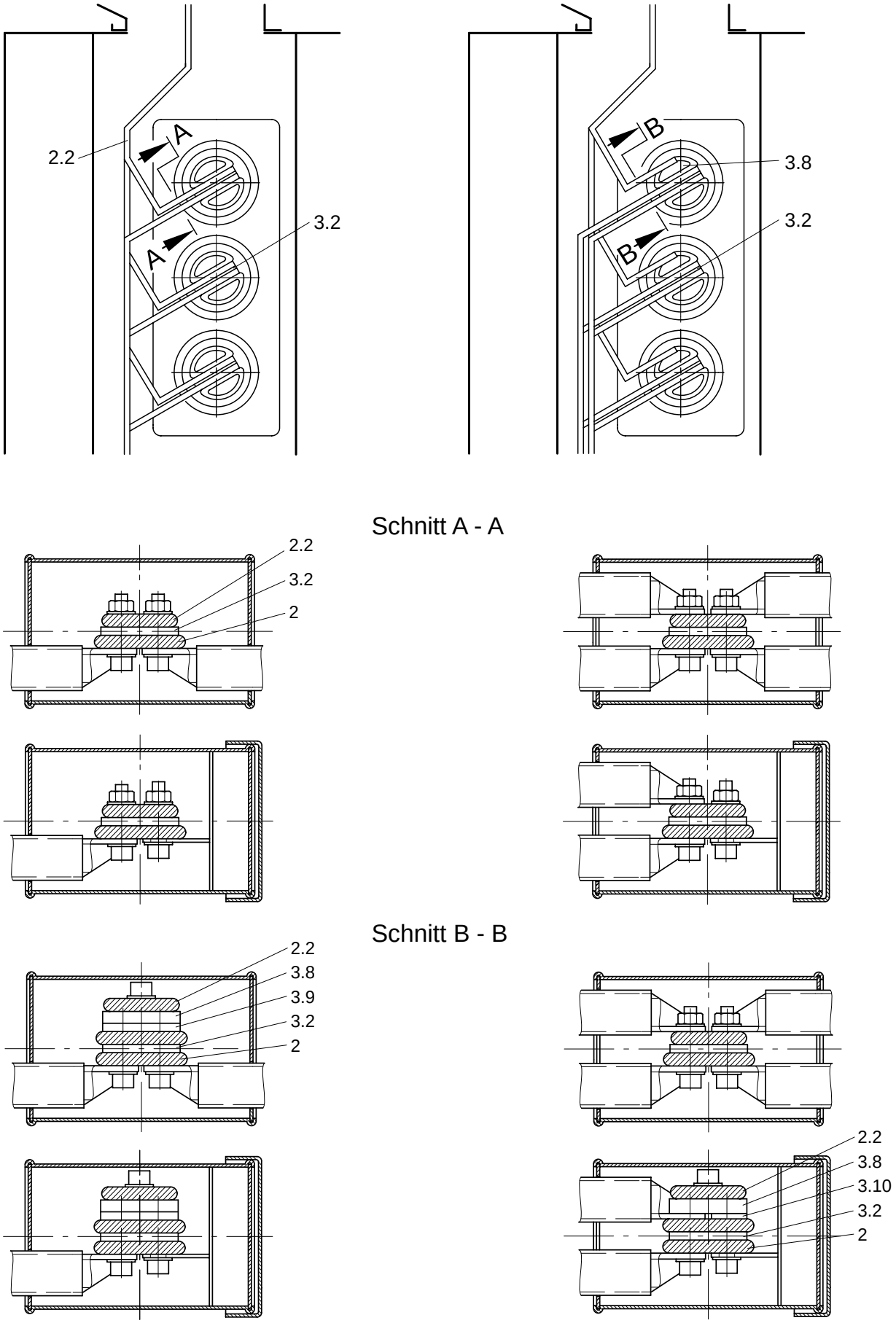


*Figure 5/14: Bar connection to the top mounted box. The figure shows the arrangement in panels **with** busbar bushing plate 28 (observe the notes in section 5.5.1).*

2	*Tee-off conductor*	*3.8*	*Tapped plate*
2.2	*Connection bar*	*3.9*	*Spacer plate, 8 mm thick*
3.2	*Spacer plate, 5 mm thick*	*3.10*	*Spacer plate, 8 mm thick*

Figure 5/15: The earthing switch operating shaft is supplied loose when the top mounted boxes are removed for transport purposes. View for the open position of the earthing switch with individual mechanism parts fitted in the positions for correct function.

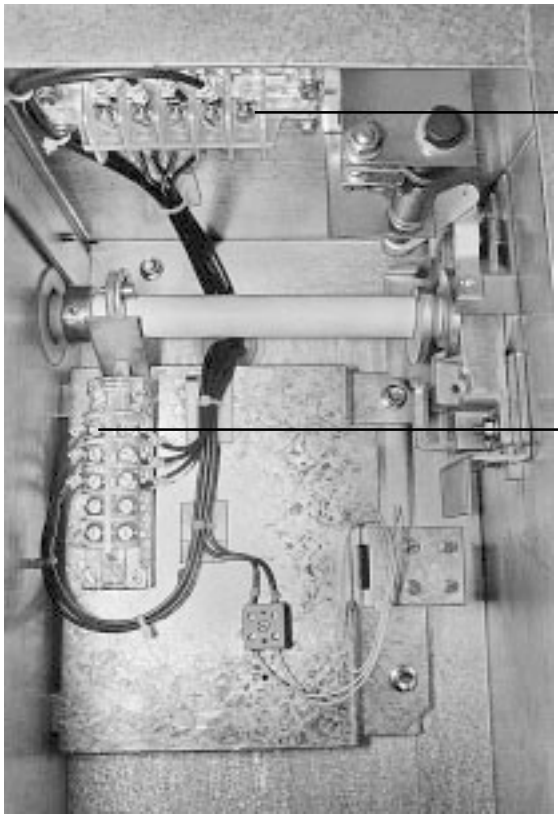
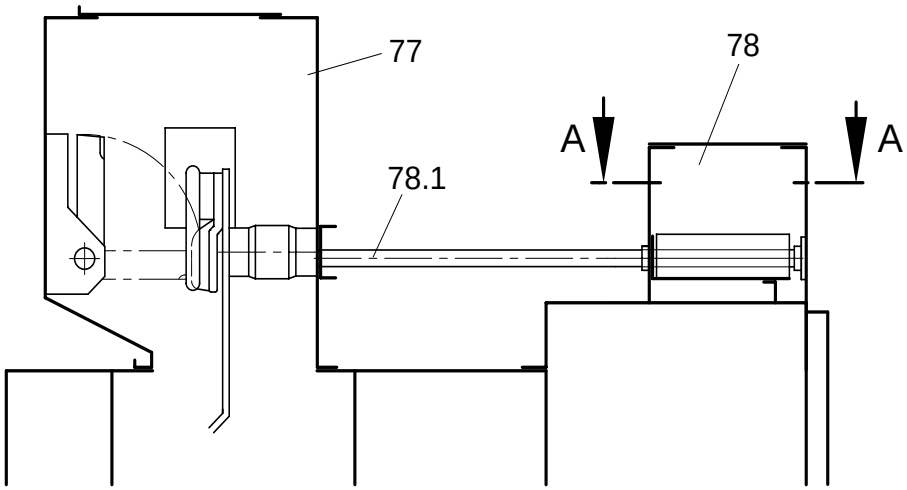


Figure 5/16: Operating mechanism area of a top mounted earthing switch in detail. Precisely follow the sequence and arrangement of the parts on the operating shaft when assembling. The figure shows the arrangement for the open position of the earthing switch.

78.4 Limit auxiliary switch for earthing switch ON
78.5 Limit auxiliary switch for earthing switch OFF



Section A-A

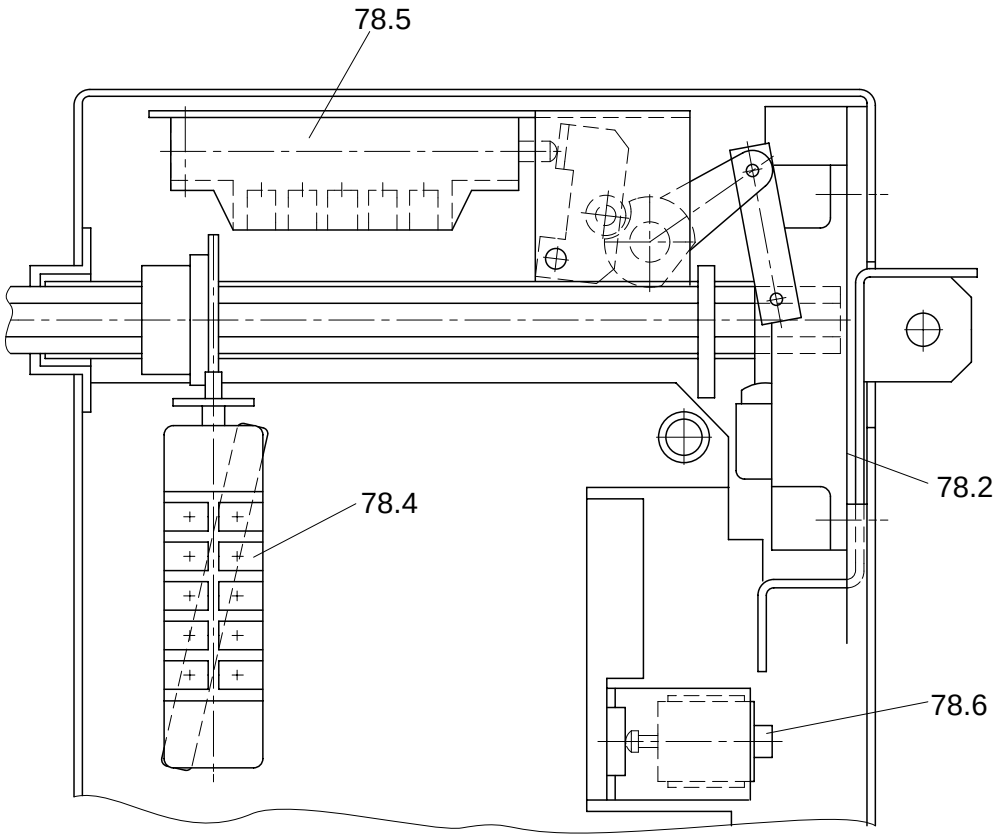
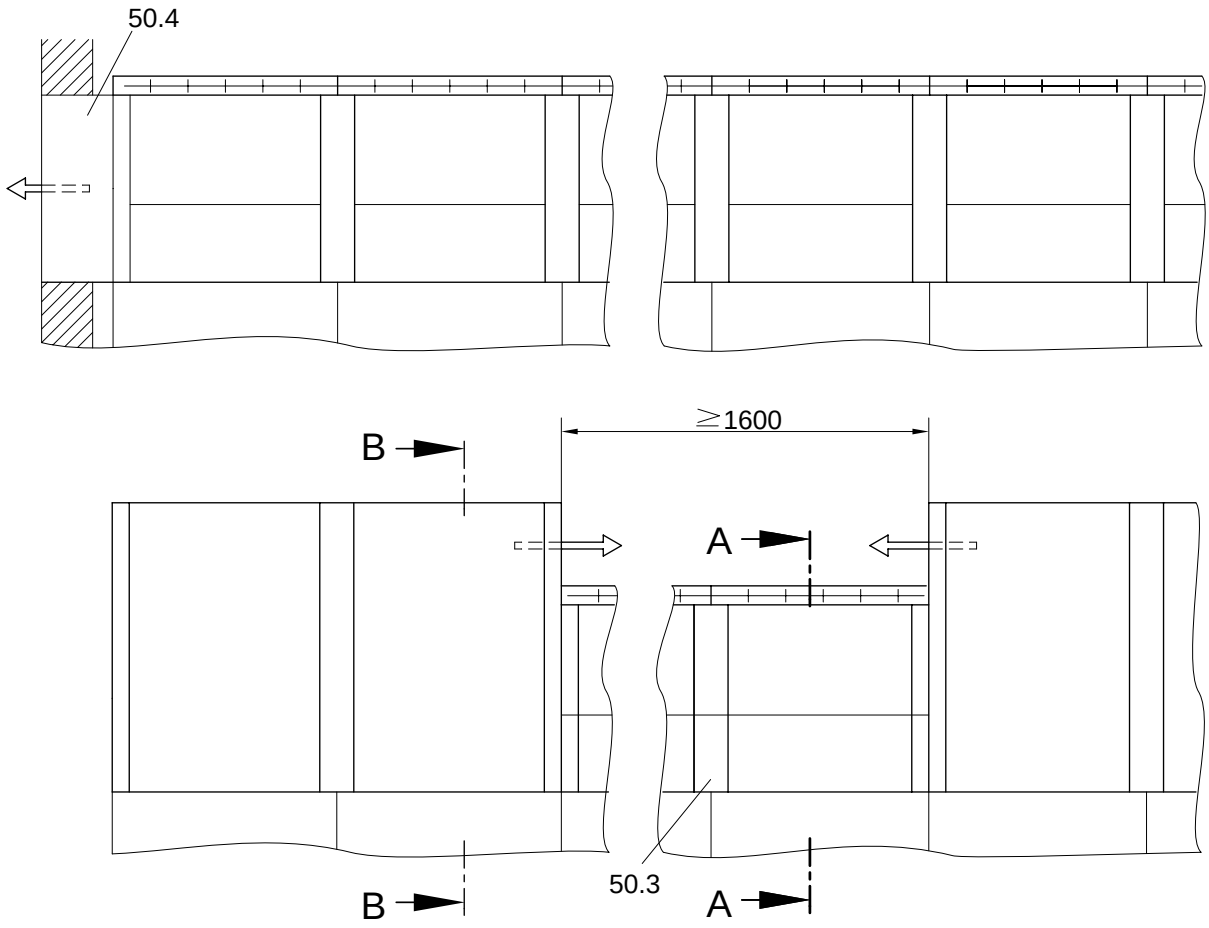
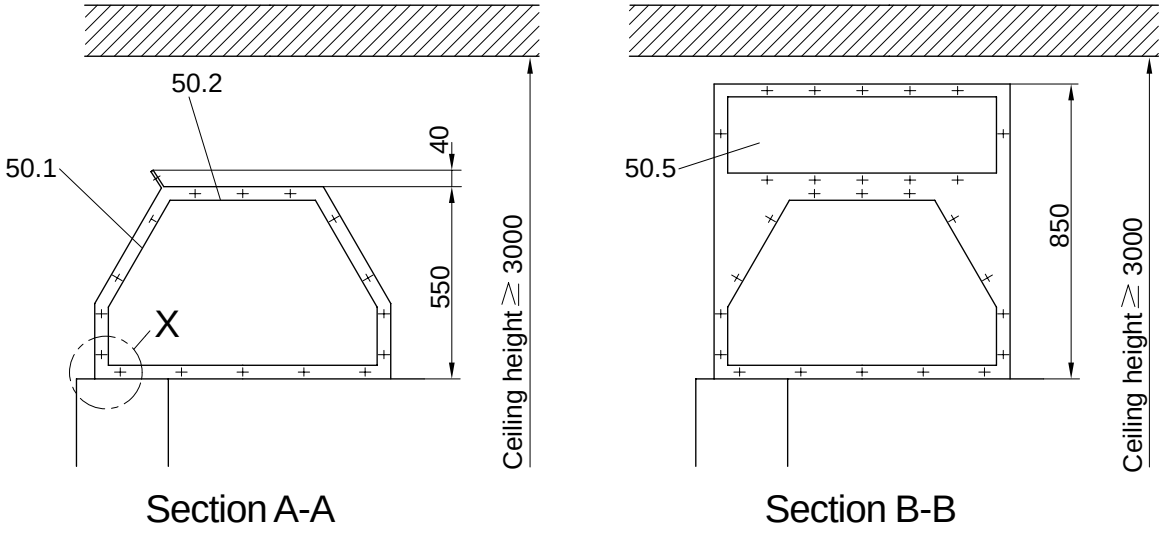


Figure 5/17: Top mounted box with earthing switch for busbar earthing

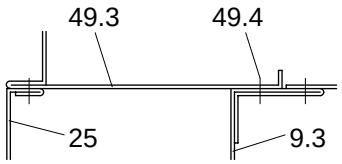
77 Top mounted box of the earthing switch
78 Operating mechanism box
78.1 Operating shaft
78.2 Slide
78.4 Auxiliary switch ON
78.5 Auxiliary switch OFF
78.6 Blocking magnet





Section A-A

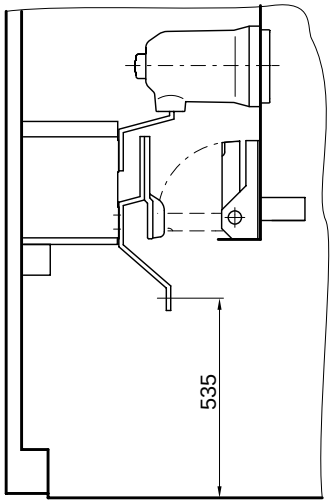
Section B-B



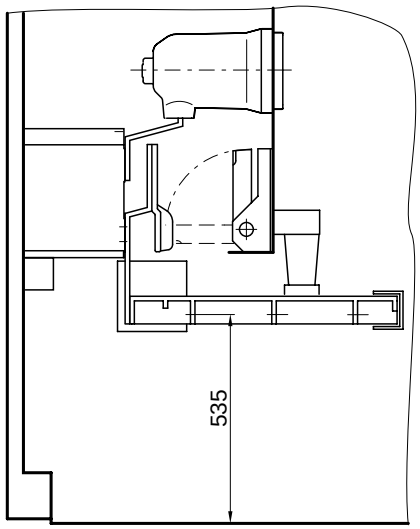
Detail X

Figure 5/18: Pressure relief duct

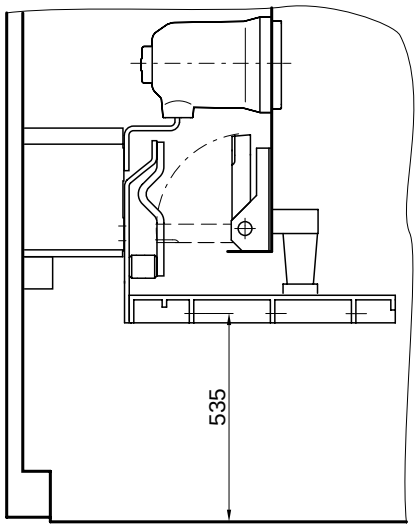
9.3 Rear wall busbar compartment
25 Rear wall panel
49.3 Pressure relief flap behind
49.4 Plastic screw
50.1 Rear wall pressure relief duct
50.2 Front wall pressure relief duct
50.3 Attachment strips
50.4 Discharge grating
50.5 Absorber grating



Cable connection bar for a single cable



Cable connection bar for 3 parallel cables,
Panel width 650 mm, ≤ 31.5 kA



Cable connection bar for 3 parallel cables,
Panel width 800 mm, ≤ 40 kA

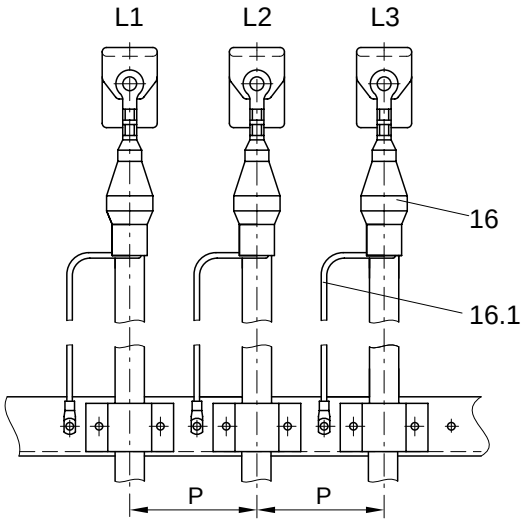
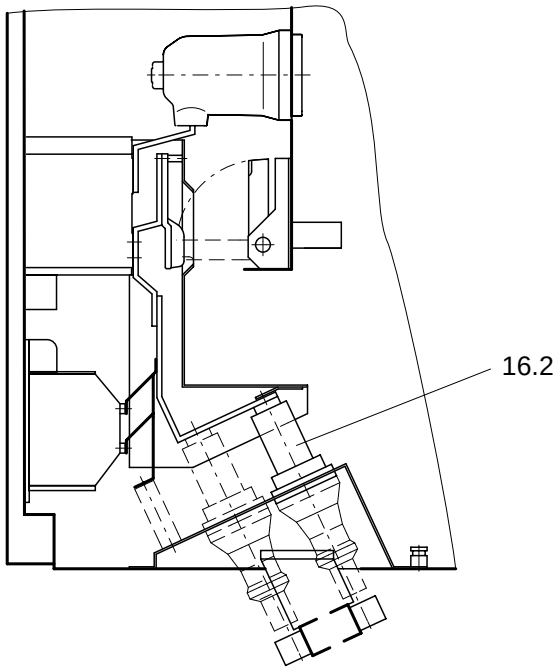


Figure 5/19: Cable termination in panels up to 1250 A

16 Cable sealing ends
16.1 Cable screen



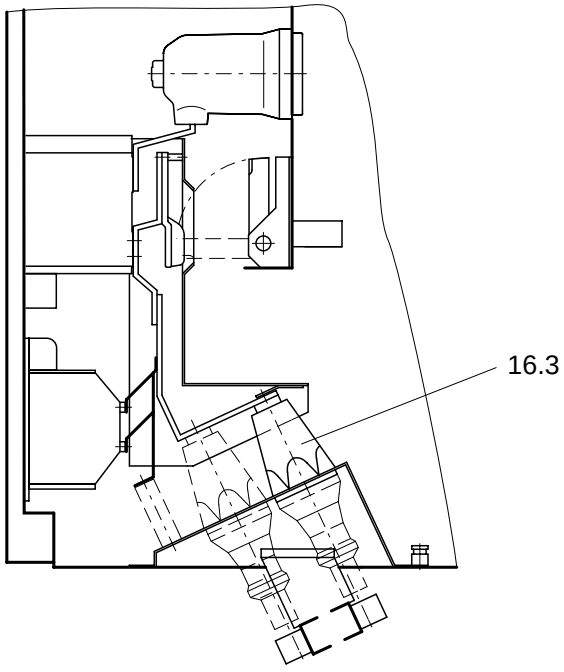
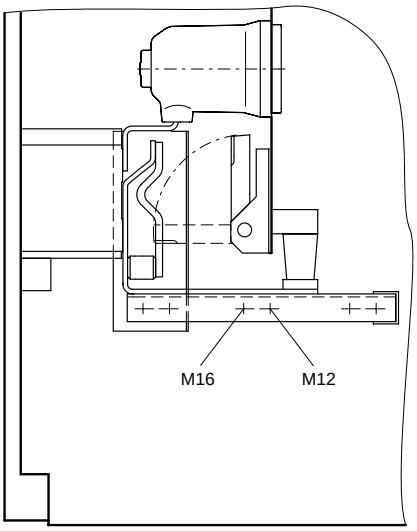
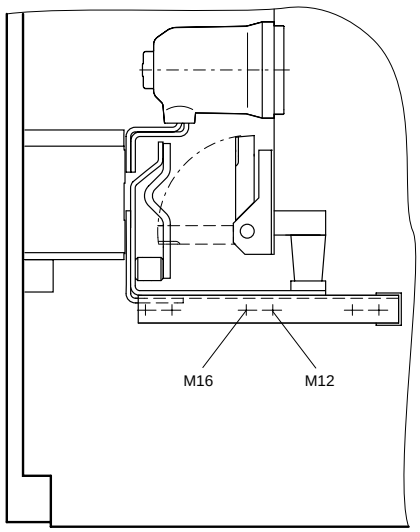


Figure 5/20: Cable termination with pluggable cable sealing ends

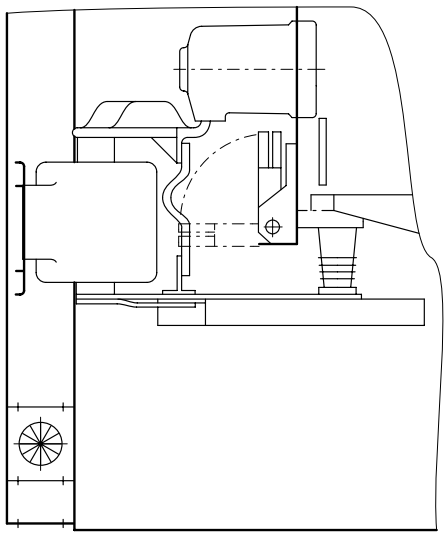
16.2 Cable sealing end, size 1
16.3 Cable sealing end, size 3



Panel width 800 mm, ≤ 40 kA



Panel width 1000 mm, ≤ 40 kA



Panel width 1000 mm
rated tee-off current 4000 A

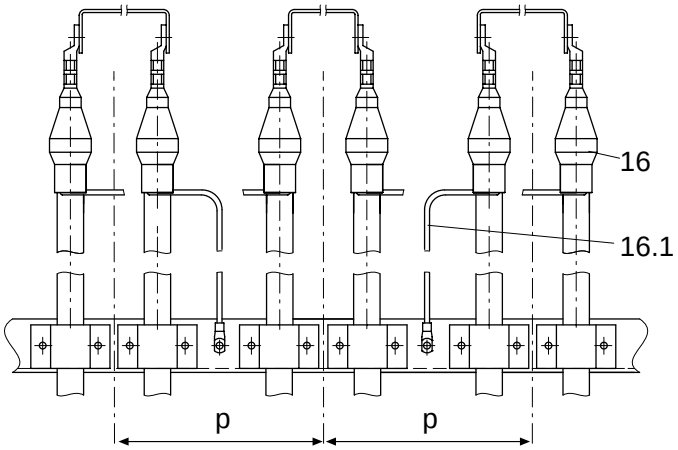


Figure 5/21: Cable termination in panels with a tee-off current ≥1600 A

16 Cable sealing ends
16.1 Cable screen

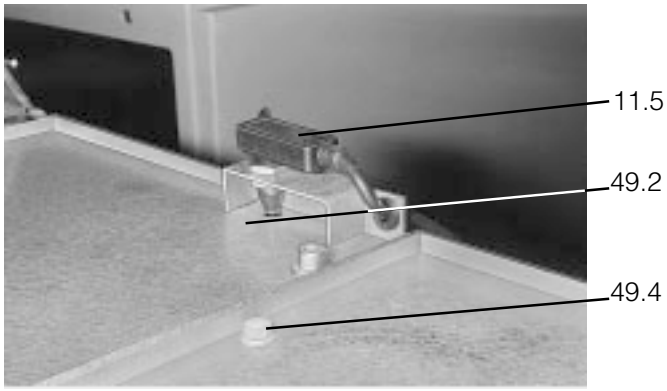


Figure 5/22: Auxiliary switch for I_{th} limitation. It may be necessary to move the auxiliary switches into their service position when the lifting lugs have been removed.

11.5 I_{th} limiter
49.2 Pressure relief flap, centre
49.4 Rupture bolt (plastic)

6 Operation of the ZS1 switchgear

The relevant work and operating procedures are to be carried out carefully by trained specialists familiar with the installation, taking into account all relevant safety regulations according to DIN VDE/IEC and other relevant professional bodies, and other local and works regulations and instructions. Special attention should also be paid to full compliance with VDE 0105 (Operation of electrical installations).

6.1 **Start-up**

6.1.1 Preparatory work

(Figures 3/10, 3/20 and 6/20)

In preparation for commissioning, the following work should be carried out prior to connection with the high-voltage power supply:

- Check the general condition of the switchgear for detrimental circumstances of all kinds.
- Perform a visual examination of the switching devices, withdrawable parts, isolating contacts, insulating parts, etc.
- Check the connection of the main earthing bar with the station earthing conductor (DIN VDE 0141).
- Check the paintwork for damage and touch up as described in section 7.4.1 where necessary.
- Remove all material residues, foreign bodies and tools from the switchgear.
- Clean the switchgear, rubbing down insulating parts with a clean, soft, non-fraying and dry cloth. Remove greasy or adhesive dirt as described in section 7.3.
- Properly refit all covers, etc., removed during assembly and testing processes.
- White transport caps 13.9 on the poles of vacuum circuit-breakers, where fitted, must be removed.
- Pole tube caps 13.10 may be fitted to the vacuum circuit-breakers in certain switchgear installations and with breakers of certain types. Their proper fit should be checked.
- Lifting lugs 13.13 for high-current circuit-breakers, if still fitted, must be removed.
- Perform AC voltage testing on the main circuits to VDE 0670, Part 6 (IEC 60298) as far as necessary. Pay special attention during this procedure to voltage transformers and cables etc. A testing and earthing withdrawable part 142 can be used to establish the connections.
- Switch the auxiliary and control voltage on.
- Carry out test operations of switching devices manually or by electrical control, and simultaneously observe the relevant position indicators.
- Check mechanical and electrical interlocks for effectiveness, without using force.
- Set the protective devices in the panel to the required values, and check their functioning with test equipment.
- In panels with an additional ventilation system due to increased ambient temperature according to section 1.3 (figures 6/21 and 6/22), the flap 20.3 hanging in partition 20 must loosely rest against leaf spring 20.4 (with the centrifugal fan at a standstill if fitted):

  To check:

  – Insert a suitable screwdriver through opening 20.5 in horizontal partition 20 and into bracket 20.6 on flap 20.3.

  – Swing flap 20.3 upwards and allow it to rest loosely again on leaf spring 20.4.

  – If the flap is in the blocked position, use the screwdriver to press leaf spring 20.4 downwards by approx. 5 mm to release the block before swinging the flap.

  – If any centrifugal fans controlled in relation to primary current are fitted, also check that they function correctly.
- On motor-driven withdrawable parts, check the direction of rotation of the travel motors as described in section 7.5.1.
- For any further questions on the functions of the withdrawable circuit-breaker part and its testing, see section 7.5.
- Instruct the local operators in the fundamental details of regular handling of the switchgear.
- Check on the operational readiness and switching status of electrical systems upstream and downstream from the switchgear.

From areas bordering on the switchgear, in accordance with responsibilities, check on the following where applicable:

- Power cables
- Auxiliary cables
- Auxiliary power source
- Remote control
- Entire earthing installation, according to DIN VDE 0141
- Switchroom equipment
- Switchroom condition.

6.1.2 Start-up

- Comply with all relevant safety regulations.
- Ensure that the circuit-breakers and switch-disconnectors in the switchgear are in the OFF position.
- Remove any existing earthing and short-circuiting connections in the critical switching area.
- Energize the feed cables.
- Connect the switchgear, step-by-step, observing the signals and indicators.

- Check that the relevant conductors are in-phase, as far as necessary when several incoming feeder cables and switchgear sections are concerned (see also section 6.3.2).
- Carry out all measurements and check all functions dependent on the high-voltage power supply being connected.
- Watch out for irregularities of any kind.

6.2 Switching operations

Perform switching operations with the front doors shut.

6.2.1 Withdrawable circuit-breaker part

(Figures 6/1, 6/5 to 6/7 and 6/9 to 6/11)

Manual insertion from the test/disconnected position to the service position:

- Connect control wiring plug 10.2.
- Close the front door.
- Ensure that the circuit-breaker is in the OFF position.
- Fit hand crank 121 on square spigot 18.1 of the spindle mechanism 18.
- Turn the crank clockwise through approx. 20 turns until the stop is reached and the withdrawable part 13 is in the service position.
- Observe the position indicator.
- Remove hand crank 121.

It has to be considered that the spring loaded piece of scenery 18.2 will lie completely on the rear side of the panel door when the hand crank will be moved from the square spigot 18.1 of the spindle mechanism 18. This ensures that the rear part of the scenery has been shift on the hexagon cap of the spindle and prevents the unintentional wrenching of the spindle during the service of the panel. The wrenching may lead to a blocking of the circuit-breaker.

Note:

The withdrawable part must not be stopped at any position in the travel range between the service position and test/disconnected position!

Manual withdrawal from the service position into the test/disconnected position:

- Ensure that the circuit-breaker is in the OFF position.
- Reverse the procedure described above for insertion into the service position.

Note:

Withdrawable parts with blocking magnet Y0 may not be forcibly moved during power failures. In such a case they are blocked along the whole travel range between the service and test positions. For deblocking, see section 7.5.5.

Motor-driven movement of the withdrawable part:

- Briefly operate the electrical control for insertion or withdrawal (the withdrawable part then automatically moves into the opposite position).
- Observe the position indicator.

Note:

When the motor fails, the withdrawable part can be moved in emergency manual operation. If the drive motor fails during movement of the withdrawable part, the withdrawable part must be moved into a limit position in emergency manual operation.

Emergency manual operation is carried out with the hand crank 121 on the spindle mechanism 18, in a similar manner to operation of a withdrawable breaker part with manual systems:

- Switch off the auxiliary power (m.c.b.), since the motor would otherwise be braked electrically.
- Turn hand crank 121 in the required direction.

When the withdrawable part moves, the motor turns. The motor functions in such a case like a generator, i.e. it can lead to reverse voltages in the terminals.

The motor protection by fuse must not be changed from the specified type and rated value, or the behaviour of the permanent magnet motor could be irreversibly impaired!

Caution:

On emergency manual operation of a motor-driven withdrawable circuit-breaker part, **the interlock with a motor operated earthing switch could not be effective!** The interlock is always effective with a manual operated earthing switch.

Withdrawal from the test/disconnected position onto the service truck:

- Open the door of the circuit-breaker compartment.
- Release control wiring plug 10.2 and engage it in the storage position on the withdrawable part.
- Position service truck 124 with the guide pins 124.2 of the adjustable bench top at the correct height facing the panel front, and allow catch 124.3 to engage.
- Move sliding handles 13.11 inwards against the springs to release withdrawable part 13, withdraw onto the service truck and secure it in the catches on the truck.
- Press the release lever 124.4 (at the front underneath the bench top) and release the service truck from the panel.
- Secure the shutter(s) in position as required with the padlock.

Insertion from the service truck into the test/ disconnected position:

- Carry out the procedure as described above for withdrawal, changing the order accordingly.

6.2.2 Withdrawable metering parts

(Figures 3/1 and 3/11)

The handling of the withdrawable metering part in the metering panel is as described in section 6.2.1, without however the switching operations and interlocking functions.

Withdrawable metering parts in incoming and outgoing feeder panels are inserted into the cable compartment using a ramp. They reach their service position immediately and engage there in the panel ground by means of the two locking pins at the sides. The voltage transformers used correspond to the type used in the metering panel, and therefore HRC fuses can also be used along with the voltage transformers.

6.2.3 Circuit-breaker

(Figure 6/5)

Charging the stored-energy spring system:

- On breakers with charging motors, charging is carried out automatically. If the charging motor should fail, the charging procedure can be carried out or completed by hand.
- On breakers with manual charging systems, door opened and withdrawable part in disconnected position, insert the charging lever 128 into the recess for charging lever and pump for approx. 25 strokes until the charged condition is indicated. When the charging condition is reached, the charging mechanism is automatically disengaged, and any further strokes of the lever have no effect.

Meaning of the charging condition symbols:

Discharged

Charged

Opening and closing the circuit-breaker:

- With the withdrawable part in the service position, on and off switching operations should only be carried out with the doors closed.
- Operate the local or remote electrical control.
- Observe the position indicator.
- The switching operation counter 13.5 for the circuit-breaker is automatically incremented by one unit with each operating cycle.

An additional control mechanism fitted in the door of the circuit-breaker compartment enables mechanical operation of the circuit-breaker with the door closed and with the withdrawable part in either position (figures 3/9 and 6/8):

- Press the relevant mechanical push-button, previously turning knob 45.2 anti-clockwise to the stop if the withdrawable part is in the service position.
- Observe the position indicator.

Operating sequences:

Example 1: Circuit-breaker with manual charging mechanism

Operating sequence (with panel door closed, except for charging)	Result of operation Switch position	Charging condition	Possible subsequent switching operation
Withdrawable part in test/ disconnected position, control wiring plug inserted in socket			–
Charging	0		On-Off
Move withdrawable part into service position			
Close breaker	I		Off
Open breaker	0		–
Move withdrawable part into test/disconnected position			

Test switching of the circuit-breaker without primary voltage can be carried out with the withdrawable part in the test position (with the control wiring plug fitted).

Example 2: Circuit-breaker with motor-operated charging mechanism, withdrawable part in service position

Operating sequence (with panel door closed)	Result of operation Switch position	Charging condition	Possible subsequent switching operation
Switch on charging motor			-
Automatic charging	0		On-Off
Close breaker... and	I		Off
automatically (re)charge	I		Off-On-Off or auto-reclosing sequence
Open breaker	0		On-Off
Close breaker... and	I		Off
automatically (re)charge	I		Off-On-Off or auto-reclosing sequence
Autoreclosing sequence Off	0		
(Activation via protection system) On	I		(automatic charging starts)
Off	0		
Automatic charging	0		On-Off
Close breaker... and	I		Off
automatically (re)charge	I		Off-On-Off or auto-reclosing sequence

Test switching of the circuit-breaker without primary voltage can be carried out with the withdrawable part in the test position (with the control wiring plug fitted).

6.2.4 Tee-off earthing switch

(Figures 3/5, 3/13, 6/13 and 6/14)

Earthing switches of type EK6 are used in ZS1 switchgear. The earthing switch has a snap-action closing mechanism which is independent of the rotary motion of the operating shaft. Earthing switches 6 assigned to circuit-breakers are only enabled for switching when the withdrawable part 13 is in the test/disconnected position or withdrawn position.

Only switch earthing switches on when the doors are closed.

Manual opening and closing:

- Press slide 14.2 on the operating lever socket down (the slide is already in this position when the switch is closed!).
- Fit the operating lever 122 to the hexagonal shaft 14.1, which is now released for operation.

  Note:

  Position the operating lever 122 in such a way pointed upwards or downwards on the hexagonal shaft that sufficient room for movement of the operating lever remains even if space is constricted at the sides.
- Turn the operating lever 122 clockwise through approx. 180° until the stop is reached to close the earthing switch, or anti-clockwise until the stop is reached to open the earthing switch.
- Observe the mechanical/electrical position indicator.
- Remove the operating lever 122. Slide 14.2 remains open if the earthing switch is in the closed position.

Make sure that the operating lever is turned right up to the stop in the opening process, to ensure that the earthing switch is in its defined final position.

The manual operating mechanism can also be fitted with a blocking magnet.

Opening and closing with motor-operated mechanism:

The earthing switch can additionally be fitted with a motor-operated mechanism.

- Briefly activate the electrical control for closing and opening the switch. The earthing switch is then automatically switched into the opposite position.

Emergency manual operation:

In case of failure of the motor-operated mechanism, the earthing switch can be switched with the operating lever by means of emergency manual operation, in a similar manner to an earthing switch with a manual mechanism.

Caution!

When activating a motor-operated earthing switch manually, the interlock is not effective!

In emergency manual operation the coupling to the drive motor is disengaged automatically. To disengage the motor-operated mechanism, first move the operating lever further in the previously selected direction until it meets the stop (slight angle of rotation). When switching with the motor-operated mechanism after it has been restored, the coupling automatically engages again.

Note:

The operating lever may only be temporarily fitted for the performance of an emergency manual switching operation.

For the duration of the motor failure, the power to the motor must be switched off.

6.2.5 Busbar earthing switch

(Figures 3/1 and 5/15 to 5/17)

To earth the busbars, earthing switches, also of type EK6, are used. Their operating mechanism is identical with that of the tee-off earthing switches (see section 6.2.4).

The conditions for panel to panel interlocking of the busbar earthing switches are described in section 3.4.2.

6.2.6 Switch-disconnector

(Figures 6/13 and 6/15)

Only operate switch-disconnectors and earthing switches when the panel doors are closed.

Notes:

- Fit operating lever 122 to the hexagonal shaft 35.1 pointing either upwards or downwards for each switching operation in such a way that it is not obstructed at the sides, even in limited space.
- Ensure that the operating lever 122 is moved fully into the final position in all switching operations.

1. Opening and closing of a switch-disconnector with snap-action ON mechanism and snap-action OFF mechasnism (type CK3):
   - Close the switch-disconnector by turning the operating lever 122 clockwise through approx. 180° up to the stop, or open the switch-disconnector by turning the operating lever anti-clockwise through approx. 180° up to the stop.
2. Opening and closing of a switch-disconnector with snap-action ON mechanism and rechargeable stored-energy spring OFF mechanism (type CR3):
   - Close the switch-disconnector by turning the operating lever 122 clockwise through approx. 180° up to the stop.
   - Recharge the stored-energy springs immediately after the closing operation by turning the operating lever 122 through 180° in an anti-clockwise direction up to the stop.

The switch-disconnector is then ready to open, also in response to fuse tripping, shunt and undervoltage releases.

- Open the switch-disconnector by turning the operating lever 122 clockwise through approx. 15°. Then turn the operating lever back anti-clockwise until the stop is reached.
- Observe the position indicator (see also section 6.2.8).

3. Opening and closing of a switch-disconnector with snap-action ON mechanism and stored-energy spring OFF mechanism (type CS3):

   - Close the switch-disconnector by turning the operating lever 122 clockwise through approx. 180° up to the stop, or open the switch-disconnector by turning the operating lever anti-clockwise through approx. 180° up to the stop.

     When the switch-disconnector is then ready to open, it will also respond to fuse tripping, shunt and undervoltage releases.

   Special case:

   Charge and engage the closing springs by turning the lever anti-clockwise through approx. 180° up to the stop (pretensioning).

   This action is only required:

   - on initial installation (stored-energy springs then normally discharged).
   - for indirect operation (tripping by HRC fuse, shunt and undervoltage release).

4. Opening and closing an integrated earthing switch:

   - Switching of a normally interlocked earthing switch is only enabled when the switch-disconnector is in the open position.
   - Close the earthing switch by turning the operating lever 122 clockwise through approx. 180° up to the stop, or open the earthing switch by turning the operating lever anti-clockwise through approx. 180° up to the stop.
   - Observe the position indicator (see also section 6.2.8).

5. Opening and closing with a motor-operated mechanism:

   Switch-disconnectors and earthing switches can also be fitted with motor-operated mechanisms.

   - Operate the electrical control to open/close the switch (briefly), and the switch-disconnector or earthing switch will then be switched automatically into the opposite position, or the stored-energy springs for the switch-disconnector charged.

Emergency manual operation:

If a fault occurs in the motor-operated mechanism, the switch-disconnector and earthing switch can be operated manually in emergencies with operating lever 122, in a similar manner to a switch witch manual mechanism. To disengage the coupling to the motor-operated mechanism, first turn the operating lever 122 up to the relevant stop (small angle of turn).

On the next operation with the motor-operated mechanism after its function has been restored, the coupling automatically reengages.

Note:

The operating lever may only be fitted temporarily for performance of an emergency manual switching operation.

The power to the motor-operated mechanism must be switched off for the duration of any breakdown.

6.2.7 Insulating protection plate

(Figure 6/15)

With the isolating distance of the switch-disconnector open, an insulating protection plate 36 can be inserted into the relevant panel on rails.

Notes:

- Always clean and inspect insulating protection plates before use.
- When moisture and dirt cause layers of foreign matter to build up on a protection plate, there is danger due to possible leakage currents.
- Insulating protection plates are only suitable as protection against accidental contact and not as protection against reclosing.
- The service duration of inserted protection plates is fundamentally limited by influence of moisture, temperature, contamination and the adjacency of live parts.
- Observe the details listed in section 7.2 with regard to the insulating protection plates.

6.2.8 Electrical/mechanical annunciation/monitoring

When the switchgear is in operation, observe all the operating data and condition indications in the secondary area.

Position indicator for switch-disconnectors:

- Type CK3: The switch position is identical to the mechanism position.
- Typ CR3: The switch position is not identical to the mechanism position.
- Typ CS3: The switch position is identical to the mechanism position when operation is direct.

  For indirect operation (by fuse or electrical release), the opening operation results in different positions for the switch and mechanism.

6.2.9 Earthing and short-circuiting with the earthing cable sets

(Figures 3/12, 3/13, 3/19, 6/12, 6/16 to 6/20)

1. Earthing in the cable compartment

For the earthing of the tee-off conductors, the usual commercially available earthing bolts are intended for use on the connecting bars and the main earthing bar in the cable compartment.

Handling:

- Use earthing cables with insulating rods in accordance with the manufacturer's instructions.
- Check for off-circuit condition.
- Attach a warning label with an earthing symbol to the panel door.

2. Earthing at the contact pins

An earthing system with cable cross-sections of 70 mm^2 to 150 mm^2 is also available on request, specifically for earthing at the fixed contact pins.

a) Handling for earthing at contact pins for rated currents up to 1250 A:

- Isolate the area to be earthed and secure against reconnection.
- Remove the withdrawable circuit-breaker part from the relevant panel.
- Secure shutter 12.1 in front of the live contact pins with padlock 130.
- Bolt on actuating bars 129.1 to the shutter operating module 129 at the required location:
  - at the top to open the lower shutter,
  - at the bottom to open the upper shutter.
- Move the shutter operating module 129 into the test/disconnected position and completely into the service position with the aid of hand crank 121.
- Check that the area to be earthed is off-circuit, e.g. with a high-voltage tester at the relevant contact pins 4.1 or at the cable terminal.
- Connect the earthing cable to the fixed earthing point.
- Fit the short-circuiting cables directly onto the contact pins using insulating rod 133.3, and fasten them in place by turning the insulating rod.
- Attach warning label with the earthing symbol to the panel door.
- Secure neighbouring live areas (e.g. possibly the feeder cables) to prevent inadvertent contact.

b) Handling for earthing at contact pins for rated currents above 1250 A:

- Isolate the area to be earthed and secure against reconnection.
- Remove the withdrawable circuit-breaker part from the relevant panel.
- Secure shutter 12.1 in front of the live contact pins with padlock 130.
- Bolt on actuating bars 142.1 to the testing and earthing module 142 at the required location:
  - at the top to open the lower shutter,
  - at the bottom to open the upper shutter.
- Fit withdrawable test and earthing part 142 with contact arms 142.2 and contact systems 142.3 at the required positions.

  Remove ball 142.4 and short-circuit bridge 142.8 if fitted.
- Move the testing and earthing module 142 into the test/disconnected position and completely into the service position with the aid of hand crank 121.
- Check that the area to be earthed is off-circuit, e.g. with a high-voltage tester at the relevant contact pins 142.7 or at the cable terminal.
- Connect the earthing cable to the fixed earthing point.
- Fit the short-circuiting cables to contact pins 142.7 using insulating rod 133.3, and fasten them in place by turning the insulating rod.
- Attach warning label with the earthing symbol to the panel door.
- Secure neighbouring live areas (e.g. possibly the feeder cables) to prevent inadvertent contact.

6.3 Test procedures

6.3.1 Testing the off-circuit conditon

(Figure 6/4)

The panels are fitted with a capacitive voltage indication system including the corresponding (hand-held) plug-in indicator for testing of the off-circuit condition.

A distinction must be made between the low resistance (LRM) system and the high resistance (HR) system. For further details, see draft standard VDE 0682 Part 415 or IEC 61243-5.

The two systems differ in several respects, including different voltage levels which constitute the display thresholds. The capacitive voltage

dividers installed in the panels are correspondingly of different ratings, and the measuring sockets and indicators units are of different types.

Note:

The only permissible indicators are those which satisfy the requirements of the IEC and VDE standards and correspond to the technical design of the indication system in the relevant switchgear !

The measuring sockets must on no account be short-circuited, except for voltage tests on the switchgear (e.g. at power frequency withstand voltage and/or impulse voltage).

Testing for the off-circuit condition is effected using a plug-in indicator at the corresponding socket pairs located among the controls on the panels.

Use of the indicator unit:

- Carry out a functional test on the unit immediately before use, e.g. with interface tester KSP. The display must be clearly perceptible.
- The presence of operating voltage is displayed by a signal.
- Always follow the details given in the instructions for the particular indicator unit for your switchgear system.

Interface testing:

- Perform an interface test as a functional test on all coupling components, e.g. with interface tester KSP.
- The interface test is a repeat test as specified in IEC 61243-5 and VDE 0682 Part 415.

6.3.2 Testing for in-phase condition

Testing for the in-phase condition, e.g. when there is more than one incoming feeder, can be carried out with a suitable phase comparator coupled to the measuring sockets of the capacitive voltage indication system (if fitted).

Test procedure:

- Only use phase comparators which comply with the IEC and VDE standards and are of suitable design for the indication system in the relevant switchgear.
- Check the function of the unit immediately prior to use.
- Ensure that the maximum permissible length of the measuring cables for each phase is not exceeded.
- Connect the measuring cables to precisely the corresponding main conductor sections.
- Follow the directions for the phase comparator in detail!

6.3.3 Current and voltage testings

(Figures 6/4 and 6/20)

Testing and earthing module 142 is available for the performance of current and voltage tests. It is equally suitable for primary current injection to any current transformers which may be fitted during measurements in the protection circuit and, for example, for the application of a test voltage during insulating testing.

- Isolate and secure the working area in accordance with the safety regulations of DIN VDE/IEC.
- For primary current feed, fasten the connecting cable of the test transformer to the contact pins 142.7.
- For AC voltage tests, ball 142.4 on the contact pin is required. The bore in the ball serves for connection of the voltage supply.
- For current tests, for example of small connected generators, the short-circuit bridge 142.8 is to be fastened onto the contact pins.

Note:

With voltage tests at power frequency withstand voltage and/or impulse voltage, observe the following:

- Short-circuit the measuring sockets 30 in the relevant panels for the duration of the test procedure (only)!
- Disconnect any voltage transformers and cover with an insulating plate.

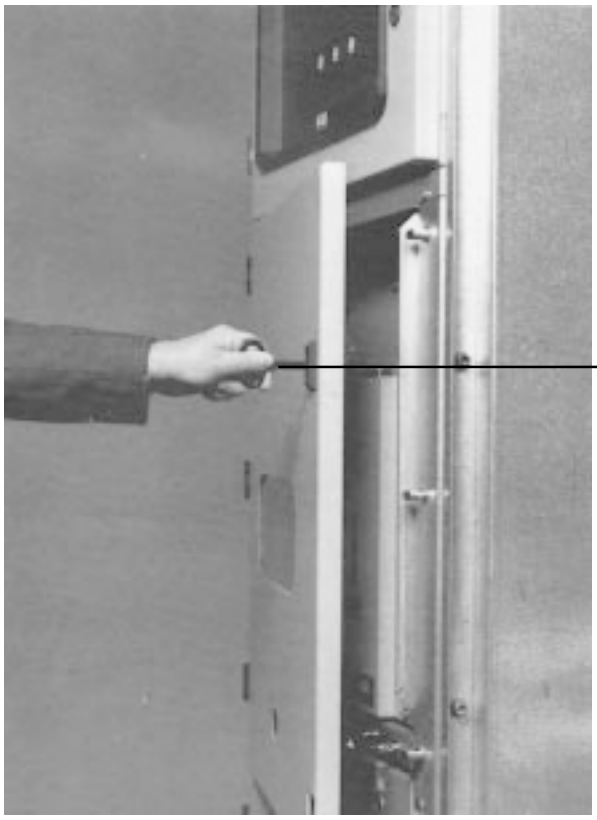


Figure 6/1: Operation of a door catch

1.6 Central catch of the high voltage compartment doors

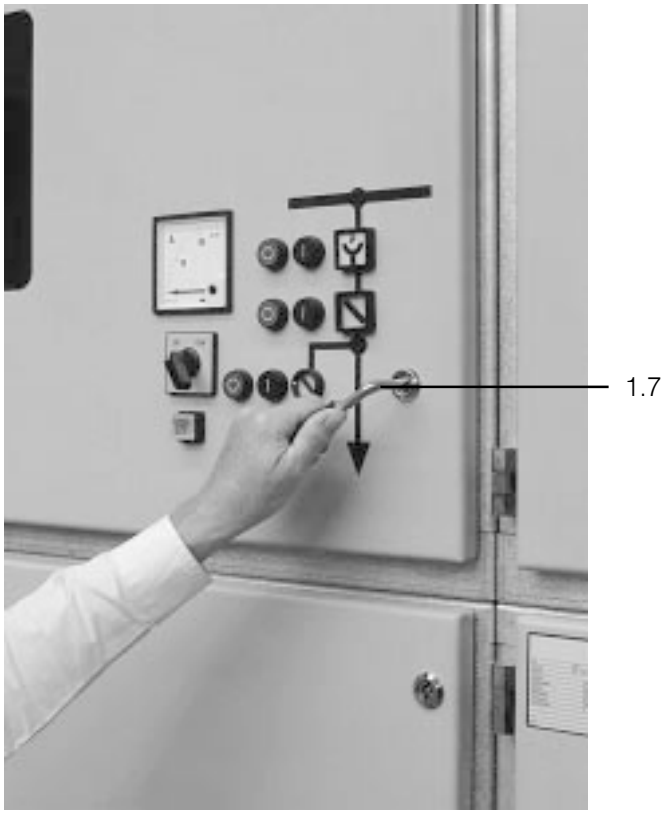


Figure 6/2: Operation of a door catch with the handle of the univeral key in the turning position

1.7 Door catch, 90° turn of the key to open or close a low-voltage compartment

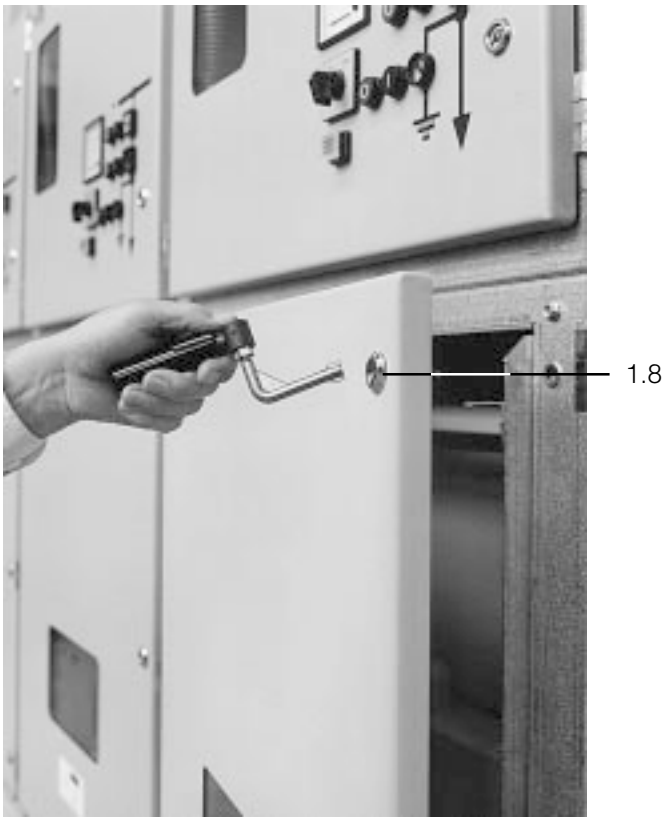


Figure 6/3: Operation of a screw-type door catch, with the handle of the univeral key in the crank position

1.8 Screw-type door catch, on the doors of the high-voltage compartments

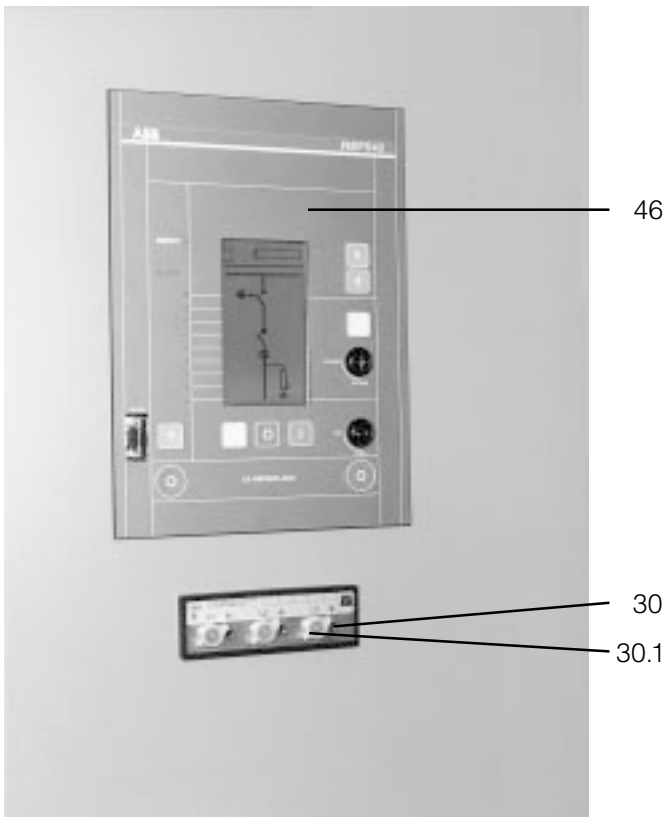


Figure 6/4: Operation and annunciation via digital control system

30 Measuring sockets (LRM-system)
30.1 Protection cover for measuring socket
46 Bay control and protection unit REF542

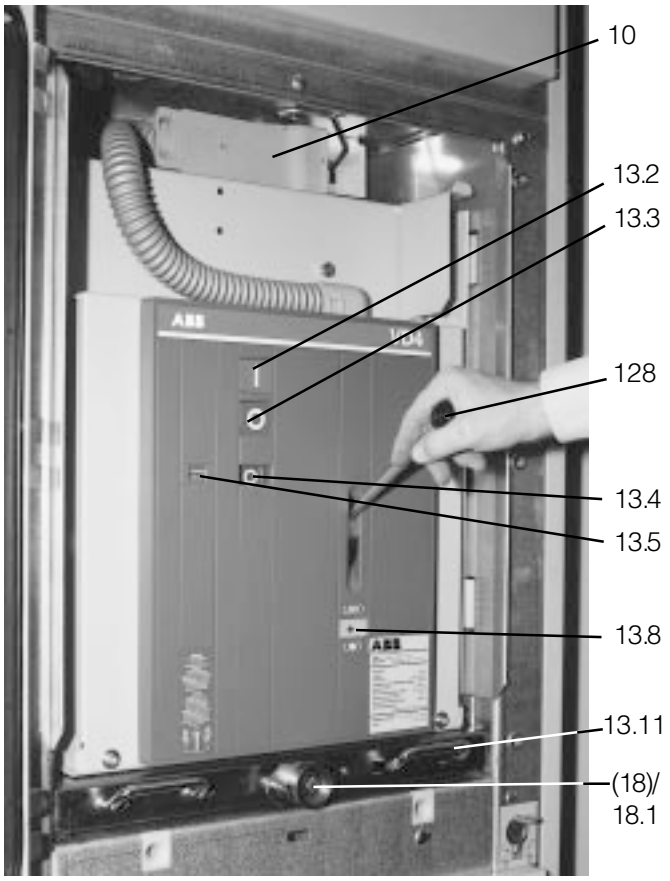


Figure 6/5: Manual operation and mechanical indicators of a circuit-breaker withdrawable part, vacuum circuit-breaker withdrawable part in test/disconnected position

10 Control wiring plug connection, closed
13.2 Mechanical ON push-button
13.3 Mechanical OFF push-button
13.4 Mechanical position indicator
13.5 Mechanical operating cycle counter
13.8 Charging condition indicator
13.11 Sliding handle, connected to the catch in the withdrawable part base frame
(18) Spindle mechanism
18.1 Square spigot
128 Charging lever

Figure 6/6: Movement of the withdrawable breaker part between the test/disconnected position and the service position, with approx. 20 turns of the crank, clockwise up to the stop for the service position and anti-clockwise for the test/disconnected position

13 Withdrawable breaker part
18 Spindle mechanism
121 Hand crank

Figure 6/7: Control wiring plug connector blocked to prevent disconnection with the withdrawable breaker part in the service position

10.1 Control wiring socket
10.2 Control wiring plug
32 Interlock

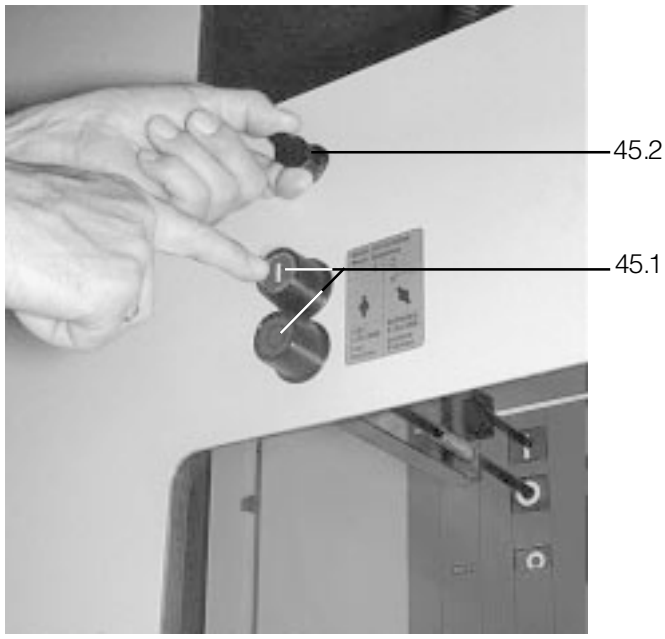


Figure 6/8: Handling of the mechanical circuit-breaker operation in the panel door (non-standard equipment) with the withdrawable part in the service position

45.1 Mechanical push-button
45.2 Knob

Figure 6/9: Service truck engaged with the panel. Withdrawable circuit-breaker part released for removal by moving the sliding handles inwards

13 Withdrawable circuit-breaker part
13.11 Sliding handle
124 Service truck (not included in supply)

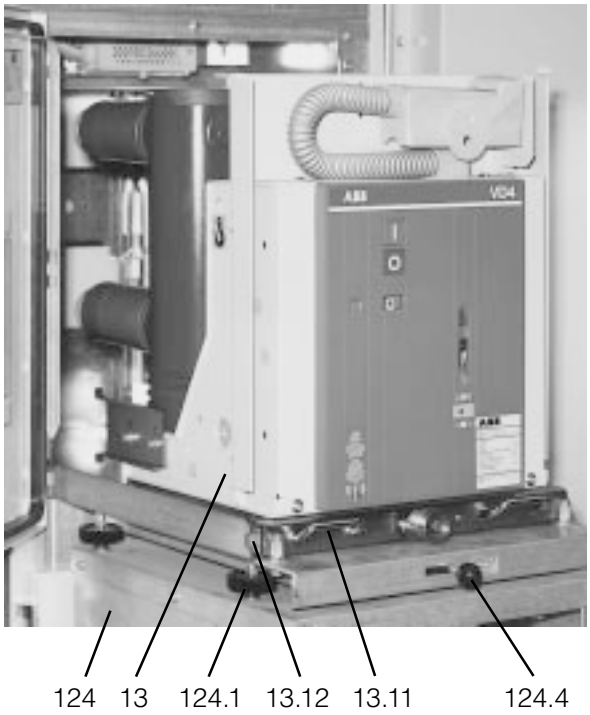


Figure 6/10: Withdrawable circuit-breaker part standing on service truck and secured in the catches

13 Withdrawable circuit-breaker part
13.11 Sliding handle
13.12 Catch (connected to sliding handle)
124 Service truck
124.1 Height adjuster for the bench top
124.4 Release lever for the catch 124.3

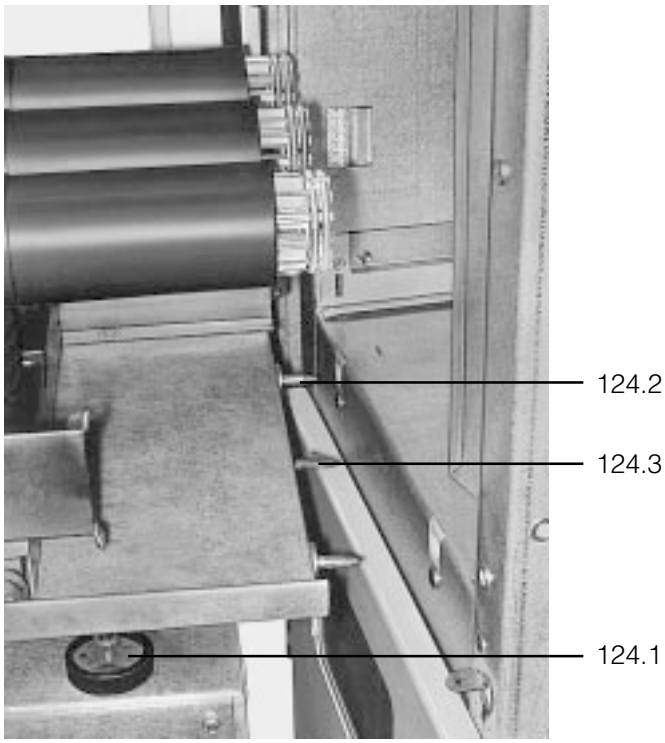


Figure 6/11: Approaching the panel and positioning the service truck with the guide pins of the adjustable height bench top at the correct height for the catch to engage

124.1 Height adjuster
124.2 Guide pin
124.3 Catch

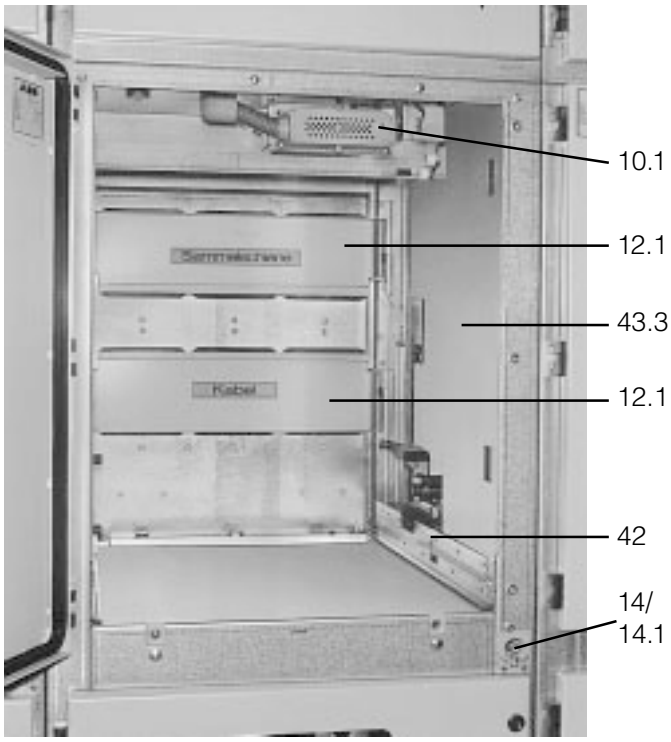


Figure 6/12: View into the circuit-breaker compartment

10.1 Control wiring socket
12.1 Shutter
14 Earthing switch mechanism
14.1 Operating shaft
42 Right-hand travel rail
43.3 Duct cover, top right

Figure 6/13: Preparation for operation of a switch-disconnector and/or integrated earthing switch

1.10 Slot cover, hinged and spring loaded
35.1 Switch-disconnector operating mechanism
35.2 Earthing switch operating mechanism
122 Operating lever

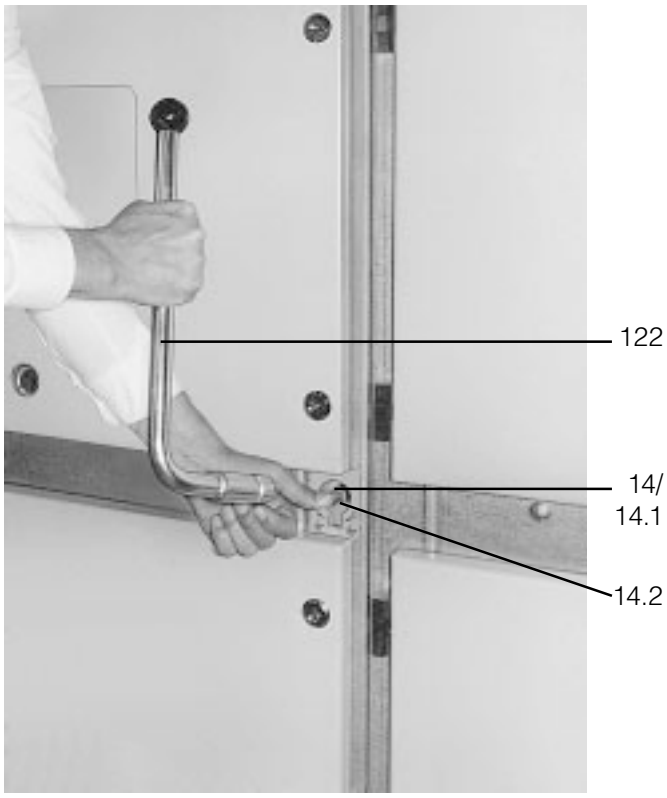


Figure 6/14: Preparation for operation of the earthing switch in a circuit-breaker panel

14 Manual operating mechanism for the earthing switch
14.1 Operating shaft
14.2 Slide
122 Operating lever

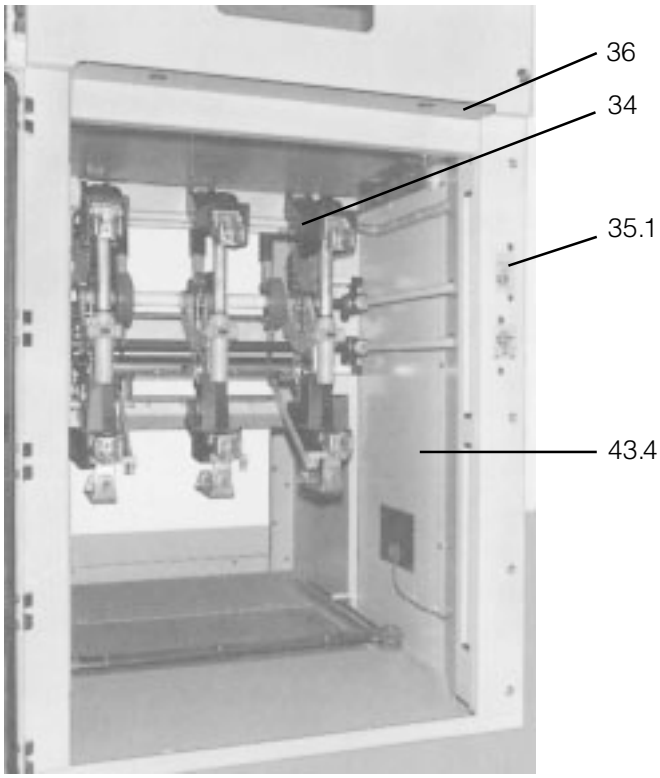


Figure 6/15: Panel with switch-disconnector and fuse assembly

34 Switch-disconnector
35.1 Switch-disconnector operating mechanism
36 Insulating protection plate
43.4 Duct cover for internal wiring

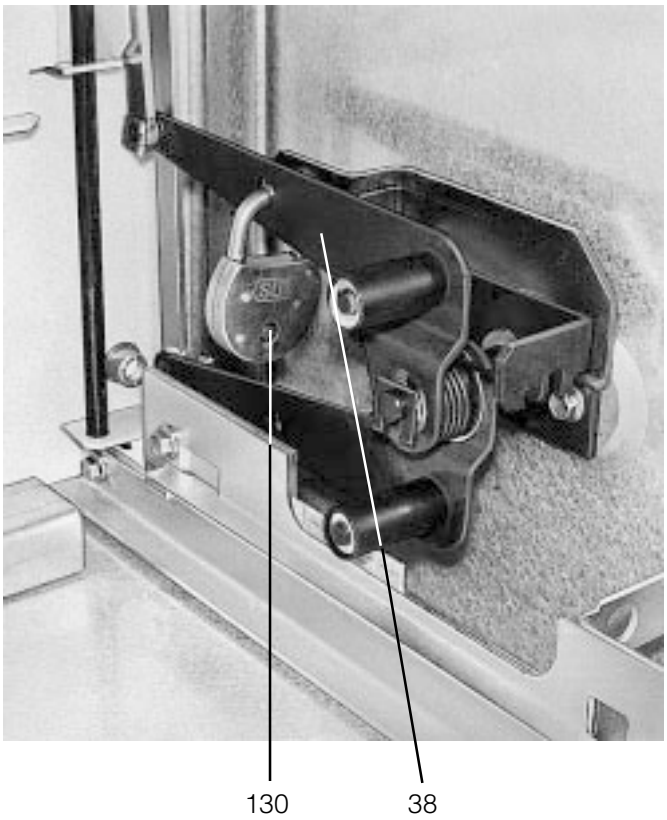


Figure 6/16: Lower shutter secured with padlock to prevent unauthorized operation

38 Lever for shutter operation
130 Padlock

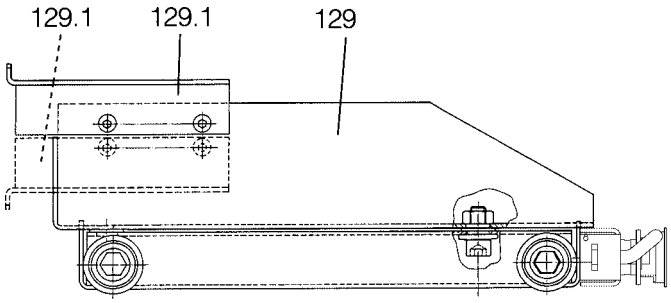


Figure 6/17: Shutter operating module, side view - actuating bars to be bolted on in the top position (for operation of the bottom shutter) or the bottom position (for operation of the top shutter) as required (example version).

129 Shutter operating module
129.1 Actuating bars (1 pair), removable

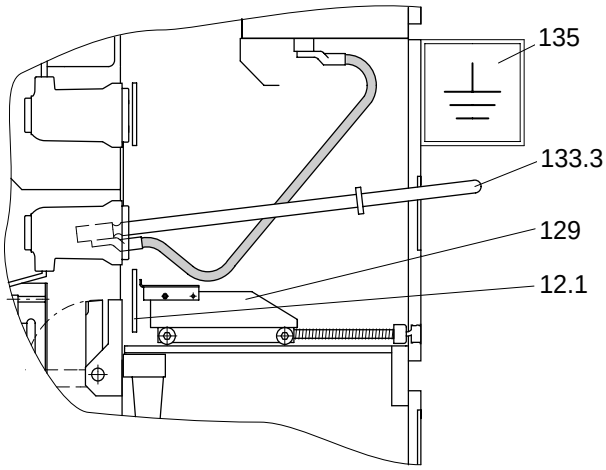


Figure 6/18: Earthing at the bottom contact pins in a 650 mm wide panel

12.1 Shutter
129 Shutter operating module
133.3 Insulating rod
135 Warning label

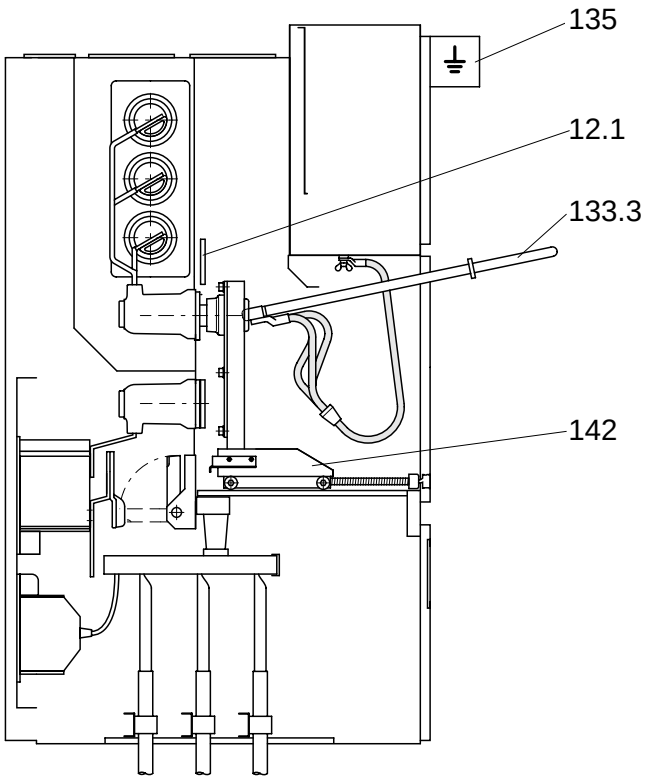


Figure 6/19: Earthing at the top contact pins in a 800 mm or 1000 mm wide panel

12.1 Shutter
142 Test / earthing module
133.3 Insulating rod
135 Warning label

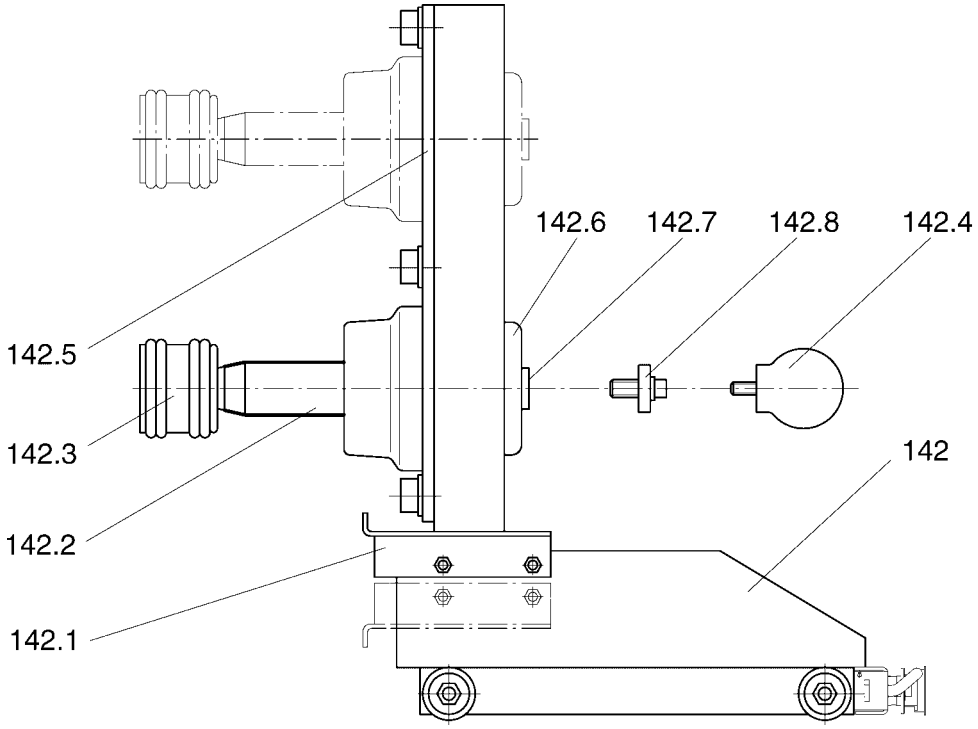


Figure 6/20: Testing and earthing module with:

- *Actuating bars, removable:*
  - *top position for bottom shutter*
  - *bottom position for top shutter*
- *Contact arm, removable:*
  - *bottom position for cable area*
  - *top position for busbar area*
- *Insulating plate, with alternating installation positions for cable or busbar earthing (for busbar earthing turn by 180°)*
- *Contact systems, exchangeable for different switchgear contact pin diameters*
- *Ball handle, removable, for voltage tests*
- *Short-circuit bridge, exchangeable for ball handles*

142 Testing and earthing module with manual operation
142.1 Actuating bar (1 pair)
142.2 Contact arm (3 pieces)
142.3 Contact system
142.4 Ball handle (3 pieces)
142.5 Insulating plate with 3 removable bushings
142.6 Bushing
142.7 Contact pin
142.8 Short-circuit bridge, complete

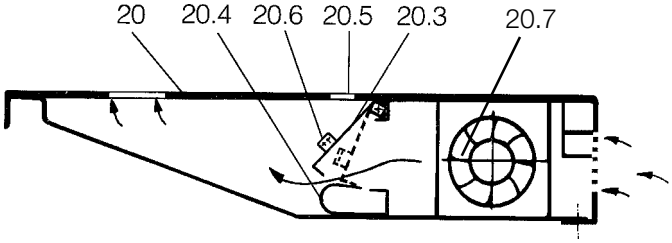


Figure 6/21: Fitting of the horizontal partition with additional ventilation for circuit-breakers due to increased ambient temperatures according to section 1.3. The internal flap is shown in the service position (open!). Side view, but without the wind vane with microswitch required with a fan

20 Horizontal partition, fitted here with additional ventilation facilities for the circuit-breaker
20.3 Flap
20.4 Leaf spring
20.5 Inspection opening
20.6 Bracket
20.7 Centrifugal fan

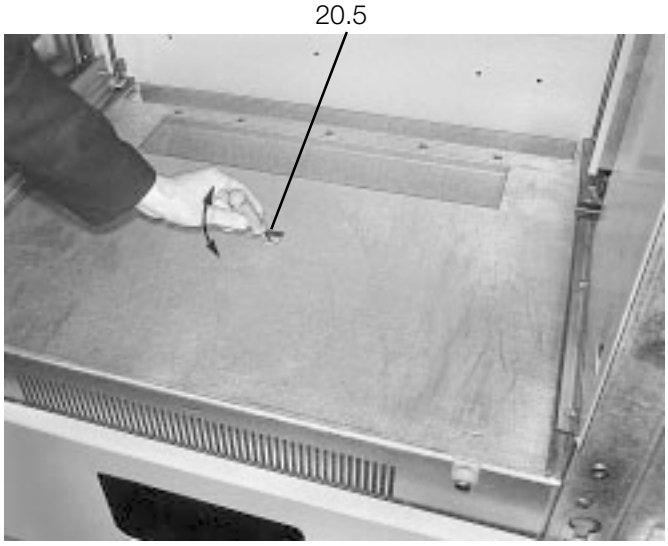


Figure 6/22: Horizontal partition with additional ventilation facilities checking of unimpedeed motion of the internal flap 20.3

20.5 Inspection opening

7 Maintenance

7.1 General

Maintenance serves to preserve trouble-free operation and achieve the longest possible working life of the switchgear. In accordance with DIN 31051 and/or IEC 61208, it comprises the following closely related activities:

Inspection: Determination of the actual condition

Servicing: Measures to maintain the specified condition

Repair: Measures to restore the specified condition.

Note:

In all repair work the regulations of the country where the equipment is installed must be strictly complied with.

In Germany, this refers, among other, to the following safety regulations and specifications:

- Accident prevention regulations VBG 1 and VBG 4
- VDE 0105 „Operation of electrical installations“

Maintenance work may only be performed in a careful manner by trained personnel familiar with the characteristics of the individual switchgear, in accordance with all relevant safety regulations according to DIN VDE/IEC and of other technical authorities, and with other overriding instructions. It is recommended that ABB service personnel be called in to perform servicing and repair work, and this is necessary for some of the work detailed below.

The inspection and servicing intervals for some of the equipment/components (e.g. replacement parts) are determined by fixed criteria such as switching frequency and number of short-circuit breaking operations. For other parts, on the other hand, the length of the intervals may depend, for example, on the different modes of operation in individual cases and the degree of loading.

The length of the intervals for inspection and servicing of the control cabinet and its equipment is influenced by ambient conditions (for instance pollution and aggresive atmosphere).

The following operating instructions must also be observed together with this instruction manual in the individual cases concerned:

- Vacuum circuit-breaker, type VD4 — BA 352/E
- Vacuum circuit-breaker, type VD4 E — BA 377/E
- Vacuum circuit-breaker, type VD4, High-current — BA 359/E
- Earthing switch, type EK6 — BA 304/E
- Switch-disconnector, type C3 — BA 275/E

If necessary, further details can be taken from the technical documentation for the switchgear (including, for example, any agreed special operating conditions).

7.2 Inspection

- Before inspection, where required, the working area must be isolated and secured against reconnection in accordance with the „Safety Regulations“ specified by DIN VDE/IEC.
- Proper condition of the switchgear should be monitored by regular inspections.
- Under normal operating conditions, inspection should be conducted once every four years by specially trained professional electricians.
- Under unusual operating conditions (including adverse climatic conditions) and/or peculiar environmental stresses (among other strong pollution and aggressive atmosphere), inspection may be necessary at shorter intervals.
- Inspection is primarily to constitute a visual check for grime, corrosion and moisture:
  - Effects of high temperature on the main circuits,
  - Traces of partial discharge on the insulating material parts,
  - Traces of leakage current on the insulating material parts,
  - Surfaces of the contact systems.
- However, inspection is also to include the proper mechanical/electrical function of the following facilities: switching devices, actuating, interlocking, protection and signalling facilities.
- On panels with additional ventilation devices due to increased ambient temperature (see also section 1.3):
  1. Check flap 20.3 for correct function. (See also section 6.1.1 and figures 6/21 and 6/22.)
  2. The centrifugal fan (if fitted) doesn’t require any special maintenance. Its working life, depending on the service conditions - one significant parameter being the room temperature - is approx. 20,000 to 30,000 operating hours.

Checking of the readiness for operation can be carried out as follows:

a) Load-dependent functional test with controllable primary current injection of the relevant instrument transformer. At current rise:

   1. to approx. 70% of the rated instrument transformer current, the fan must start,

      and

   2. to 80 % of the rated instrument transformer current, the fan must have reached the required minimum air flow. Corresponding monitoring/signalling by the wind vane with microswitch.

b) Basic checking with temporary operation of the centrifugal fan with an external power supply of 220 V AC.

c) In both cases, check for unimpeded normal running of the fan and listen for any unusual bearing noise. Remove any dirt on the fan rotor.

d) Check the unimpeded function of the wind vane and microswitch by starting the fan several times.

e) The wiring to the removable horizontal partition 20 can be disconnected behind the right-hand side duct cover 43.4 (figure 3/13). Observe the circuit diagram and carefully reconnect the wiring on completion.

   Caution: instrument transformer circuit.

- With regard to the switching devices, their separate Instruction manual should be observed.
- Check all switchgear accessories and auxiliary facilities (e.g. storage batteries).
- No external discharge may occur on the surfaces of equipment at operating voltage. This can, for example, be detected by characteristic noises, a clearly perceptible smell of ozone, or visible glowing in the dark.
- Visual checking of the contact system. We recommend to turn alternately the contact system in order to clean the inner contact points of the contact system.

  The contact points should be cleaned if signs of unperminable overheating (discoloured surface) are visible (see section 7.4).
- If irregular conditions are detected, then corresponding repair measures should be initiated.

7.3 Servicing

If, on the occasion of an inspection in accordance with 7.2, the necessity of cleaning measures has been established, proceed as follows:

- Before cleaning, where required, the working area must be switched off and secured against reconnection in accordance with the „Safety Regulations“ specified by DIN VDE/IEC.
- Cleaning the surfaces in general:
  - Weakly adhering dry dust deposits with a soft dry cloth.
  - More strongly adhering grime with mildly alkaline household cleanser or with Rivolta BWR 210.
- Cleaning insulating surfaces and conductive components:
  - Minor pollution with Rivolta BWR 210.
  - Strongly adhering pollution with Cold cleanser 716.
- Observe the manufacturers’ directions and in particular ABB Instruction manual BA 1002/E and BA 1006/E on safety at work.
- Wipe down after cleaning, using clean water, and dry properly.
- Should external discharges occur as a result of condensation, application of a thin silicone film on the surface concerned is often effective as a temporary remedy. It is advisable to request advice from the ABB after-sales service department on permanent solutions to such unusual problems.

7.4 Repair

7.4.1 Switchgear in general

Repair of surface damage:

- Carry out repair work immediately after a defect has been discovered.
- Completely remove all rust from damaged paintwork areas on steel sheet and other steel parts by mechanical means, e.g. with a wire brush.

  Lightly grind the surrounding paint coat and carefully degrease the entire area. Then immediately apply an anti-rust primer and, after an appropriate hardening time, apply the top coat. Only use suitable and compatible paint products.

  Apply the top coat in standard colour RAL 7035, or the relevant special colour.

- Carefully remove any white rust on aluminium/ zinc surfaces with a wire brush or cleaning pad, e.g. Scotch-Brite, and clean loosely adhering particles with a dry, non-fraying cloth. Next treat the cleaned parts with zinc spray or zinc dust paint and, finally, treat with aluminium spray for colour matching.
- Carefully remove any white rust from passivated functioning parts and rust formation on phosphatised parts with a wire brush or metal-free cleaning pad, e.g. Scotch-Brite, and clean with a dry cloth. Then grease evenly (with Isoflex Topas NB 52).

Switchgear in general:

- Observe the maintenance instructions in the manuals for the individual equipment components.
- Check that the bolt connections at the contact points in the busbar system and the earth connections are tight, and that the contact system functions correctly.
- Where required, regrease or thoroughly clean slide plates and bearings in the panel and regrease them with Isoflex NB 52 lubricant.
- Top up grease on contact areas in the contact system when corroded or otherwise as necessary, or, when lubrication is inadequate or missing, thoroughly clean the areas concerned and regrease with Isoflex Topas NB 52 lubricant.
- Remove the contact system for thoroughly cleaning as described below (Figures 7/1 to 7/3):
  - Slide the two inner annular tension springs 4.4 facing the breaker pole to a position beside the other two outer annual tension springs, thus releasing contact system 4.3, and remove the contact system from contact arm 4.2.
  - The contact pin of the contact system and the slot on the contact arm are to be cleaned and greased.. Fit contact system back to front on the thin end of arbor 127 or 127.2, and slide it forwards onto the thicker part of the shank.
  - Fit arbor 127 or 127.2 onto the relevant contact arm 4.2, slide the contact system 4.3 over onto the contact arm, and withdraw the arbor.
  - Check all contact fingers and annular tension springs for perfect fit.

  Note:

  The set installation position of contact arms 4.2 must not be changed by the improper use of force.

Replacement of the contact pins when the surface is damaged:

(Figure 3/19)

After any required replacement of contact pins 4.1, the latter should be retightened using the socket head bolts.

Thread	Rated tightening torque ungreased
M 10	46 Nm
M 20	250 Nm

7.4.2 Replacement of complex functional groups

(Figures 6/6 and 7/4 to 7/10)

The precise matching of functions for control, interlocking and signalling only permits the replacement of individual components to a limited extent.

The following assemblies are prefabricated and tested at the works, maintaining high quality standards. In the case of faults, they are therefore to be completely replaced.

1. Withdrawable assembly:
   - Disconnect plug connector 10.3,
   - Remove interlock rod 13.91 with pin 13.27 from the withdrawable assembly.
   - For motor-operated withdrawable assemblies, remove the two socket head bolts (M4) which are accessible from below the assembly.
   - Remove the circuit-breaker from the withdrawable assembly (4 x M12 bolts).
   - Mount the circuit-breaker on a new withdrawable assembly in the reverse order, using new circlip and special pliers for pin 13.27.
   - Check the setting of interlocking rod 13.91:
     - Turn spindle 18 anti-clockwise to the stop for the disconnected position:

       The distance between lever 13.26 and cam 13.25 must be 2^{+1} mm.

       The distance between roller 13.24 and angle lever 13.92 must be 0.5 mm.
     - Turn spindle 18 clockwise to the stop for the service position:

       The distance between lever 13.26 and cam 13.25 must be 2^{+1} mm.

       The distance between roller 13.24 and angle lever 13.92 must be 0.5 mm.
     - Loosen bolts 13.91.2 or 13.92.1 for any necessary adjustment.

2. Motor-operated mechanism for the earthing switch:

   - Disconnect the terminals.
   - Loosen the grub-screw in the set collars.
   - Withdraw operating shaft 14.1.

     Observe the position of blocking disc 14.6 relative to cam 14.7!
   - Replace the motor-operated mechanism.
   - Slide the operating shaft through from the front.

     Observe the position of blocking disc 14.6 relative to cam 14.7!
   - Tighten the grub-screw in the set collars.
   - Connect the control wiring.
   - Set the operating mechanism manually in an intermediate position and only then perform a test run to determine the direction of rotation.

     Ensure that the motor shuts down correctly in the final positions!

Note:

The auxiliary switches of the interchangeable groups are adjusted at works.

When the final installation of the earthing switch and drive takes place on site, it may be necessary to undertake a further exact adjustment of the auxiliary switch. In this case, the following should be taken into account:

- There must be a run-on of 0.5 mm in the fully operated position before the plunger reaches the stop (for safety reasons).
- Limit auxiliary switch 11.4 for earthing switch ON must be operated immediately after the dead centre position of the toggle spring mechanism is reached in the closing process and the automatic quick-closing process has started.
- Limit auxiliary switch 11.3 for earthing switch OFF must

  a) be operated on earthing switches with manual mechanisms during the opening motion of the slide 14.2 before half of the hexagon shaft has become visible, or 1 mm before the tongue of the slide makes contact with the armature of the unexcited blocking magnet.

  b) be operated on earthing switches with motor-operated mechanisms (no slide 14.2 then fitted) immediately after the toggle spring mechanism has passed the dead centre position during rotation to the OFF position.

7.5 Testing withdrawable parts with a VD4 type circuit-breaker

(Figures 7/4 to 7/7)

When functional tests are carried out on withdrawable parts, compliance with the conditions listed below should also be checked.

7.5.1 Motor-driven withdrawable parts

(not standard)

Carry out testing of motor-driven withdrawable parts in the same way as for manually operated withdrawable part:

- Switch off the auxiliary power (m.c.b.), since the motor could otherwise be braked electrically.
- Turn hand crank 121 in the required direction.
- Ensure that the spindle nut is correctly lubricated.

Note:

When the withdrawable part moves, the motor turns. The motor functions in such a case like a generator, i.e. it can lead to reverse voltages in the terminals.

7.5.2 Checking the correctness of dimensional settings

(Figures 7/4, 7/9 and 7/10)

1. The distance between lever 13.26 operated by link rod 13.91 and plastic cam 13.25 should be **2^{+1} mm**.

   If adjustment is required, loose the two bolts 13.91.1 and 13.91.2. Deviations from the specified value can have the following effects:

   - Dimensions too large, blocking system for the drive spindle deactivated.
   - Dimensions too small, proper action of the electrical interlock no longer guaranteed.

2. The distance between roller 13.24 and angle lever 13.92 should be **0.5 mm** when the circuit-breaker is closed.

   If adjustment is required, loose the two bolts 13.91.2 and 13.92.1.

7.5.3 Checking auxiliary switch settings on withdrawable parts

(Figures 3/21, 7/4 and 7/6)

Compliance with the interlock conditions in the test/disconnected and service position areas is ensured by position signalling switches S8 and S9 located in the withdrawable assembly and factory-set.

In test operations, the withdrawable part must be moved by hand with the crank fitted with the motor power switched off.

1. Settings in the area of the test/disconnected position:

   - Move the withdrawable part out of the test/ disconnected position towards the service position with a few turns of the crank.
   - Slowly move the withdrawable part back to the stop.

     Auxiliary switch S8 must then switch over just before the stop is reached.
   - Slowly insert the withdrawable part from the test/disconnected position towards the service position until auxiliary switch S8 just operates.

     In this position, it must still just be possible to move closing push rod 13.2.1. For this test, the function of the blocking magnet Y0 must be deactivated manually.

     This condition ensures that the electrical interlock takes effect before the mechanical interlock in the motion sequence involved.

2. Settings in the area of the service position:

   - Move the withdrawable part out of the limit position towards the test/disconnected position with a few turns of the crank.
   - Slowly move the withdrawable part forwards again to the stop.

     Auxiliary switch S9 must then switch over just before the stop is reached.

7.5.4 Checking the direction of rotation of the travel motors on motor-driven withdrawable parts

- Move the withdrawable part by hand into a central position between the test/disconnected position and the service position.
- Remove the hand crank.
- Switch the auxiliary voltage for the travel motor on.
- Use the local electrical controls to check that the withdrawable part moves in the correct direction.

Caution:

Do not allow the withdrawable part to run up against a block when the travel direction is incorrect! Switch the motor voltage off immediately (the travel process functions electrically by a seal-in system with limit position switch-off).

There may be a danger of injury when the door is open!

7.5.5 Testing of interlock conditions

(Figures 3/8, 3/21, 6/5 to 6/7, 7/6 and 7/7)

1. The withdrawable part must only be movable from the test/disconnected position into the service position when the circuit-breaker is open and the earthing switch is open.

   Check the following conditions individually:

   - With the circuit-breaker closed, insertion of the withdrawable part towards the service position must be blocked after only half a turn of the crank in the clockwise direction, and the travel motor on motor-operated withdrawable parts must not be capable of being switched on.
   - With the earthing switch closed, insertion of the withdrawable part towards the service position must be blocked after only two clockwise turns of the crank, and the travel motor on motor-operated parts must not be capable of being switched on.

     Use no force!

2. The withdrawable part must only be movable from the service position into the test/disconnected position with the circuit-breaker open.

   Check this condition as follows:

   - With the circuit-breaker closed, withdrawal movement of the withdrawable part must be blocked after only half a turn of the crank in anti-clockwise direction, and the travel motor on motor-operated withdrawable parts must not be capable of being switched on.

3. Closing of the circuit-breaker must only be possible when the withdrawable part is in the defined test/disconnected position or service position.

   The control wiring plug 10.2 must previously have been inserted.

   Check this condition as follows:

   - It must not be possible to close the circuit-breaker with the withdrawable part in any position between the test/disconnected position and the service position.

     Enabling of switching when the withdrawable part moves into the service position is effected electrically by operation of auxiliary switch S9 in the withdrawable assembly, and mechanically slightly earlier; the latter corresponds to a position approximately half a turn of the crank before stop.
   - For motion into the test/disconnected position, the same enabling conditions apply analogously, in this case by means of auxiliary switch S8 in the withdrawably assembly.

4. It must only be possible to open the circuit-breaker (manually) when the withdrawable part is in the service position or test/disconnected position and the control voltage has failed.

   Check this condition.

5. Withdrawable parts with order-related blocking magnet Y0 may not be moved in case of control voltage failure, or when there is no control voltage. Do not forcibly move blocked withdrawable parts! The blocking magnet Y0 is only present on manually operated withdrawable parts.

Releasing the blocking magnet Y0:

- Remove front plate 13.17,
- Disengage blocking magnet Y0 by pulling the magnet armature,
- While doing so, turn crank 121 about one half turn (either direction of rotation is permissible).

  The blocking magnet is only active in the test position and service position. In intermediate positions it has no effect.

6. Disconnection of the control wiring plug 10.2 as well as later insertion must be blocked in the withdrawable part's service position.

   Check this condition:

7. Operation of the earthing switch must only be possible when withdrawable part 13 is in the test/disconnected position or the removed position (subject to any additional electro-magnetic interlocks in individual cases!).

   Check this condition:

   - With the withdrawable part in the test/ disconnected position, it must be possible to press slide 14.2 in front of the earthing switch operating shaft 14.1 downwards to the opening position. The earthing switch can then be operated.
   - With the slide pressed down, it must also be impossible to start the travel motor on motor-driven withdrawable parts.
   - If the slide is pressed down slightly when the travel motor is running, the motor must then automatically switch off immediately.

     The selected travel direction is continued by pressing the button.

     It is only possible to press slide 14.2 down fully with a running travel motor when the latter is in the start-up phase.
   - When the withdrawable part is moved inwards towards the service position, pressing down of the slide 14.2 must be blocked after only one and a half clockwise turns on the crank.

7.6 Tests on the panel

7.6.1 Auxiliary switch settings on the earthing switch

(Figures 7/7 and 7/8)

1. There must be a run-on of **0.5 mm** in the fully operated position before the plunger reaches the stop (for safety reasons).
2. Limit auxiliary switch 11.4 for earthing switch ON must be operated immediately after the dead centre position of the toggle spring mechanism is reached in the closing process and the automatic quick-closing process has started.
3. Limit auxiliary switch 11.3 for earthing switch OFF must

   a) be operated on earthing switches with manual mechanisms during the opening motion of the slide 14.2 before half of the hexagon shaft has become visible, or **1 mm** before the tongue of the slide makes contact with the armature of the unexcited blocking magnet.

   b) be operated on earthing switches with motor-operated mechanisms (no slide 14.2 then fitted) immediately after the toggle spring mechanism has passed the dead centre position during rotation to the OFF position.

   Note:

   Check the direction of rotation of the motor after repair work.

   Do not allow the motor to run up against a block if the direction of rotation is incorrect (see also section 7.5.4).

7.7 Spare parts, auxiliary materials, lubricants

7.7.1 Spare parts

A spare parts list is available on request for procurement of spare parts. It fundamentally comprises moving parts and parts subject to wear. When parts are required, the serial number of the relevant switchgear or switching device should always be quoted.

7.7.2 Auxiliary materials, lubricants

	Part no. (order ref.)
Lubricant:	
• Isoflex Topas NB 52	GCE0007249P0100
Halogen-free cleansers:	
• Rivolta BWR 210 (for general cleaning)	GCE0007707P0100
Corresponding ABB operating instructions BA 1002/E	GCEA901002P0102
• Cold cleanser 716 (for use with conductive components, components of insulating materials and in case of serious grime!)	GCE0007706P0100
Corresponding ABB operating instructions BA 1006/E	GCEA901006P0102
Touch-up paint:	
Standard colour RAL 7035	
• 1kg-box	GCE9014060R0103
• Spray tin	GCE0007895P0100

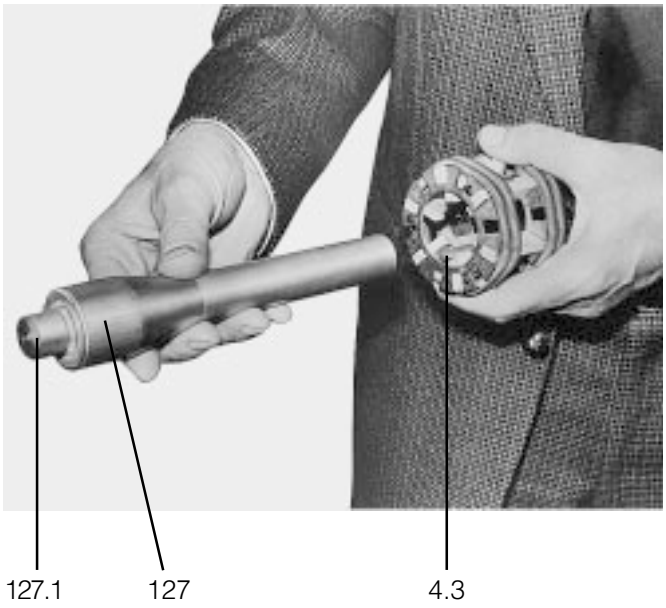


Figure 7/1: Fit the contact system back-to-front on the thin end of the arbor and slide it onto the thicker shank area

4.3 Contact system
127 Arbor
127.1 Journal

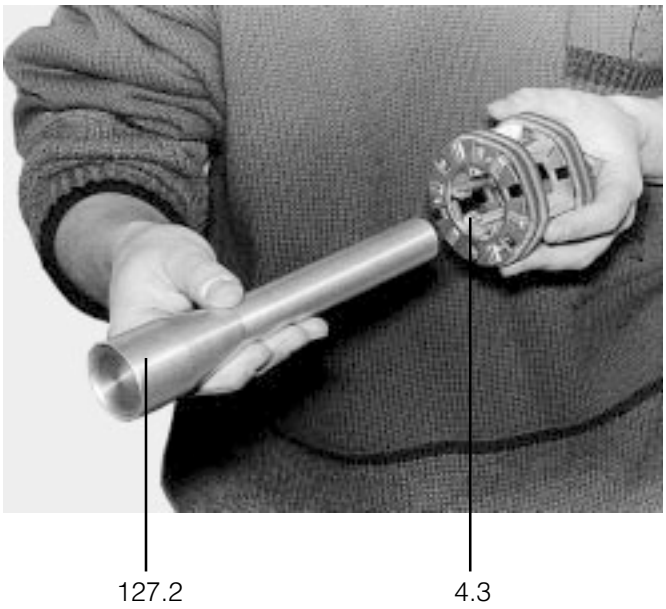


Figure 7/2: Preparation for assembly of the VD4 E contact system. Handling as described in figure 7/1

4.3 Contact system
127.2 Arbor for VD4 E

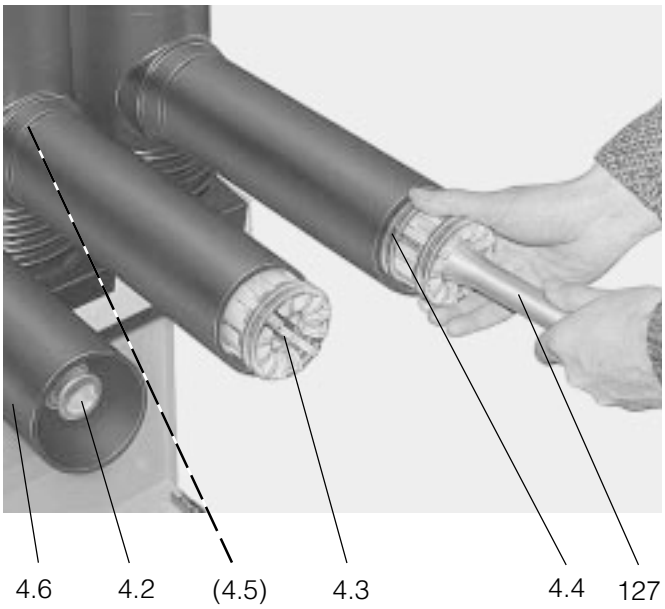


Figure 7/3: Slide the contact system over from the arbor onto the contact arm and allow it to engage there

4.2 Contact arm
4.3 Contact system
4.4 Internal tension springs
(4.5) Socket head bolt
4.6 Insulating sleeve
127 Arbor

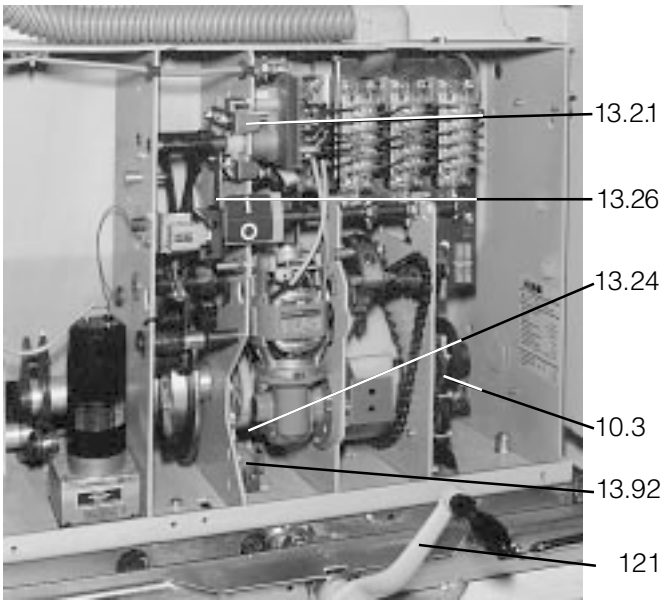


Figure 7/4: Motor-driven withdrawable part in an intermediate position close to the test/disconnected position, with fitted crank for manual operation and breaker front plate removed

10.3 Control wiring plug connector for withdrawable assembly
13.2.1 ON push rod
13.24 Roller
13.26 Lever
13.92 Angle lever
121 Hand crank

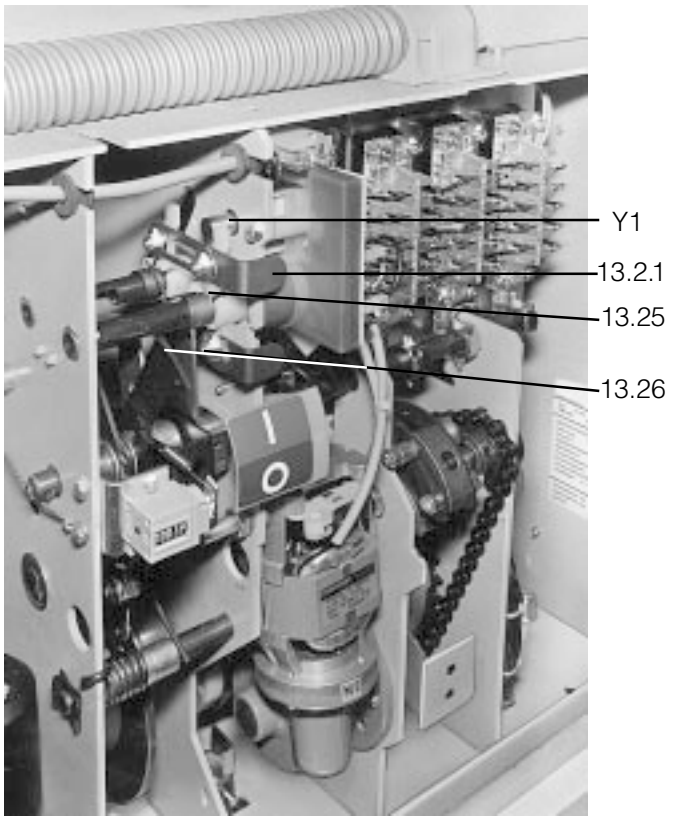


Figure 7/5: Detailed view of the opening and closing mechanism

13.2.1 ON push rod
13.25 Plastic cam
13.26 Lever
Y1 Closing blocking magnet

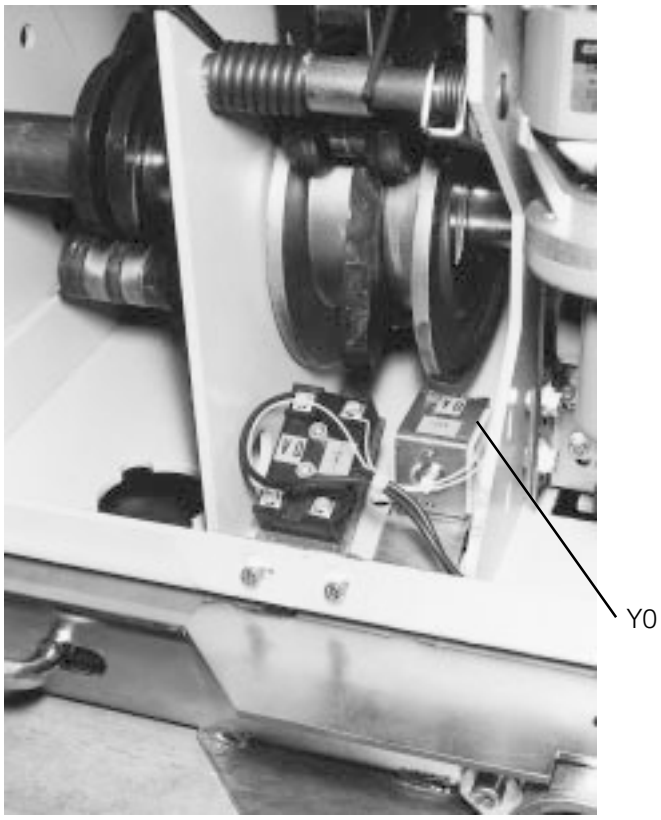


Figure 7/6: Manually moveable withdrawable part, front plate removed

Y0 Blocking magnet for withdrawable part

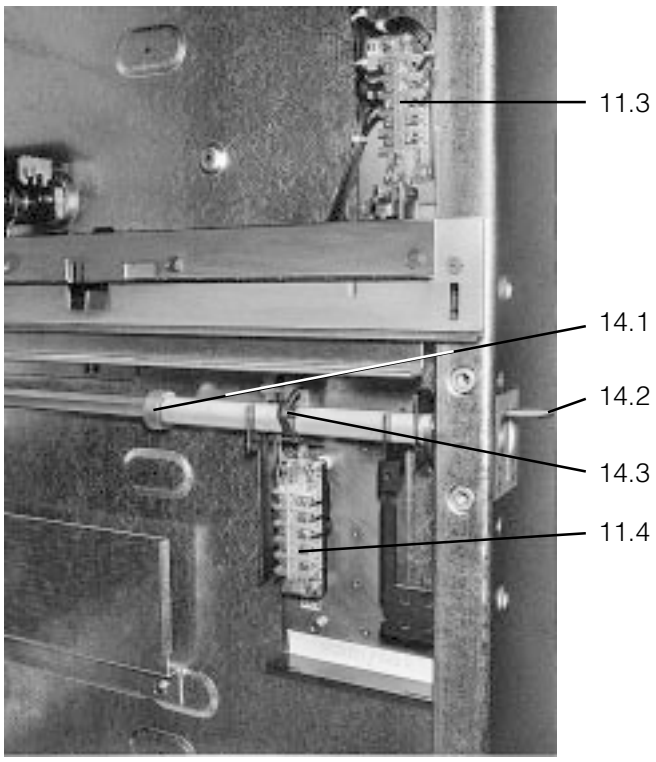


Figure 7/7: Manual earthing switch mechanism with auxiliary switches

11.3 Auxiliary switch Q8S1, earthing switch OFF
11.4 Auxiliary switch Q8S2, earthing witch ON
14.1 Operating shaft (earthing switch)
14.2 Slide
14.3 Cam plate, adjustable

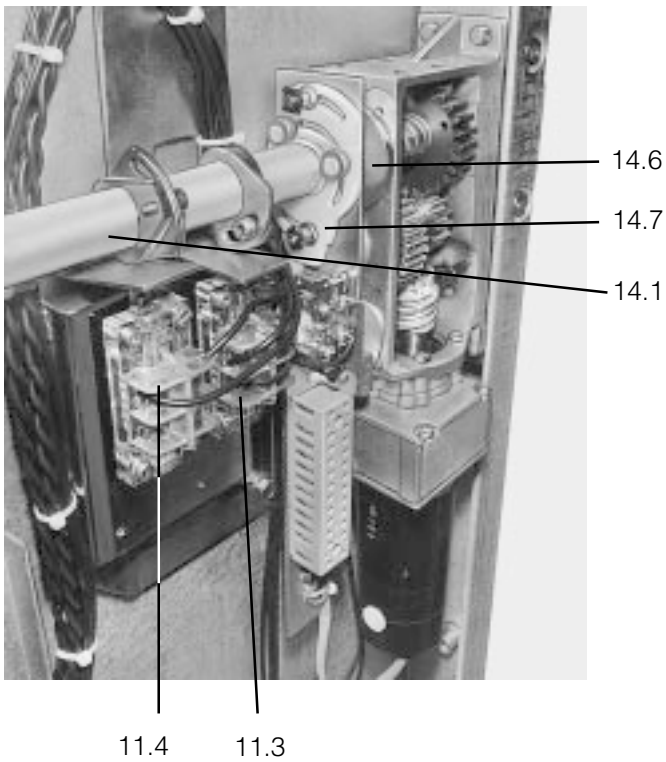


Figure 7/8: Motor-operated earthing switch mechanism with auxiliary switches as installed, covers removed

11.3 Auxiliary switch Q8S1, earthing switch OFF
11.4 Auxiliary switch Q8S2, earthing switch ON
14.1 Operating shaft
14.6 Blocking disc
14.7 Cam

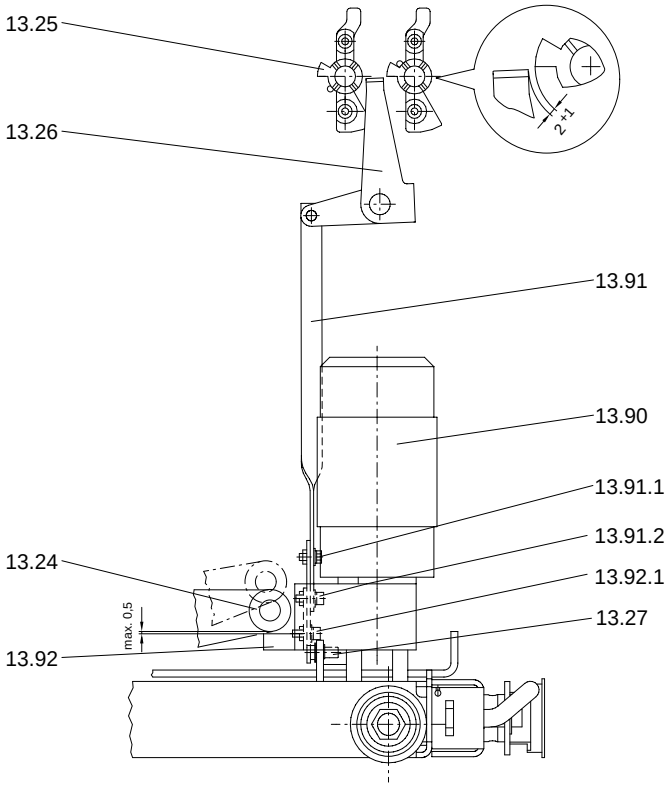


Figure 7/9: Detail in the area of a withdrawable part with travel motor, viewed from the left-hand side

13.24	*Roller*
13.25	*Cam*
13.26	*Lever*
13.27	*Pin*
13.90	*Travel motor*
13.91	*Link rod*
13.91.1	*Bolt*
13.91.2	*Bolt*
13.92	*Angle lever*
13.92.1	*Bolt*

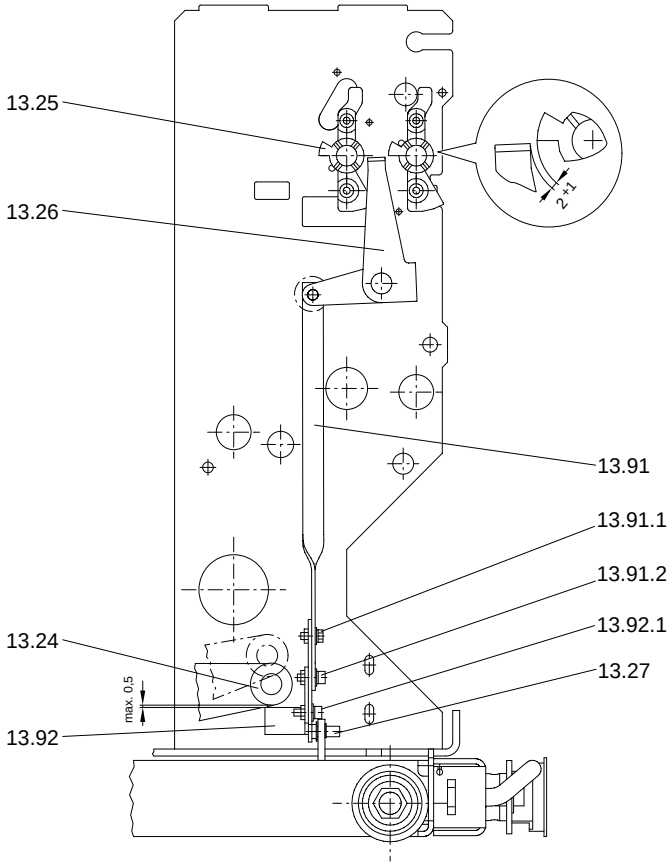


Figure 7/10: Mechanical interlock, lock and release device/circuit-breaker with manually operated withdrawable parts

13.24	*Roller*
13.25	*Cam*
13.26	*Lever*
13.27	*Pin*
13.91	*Link rod*
13.91.1	*Bolt*
13.91.2	*Bolt*
13.92	*Angle lever*
13.92.1	*Bolt*

Instruction manual **no. GCEA 68 0372 P0102** Printed in Germany (03.01-250-PPI) We reserve the right to make changes in the course of technical development.

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