SIEMENS

Medium-Voltage Switchgear

Type 8DA Extendable Fixed-Mounted Circuit-Breaker Switchgear up to 40.5 kV,

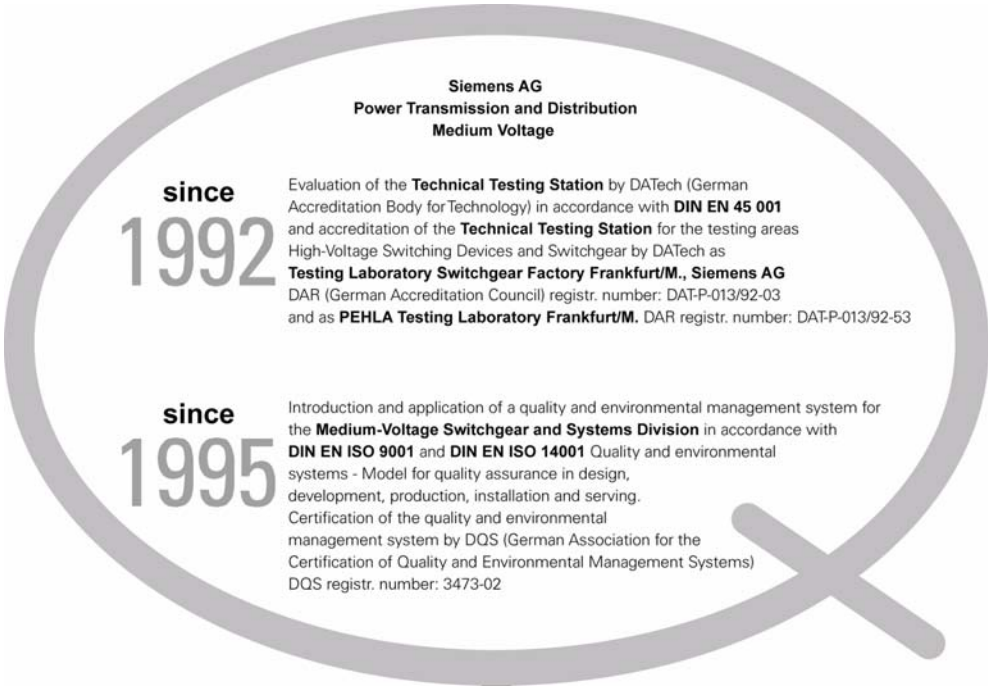
Single Busbar, Single-Pole Metal-Enclosed, Gas-Insulated



Medium-Voltage Switchgear

INSTALLATION AND OPERATING INSTRUCTIONS

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About these Instructions

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation or operation.

Should further information be desired or should particular problems arise which are not covered sufficently by these instructions, the matter should be referred to the competent Siemens department.

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Subject to changes.

Contents

Safety instructions 5

1 Signal terms and definitions 5

2 General instructions 5

3 Due application 6

4 Qualified personnel 6

Description 7

5 Application and typical uses 7

6 Features 7

7 Type classification 8

8 Circuit-breaker panel 9

8.1 Function 9

8.2 Frame 9

8.3 Low-voltage compartment 9

8.4 Switchpanel pole 9

8.5 Switchpanel 10

9 Circuit-breaker 11

9.1 Design 11

9.2 Operating mechanism box 13

10 Three-position disconnector 14

11 Current and voltage transformers 16

11.1 Voltage transformers 16

11.2 Current transformers 16

12 Gas compartments 17

13 Panel connections 18

13.1 Overview 18

13.2 Panel connection types 18

14 Technical data 20

14.1 Electrical data 20

14.2 Three-position disconnector 20

14.3 Vacuum circuit-breaker 21

14.4 Insulating gas SF6 23

14.5 Classification of 8DA switchgear according to IEC 62 271-200 26

14.6 Standards, specifications, guidelines 26

14.7 Phase sequence 28

14.8 Center of gravity 29

14.9 Gas leakage rate 29

14.10 Rating plates 30

15 Accessories 31

15.1 Standard accessories 31

15.2 Other accessories 32

Installation 33

16 Before installation 33

16.1 Preliminary clarifications 33

16.2 Switchgear room 33

16.3 Installation dimensions and floor fixing 34

16.4 Intermediate storage 37

16.5 Tools/auxiliary means 39

16.6 Installation and fixing material 39

17 Unloading and erecting the transport units 40

17.1 Packing and transport unit 40

17.2 Checking the delivery for completeness and transport damage 40

17.3 Checking the SF6 gas pressure 41

17.4 Unloading transport units 42

17.5 Transporting the units to the place of installation 44

17.6 Setting down the transport units at the place of installation 46

17.7 Aligning the switchgear 49

18 Assembling the switchgear 50

18.1 Preparing busbar assembly 51

18.2 Installing the transport unit 55

18.3 Installing further transport units 58

18.4 Completing switchgear installation 58

19 Installation work with SF6 gas before commissioning 62

19.1 Completing busbar assembly and filling with SF6 gas 62

19.2 Assembling panel connections supplied separately, and filling circuit-breaker housings with SF6 gas 66

19.3 Installing solid-insulated bars at the panel connection, and filling the circuit-breaker housings with SF6 gas 70

20 Performing the power-frequency voltage test 71

21 Installing voltage transformers 73

21.1 Installation of voltage transformers type 4MT3 74

21.2 Installation of voltage transformers type 4MU4 79

21.3 Installation of voltage transformers type 4MT7 82

22 Removal and installation of voltage transformers ... 86
22.1 Removal of voltage transformers type 4MT3 ... 87
22.2 Removal of voltage transformers type 4MU4 ... 89
22.3 Removal of voltage transformers type 4MT7 ... 91
23 Final installation work ... 93
23.1 Mounting cables with plugs ... 93
23.2 Connecting low-voltage cables ... 93
23.3 Mounting the metal covers ... 93
24 Tests ... 94
24.1 Checking the SF6 gas filling ... 94
24.2 Checking the circuits of the low-voltage equipment ... 95
24.3 Checking high-voltage connections ... 95
24.4 Checking electrical connections ... 95
24.5 Checking protection against environmental influences ... 95
25 Commissioning ... 96
25.1 Checking the installation work ... 96
25.2 Test operation ... 96
25.3 Emergency release of the electromechanical interlock in the disconnector operating mechanism ... 98
25.4 Checking the accessories ... 101
25.5 Correcting circuit diagrams ... 101
25.6 Instructing the operating personnel ... 101
Operation ... 102
26 Control elements and indicators ... 103
27 Circuit-breaker operation ... 105
27.1 Closing the circuit-breaker manually ... 105
27.2 Opening the circuit-breaker manually ... 105
27.3 Recommendation for sealing the pushbuttons ... 106
27.4 Test operation without auxiliary voltage ... 106
27.5 Test operation with auxiliary voltage (motor operating mechanism) ... 107
27.6 Charging the closing spring manually ... 107
28 Three-position disconnector operation ... 108
28.1 Control elements and indicators ... 108
28.2 Closing the three-position disconnector manually ... 109
28.3 Opening the three-position disconnector manually ... 110
28.4 Activating the ready-to-earth function manually ... 110
28.5 Deactivating the ready-to-earth function ... 112
28.6 Three-position disconnector with auxiliary voltage (motor operating mechanism) ... 112
28.7 Emergency operation of the three-position disconnector ... 112
29 Feeder earthing and de-earthing ... 116
29.1 Feeder earthing ... 116
29.2 Feeder de-earthing ... 117
30 Operation of the busbar earthing switch ... 118
30.1 Control elements and indicators ... 118
30.2 Closing ... 119
30.3 Opening ... 120
31 Interlocks ... 121
32 Verification of safe isolation from supply ... 122
33 Overview of switching operations ... 123
33.1 Switching operations in the circuit-breaker panel ... 123
33.2 Switching operations in the bus sectionalizer ... 126
33.3 Switching operations in top-mounted bus sectionalizer ... 128
33.4 Switching operations for disconnectable voltage transformers ... 130
33.5 Switching operations for disconnectable busbar connection ... 131
34 Cable testing ... 133
34.1 Function test ... 133
34.2 Safety instructions ... 133
34.3 Procedure ... 134
Servicing ... 136
35 Maintenance ... 136
35.1 Switchgear maintenance ... 136
35.2 Safety instructions ... 136
35.3 Maintenance recommendation ... 136
35.4 Procedure for bolted joints and seals ... 138
35.5 Maintenance of the vacuum circuit-breaker operating mechanism ... 138
35.6 Cleaning agents and cleaning aids ... 140
35.7 Lubricants ... 141
35.8 Switchgear extension and replacement of panels and components ... 141
35.9 Spare parts ... 141
36 End of service life ... 142
Index ... 143

Safety instructions

1 Signal terms and definitions

	**DANGER!** as used in these instructions, this means that personal injuries can occur if the relevant precautionary measures are not taken. ⇨ Observe the safety instructions.

	**ATTENTION!** as used in these instructions, this means that damage to property or environment can occur if the relevant precautionary measures are not taken. ⇨ Observe the safety instructions.

	**NOTE!** as used in these instructions, this points at facilitations of work, particularities for operation or possible maloperation. ⇨ Observe the notes.

Symbols used

⇨ Operation symbol: Identifies an operation.
Asks the operator to perform an operation.

✔ Result symbol: Identifies the result of an operation.

2 General instructions

Independently of the safety instructions given in these operating instructions, the local laws, ordinances, guidelines and standards for operation of electrical equipment as well as for labor, health and environmental protection apply.

Five Safety Rules of Electrical Engineering

The Five Safety Rules of Electrical Engineering must generally be observed during operation of the products and components described in these operating instructions:

- Isolating.
- Securing against reclosing.
- Verifying safe isolation from supply.
- Earthing and short-circuiting.
- Covering or barriering adjacent live parts.

3 Due application

The switchgear corresponds to the relevant laws, prescriptions and standards applicable at the time of delivery. If correctly used, they provide a high degree of safety by means of logical mechanical interlocks and shockproof metal enclosure of live parts.



DANGER!

The perfect and safe operation of this switchgear is conditional on:

- ⇨ Observance of operating and installation instructions.
- ⇨ Qualified personnel.
- ⇨ Proper transportation and correct storage of the switchgear.
- ⇨ Correct installation and commissioning.
- ⇨ Diligent operation and maintenance.
- ⇨ Observance of the instructions applicable at site for installation, operation and safety.

4 Qualified personnel

Qualified personnel in accordance with these instructions are persons certified by the Switchgear Factory Frankfurt who are familiar with transport, installation, commissioning, maintenance and operation of the product and have appropriate qualifications for their work, e.g.:

- Training and instruction or authorization to switch on, switch off, earth and identify power circuits and equipment / systems as per the relevant safety standards.
- Training regarding the applicble specifications for the prevention of accidents and the use of appropriate safety equipment.
- Training in first aid and behavior in the event of possible accidents.

Description

5 Application and typical uses

Extendable fixed-mounted circuit-breaker switchgear of the 8DA series is mainly used in transformer and distribution substations as well as for switching duties in industrial plants and railway systems.

The panels are designed for rated voltages up to 40.5 kV and rated currents up to 3150 A. They are suitable for a maximum permissible rated short-circuit current of 100 kA and a maximum short-circuit breaking current of 40 kA.

6 Features

The fixed-mounted circuit-breaker switchgear of the 8DA type has the following features:

- Factory-assembled, type-tested and metal-enclosed switchgear for indoor installation
- Insulating medium SF_6 gas
- Safe-to-touch connection and interconnection system for cables as well as for solid-insulated bar and SF_6 gas-insulated bar
- Single busbar
- Single-pole metal enclosure
- Minimum fire load
- Maintenance-free
- Complete switchgear interlocking system with logical mechanical interlocks
- Primary part independent of environmental effects (pollution, humidity and small animals) due to hermetically sealed enclosure

This provides:

- Maximum personal safety
- Maximum security of operation

7 Type classification

The following table shows the different types of the 8DA series.
These instructions **only** contain the description of the type 8DA10.
For information to the switchgear types 8DA11 / 8DA12,
please refer to the specific operating and installation instructions 8DA11/12 .

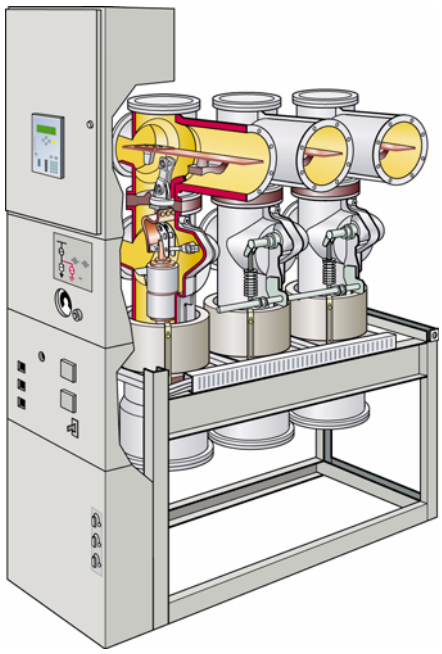


Fig. 1: 8DA10 (3-pole)

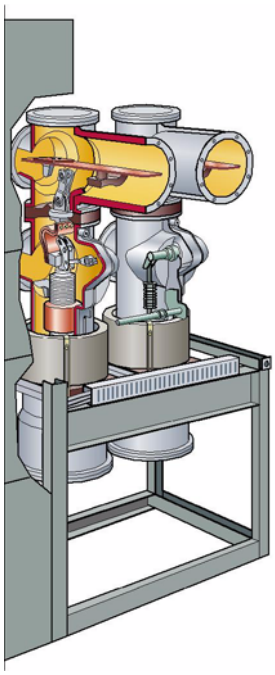


Fig. 2: 8DA12 (2-pole)

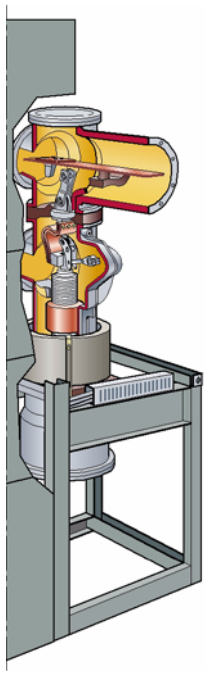


Fig. 3: 8DA11 (1-pole)

8 Circuit-breaker panel

8.1 Function

The circuit-breaker panel is the basic panel type of the 8DA series.
The circuit-breaker panel can fulfil the function "incoming feeder" or "outgoing feeder".
It can carry or switch all rated busbar and feeder currents as well as the short-circuit currents quoted on the respective rating plates.

8.2 Frame

- Support for switchpanel poles and switchgear front
- Forms the cable connection compartment

8.3 Low-voltage compartment

- For accommodation of protection, control, measuring and metering equipment
- With plug-in cables of the circuit-breaker and three-position disconnector operating mechanisms on C-profile for incoming and outgoing cables (e. g. bus wires)
- Devices can be optionally mounted in the door or on mounting plates inside the low-voltage compartment

8.4 Switchpanel pole

- Poles arranged one behind the other.
- One switchpanel pole consists of a vertically arranged housing with a vacuum interrupter inside.
- The busbar housing with the three-position disconnector inside is arranged horizontally over the switchpanel pole.

8.5 Switchpanel

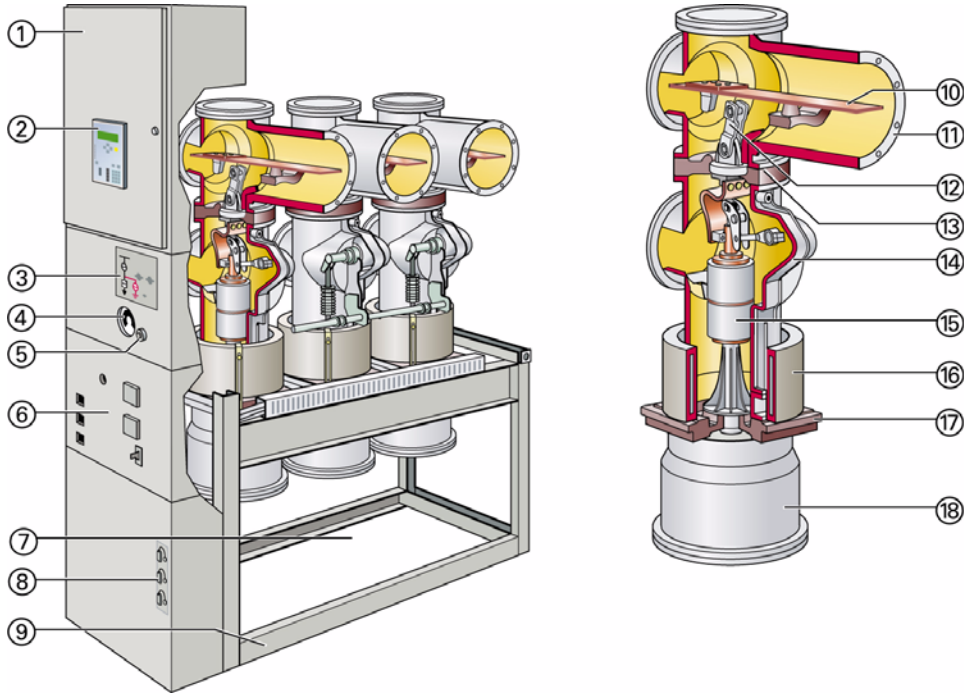


Fig. 4: 8DA10 circuit-breaker panel and switchpanel pole

①	Low-voltage compartment (standard heights: 850/1200 mm)	⑩	Busbar
②	SIPROTEC bay controller (option)	⑪	Busbar housing
③	Control and indication board for three-position disconnector with position indicator for circuit-breaker	⑫	Three-position disconnector
④	Gas pressure indicator for feeder gas compartments (B0)	⑬	Upper bushing
⑤	Gas filling valve	⑭	Circuit-breaker housing
⑥	Control and indication board for vacuum circuit-breaker	⑮	Vacuum interrupter
⑦	Cable compartment	⑯	Current transformer
⑧	Sockets for voltage detecting system	⑰	Lower bushing
⑨	Frame	⑱	Panel connection housing

9 Circuit-breaker

9.1 Design

The vacuum circuit-breaker 3AH49 is an integral part of the switchpanel and consists of the following components:

- Operating mechanism with stored-energy spring mechanism and control elements
- Switching rods for contact operation
- 3 switchpanel poles with vacuum interrupters

Mechanical interlock

The circuit-breaker and the three-position disconnector are mechanically interlocked against each other. The mechanical interlock prevents the circuit-breaker from being closed as long as the three-position disconnector is not in a defined end position (CLOSED/OPEN). Furthermore the mechanical interlock prevents the three-position disconnector from being operated while the circuit-breaker is closed.

Vacuum interrupters

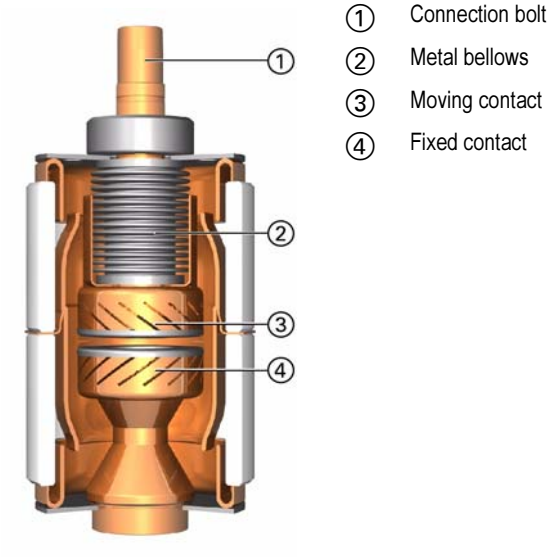
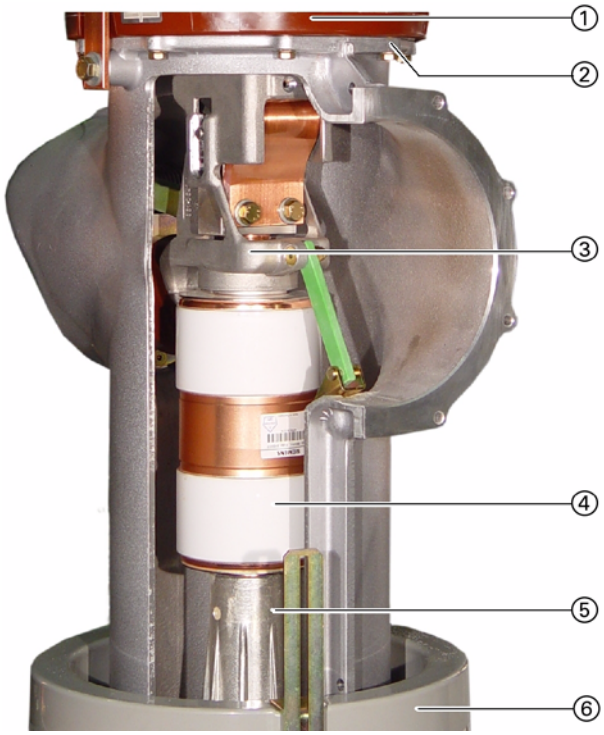


Fig. 5: Sectional view of a vacuum interrupter

The vacuum interrupter is fixed at the terminal of the circuit-breaker pole.
The fixed contact ④ is directly connected to the housing. The moving contact ③ is firmly connected to the connection bolt ① and is centrally aligned in the guide.
The metal bellows ② inside the interrupter forms the vacuum-tight connection to the gas compartment.

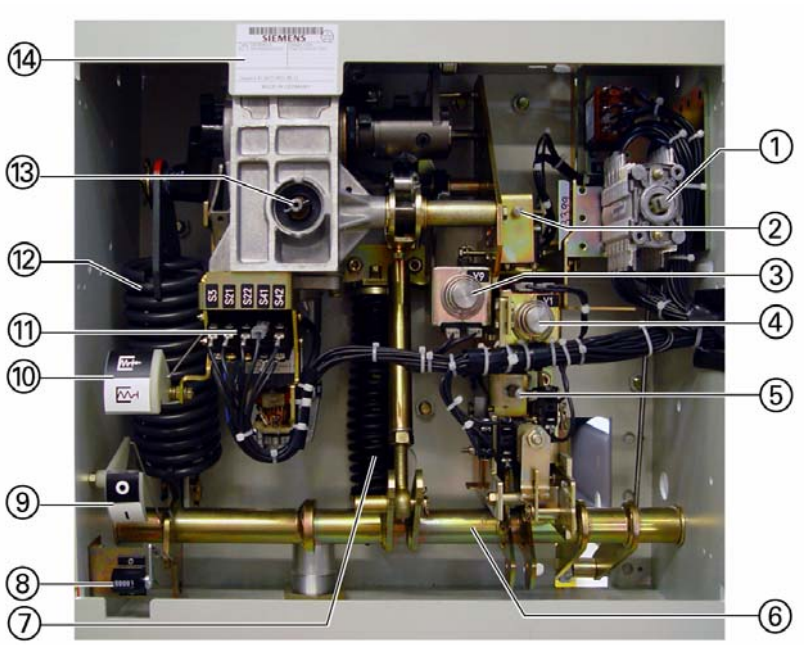


1 Bushing
2 Top flange
3 Interrupter support
4 Vacuum interrupter (example type)
5 Terminal
6 Current transformer

Fig. 6: Sectional view of switchpanel pole with vacuum interrupter

9.2 Operating mechanism box

Design The operating mechanism box is closed with a removable front plate. The front plate contains openings for the control elements and indicators. The operating mechanism box accommodates all components required to operate the circuit-breaker.



① Auxiliary switch S1
② ON pushbutton
③ Closing solenoid
④ Shunt release
⑤ OFF pushbutton
⑥ Operating shaft for circuit-breaker
⑦ Opening spring
⑧ Operatinons counter
⑨ Position indicator for circuit-breaker
⑩ "Closing spring charged / not charged" indicator
⑪ Auxiliary switch
⑫ Closing spring
⑬ Gear with hand crank coupling
⑭ Rating plate

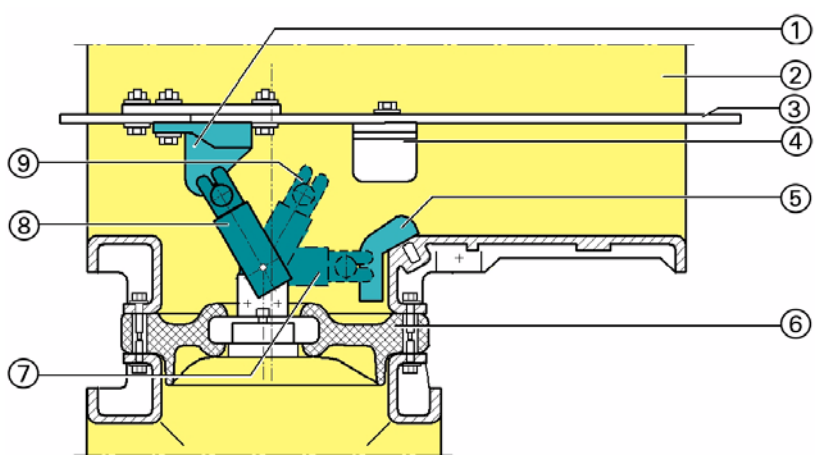
Fig. 7: Circuit-breaker operating mechanism without front plate

Function Depending on its design, the circuit-breaker is closed electrically or mechanically with the ON pushbutton. The operating power is transmitted to the vacuum interrupters through an operating linkage. The closing spring is immediately recharged by the motor after closing.

If the motor supply voltage fails, the closing spring can be charged manually.
To do this, there is an opening in the removable front plate with the hand crank coupling of the gear behind. The charging condition of the spring can be read on the indicator.

10 Three-position disconnector

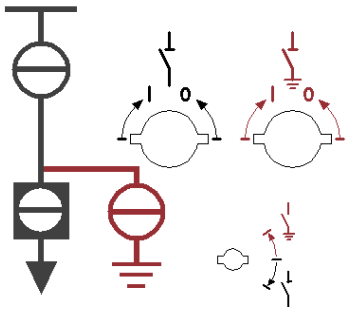
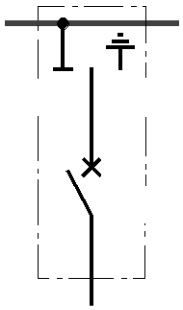
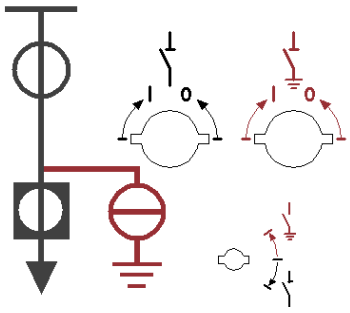
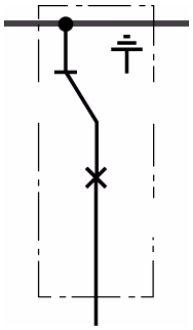
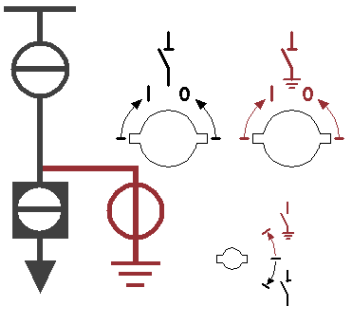
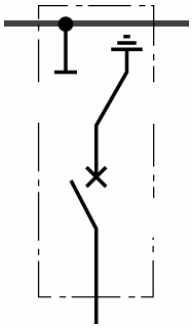
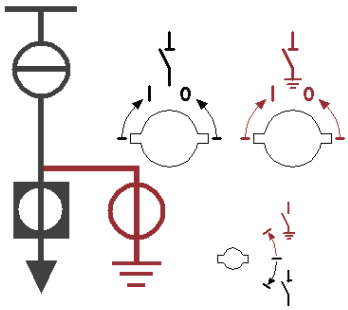
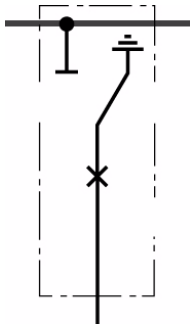
Function The three-position disconnector combines the functions of a disconnector and an earthing switch. It is designed for no-load operation only.



① Fixed contact, CLOSED position
② Busbar housing
③ Busbar
④ Busbar support
⑤ Fixed contact, READY-TO-EARTH position
⑥ Bushing
⑦ Moving contact in READY-TO-EARTH position
⑧ Moving contact in CLOSED position
⑨ Moving contact in OPEN position

Fig. 8: Three-position disconnector with busbar and bushing

Switch positions

Switch positions	Position indicator	Basic scheme
 OPEN		 - Three-position disconnector OPEN - Circuit-breaker OPEN
 CLOSED		 - Three-position disconnector CLOSED - Circuit-breaker CLOSED
 READY-TO-EARTH		 - Three-position disconnector READY-TO-EARTH - Circuit-breaker OPEN
 EARTHED		 - Three-position disconnector EARTHED - Circuit-breaker CLOSED

11 Current and voltage transformers

11.1 Voltage transformers

Features

- According to IEC 60 044-2
- Cast-resin insulated
- Inductive type
- Safe-to-touch due to metal enclosure

Option:

- Designed as low-power voltage transformer (resistor divider):
  - According to IEC 60 044-7
  - Mounted over the panel connection as flange dividers, or pluggable in any free sokket as an inside-cone plug-in system
  - Suitable for all protection and measuring functions
  - No ferroresonance possible anymore
  - No disconnection for switchgear or cable tests
  - Resistant against transient overvoltages
  - Extended voltage measuring range from 0.4 to 1.2 times rated voltage
  - High reliability and availability
  - Short-circuit-proof
  - Rating-independent wiring
  - System conformity to mumerical secondary systems

Voltage transformer types

Mounting locations	Type	Remark
Busbar	4MT3	optionally with voltage transformer disconnector
	4MU4	
Panel connection	4MU3	external
	4MT7	directly pluggable

11.2 Current transformers

Features

- According to IEC 60 044-1
- Designed as ring-core current transformers:
  - Ring core as carrier of secondary winding
  - Main circuit corresponds to primary winding
- Arranged outside the primary enclosure (switchgear vessel) due to single-pole design of the panel
- Free of dielectrically stressed cast-resin parts

Mounting locations

- On the busbar
- On the circuit-breaker housing
- At the panel connection
- On the cable

12 Gas compartments

Function The distribution of the gas compartments is decisive for working on the switchgear during operation and the resulting operational restrictions. Thus, in case of fault, the distribution of the gas compartments determines the extent of work.
The following example shows the distribution of the gas compartments in a single-pole insulated switchgear with the associated gas weights and gas compartment volumes required to reorder SF_6 gas. As for data to other configurations please contact your regional Siemens representative.

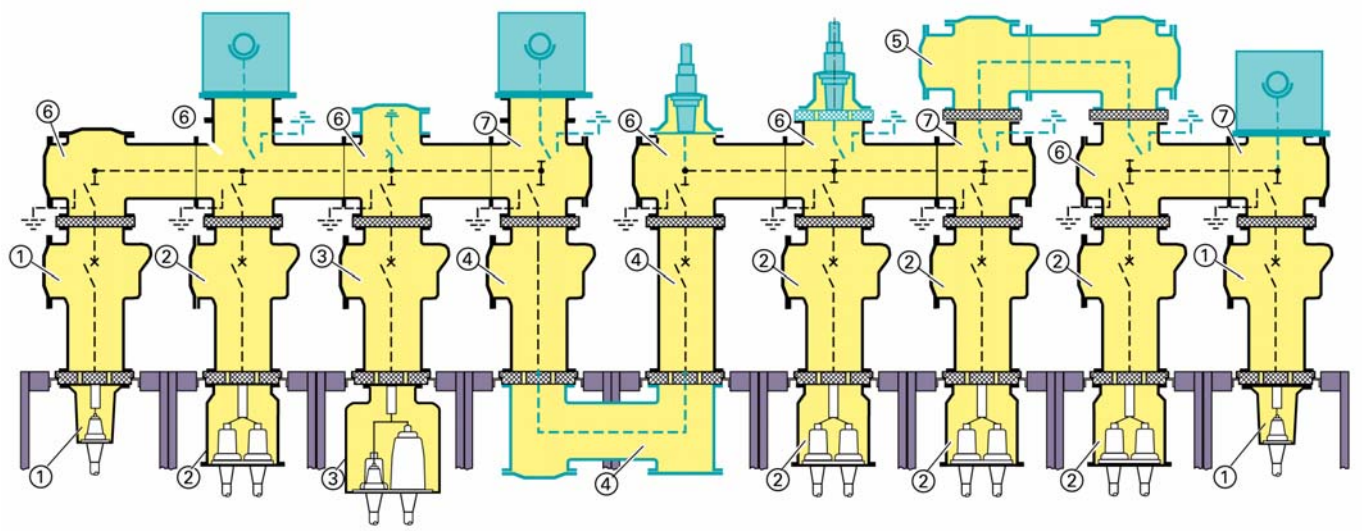


Fig. 9: Example 8DA10

Gas quantities (all data are 3-pole per panel)

		SF_6 gas weight (at 20° C)				**Total volume**
Item	**Gas compartment**	**50 kPa** Gas quantity in kg	**70 kPa** Gas quantity in kg	**100 kPa** Gas quantity in kg	**120 kPa** Gas quantity in kg	Volume in liters
①	Circuit-breaker housing + small connection housing (single cable termination)	0.9	-	1.1	1.3	94
②	Circuit-breaker housing + medium connection housing (multiple cable connection)	1.3	-	1.8	1.9	145
③	Circuit-breaker housing + large connection housing (multiple cable connection)	2.3	-	3.1	3.4	253
④	Circuit-breaker housing + bus riser housing + longitudinal interconnection	2.5	-	3.4	3.7	276
⑤	Top-mounted busbar sectionalizer	-	0.7	-	0.9	69
⑥	Long busbar housing*	-	1.0	-	1.3	96
⑦	Short busbar housing*	-	0.8	-	1.0	76
* Mean value for switchgear designs with and without busbar components						

13 Panel connections

13.1 Overview

The fully insulated panel connections are available for cables with inside-cone plug-in system, or for solid-insulated or gas-insulated bars. Three different sizes of cable plugs are available, depending on the cable cross-section. Besides single connections, multiple connections for a maximum of six cables are possible, too.
With multiple connections it is also possible to combine different interface types. Multiple connections for two cables can also be used to connect a voltage transformer (external or plug-in type) instead of the second cable.

13.2 Panel connection types

Selection table

Cable plugs, inside cone

Plug size	**2**	**2**	**3**	**3**	**3S**	**4**
Capacitive voltage tap	No	Yes	No	Yes	Yes	No
Rated normal current (A)	800	800	1250	1250	1250	1250
Rated lightning impulse withstand voltage (kV)	200	200	200	200	250	325
Rated short-duration power-frequency withstand voltage (kV)	95	95	95	95	95	140
Min. cross-section (mm^2)	25	25	50	50	50	95
Min. core diameter (mm)	4.9	4.9	7.2	7.2	7.2	9.3
Max. cross-section (mm^2)	325	325	800	800	800	1200
Max. core diameter (mm)	22.3	22.3	34.6	34.6	34.6	45.4
Min. diameter across insulation (mm)	13.5	13.5	15.5	15.5	15.5	33
Max. diameter across insulation (mm)	40.0	36.0	51.0	47.0	47.0	66.0

Examples

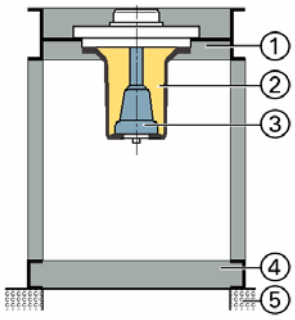


Fig. 10: Single cable connection, interface type 2

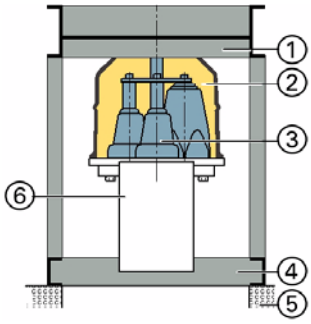


Fig. 11: Multiple cable connection with plugged-in voltage transformer

① Switchgear frame (upper part)
② Panel connection housing, gas-insulated
③ Panel connection for inside-cone plug-in system
④ Switchgear frame (lower part)
⑤ Floor of switchgear room
⑥ Voltage transformer, plugged in
⑦ Solid-insulated bar
⑧ Gas-insulated bar

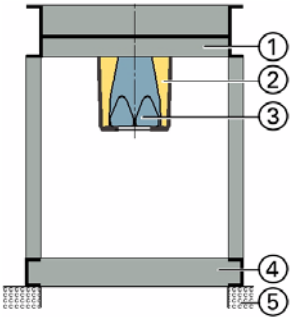


Fig. 12: Single cable connection, interface type 3

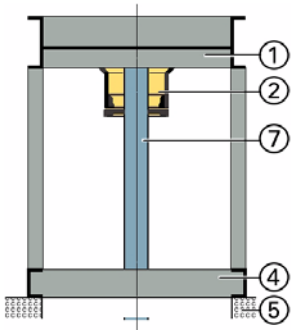


Fig. 13: Connection for solid-insulated bar

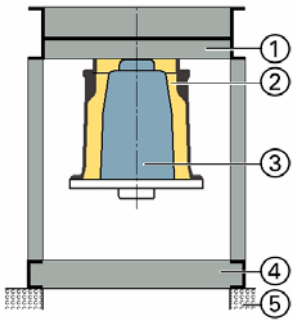


Fig. 14: Single cable connection, interface type 4

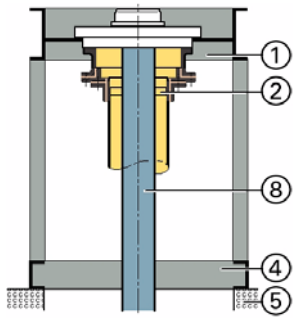


Fig. 15: Connection for gas-insulated bar

14 Technical data

14.1 Electrical data

Complete switchgear

Rated-						
voltage	kV	**12**	**24**	**36**	**38**	**40.5**
frequency	Hz	50/60				
short-duration power-frequency withstand voltage	kV	28	50	70	80	85/95
lightning impulse withstand voltage	kV	75	125	170	200	185
short-circuit breaking current	max. kA	40				
short-time withstand current 3s	max. kA	40				
short-circuit making current	max. kA	100				
peak withstand current	max. kA	100				
normal current of busbar	max. A	3150				
normal current of feeders	max. A	2500				

14.2 Three-position disconnector

Rated						
voltage	kV	**12**	**24**	**36**	**38**	**40.5**
short-duration power-frequency withstand voltage	kV	32	60	80	90	90/110
lightning impulse withstand voltage	kV	85	145	195	230	218

14.3 Vacuum circuit-breaker

Operating times

Operating times	Component		Duration	Unit
Closing time			≤95	ms
Charging time			≤15	s
Opening time	Shunt release	(Y1)	≤70	ms
	Additional release 3AX 11	(Y2), (Y4),(Y7)	≤55	ms
Arcing time			≤15	ms
Break time	Shunt release	(Y1)	≤85	ms
	Additional release 3AX 11	(Y2), (Y4),(Y7)	≤70	ms
Dead time			≤300	ms
Close-open contact time	Shunt release	(Y1)	≤80	ms
	Additional release 3AX 11	(Y2), (Y4),(Y7)	≤65	ms
Minimum command duration				
CLOSE	Closing solenoid	(Y9)	≤45	ms
OPEN	Shunt release	(Y1)	≤40	ms
OPEN	Additional release 3AX 11	(Y2), (Y4),(Y7)	≤20	ms
Shortest impulse duration of the c.b. tripping signal	1st shunt release		≥15	ms
	2nd/3rd shunt release		≥10	ms
Syncronism error between the poles			2	ms

Number of operating cycles

Rated normal current	10 000 times
Short-circuit breaking current	50 times

Closing time The interval of time between the initiation (command) of the closing operation and the instant when the contacts touch in all poles.

Opening time The interval of time between the initiation (command) of the opening operation and the instant when the contacts separate in all poles.

Arcing time The interval of time from the first initiation of an arc and the instant of final arc extinction in all poles.

Break time The interval of time between the initiation (command) of the opening operation and the instant of final arc extinction in the last-pole-to-clear (=opening time and arcing time).

Close-open contact time The interval of time - in a make-break operating cycle - between the instant when the contacts touch in the first pole in the closing process, and the instant when the contacts separate in all poles in the subsequent opening process.

Motor operating mechanism

The operating mechanisms of the 3AH vacuum circuit-breakers are suitable for auto-reclosing. For DC operation, the maximum power consumption is approx. 350 W. For AC operation, the maximum power consumption is approx. 400 VA.

The rated current of the motor protection equipment is shown in the following table:

Rated supply voltage [V]	Recommended rated current for the protection equipment* [A]
DC 24	8
DC 48	6
DC 60	4
DC/AC 11050/60 Hz	2
DC 220/AC 23050/60 Hz	1.6
*) M.c.b. assembly type 8RL74 or m.c.b. with C-characteristic	

The supply voltage may deviate from the rated supply voltage specified in the table by -15% to +10%.

The breaking capacity of the auxiliary switch 3SV92 is shown on the following table:

Breaking capacity	Operating voltage [V]	Normal current [A]	
AC 40 to 60 Hz	up to 230	10	
		Resistive load	Inductive load
DC	24	10	10
	48	10	9
	60	9	7
	110	5	4
	220	2,5	2

Closing solenoid (Y9)

The closing solenoid 3AY1510 closes the circuit-breaker.
After completion of a closing operation, the closing solenoid is de-energized internally. It is available for AC or DC voltage. Power consumption: 140 W or 140 VA.

Shunt releases

The shunt releases are used for automatic and deliberate tripping of circuit-breakers. They are designed for connection to external voltage (DC or AC voltage). In special cases, for deliberate tripping, they can also be connected to a voltage transformer.

Shunt releases based on two different principles are used:

- The **shunt release (Y1)** 3AY1510 is used as standard in the basic circuit-breaker version. With this design, the circuit-breaker is opened electrically.
  Power consumption: 140 W or. 140 VA.
- The **shunt release (Y2)** 3AX1101 with energy store is fitted if more than one shunt release is required. With this design, the electrical opening command is transferred magnetically and thus, the circuit-breaker is opened.
  Power consumption: 70 W or 50 VA.

Undervoltage release

Undervoltage releases are tripped automatically through an electromagnet or deliberately. The deliberate tripping of the undervoltage release generally takes place via a NC contact in the tripping circuit or via a NO contact by short-circuiting the magnet coil. With this type of tripping, the short-circuit current is limited by the built-in resistors. Power consumption: 20 W or 20 VA.

Circuit-breaker tripping signal

When the circuit-breaker is tripped by a release (e.g. by protection tripping) there is a signal through the NO contact -S6. If the circuit-breaker is tripped deliberately with the mechanical pushbutton, this signal is suppressed by the NC contact -S7.

C.t-operated releases (Y6)

The following c.t.-operated releases are available:

- The c.t.-operated release **3AX1102** consists of an energy store, an un latching mechanism and an electromagnetic system. Rated tripping current: 0.5 A/1 A
- The c.t.-operated release **3AX1104** (low-energy release) is adequate for a tripping pulse of ≤ 0.1 Ws in connection with adequate protection systems.
  It is used if auxiliary voltage is missing, tripping via protection relay.

Integrated varistor



ATTENTION!

Switching overvoltages can damage electronic control devices.

⇨ Do not switch off inductive consumers in DC circuits.

With the varistor integrated in the motors, the inductances of the circuit-breaker operating mechanism and the circuit-breaker control system can be operated with DC. The intergrated varistor limits the overvoltage to approx. 500 V and is available for rated operating voltages from 60 V (DC) up to 220 V (DC).

14.4 Insulating gas SF_6

Sulphur hexafluoride SF_6 according to IEC 60 376 is used as insulating gas.
SF_6 insulates live parts between each other and against earth potential.

Features

- Non-toxic
- Odorless
- Colorless
- Non-inflammable
- Chemically neutral
- Electronegative
- Heavier than air

Filling degree of compressed gas cylinders

1,04 kg SF_6 / liter cylinder volume (valid at a max. ambient air temperature of + 65 °C).

Vapor pressure over liquid SF_6

In the supplied cylinders, about 2/3 of the cylinder volume is liquid at + 20 °C, the rest is saturated SF_6 vapor.

Vapor pressure as a function of temperature

Temperature	Vapur pressure
+ 20 °C	2100 kPa
+ 30 °C	2700 kPa
+ 65 °C	7000 kPa (test pressure of cylinder)

Storage Store the cylinders in vertical position in a cool place.

Gas pressures in kPa at 20°C

	Busbar housing			
Rated busbar current [A]	≤ 2500	≤ 3150		
Rated voltage [kV]	≤ 40,5			
Rated lightning impulse withstand voltage [kV]	≤ 185	185	200	
Rated short-duration power-frequency withstand voltage [kV]	≤ 85	95	80	95
Rated functional level [kPa]	70	120		
Min. functional level [kPa]	50	100		
Signal "pressure too low" [kPa]	50	100		
Max. functional level [kPa]	120	180		
Signal "pressure too high" [kPa]	120	180		

	Circuit-breaker housing				
Rated feeder current [A]	≤ 1600	≤ 2000			
Rated voltage [kV]	≤ 36	40,5			
Rated lightning impulse withstand voltage [kV]	≤ 170	185		200	
Rated short-duration power-frequency withstand voltage [kV]	≤ 70	85	95	80	95
Rated functional level [kPa]	50	100	120		
Min. functional level [kPa]	30	80	100		
Signal "pressure too low" [kPa]	30	80	100		
Max. functional level [kPa]	90	150	180		
Signal "pressure too high" [kPa]	90	150	180		

Gas pressure - temperature characteristics

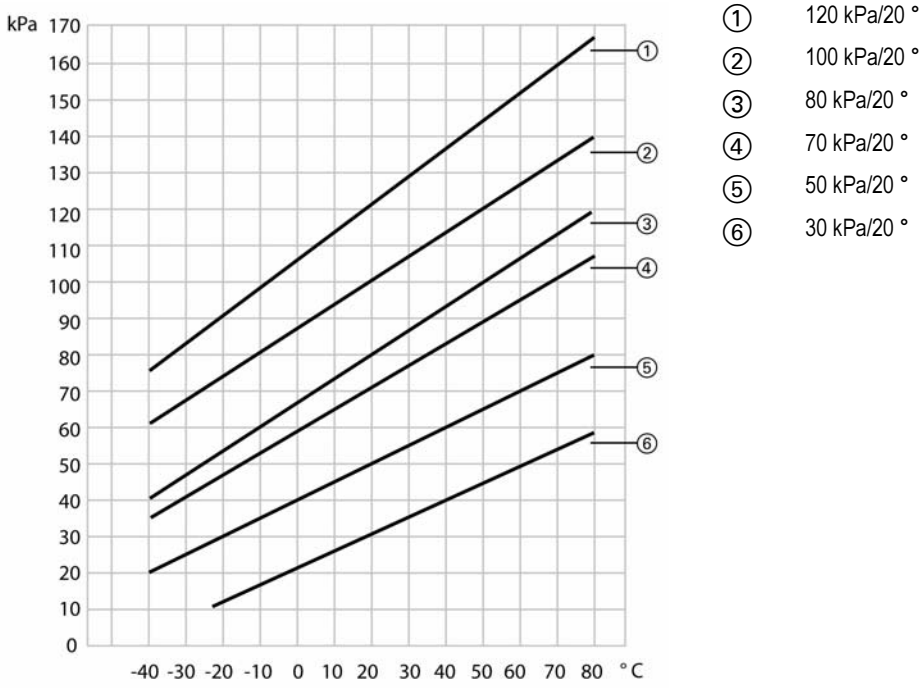


Fig. 16: Characteristics of gas pressure as a function of temperature

The characteristics of the gas pressures as a function of temperature show the behavior of the SF_6 gas at different gas filling levels depending on the ambient air temperature.

Due to the different configurations of the gas compartments, installed switchgear assemblies may deviate from the above characteristics.

14.5 Classification of 8DA switchgear according to IEC 62 271-200

Design and construction

Partition class	**PM (metallic partition)**	
Loss of service continuity category	LSC 2B	
Accessibility to compartments	Busbar compartment:	tool-based
	Switching device compartment:	tool-based
	Low-voltage compartment:	tool-based
	Cable compartment:	tool-based

Internal arc classification

Designation of the internal arc classification IAC		
IAC class for		
- Wall-standing arrangement		IAC A FL 40 kA, 1 s
- Free-standing arrangement		IAC A FLR 40 kA, 1 s
Type of accessibility A		Switchgear in closed electrical service location
		Access “for authorized personnel only“ according to IEC 62 271-200
	- F	Front
	- L	Lateral
	- R	Rear (for free-standing arrangement)
Arc test current		40 kA
Test duration		1 s

14.6 Standards, specifications, guidelines

Basic prescriptions and standards

The fixed-mounted circuit-breaker switchgear 8DA10 for indoor installation complies with the following prescriptions and standards:

		IEC/EN standard	**VDE standard**
Switchgear		62 271-1	0670-1000
		62 271-200	0671-200
Switching devices	Circuit-breaker	62 271-100	0671-100
	Disconnector/earthing switch	62 271-102	0671-102
Voltage detecting systems		61 243-5	0682-415
Surge arresters		60 099	0675
Degree of protection		60 529	0470-1
Instrument transformers	Current transformers	60 044-1	0414-1
	Voltage transformers	60 044-2	0414-2
	Low-power instrument transformer	60 044-7	0414-7
Degree of purity and utilization of SF_6		60 376	0373-1
Installation and earthing		61 936-1 / HD 637 -S1	0101
Environmental conditions		60 721-3-3	DIN EN 60 721-3-3

The vacuum interrupters fitted in the vacuum circuit-breakers 3AH49 are type-approved in accordance with the X-ray regulations of the Federal Republic of Germany.
They conform to the requirements of the X-ray regulations of January 8, 1987 (Federal Law Gazette Page 144), §8 and Annex III, Section 5 up to the rated short-duration power frequency voltage stipulated in accordance with DIN VDE/IEC.

Electromagnetic compatibility - EMC

The a.m. standards as well as the "EMC Guideline for Switchgear"* are applied during design, manufacture and erection of the switchgear. Installation, connection and maintenance has to be performed in accordance with the stipulations of the operating instructions. For operation, the legal stipulations applicable at the place of installation have to be observed additionally. In this way, the switchgear assemblies of this type series fulfill the basic protection requirments of the EMC guideline.

The switchgear operator / owner must keep the technical documents suplied with the switchgear throughout the entire service life, and keep them up-to-date in case of modifications of the switchgear.

* (Dr. Bernd Jäkel, Ansgar Müller; Medium-Voltage Systems - EMV Guideline for Switchgear; A&D ATS SR/PTD M SP)

Protection against solid foreign objects, electric shock and water

The fixed-mounted circuit-breaker switchgear of the 8DA series fulfills the following degrees of protection according to IEC 60 529:

- IP3XD standard for external enclosure
- IP65 standard for parts under high voltage
- IP31D option for low-voltage compartment

Transport regulations

According to Annex 1 of the European agreement about international transportation of hazardous materials on the road (ADR), Siemens SF_6-gas insulated medium-voltage switchgear do not belong to the category of hazardous materials in respect of transportation, and are exempted from special transport regulations according to ADR, Clause 1.1.3.1 b).

14.7 Phase sequence

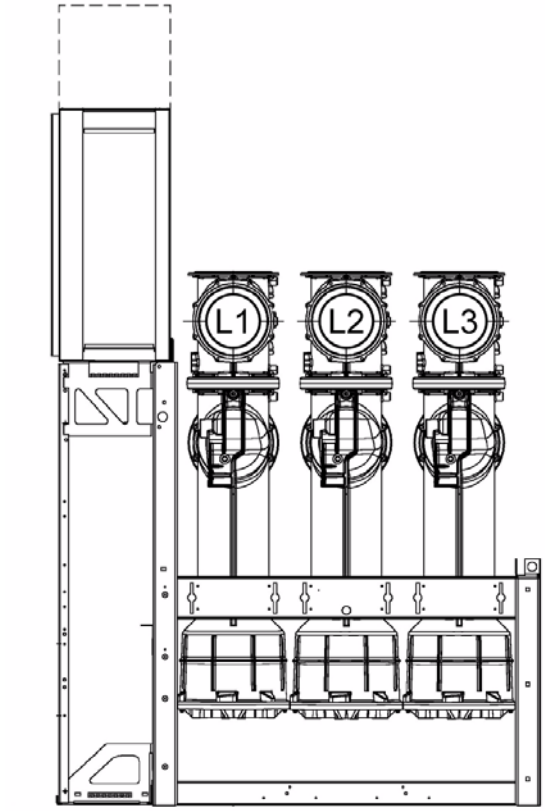


Fig. 17: Phase sequence of bushings in the busbar compartment

14.8 Center of gravity

Center of gravity

The position of the center of gravity can vary depending on the switchgear design.

In the following construction, the center of gravity is located at the marked position:

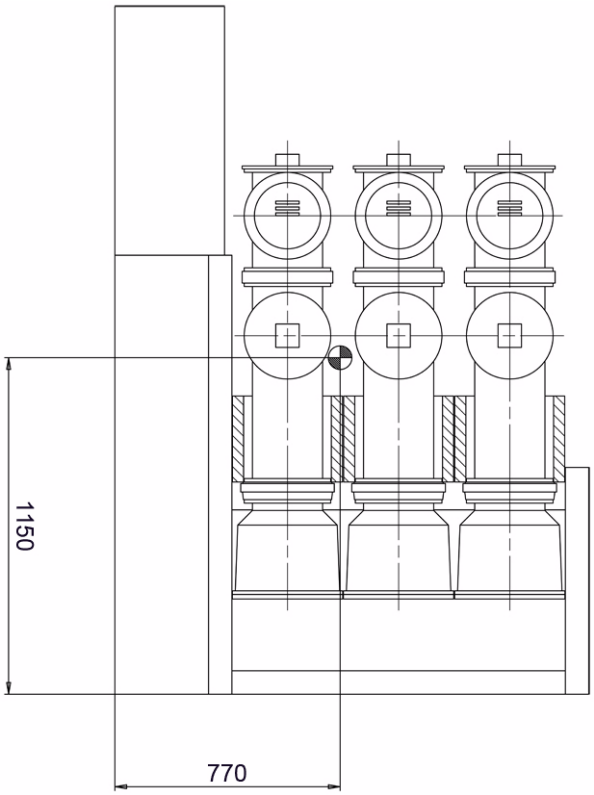


Fig. 18: Position of the center of gravity (depending on the switchgear version)

14.9 Gas leakage rate

Gas leakage rate

The gas leakage rate is < 0.1% per year (referred to the absolute gas pressure).

14.10 Rating plates

Switchpanel

Th rating plate contains all informatin that is binding for the panel.
It is provided on the inside of the door of the low-voltage compartment of each panel.
If the circuit-breaker class is specified as M2*, a maximum of 30,000 mechanical operating cycles are possible with the circuit-breaker.

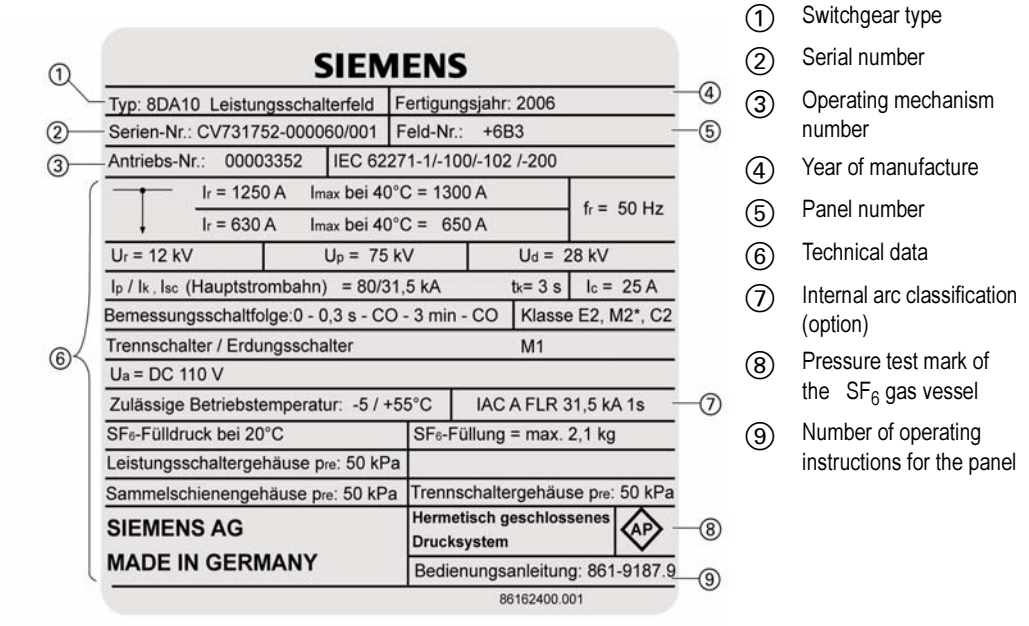


Fig. 19: Rating plate of switchgear (example)

The IAC classification is referred to each panel. The data on the rating plate (see item ⑦) describes the areas classified for the corresponding panel.

15 Accessories

15.1 Standard accessories

- Operating and installation instructions
- Operating lever for three-position disconnector: DISCONNECTING function
- Operating lever for three-position disconnector:
  EARTHING/READY-TO-EARTH function
- Emergency operating lever for three-position disconnector
  (for motor operating mechanism only)
- Hand crank to charge the circuit-breaker closing spring
- Double-bit key (selector key)

Option: Service flap in the switchgear end wall to store the standard accessories.

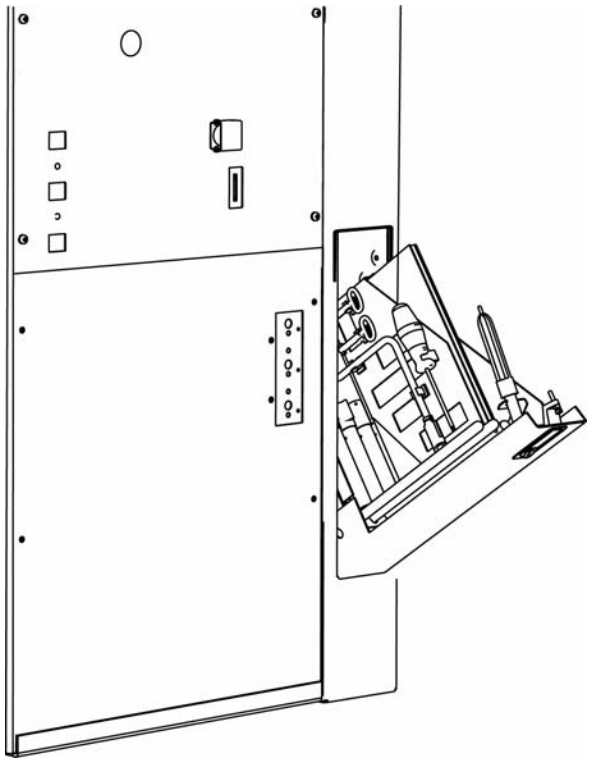


Fig. 20: Service flap in the switchgear end wall (open)

15.2 Other accessories

According to the order documents/purchase order (selection):

- Cable plugs / adapter systems
- Surge arresters / limiters
- Voltage detecting system CAPDIS S1+/CAPDIS S2+
- LRM voltage indicators, plug-in type (e. g. make Horstmann)



- Test units to check the capacitive interface and the voltage indicators



- Phase comparison test units (e.g. make Pfisterer, type EPV)



Installation

16 Before installation

16.1 Preliminary clarifications

In order to load the transport units in a suitable installation order, the responsible Siemens representative requires the following information from you several weeks before delivering the switchgear:

- Sketch of the installation room including the locations and numbers of the individual switchpanels and the storage space for the accessories
- Sketch of the access route from the public road to the switchgear building and information concerning the condition thereof (meadows, arable soil, sand, gravel, etc.)
- Sketch of the transport route inside the switchgear building with the locations and dimensions of doors and other narrow points, as well as the floor number of the installation room
- Information about available lifting equipment, e.g. mobile crane, fork-lift truck, lifting truck, hydraulic jack, roller pads. If no lifting equipment is available, please notify this explicitly.

16.2 Switchgear room

Please observe the following points while preparing the switchgear room:

- Transport ways to the switchgear room
- Distribution and intermediate storage spaces
- Construction and load-bearing capacity of the floor
- Illumination, heating, power and water supply
- Dimensions of installation scaffoldings and foundation rails
- Installation of high-voltage cables
- Earthing system
- Cleanliness: Switchgear room free of dirt and dust

16.3 Installation dimensions and floor fixing

To erect and install switchgear type 8DA, the place of installation (switchgear room) must have certain dimensions. Important data for erection and installation of the switchgear are, among other things, the room width, depth and height, as well as the necessary floor openings.

Dimensions of the switchgear room

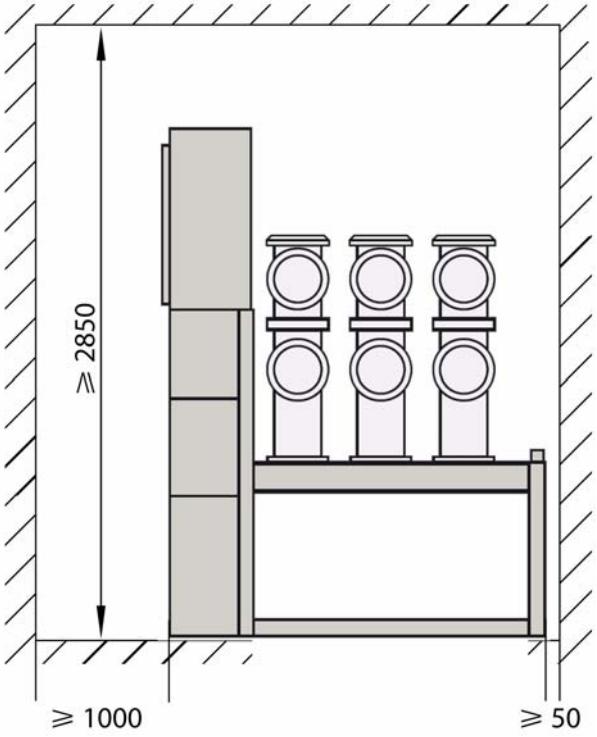


Fig. 21: Room height

Room dimensions and wall distances

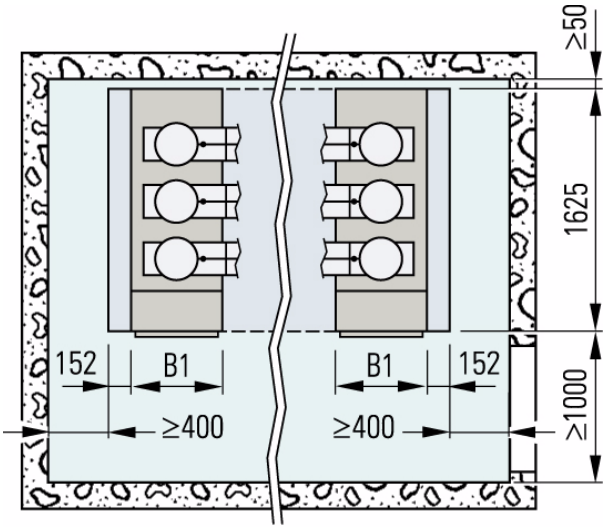


Fig. 22: Wall-standing arrangement

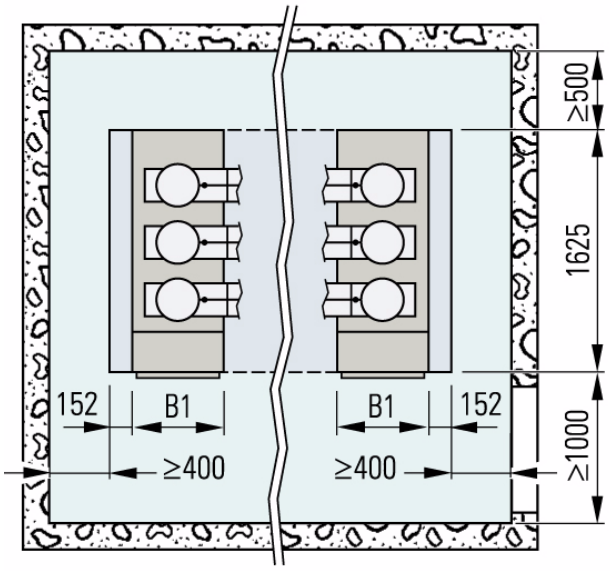


Fig. 23: Free-standing arrangement

Foundation

Please observe the following items when preparing the foundation:

- A suitable foundation can be a false floor, a double floor or a reinforced-concrete foundation. The reinforced-concrete floor must be equipped with foundation rails for supporting the panels.
- As for design and construction of the foundation, the relevant standards DIN 43 661 "Fundamentschienen in Innenanlagen der Elektrotechnik" (Foundation rails in electrical indoor installations) and DIN 18 202 "Maßtoleranzen im Hochbau" (Blatt 3) (Measuring tolerances in structural engineering (Sheet 3)) apply.
- Provide for suitable fixing points, e.g. according to the drawing "Floor fixing" E50220-W0007-P005 (Sheet 4).

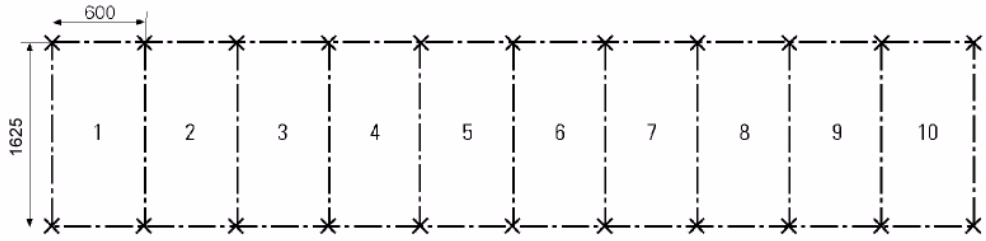
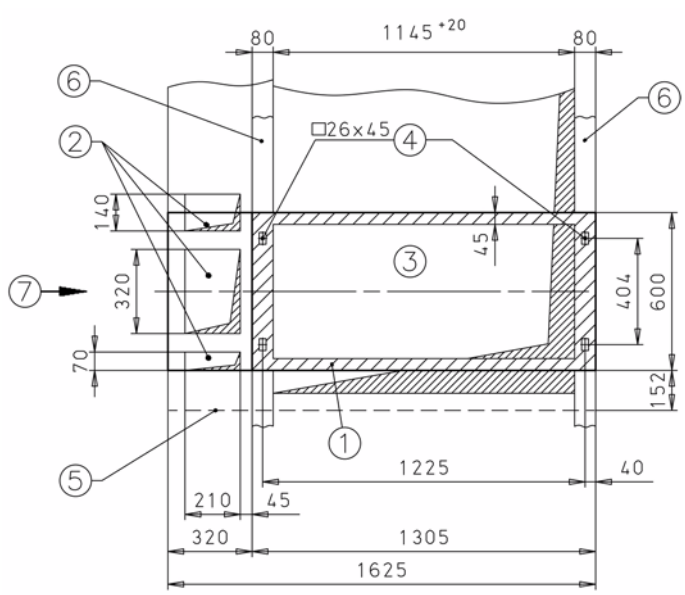


Fig. 24: Measuring sheet for the foundation

The measuring sheet for the foundation shows:
Straightness tolerance according to DIN 4366:
1mm for 1 m length, 2 mm for the total length.

Floor openings and fixing points



① Base frame
② Floor opening for control cables
③ Floor opening for control cables
④ Fixing holes (26x45)
⑤ Switchgeare end wall
⑥ Fpundation rails
⑦ Operating side of the panel

Fig. 25: Floor opening and fixing points

Floor openings

Recommendation: A base frame to fasten the panels on should be prepared in the floor of the switchgear room. The panels can be bolted or welded to the base frame.

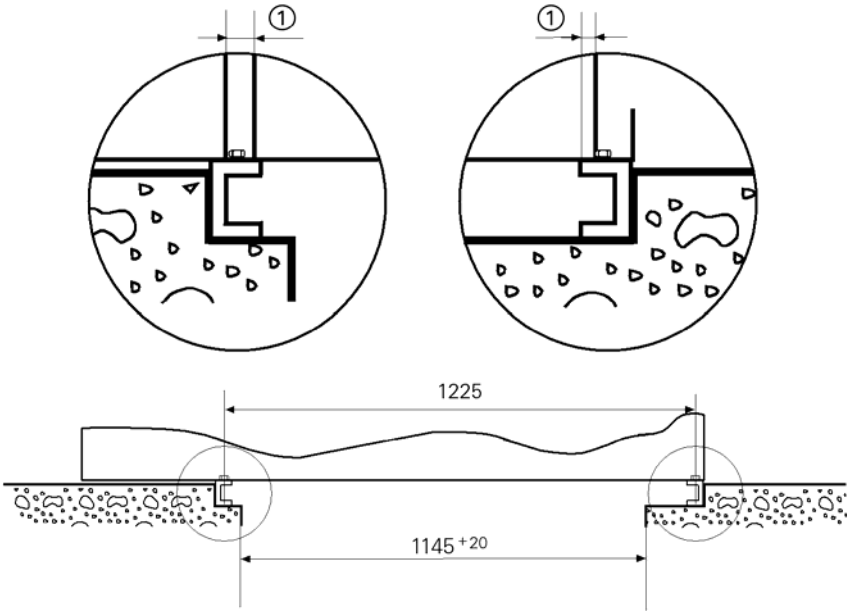


Fig. 26: Base frame

① Standing surface

16.4 Intermediate storage

	**DANGER!** Risk of injury and damage to the stored goods if the storage surface is overloaded or the transport units are stacked. ⇨ Observe the load-bearing capacity of the floor. ⇨ Do not stack the transport units.

	**DANGER!** Fire risk! ⇨ No smoking. ⇨ Keep fire extinguishers in a weatherproof place. ⇨ Mark the location of the fire extinguisher.

	**ATTENTION!** Supplied desiccant bags lose their effectivemess if they are not stored in the undamaged original packings. ⇨ Do not damage or remove packing of desiccant bags. ⇨ Do not unpack desiccant bags before use.

	**ATTENTION!** The transport units may be damaged if they are stored outdoors without seaworthy packing (seaworthy crate). ⇨ Store transport units outdoors in seaworthy packing (seaworthy crate) only.

If the comprehensive accessories, the delivered switchgear or parts thereof have to be stored before installation, a suitable storage room or place has to be selected and prepared.

Intermediate storage of the transport units:

- In original packing as far as possible
- Observe the permissible storage temperature from -25° C to +70° C in accordance with the installed secondary devices. In the individual case, the electronic components must be checked regarding the permissible limit temperature and the relevant temperatures for the application.
- In a weatherproof place
- Protected against damage
- Store transport units in such a way that they can be taken out later in the correct order for installation.

Storage in closed rooms

The following switchgear parts must be stored in closed rooms:

- Unpacked parts
- Transport units which are not packed in seaworthy crates

The storage room must have the following characteristics:

- Well-ventilated
- Free of dust
- Dry and protected against flooding
- Relative humidity should not exceed 50%
- Protected against vermin (e.g. insects, mice, rats)
- Even floor to enable stable storage
- Floor with adequate load-bearing capacity
- Sufficient size to enable clearly arranged storage

⇨ Do not unpack small parts to avoid corrosion and loss.

⇨ Store transport units in such a way that they can be taken out later in the correct order for installation.

⇨ Provide for sufficient ventilation in heated storage rooms.

⇨ Check transport units for condensation every 4 weeks.

⇨ If the inside of the packing or parts of the switchgear show condensation: Remove the packing, dry the switchgear and the packing. Refit the packing.

Outdoor storage

The storage place must have the following characteristics:

- Protected against rain water
- Protected against flooding as well as melting water from snow and ice
- Protected against pollution and vermin (e.g. insects, mice, rats)
- Even floor to enable stable storage
- Floor with adequate load-bearing capacity
- Sufficient size to enable clearly arranged storage

⇨ Place transport units on planks or square timber for protection against floor humidity.

⇨ Store transport units in such a way that they can be taken out later in the correct order for installation.

⇨ After 6 months of storage, unpack the transport units and store them in closed rooms, or regenerate the seaworthy packing (see below).

Regenerating the seaworthy packing

After 6 months of storage, the protection of the seaworthy packing is exhausted. If the transport units still need to be stored outdoors, the seaworthy packing must be regenerated.

⇨ If there is no sufficient knowledge about professional regeneration of the packing: Ask for expert personnel via the competent Siemens representative.

⇨ Open the packings.

⇨ Renew desiccant bags.

⇨ Refit the packings so as to reach full protection: Weld the PE protective foils hermetically tight and rebuild the seaworthy crates completely.

16.5 Tools/auxiliary means

Before starting to work on the switchgear, provide the tools/auxiliary means required:

- Vacuum pump (e.g. DILO type B048R01), DN8 connection
- Dew-point meter (e.g. DILO type 3-035-R001), DN8 connection
- Percentage meter (z. B. DILO type 3-027-R002), DN8 connection
- Leakage detector (e.g. CPS type LS790)
- SF_6 gas filling device (type 3-393-R001)
- Vacuum cleaner with flexible and thin tube
- 1 set roller pads
- Round-steel bars; diameter: 25 mm, length: 1600 mm for double panel + 600 mm for each additional panel
- Chain with transport shackles
- Roller crowbars
- Reinforcing bars
- Racks (crank winch)
- Hydraulic jack (2 to 3 t, for vertical and horizontal stroke)
- Emery paper (K 360)
- Step-ladder
- Cable drum 220V~
- Drill
- Torque wrench 8 – 20 Nm, 20 to 70 Nm
- Shim plates 0.5 to 1 mm
- Cleaning agent HAKU 1025/90
- Soft, lint-free cloth
- Torx reversing ratchet / screwdriver T10/80, T20/100, T25/100, T30/115
- Water level
- Guide string
- Rod magnet with flexible shaft
- Open spanners SW 13, 16, 17, 18, 19, 24, 27, 32 , 36
- Ring spanners SW 13, 16, 17, 18, 19, 22, 24, 27
- Various screwdrivers
- Vernier caliper
- Water pump pliers
- Mirror with flexible shaft (welding mirror)

16.6 Installation and fixing material

Before starting to install the individual components, provide for the required installation and fixing material.

17 Unloading and erecting the transport units

17.1 Packing and transport unit

Packing

The transport units can be packed as follows:

- On pallets, covered with PE protective foil
- In a seaworthy crate (switchgear is sealed with desiccant bags in PE foil)
- Other packings in special cases



NOTE!

The packing material of 8DA switchgear can be disposed of as classified materials.

⇨ Please observe the local regulations for disposal and environmental protection.

Transport unit

Transport units consist of:

- Individual panels or panel groups consisting of up to 4 individual panels
- Accessories

17.2 Checking the delivery for completeness and transport damage

Before installation, the transport units must be checked for completeness and damage.



ATTENTION!

Transport units may be damaged if stored without intact packing.

⇨ If the transport units are stored before installation, open packing for checks only if the packing is damaged so much that the content must be assumed to be damaged as well.

⇨ Refit the packing before installation.

⇨ Observe instructions to intermediate storage (see Page 37, "Intermediate storage").

Checking for completeness

⇨ Check whether the delivery is complete and correct using the delivery note and packing lists.

⇨ Compare the serial number of the switchgear panels on the delivery note with that on the packing and the rating plates of the panels.

⇨ Check whether the accessories are complete.

Checking for transport damage

⇨ Unpack the transport units. Do not unpack parts supplied with the switchgear in order to avoid loss and damage.

⇨ Inform the forwarding agent immediately about any defects or transport damages; if required, refuse to accept the delivery.

⇨ As far as possible, document larger defects and transport damages photographically; prepare a damage report and inform the regional Siemens representative immediately.

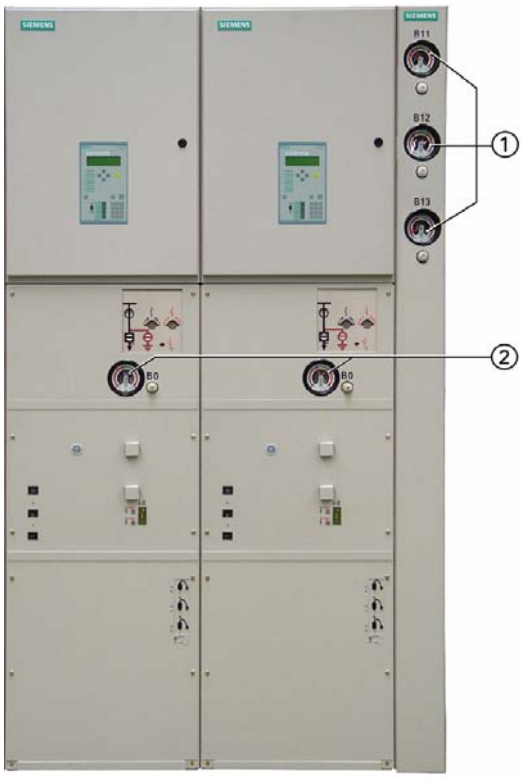
⇨ Have the transport damages repaired, otherwise you may not start installation.

⇨ Check the SF_6 gas pressure.

⇨ Refit the packing.

17.3 Checking the SF_6 gas pressure

The housings of circuit-breakers and non-disconnectable voltage transformers of the switchgear type 8DA are filled with SF_6 gas at the factory. To exclude any gas losses during transportation in the gas compartments filled at the factory, ckeck the gas pressure indicators on the panels.



① Gas pressure indicators for the busbar compartments (number according to the design of the busbar system)

② Gas pressure indicator for the circuit-breaker housing

Fig. 27: Gas pressure indicators at the panel



① Minimum permissible gas pressure (signaling contact))

② Actual gas pressure

③ Maximum permissible gas pressure (signaling contact)

Fig. 28: Gas pressure indicators at the panel



DANGER!

Operation with incorrect SF_6 gas pressure can destroy parts of the switchgear.

⇨ Do not install or put the switchgear into operation with incorrect SF_6 gas pressures.

⇨ Check the gas pressure in the compartments pre-filled at the factory on the associated gas pressure indicators. The values must no drop below the temperature-dependent limit values.

⇨ If the filling pressure is too low: Do not assemble the part of the switchgear concerned and inform the regional Siemens representative concerned.

17.4 Unloading transport units



DANGER!

Risk of injury due to transport units falling down. The transport units can slip off the transport tackle due to the high position of the center of gravity.

⇨ Do not stay under suspended loads.

⇨ Avoid heavy movement of the load.

⇨ Secure the fixing points of the ropes against slipping off.



ATTENTION!

Parts of the switchgear may be damaged by touching ropes or chains when lifted.

⇨ Use transport tackle / expander.

Lifting packed transport units with the crane

To avoid damage and pollution, the transport units should be transported as long as possible in their original packing. Packed transport units are always lifted with the wooden pallet.

⇨ Use transport tackle / expander to prevent the transport units from being damaged by the ropes.

⇨ Sling the ropes around the ends of the wooden pallet.

⇨ Unload the transport units and set them down as close to the switchgear building as possible in order to avoid unnecessary ways.

⇨ Move the transport units into the building, if possible on their wooden pallets. Only remove packing where absolutely necessary in order to keep the switchgear as clean as possible.

⇨ Removeteh foil only in the building, right before assembling the transport units.

Removing transport units from wooden pallets

Unpack transport units and remove from the pallets only if

- there are only short transportation ways left inside the switchgear building, or
- the transport units can be set down with the crane directly at the switchgear building.

The transport unit is screwed on the pallet. The fixing points for transport are located behind the front metal cover in the frame and at the rear cross member.

⇨ Remove the metal covers of the panel frames.

⇨ Remove all fixing bolts.

Lifting unpacked transport units with the crane

To lift the transport unit, two round steel bars with a diameter of 25 mm are required. Minimum length of the round steel bars: Width of transport unit plus 400 mm.

The transport holes for pushing the round bars in are marked on the transport units with a red symbol.



Fig. 29: Position of transport holes



Fig. 30: Marking of transport holes

⇨ Push the round steel bars into the transport holes at the front and at the rear.

⇨ Attach ropes or chains at the ends of the round steel bars.

⇨ Stretch the ropes or chains by lifting the hoisting tackle carefully.

⇨ If the ropes or chains are touching the transport unit, use transport tackle / expander.

⇨ Lift the transport unit carefully.

17.5 Transporting the units to the place of installation

Preparing the switchgear room

	**DANGER!**
	Risk of falling down when crossing provisionally bridged floor openings with the transport units. ⇨ Observe sufficient load-bearing capacity of the bridges. ⇨ Support bridges adequately. ⇨ Secure bridges against displacement.

⇨ Bridge floor openings that have to be crossed and prop up with adjustable supports.

⇨ Fix the bridges to secure them against displacement.

⇨ Clean the switchgear room. Special cleanliness is required.

⇨ Draw a marking line at the place of installation in order to align the switchgear.

⇨ Unpack the transport units inside the switchgear building. Do not unpack parts supplied with the switchgear in order to avoid loss and damage.

Transporting the units with the pallets

	**ATTENTION!**
	Sensitive parts of the switchgear may be damaged during transport. ⇨ Push the transport units only at the corners of the base frame. ⇨ While pushing, take care not to damage any sensitive parts of the switchgear such as gas pipes, bursting discs, shafts, etc.

⇨ Move the transport units as close as possible to the place of installation (switchgear room) by means of lifting trucks or fork-lift trucks.

Lifting the transport unit with hydraulic or lifting jacks

Two round steel bars with a diameter of 25 mm are required which are pushed into the transport holes at the transport unit, same as described for lifting with the crane (see Page 42, "Unloading transport units").

	**DANGER!**
	If they are lifted unevenly, the transport units can fall over due to their high center of gravity. ⇨ Lift the transport units slowly and evenly.

⇨ Push the round steel bars into the transport holes at the front and at the rear.

⇨ Support the hydraulic or lifting jacks with robust and stable platforms so that they will reach the bars in lowered condition.

⇨ Lift the transport unit carefully.

Transporting the unit on roller pads/bars

⇨ Prepare four roller pads (reinforced rollers) or two bars.

⇨ Lift the transport unit as described above.

⇨ Place the roller pads in position at the external corners of the base frame under the vertical frame supports, or lay the bars crosswise under the base frame of the transport unit.

⇨ Lower the transport unit slowly and evenly onto the roller pads.

	**NOTE!**
	A transport unit standing on roller pads can only be moved straight ahead. To change the direction, the position of the roller pads must be changed.

17.6 Setting down the transport units at the place of installation

Depending on the constructional facts in the switchgear room, there are two basic possibilities for setting down the transport units at the place of installation:

1. Setting down from the narrow side of the floor opening	The transport units are moved over the floor opening to the cable basement coming from the narrow side of the floor opening, and are set down side by side
2. Setting down from the long side of the floor opening	The transport units are set down in front of the long side of the floor opening to the cable basement, and are pushed over the floor opening

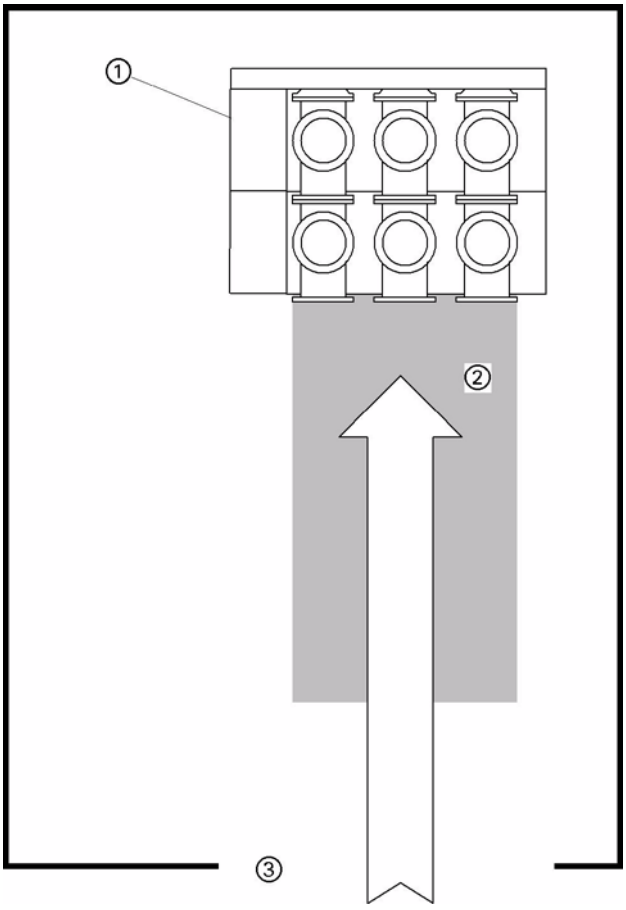


Fig. 31: Setting down from the narrow side of the floor opening

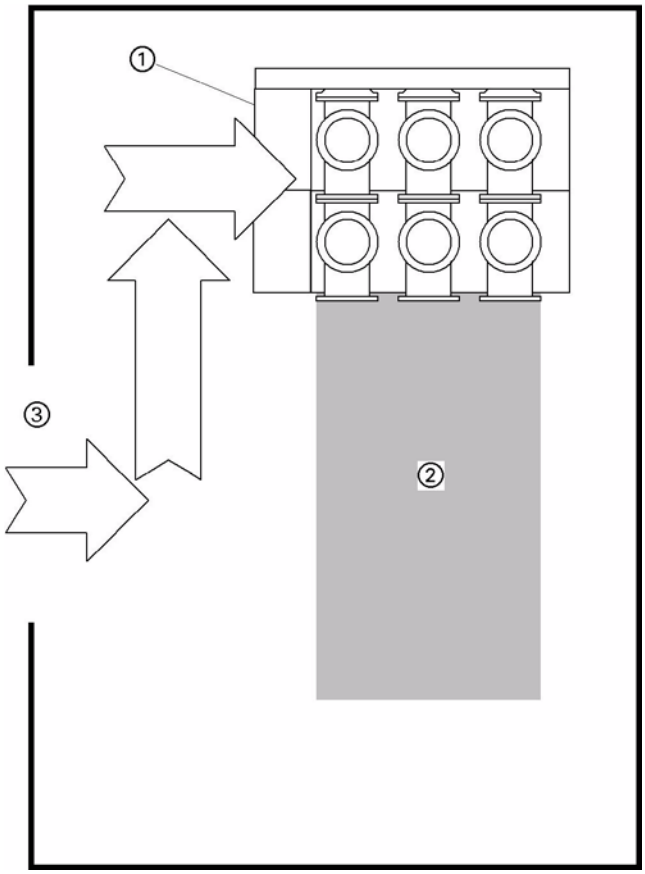


Fig. 32: Setting down from the long side of the floor opening

① Transport unit
② Floor opening
③ Door to the switchgear room

Setting down the transport units from the narrow side of the floor opening

Precondition:
The transport units must be standing on the roller pads / bars without pallets.

	**DANGER!**
	The transport units can fall down when they are moved over the floor opening. ⇨ When moving the transport unit on the floor opening, take care that the roller pads / bars are always touching the foundation completely. ⇨ Check the moving direction of the transport unit all the time.

	**ATTENTION!**
	Without roller pads / bars underneath, the transport units are moved using hydraulic or lifting jacks. The transport units may be damaged. ⇨ Apply auxiliary devices at floor level and only at the base frame of the transport units. ⇨ Place boards under the points where auxiliary devices are applied.

⇨ Roll the first transport unit (end panel) along the floor opening up to its final position.

⇨ Lift the transport unit.

⇨ Remove the roller pads / bars from underneath the transport unit.

⇨ Set down the transport unit carefully.

⇨ Shift the transport unit with hydraulic jacks, lifting equipment or lifting jacks until it is exactly aligned on its mounting position. Prop the hydraulic equipment or jacks up at the surrounding walls.

⇨ Roll the next transport unit along the floor opening, place it at a distance of 500 mm from the first transport unit and align it roughly.

⇨ Lift the transport unit, remove the roller pads / bars and set down the transport unit carefully.

⇨ Proceed in the same way with the other transport units, keeping a distance of 500 mm between them.

Setting down the transport units from the long side of the floor opening

Precondition:
The transport units must be standing on the roller pads / bars without pallet.

	**DANGER!**
	The transport units can fall down when they are moved over the floor opening. ⇨ When moving the transport unit on the floor opening, take care that the roller pads / bars are always touching the foundation completely. ⇨ Check the moving direction of the transport unit all the time.

	**ATTENTION!**
	Without roller pads / bars underneath, the transport units are moved using hydraulic or lifting jacks. The transport units may be damaged. ⇨ Apply auxiliary devices at floor level and only at the base frame of the transport units. ⇨ Place boards under the points where auxiliary devices are applied.

⇨ Roll the first transport unit up to the final position in parallel to the floor opening.

⇨ Lift the transport unit.

⇨ Remove the roller pads / bars from underneath the transport unit.

⇨ To shift the transport unit easily and to protect the floor, shims can be laid under as a sliding aid.

⇨ Set down the transport unit carefully.

⇨ Shift the transport unit with hydraulic jacks, lifting equipment or lifting jacks until it is exactly aligned on its mounting position. Prop the hydraulic equipment or jacks up at the surrounding walls.

⇨ If the transport unit is still partly or totally standing on the shims, remove the shims and carefully set down the transport unit again.

⇨ Roll the next transport unit in front of the floor opening and place it beside the first transport unit at a distance of 500 mm.

⇨ Lift the transport unit.

⇨ Remove the roller pads / bars from underneath the transport unit and lay shims under, if required.

⇨ Set down the transport unit carefully and push it over the floor opening as described above.

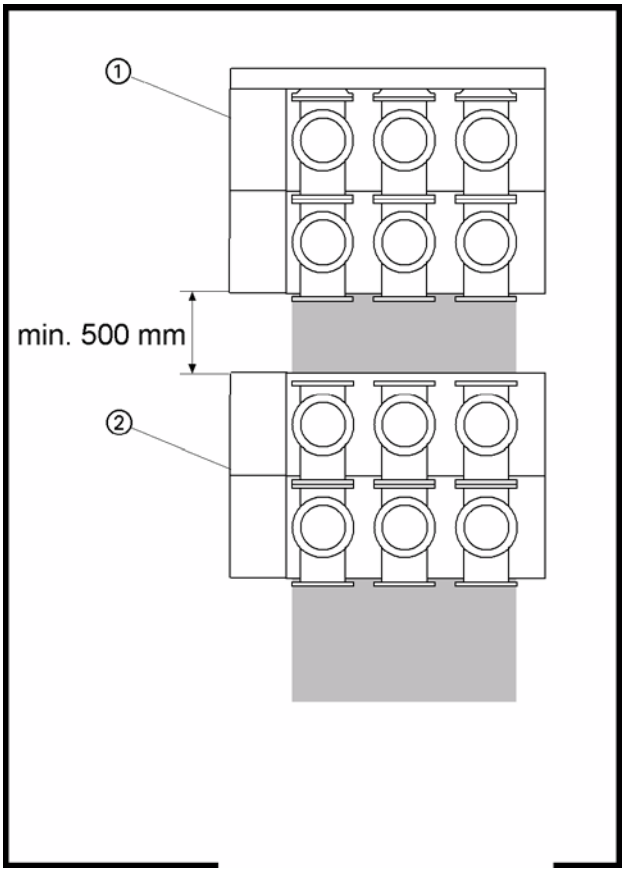
⇨ Align the transport unit roughly, observing a side distance of at least 500 mm.

⇨ Remove the shims from underneath the transport unit as described above.

⇨ Proceed in the same way with all other transport units.

17.7 Aligning the switchgear

To align the switchgear, please follow the illustration below:



① First transport unit, completely aligned

② Other transport units, roughly aligned

Fig. 33: Position of the transport units after erection

⇨ Align the first transport unit (end panel) completely and bolt it to the foundation (see Page 34, "Installation dimensions and floor fixing").

⇨ Just align the other transport units (panels) roughly first.

⇨ Keep a distance of at least 500 mm between the transport units for the following installation work.

If not all parts of the switchgear can be brought into the switchgear room before installation due to the little space available, proceed as follows:

⇨ Place as many transport units as possible side by side.

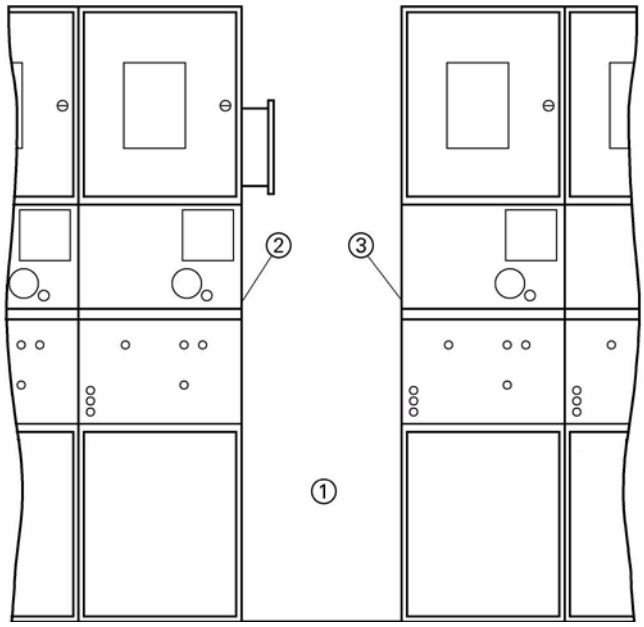
⇨ Mount these transport units.

⇨ Put other transport units on the free space left, etc.

18 Assembling the switchgear

	**NOTE!** The activities described hereafter must be carried out by qualified personnel who is familiar with installation of switchgear type 8DA. ⇨ The switchgear assembling must be done by qualified personnel.

The points the transport units are interconnected at are called **panel joints** hereafter.



① Panel joint
② Transport unit on the left of the panel joint
③ Transport unit on the right of the panel joint

Fig. 34: Term "panel joint"

Precondition: The transport units are standing in the switchgear room and are aligned for assembly (see Page 49, "Aligning the switchgear").

Procedure: Repeat the following operations for all transport units until final assembly.

18.1 Preparing busbar assembly

Removing the transport blocks

During transport, fixing brackets retain the busbars at the open flange connections of the busbar housings. The fixing brackets are bolted together with the flanges of the busbar housings and the busbar ends.

	ATTENTION!
	If the switchgear is transported without transport blocks (fixing brackets), parts of the switchgear may be damaged. ⇨ Do not remove the transport blocks until right before assembly. ⇨ Do not move the transport units over longer distances without transport blocks.

⇨ Switch all three-position disconnectors of the transport units located on the right ③ and on the left ② of the panel joint to READY-TO-EARTH position.

⇨ If there are any make-proof busbar earthing switches: Switch the make-proof busbar earthing switches to OPEN position.

⇨ Remove the fixing brackets from all flanges at the panel joint.

Preparing busbar assembly on the panel located on the right of the busbar joint

This operation is **only** performed if there is a horizontal flange cover available on the busbar housing of the panel located on the right of the panel joint.

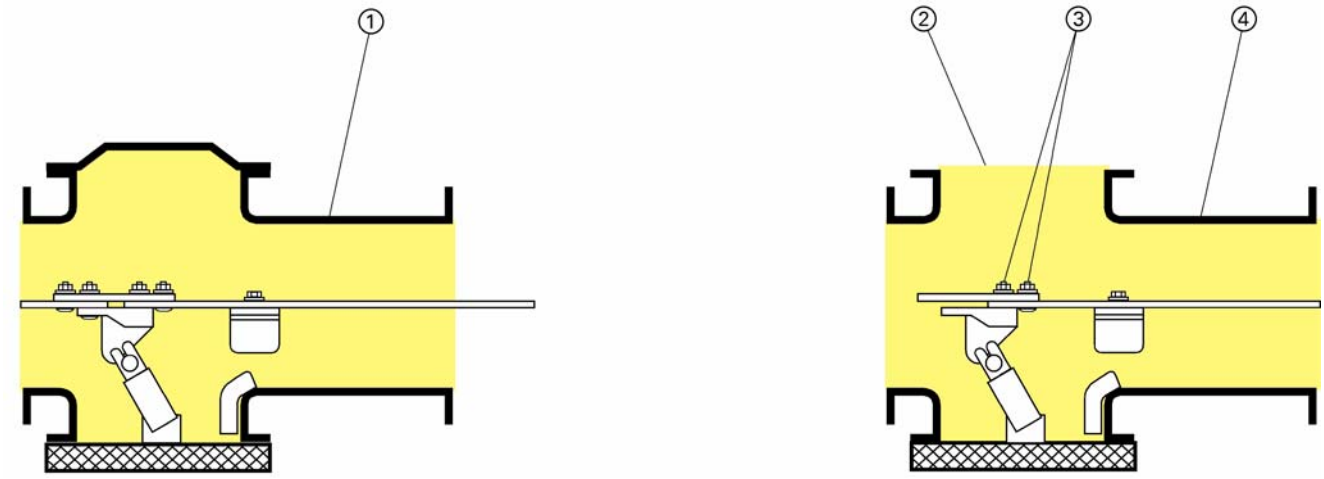


Fig. 35: Preparing busbar assembly on the panel located on the right of the panel joint

① Busbar housing of the panel located on the left of the panel joint

② Assembly openings (horizontal flanges) in the busbar housings of the panel located on the right of the panel joint

③ Rear fixing bolts

④ Busbar housing of the panel located on the right of the panel joint

⇨ Remove all horizontal flange covers from the assembly openings ② on the busbar housings ④ of the panel located on the right of the panel joint.

⇨ Loosen the rear fixing bolts ③ at the busbar ends.

Re-assembling the busbars

This operation is **only** performed if one of the following devices is mounted on the busbar housings of the panel located on the right of the panel joint:

- Disconnectable busbar connection
- Disconnectable busbar voltage transformer
- Make-proof busbar earthing switch
- Top-mounted busbar sectionalizer

In these cases, the busbar joints are not accessible anymore after the transport units have been interconnected.

For this reason, the busbar sections must be re-assembled from the panel on the left of the panel joint to the panel on the right before starting the assembly.
The illustrations below show the final position after re-assembling.

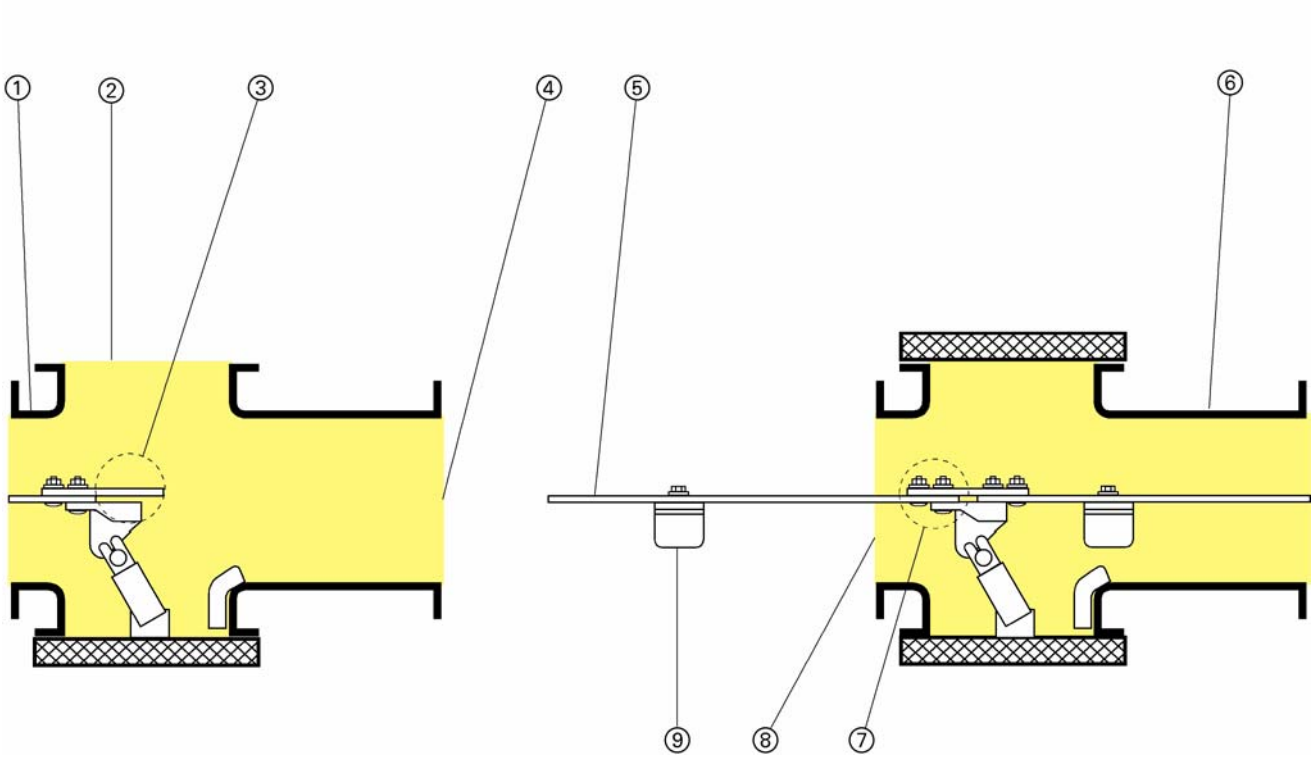


Fig. 36: Re-assembling the busbars

① Busbar housing of the panel located on the left of the panel joint
② Assembly openings (horizontal flanges)
③ Joints of the panel located on the left of the panel joint
④ Vertical flanges of the panel located on the left of the panel joint
⑤ Busbar sections
⑥ Busbar housing of the panel located on the right of the panel joint
⑦ Joints of the panel located on the right of the panel joint
⑧ Vertical flanges of the panel located on the right of the panel joint
⑨ Busbar support

- ⇨ Clear the assembly opening ② : Remove all horizontal flange covers on the busbar housings ① of the panel located on the left of the panel joint.
- ⇨ Undo the busbar sections ⑤ at the joints ③ in the busbar housing through the assembly opening ②. The busbar supports ⑨ remain on the disassembled busbar sections.
- ⇨ Take the busbar sections ⑤ out of the housings together with the associated busbar supports ⑨ through the vertical flange ④.
- ⇨ Mount the busbar sections at the joints ⑦ in the busbar housings ⑥ of the panel located on the right of the panel joint. Assembly takes place through the vertical flanges ⑧.
- ⇨ Check alignment and parallel position of the assembled busbar sections and correct if required.

Special configurations of the interconnected busbar

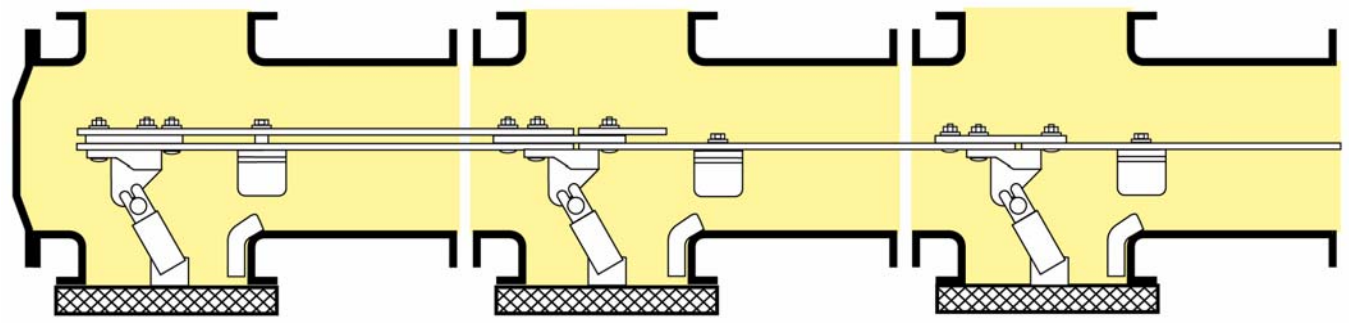


Fig. 37: 1250 A Busbar assembly, left end panel

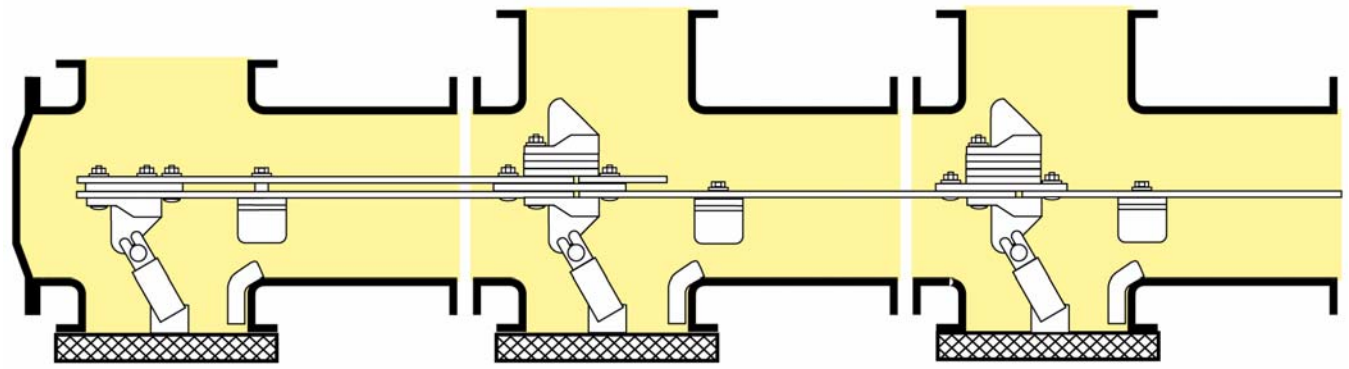
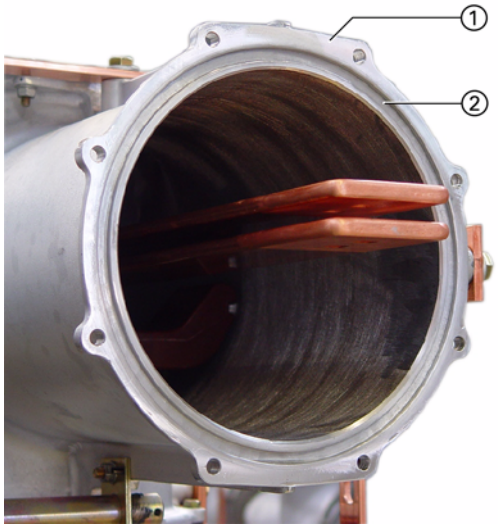


Fig. 38: 1250 A Busbar assembly, left end panel, adjacent panel with disconnectable busbar components

Preparing the flanges of the busbar housings



① External contact surface of the flange
② Groove for O-ring

Fig. 39: Flange on the busbar housing

⇨ Clean all vertical flanges of the busbar housings at the panel joint and the grooves for the sealing rings carefully with lint-free paper.

⇨ Carefully check the external contact surfaces ① of the flanges and the grooves ② for scratches, other damages or pollution. Damages and pollution will cause leaks.

⇨ If any external contact surfaces or grooves are damaged: Inform the regional Siemens representative and co-ordinate the elimination of damages.

⇨ Apply a thin film of the supplied mounting paste on the external contact surfaces of the flanges and the O-rings (sealing rings). To do this, apply a grease strip of approx. 3 mm thickness on the external contact surfaces of the flanges.

⇨ Put the O-rings into the grooves of the flanges.

18.2 Installing the transport unit

Positioning the transport unit

The transport unit to be attached is moved evenly by two people, if possible, using hydraulic hoisting cylinders, hydraulic jacks or lifting jacks. A third person acts as an **observer** and corrects the joining of the busbar sections and the flanges during the process.

	**ATTENTION!** When joining the transport units, the busbar supports may be damaged. ⇨ Join the transport units carefully. ⇨ Observe the position of the busbar supports.

	**ATTENTION!** Without roller pads / bars underneath, the transport units are moved using hydraulic equipment or lifting jacks. The transport units may be damaged. ⇨ Apply auxiliary devices at floor level and only at the base frame of the transport units. ⇨ Place boards under the points where auxiliary devices are applied.

	**ATTENTION!** Sensitive parts of the switchgear may be damaged during installation work at the busbar and the busbar housings. ⇨ While working at the busbars or the busbar housings, prop up only on the base frame of the transport unit. ⇨ Do not prop up on sensitive parts of the switchgear like gas pipes, bursting discs, shafts, etc.

⇨ Apply one lifting gear each at the rear and at the front of the base frame of the transport unit to be shifted. Prop the lifting gear up at the surrounding walls.

⇨ Place one person in observer position at the already mounted transport unit. The observer must watch the movement of the flanges and the busbars and must be able to reach the busbar sections by hand through the assembly openings.

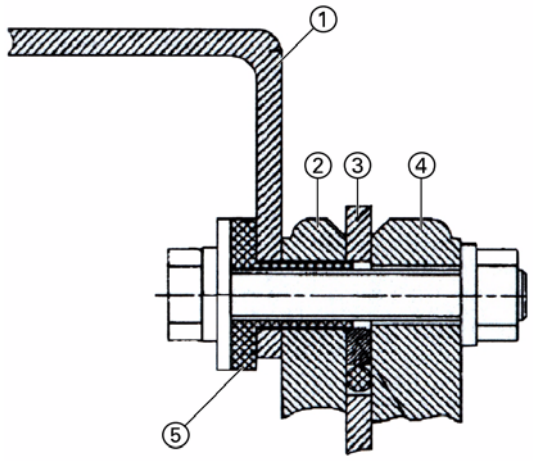
⇨ If the flange connections are equipped with a compensator or insulating joint: Fix the associated insulating rings / insulating plates provisionally at the flange side of the already fixed-mounted transport unit.

⇨ On the observer´s command, push the transport unit to be attached towards the already mounted one using the lifting gear. The observer checks and corrects the approach of the busbar sections.

⇨ Continue approaching the transport units until the flanges touch evenly.

⇨ In case of deviations, correct the position of the transport unit, compensating any floor unevenness with shims under the corners (same points as for roller pads / bars).

Bolting the flanges of the busbar housings together



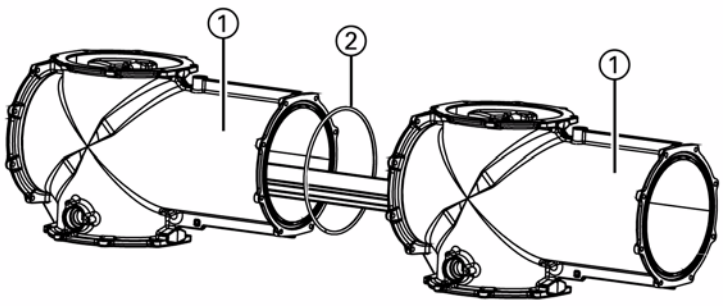
① Current transformer mounting plate
② Flange
③ Insulating ring
④ Compensator
⑤ Insulating sleeve

Fig. 40: Flange connections with insulating sleeve

Bolting the flanges of the busbar housings together

	**ATTENTION!** Sensitive parts of the switchgear may be damaged during installation work at the busbar and the busbar housings. ⇨ While working at the busbars or the busbar housings, prop up only on the base frame of the transport unit. ⇨ Do not prop up on sensitive parts of the switchgear like gas pipes, bursting discs, shafts, etc.

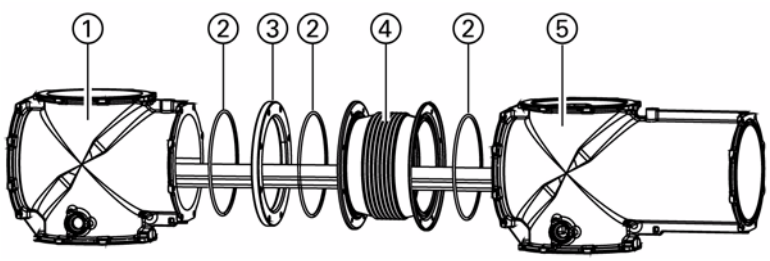
⇨ **Flange-to-flange connections:**
Tighten M8x40 bolts crosswise.
Tightening torque: 20 Nm.



① Busbar housing
② O-ring

Fig. 41: Flange-to-flange connection

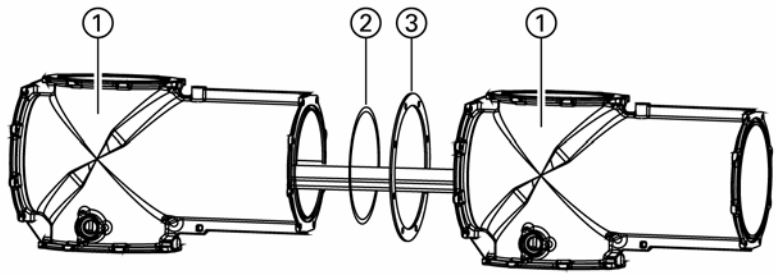
⇨ **Flange connections with compensator:**
Push insulating ring between the flanges.
Fasten M8x55 bolts crosswise with one insulating sleeve each.
Tightening torque: 20 Nm.



① Busbar housing (bolts M8x55)
② O-ring
③ Insulating ring (thickness: 18 mm)
④ Compensator
⑤ Busbar housing (bolts M8x35)

Fig. 42: Short busbar housing with compensator

⇨ **Flange connections with insulating joint:**
Push insulating ring between the flanges.
Fasten M8x45 bolts crosswise with one insulating sleeve each.
Tightening torque: 20 Nm.



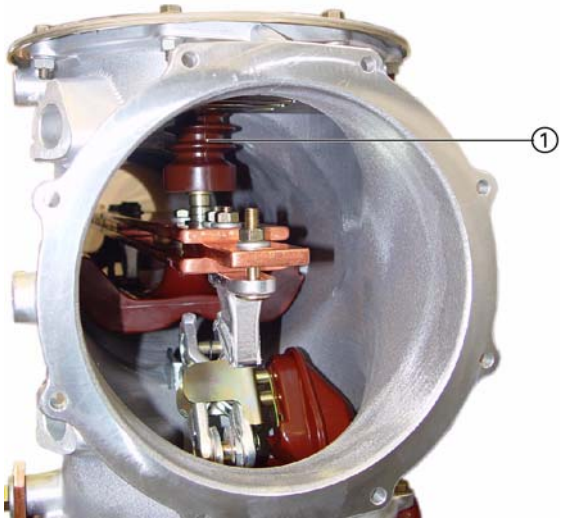
① Busbar housing
② O-ring
③ Insulating ring (thickness: 4 mm)

Fig. 43: Long busbar housing with insulating joint

Bolting busbars together

The busbars are accessed throuogh the horizontal flanges of the busbar housings (assembly openings).

⇨ Check whether the busbar has been pre-assembled with a post insulator ①



⇨ Align busbar and post insulator horizontally with each other using the clearance of the busbar hole.

⇨ Align the busbars and the links so that the busbar sections are in line and the fixing bolts will fit through the holes.

⇨ Tighten the fixing bolts just a little. The busbar sections must still be able to move.

18.3 Installing further transport units

⇨ Repeat the work operations (see Page 50, "Assembling the switchgear") until all transport units are installed.

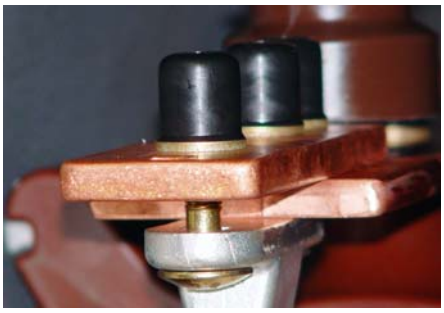
18.4 Completing switchgear installation

As a precondition for this work, the switchgear must have been completely assembled as described above (see Page 50, "Assembling the switchgear").

Tightening the busbar fixing bolts

⇨ Tighten the fixing bolts of all busbars and fixed contacts at all panel joints of the switchgear. Tightening torque: 40 Nm.

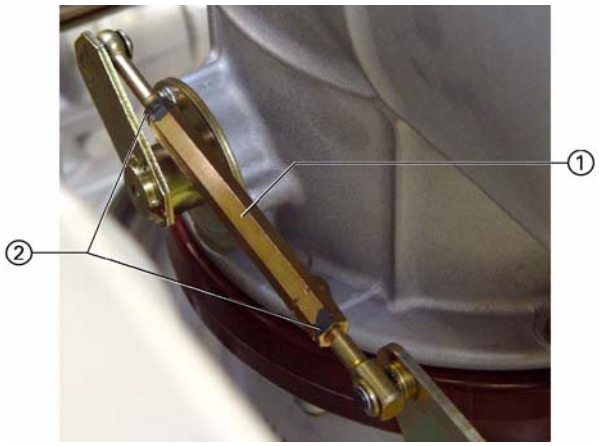
⇨ Then fit the protective caps on the busbar joints.



⇨ Check overlapping of disconnector contacts using a mirror. In the CLOSED position, the contact blades must hold the fixed contacts centrally.

⇨ If the contact blades do not hold the fixed contacts centrally in the CLOSED position, the contact overlapping must be corrected with the disconnector coupling rod (see below).

Correcting contact overlapping of disconnector contacts



① Hexagonal sleeve of the disconnector coupling rod

② Lock nuts

Fig. 44: Disconnector coupling rod

⇨ Undo the lock nuts ② at the hexagonal sleeve of the disconnector coupling rod ①.

⇨ Modify the length of the disconnector coupling rod by turning the hexagonal sleeve ① until the contact blades hold the fixed contacts centrally in the CLOSED position.

⇨ Tighten the lock nuts ② again. Tightening torque: 20 Nm.

Mounting busbar housing covers without desiccant bag holders

	ATTENTION!
	In the ambient air, the desiccant bags lose their effectiveness rapidly and cannot be used anymore. ⇨ Use only desiccants bags whose packing is not damaged and whose humidity indicators in the packing are **blue**. ⇨ Do **not** use desiccant bags if the humidity indicators are **pink**. ⇨ After opening the packings, mount the desiccant bags in the gas compartment within 30 minutes and close the gas compartment hermetically.

For this reason, the busbar housing covers **without** a holder for desiccant bags are mounted first (cover **without** "Filter" inscription).

⇨ Remove tools, clean the inside of the housings with a hand vacuum cleaner, and clean the bushing plates with a rag.

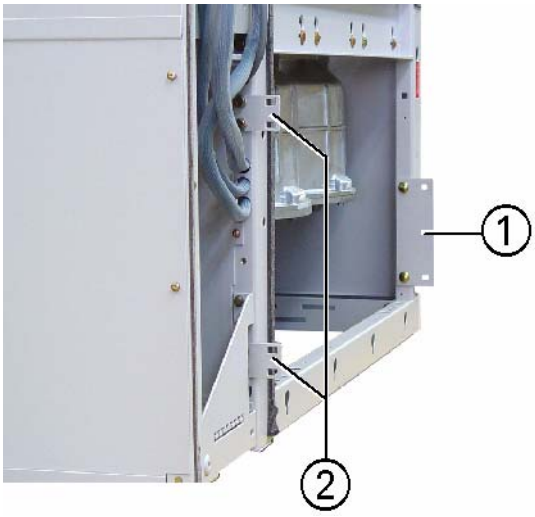
⇨ Prepare the flanges of the cleaned busbar housings for assembly (see Page 51, "Preparing busbar assembly").

⇨ Clean the sealing surfaces of the busbar housing covers with a lint-free paper, and apply a thin film of grease (see Page 51, "Preparing busbar assembly").

⇨ Put the covers on the prepared flanges and bolt them tight crosswise. Tightening torque: 20 Nm.

Bolting supporting frames together

The supporting frames of the transport units are bolted together at the panel joints using connecting links at the front and a connecting plate at the rear.



① Connecting plate (rear)
② Connecting links (front)

Fig. 45: Bolting supporting frames together

⇨ Align adjacent connecting links at the supporting frames. Holes must be in line.

⇨ Bolt transport units together at the front connecting links using four bolts M10x20 (tightening torque 40 Nm), and at the rear connecting plate using two coach bolts M10x20 (tightening torque 40 Nm).

Fastening the panels to the foundation

⇨ Fasten the panels to the foundation
(see Page 34, "Installation dimensions and floor fixing").

Bolting earthing busbars together

The earthing busbar runs at the rear of the supporting frames.
The units overlap and are interconnected with two bolts each.



① Earthing busbar section folded upwards (as-delivered)
② Joint
③ Pre-assembled earthing busbar section

Fig. 46: Bolting earthing busbars together

⇨ Remove left-hand bolt at the joint ② (see illustration).

⇨ Undo right-hand bolt at the joint ② and fold the earthing busbar section ① to the left into horizontal position.

⇨ Bolt the earthing busbar section ① together with the earthing busbar of the next transport unit using 2 bolts. Tightening torque: 70 Nm.

⇨ Refit the removed bolt at the joint ② and tighten the two bolts at the joint. Tightening torque: 70 Nm.

⇨ Proceed in the same way with all other transport units until all earthing busbar ends of the switchgear are interconnected.

Earthing the panels

The cross-sections and materials of the earthing conductors are specified in the DIN/VDE 0141 standard or in the relevant country-specific standards.

⇨ Connect the earthing busbar to the substation earth.

Recommendation: In case of panel groups, earth the end panels (M12 bolts) and every fifth panel at least.

19 Installation work with SF_6 gas before commissioning

If a rated short-duration power-frequency withstand voltage test has to be carried out at site, the work with insulating sulphur hexafluoride gas (SF_6) described in this section must be performed in advance.



DANGER!

SF_6 gas is heavier than air and concentrates first near to the floor and in floor openings. Danger of suffocation!

⇨ Do not let SF_6 gas get into the environment.

⇨ While working with SF_6 gas, provide for sufficient ventilation.

⇨ After working with SF_6 gas, vent the cable basement and any hollows in the floors with special care.

⇨ Observe the safety data sheet for SF_6 gas.

19.1 Completing busbar assembly and filling with SF_6 gas

The individual phases and sections of the busbar (called **busbar runs** hereafter) must be filled with SF_6 gas at site. Each busbar run forms one gas compartment.

Busbar runs within one transport unit that are already filled and closed hermetically at the factory **are not refilled with SF_6 gas on site.**

All parts of the switchgear that have to be filled with gas are equipped with desiccant bags in order to eliminate residual humidity in the gas filling. In ambient air, the desiccant agent loses its effectiveness rapidly.

To expose the desiccant bags as briefly as possible to the ambient air, the following installation and gas work is performed **completely on one busbar run**, and is then continued on the next busbar run, etc.

Preparing the busbar run for filling gas

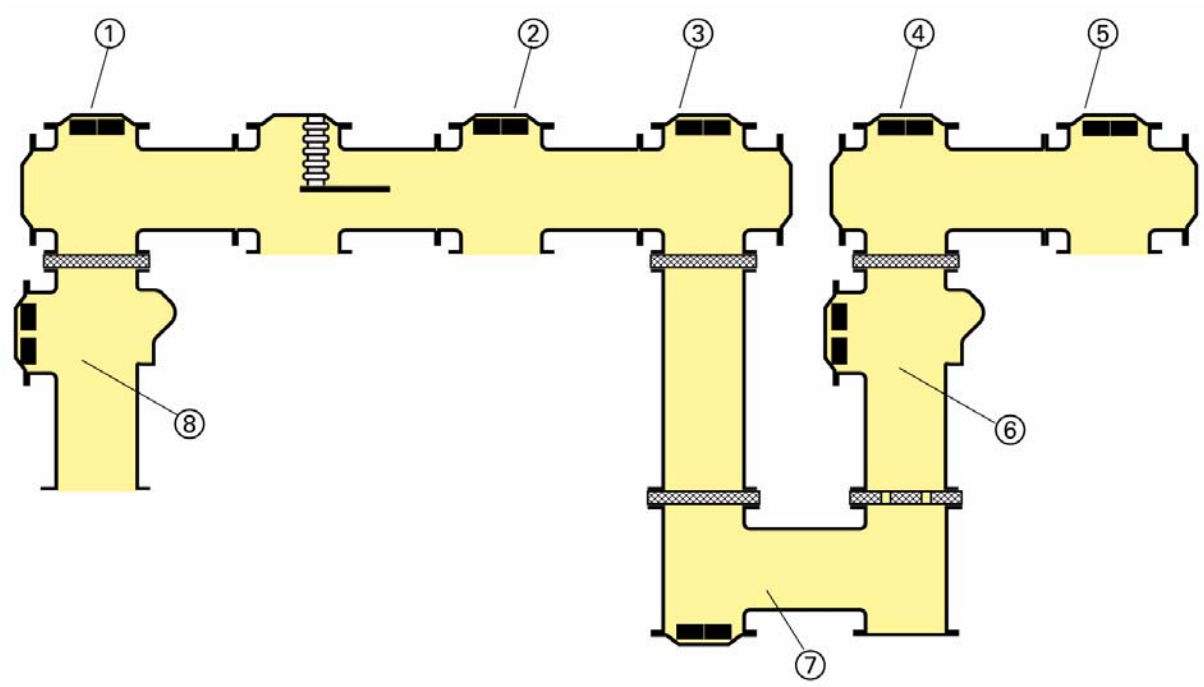


Fig. 47: Desiccant bags in the gas compartments (position identified in the illlustration by black squares; on the switchgear, with the inscription „Filter“ on the outside)

Item no.	Designation	Desiccant bags
①	Busbar housing, left end panel	2 x 250 g
②	Busbar housing, general type with "Filter" inscription on the cover	2 x 250 g
③	Busbar housing, left-hand panel of bus sectionalizer	2 x 250 g
④	Busbar housing, right-hand panel of bus sectionalizer	2 x 250 g
⑤	Busbar housing, right end panel	2 x 250 g
⑥	Bus riser housing of bus sectionalizer	2 x 250 g
⑦	Connection housing of bus sectionalizer	2 x 250 g
⑧	Circuit-breaker housing, general type	2 x 250 g

	NOTE!
☞	If the circuit-breaker housing of a bus sectionalizer is mounted in the right-hand panel, the interconnection housing of the bus sectionalizer ⑦ is located in the left-hand panel.



ATTENTION!

In the ambient air, the desiccant bags lose their effectiveness rapidly and cannot be used anymore.

⇨ Use only desiccant bags whose packing is not damaged and whose humidity indicators in the packing are **blue**.

⇨ Do **not** use desiccant bags if the humidity indicators are **pink**.

⇨ After opening the packings, mount the desiccant bags in the gas compartment within 30 minutes and close the gas compartment hermetically.

⇨ Remove all covers with the **"Filter"** inscription from the housings of one busbar run.

⇨ Clean busbar housings that are dirty inside with a hand vacuum cleaner. In this case, clean the bushing plates too with a rag.

⇨ Prepare the flanges of the busbar housings for assembly
(see Page 51, "Preparing busbar assembly").

⇨ Clean the sealing surfaces of the busbar housing covers with a lint-free paper, and apply a thin film of grease.

⇨ Determine the size of the desiccant bags required for each busbar housing and place the originally packed desiccant bags at the corresponding covers.

⇨ Take the desiccant bags out of the packings and lay them completely into the associated holder in the covers.

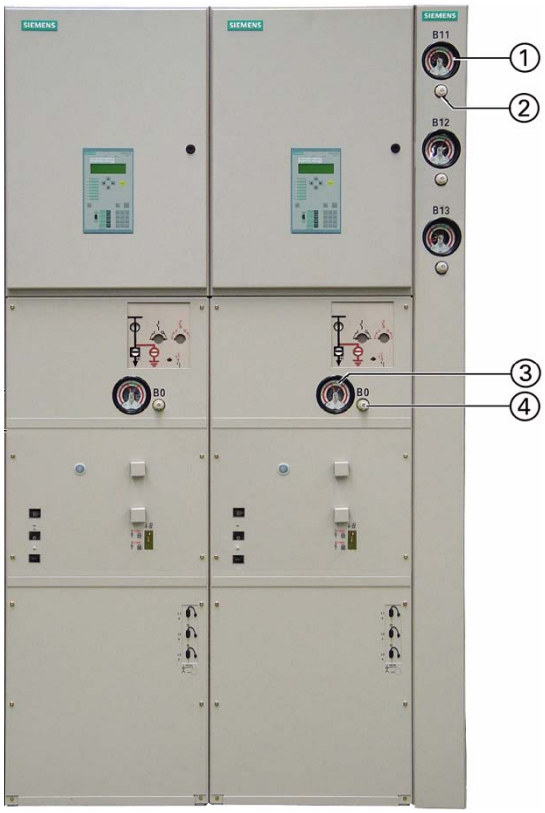
⇨ Put the busbar cover with the bags into position, observing that no part of the bags is jammed in the sealing surfaces in order to prevent leaks.

⇨ Bolt the covers tight crosswise. Tightening torque: 20 Nm.

Evacuating the busbar run with the vacuum pump

Before filling SF_6 gas in, the air must be removed from the busbar run to be filled with gas (evacuation). One of the metal covers next to the right and left end panel of the switchgear contains the pressure indicators and maintenance valves for all busbar runs.

Evacuating a five-panel busbar run takes about 30 to 40 minutes.



① Pressure indicator for busbar housings (number according to design of busbar system)

② Gas filling valve for busbar housings (number according to design of busbar system)

③ Pressure indicator for circuit-breaker housing

④ Gas filling valve for circuit-breaker housing

Fig. 48: Pressure indicators and maintenance valves at the switchgear front

⇨ Undo the locking cap of the maintenance valve ② for the completely closed busbar run.

⇨ Connect the vacuum pump to the valve of the busbar run ②.
Use short tubes with the largest inside diameter possible.

⇨ Evacuate the housings down to a pressure of less than 2 kPa.
Manometer indication: -100 kPa.
Measure the pressure with the vacuum pump locked.

⇨ Depending on the inside diameter and length of the vacuum pump tube, let the pump operate for another 5 to 15 minutes.

⇨ Remove the pump tube. The maintenance valve closes automatically.

Filling the busbar run with an SF_6 gas cyclinder

⇨ Determine the filling pressure required according to the rating plate and the data given in Section "Technical data" (see "Description" 14.4, Page 22).
The pressure depends on the gas temperature.

⇨ Connect the SF_6 gas cylinder to the maintenance valve of the evacuated busbar run.

⇨ Fill SF_6 into the busbar run until the necessary pressure is reached.
Check the filling pressure on the pressure indicator of the busbar run and on the pressure indicator of the gas filling equipment.

⇨ Remove the connecting tube of the gas cylinder from the maintenance valve.
The maintenance valve closes automatically.

⇨ Refit the locking cap of the maintenance valve.

⇨ The limit value indicators on the pressure indicator of the busbar run have been pre-adjusted at the factory. Check the limit pressures according to the table and the graphics, and correct with the supplied square socket spanner in case of deviations.

Completing the assembly of further busbar runs and filling with SF_6 gas

⇨ Fill all other busbar runs as described above
(see Page 62, "Completing busbar assembly and filling with SF_6 gas").

19.2 Assembling panel connections supplied separately, and filling circuit-breaker housings with SF_6 gas

For the installation of panel connections that are supplied separately, the circuit-breaker housing is not filled with SF_6 gas at the factory.

To expose the desiccant bags as briefly as possible to the ambient air, the installation work described hereafter is performed **completely on one circuit-breaker housing in one panel**.

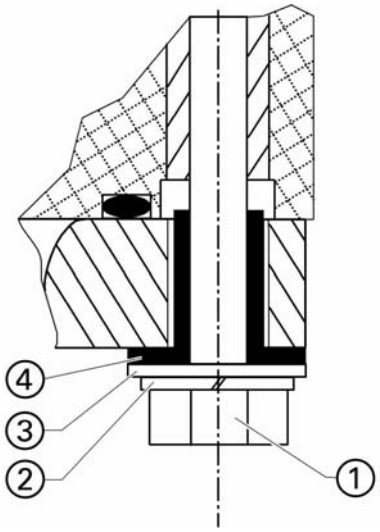


ATTENTION!

Desiccant bags that have been fitted in the circuit-breaker housings at the factory are not effective anymore if the housings remain open for more than half an hour.

⇨ Replace desiccant bags in circuit-breaker housings that have been open for more than half an hour.

Assembling panel connections supplied separately



① Bolt M8x45
② Contact washer
③ Plain washer
④ Insulating sleeve

Fig. 49: Bolted joint of flange for panel connections

⇨ Remove the provisional cover located underneath the circut-breaker housing.

⇨ Prepare the flange of the circuit-breaker housing and the flange of the panel connection for assembly.

⇨ Observe that the contact laminations are greased. The mounting paste for the busbar asembly can be used for this purpose.

⇨ Bolt the panel connection crosswise to the flange of the circuit-breaker housing using M8x45 bolts ①, contact washers ②, plain washers ③ and with one insulating sleeve ④ each. Tightening torque: 20 Nm.

⇨ Connect the earthing cable.

⇨ Repeat the above work operations for all other panel connections in the same panel.

Replacing desiccant bags in the circuit-breaker housings

The desiccant bags are located behind the cover of the bursting disc at the side of the circuit-breaker housing. The cover has the inscription "Filter".



① Cover of bursting disc

Fig. 50: Cover of bursting disc on circuit-breaker housing

	**ATTENTION!** In the ambient air, the desiccant bags lose their effectiveness rapidly and cannot be used anymore. ⇨ Use only desiccant bags whose packing is not damaged and whose humidity indicators in the packing are **blue**. ⇨ Do **not** use desiccant bags if the humidity indicators are **pink**. ⇨ After opening the packings, mount the desiccant bags in the gas compartment within 30 minutes and close the gas compartment hermetically.

⇨ Remove the lateral cover of the bursting disc with the **"Filter"** inscription on **one** circuit-breaker housing.

⇨ Unpack two new desiccant bags of 250 g each per pole, and put them completely into the holder.

⇨ Prepare the housing flange for assembly.

⇨ Clean the sealing surfaces of the cover of the bursting disc with a lint-free paper, and apply a thin film of grease.

⇨ Put the cover of the bursting disc with the bags into position, observing that no part of the bags is jammed in the sealing surfaces in order to prevent leaks.

⇨ Bolt the covers tight crosswise. Tightening torque: 20 Nm.

⇨ Repeat the above work operations for all circuit-breaker housings on the same panel where the desiccant bags must also be fitted.

⇨ After completing the replacement of desiccant agent in the panel, evacuate the circuit-breaker housings and fill them with SF_6 gas (see below).

Evacuating the circuit-breaker housings with the vacuum pump

The circuit-breaker housings of one panel form a common gas compartment. Before filling SF_6 gas in, the air must be removed from the circuit-breaker housings (evacuation).

The pressure indicator and the maintenance valve for the circuit-breaker housings of one panel are located on the right side of the housing front (see Fig. 23:, Page 35).

⇨ Undo the locking cap of the maintenance valve for the circuit-breaker housings.

⇨ Connect the vacuum pump to the valve. Use short tubes with the largest inside diameter possible.

⇨ Evacuate the housings down to a pressure of less than 2 kPa.
Manometer indication: -100 kPa.
Measure the pressure with the vacuum pump locked.

⇨ Depending on the inside diameter and length of the vacuum pump tube, let the pump operate for another 5 to 15 minutes.

⇨ Remove the pump tube. The maintenance valve closes automatically.

Filling the circuit-breaker housings with SF_6 gas

- ⇨ Determine the filling pressure required according to the rating plate and the data given in Section "Technical data" (see OPERATING INSTRUCTIONS, "Technical data"). The pressure depends on the gas temperature.
- ⇨ Connect the SF_6 gas cylinder to the maintenance valve of the evacuated circuit-breaker housings.
- ⇨ Fill SF_6 into the circuit-breaker housings until the necessary pressure is reached. Check the filling pressure on the pressure indicator of the circuit-breaker housings and on the pressure indicator of the gas filling equipment.
- ⇨ Remove the connecting tube of the gas cylinder from the maintenance valve. The maintenance valve closes automatically.
- ⇨ Refit the locking cap of the maintenance valve.
- ⇨ Adjust the limit pressures on the pressure indicator for the circuit-breaker housings with the supplied square socket spanner (see OPERATING INSTRUCTIONS, "Insulating gas SF6 ").

Evacuating and filling the circuit-breaker housings with the maintenance unit

The procedure to be followed corresponds to the work operations described above for evacuating and filling without maintenance unit. As against working with vacuum pump and gas cylinder, the maintenance unit offers better environmental protection due to reduced SF_6 losses.

The same gas pressure data apply as for filling with gas cylinder.
Observe the operating instructions of the maintenance unit!

19.3 Installing solid-insulated bars at the panel connection, and filling the circuit-breaker housings with SF_6 gas

When solid-insulated bars are installed, the circuit-breaker housings are ventilated. The circuit-breaker housings are already equipped with desiccant bags for eliminating the residual humidity in the gas filling. In ambient air, the desiccant agent loses its effectiveness rapidly.

To expose the desiccant bags as briefly as possible to the ambient air, the following work operations are performed **completely for one bar connection on one panel**.



ATTENTION!

Desiccant bags that have been fitted in the circuit-breaker housings at the factory are not effective anymore if the housings remain open for more than half an hour.

⇨ Replace desiccant bags in circuit-breaker housings that have been open for more than half an hour.

Mounting solid-insulated bars

⇨ Remove provisional cover from one of the circuit-breaker housings.

⇨ Write down the beginning of the ventilation time of the circuit-breaker housing.

⇨ Prepare the flange of the solid-insulated bar and the connection flange of the circuit-breaker housing for assembly.

⇨ Bolt the solid-insulated bar tight using bolts ①, contact washers ② and plain washers ③. Tightening torque: 20 Nm.

⇨ If the circuit-breaker housing was ventilated for more than half an hour, replace the desiccant bags (see Page 66, "Assembling panel connections supplied separately, and filling circuit-breaker housings with SF_6 gas").

⇨ Evacuate the circuit-breaker housings and fill with SF_6 gas (see Page 66, "Assembling panel connections supplied separately, and filling circuit-breaker housings with SF_6 gas").

⇨ Repeat the above work operations for all other bars in the same panel.

20 Performing the power-frequency voltage test

The transport units are already tested at the factory at rated short-duration power-frequency withstand voltage. On the customer´s request, the dielectric strength of the switchgear can be tested on site. This is a repeat test at 80% of the values according to IEC 60044-2.

Preparing the power-frequency voltage test

	**DANGER!**
	High voltage! Danger! If the panel feeders are included in the rated short-duration power-frequency withstand voltage test, the panel connections are live during the test. ⇨ Keep a minimum distance of 3 m to the panel connections.

	**ATTENTION!**
	If the rated short-duration power-frequency withstand voltage test is performed incorrectly, the switchgear may be damaged. ⇨ Do not perform a rated short-duration power-frequency withstand voltage test without the manufacturer´s assistance.

	**ATTENTION!**
	Already mounted non-disconnectable inductive voltage transformers which are not suitable for tests at 80% values according toh IEC 60044-2 will be damaged during the rated short-duration power-frequency withstand voltage test. ⇨ Remove already mounted non-disconnectable inductive voltage transformers. ⇨ Do not install non-disconnectable inductive voltage transformers until the rated short-duration power-frequency withstand voltage test has been completed.

- ⇨ Check the SF_6 gas filling (see Page 41, "Checking the SF_6 gas pressure").
- ⇨ Earth all disconnectable inductive voltage transformers at the feeder through the associated voltage transformer disconnector.
- ⇨ Before the test, remove non-disconnectable voltage transformers which are not suitable for tests at 80% values according to IEC 60044-2.
- ⇨ For 4MT3: Close transformer bushings with surge-proof caps.
- ⇨ For 4MU4 and 4MT7: Fit surge-proof dummy plug on sockets.
- ⇨ For the rated short-duration power-frequency withstand voltage test, switch the circuit-breaker and the three-position disconnector in the incoming panel to CLOSED position.
- ⇨ Close all free sockets in the test section with dummy cable plugs.
- ⇨ Earth and short-circuit all test sockets of the voltage detecting system.
- ⇨ Switch all other three-position disconnectors to READY-TO-EARTH position.
- ⇨ Apply the power-frequency test voltage in a surge-proof way at the cable connection bushing via test adapters.
- ✔ Now you can perform the rated short-duration power-frequency withstand voltage test.

Performing the power-frequency voltage test

- ⇨ Apply 80 % of the rated short-duration power-frequency withstand voltage consecutively to phases L1, L2 und L3 for 60 seconds each.

Completing the power-frequency voltage test

- ⇨ Switch the voltage transformer disconnector of the disconnectable voltage transformers to CLOSED position.
- ⇨ After the test, mount non-disconnectable voltage transformers which are not suitable for tests at 80% values according to IEC 60044-2.

21 Installing voltage transformers

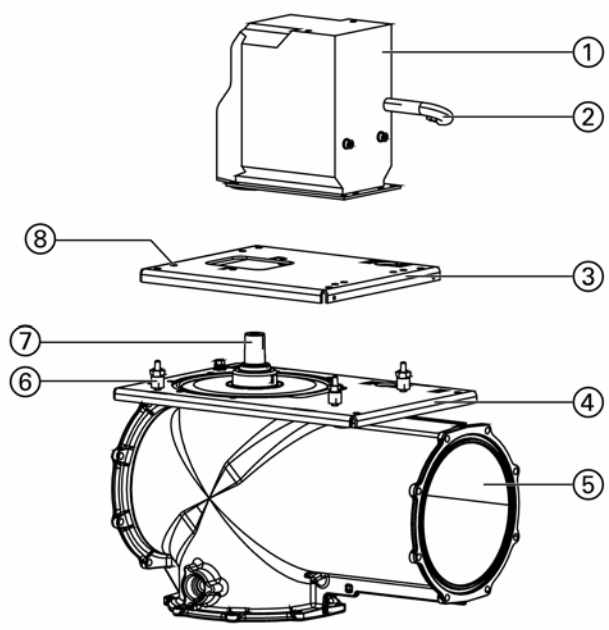
	**DANGER!** High voltage! Danger! Before starting installation work at the busbar voltage transformers, the busbar must have been isolated and earthed. ⇨ Isolate and earth the busbar.

	**ATTENTION!** Sensitive parts of the switchgear may be damaged during installation work at the busbar and the busbar housings. ⇨ While working at the busbars or the busbar housings, prop up only on the aluminum housings and the supporting frame. ⇨ Do not prop up on sensitive parts of the switchgear like gas pipes, bursting discs, shafts, etc.

	**ATTENTION!** While working on metal-coated voltage transformers, the coating may be scratched or damaged. Then, the voltage transformers cannot be touched anymore. ⇨ Work carefully while mounting metal-coated voltage transformers. ⇨ Take care not to scratch or damage the metal coating.

	**ATTENTION!** Risk of partial discharges at the voltage transformer bushings due to pollution. ⇨ Clean all bushings at the panel at the voltage transformer carefully before starting installation work. ⇨ Observe extreme cleanliness while working.

21.1 Installation of voltage transformers type 4MT3



① 4MT3 voltage transformer
② Low-voltage plug connector
③ Adapter plate
④ Voltage transformer mounting plate
⑤ Busbar housing
⑥ Distance sleeves
⑦ Outside-cone bushing
⑧ Hole with setnut for press-out bolt

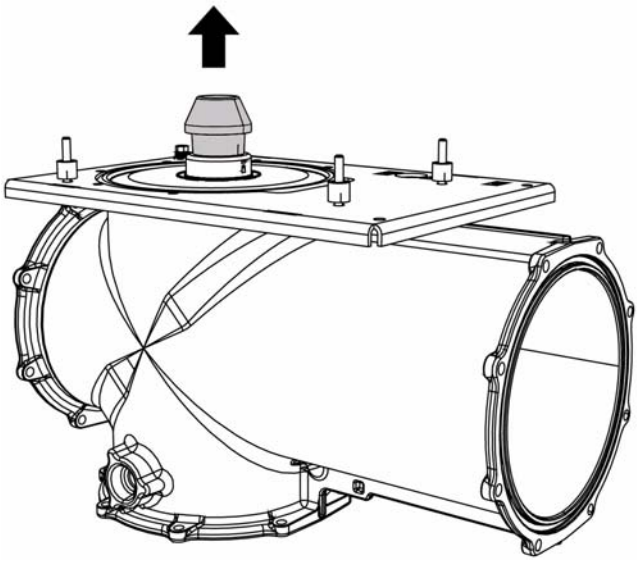
Fig. 51: 4MT3 busbar voltage transformer (shown without cover

⇨ Isolate and earth the busbar.

⇨ Verify safe isolation from supply.

⇨ For first installation: Remove protective cap.

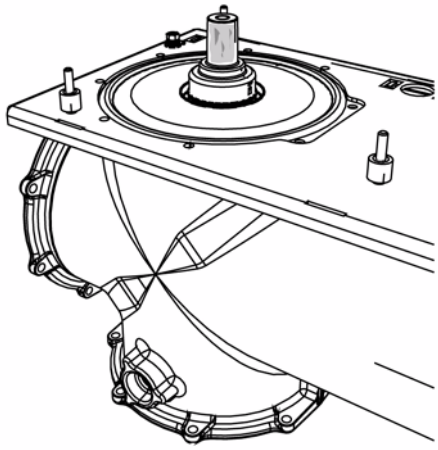
⇨ If available: Disassemble surge-proof caps of the outside-cone bushing.



⇨ Clean the silicone adapter of the voltage transformer and the outside-cone bushing carefully using a cleaning agent without solvents and a lint-free cloth.

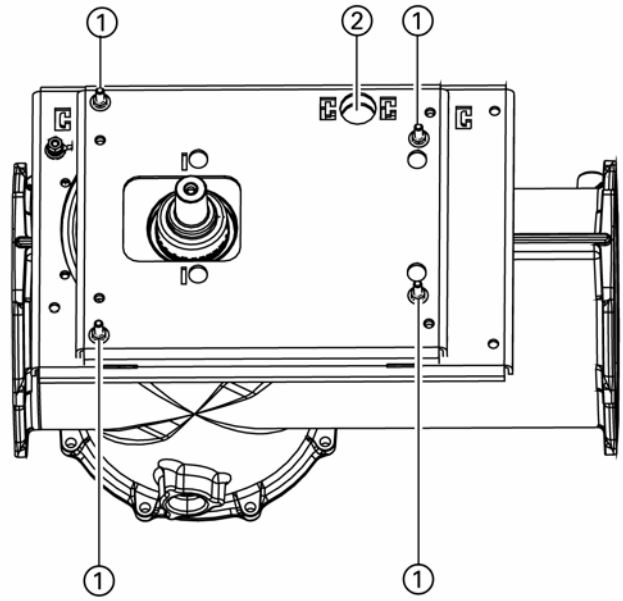
⇨ Grease the silicone adapter of the voltage transformer and the outside-cone bushing of the voltage transformer mounting plate uniformly with mounting paste.





⇨ If not yet pre-assembled, mount the adapter plate on the voltage transformer.

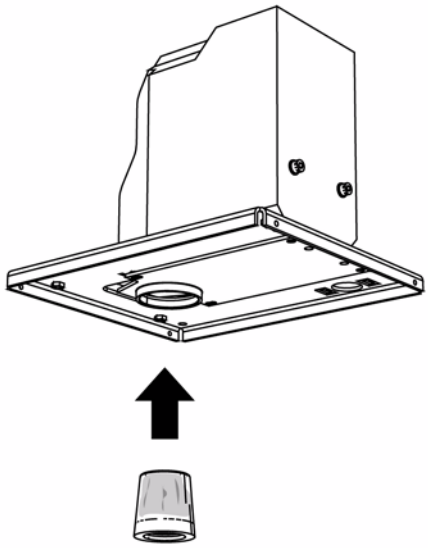
	NOTE!
	The already assembled adapter plate can be displaced due to vibrations during transport. To position the adapter plate correctly: ⇨ Loosen the M8 bolts of the adapter plate a little bit. ⇨ Bolt the adapter plate uniformly together with the voltage transformer mounting plate. Tightening torque: 30 Nm.



① M8 bolts for fixing the adapter plate on the voltage transformer mounting plate

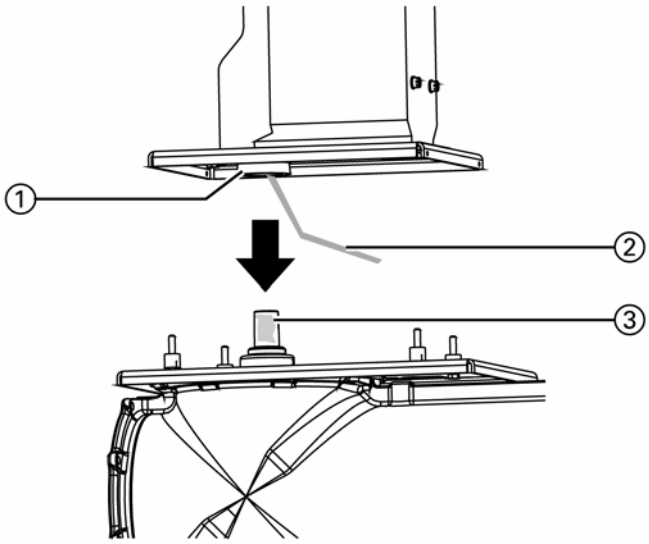
② Bushing for low-voltage plug connector

⇨ Insert the silicone adapter in the voltage transformer.



	**ATTENTION!** Risk of partial discharges at the outside-cone bushing. ⇨ Make sure that the connecting lug of the capacitive connecting point of the outside-cone bushing is earthed.

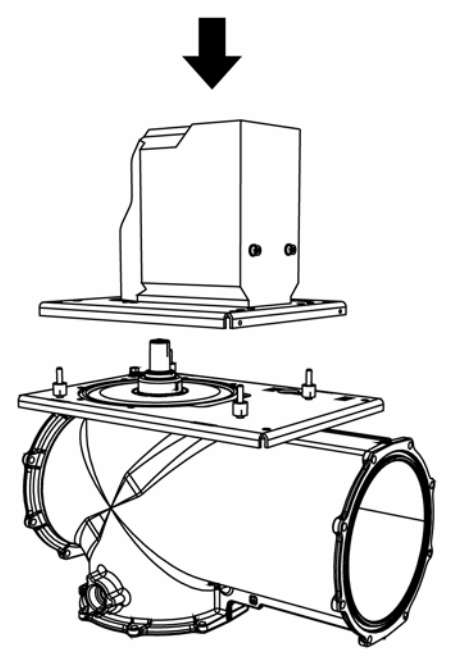
⇨ To let excess air out of the plug connection while mounting the voltage transformer, fit a nylon thread or a cable strap into the inside cone of the silicone adapter in the voltage transformer.



① Silicone adapter
② Cable strap
③ Outside-cone bushing

	**DANGER!** Risk of injury! The voltage transformer type 4MT3 has a weight of approx. 40 kg. ⇨ Secure the voltage transformer against falling down. ⇨ If necessary, transport the voltage transformer with several persons or with suitable aids.

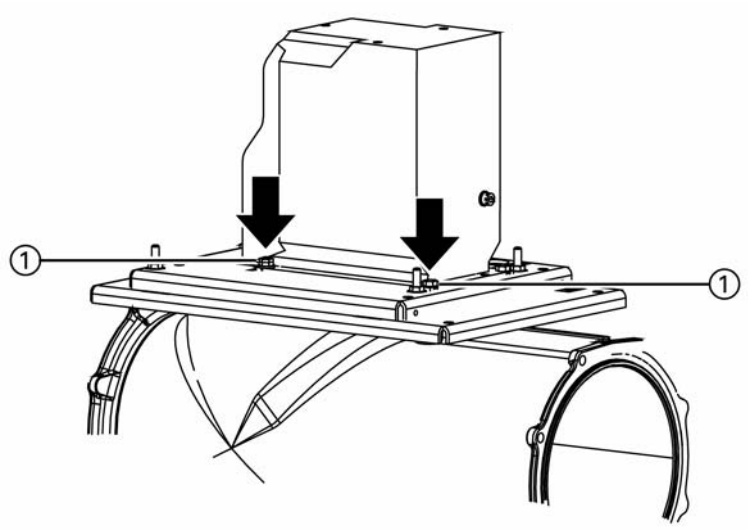
⇨ Lower the voltage transformer slowly onto the bushing, pulling the cable strap out of the inside cone of the voltage transformer at the same time.



⇨ Connect the low-voltage plug connector to the voltage transformer.

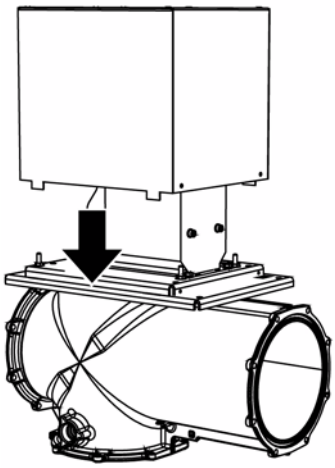
⇨ Fasten the voltage transformer at the panel. To do this, bolt the voltage transformer uniformly together with the voltage transformer mounting plate using four M8 bolts. Tightening torque: 30 Nm.

	NOTE!
	To have the voltage transformer correctly seated on the voltage transformer mounting plate: ⇨ Prevent the voltage transformer from canting during installation.

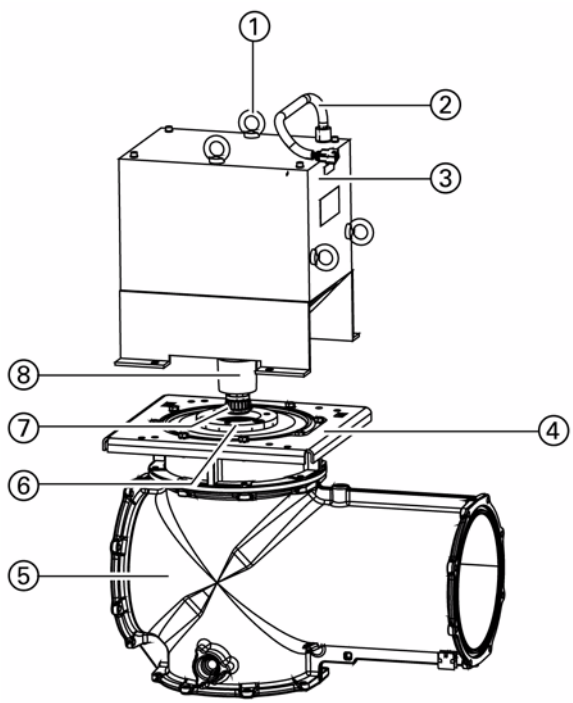


① Fixing bolts to connect the voltage transformer with the voltage transformer mounting plate

⇨ Mount the cover of the voltage transformer.



21.2 Installation of voltage transformers type 4MU4



① Crane eyes
② Low-voltage plug connector
③ 4MU4 voltage transformer
④ Voltage transformer mounting plate
⑤ Busbar housing
⑥ Inside-cone bushing
⑦ Primary terminal at the voltage transformer
⑧ Silicone adapter

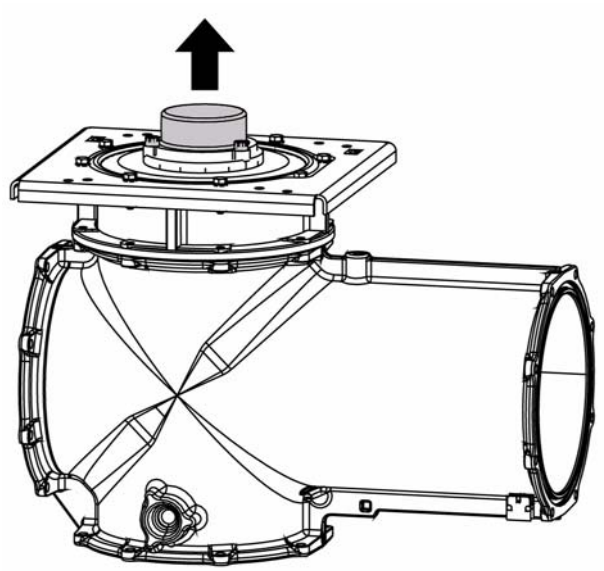
Fig. 52: 4MU4 busbar voltage transformer

⇨ Isolate and earth the busbar.

⇨ Verify safe isolation from supply.

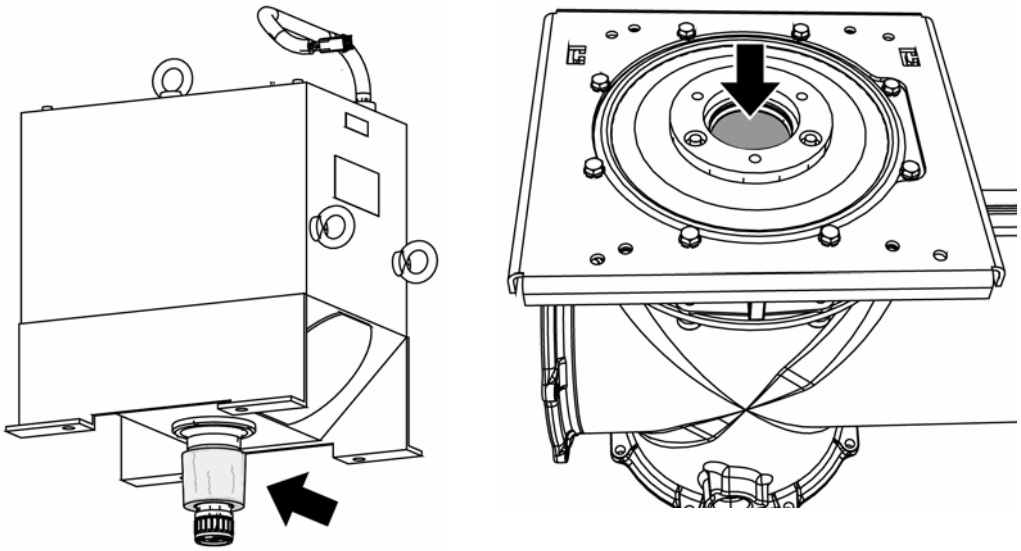
⇨ For first installation: Remove protective cap.

⇨ Remove the surge-proof plug from the inside-cone bushing.
To do this, remove the three M8 hexagon socket-head bolts.



⇨ Clean the silicone adapter and the inside-cone cast-resin socket carefully using a cleaning agent without solvents and a lint-free cloth.

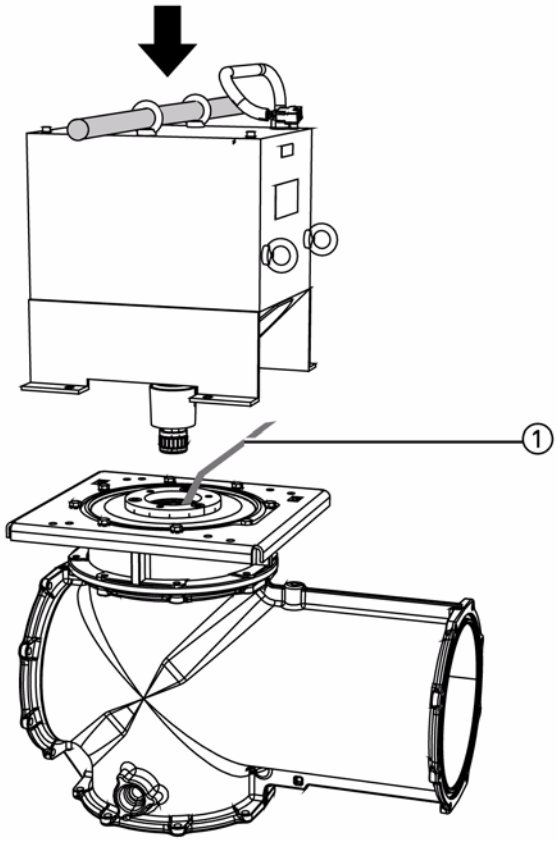
⇨ Grease the silicone adapter and the inside-cone cast-resin socket uniformly with mounting paste.



	ATTENTION!
	Risk of injury! The voltage transformer type 4MU4 has a weight of approx. 60 kg. ⇨ Secure the voltage transformer against falling down. ⇨ If necessary, transport the voltage transformer with several persons or with suitable aids (e.g. a supporting rod).

⇨ Lower the voltage transformer slowly onto the busbar housing.

① Cable strap

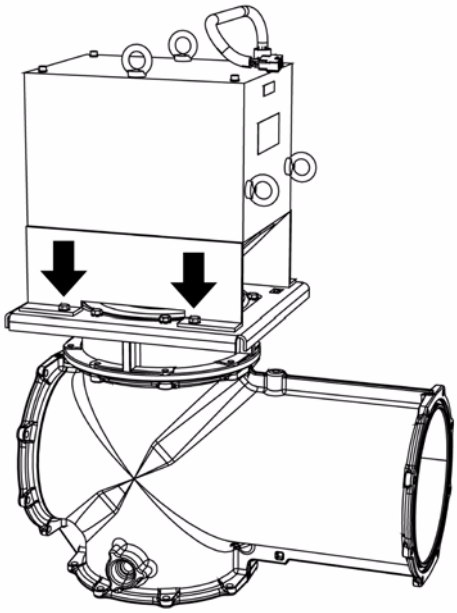


⇨ To let excess air out of the plug connection while mounting the voltage transformer, fit a nylon thread or a cable strap into the inside cone of the voltage transformer mounting plate.

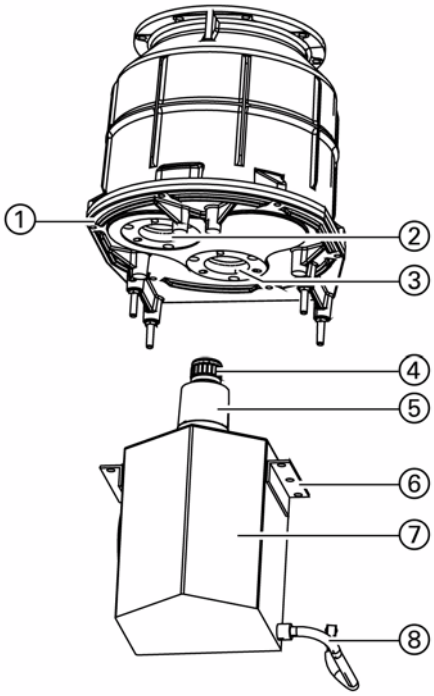
⇨ Insert the primary terminal of the voltage transformer slowly into the inside cone on the mounting plate, pulling the cable strap out at the same time.

⇨ Connect the low-voltage plug connector to the voltage transformer.

⇨ Fasten the voltage transformer at the panel. To do this, bolt the voltage transformer uniformly together voltage transformer mounting plate using four M8 bolts. Tightening torque: 30 Nm.



21.3 Installation of voltage transformers type 4MT7



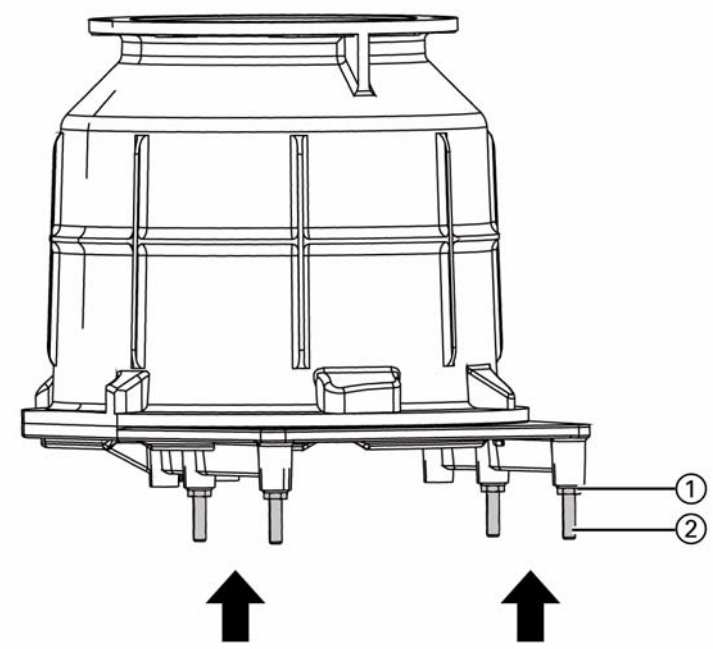
① Panel connection cover
② Inside-cone bushing for cable
③ Inside-cone bushing for primary terminal of transformer
④ Primary terminal at the voltage transformer
⑤ Silicone adapter
⑥ Fixing bracket (fastened to the voltage transformer housing)
⑦ 4MT7 voltage transformer
⑧ Low-voltage plug connector

⇨ Isolate and earth the busbar.

⇨ Verify safe isolation from supply.

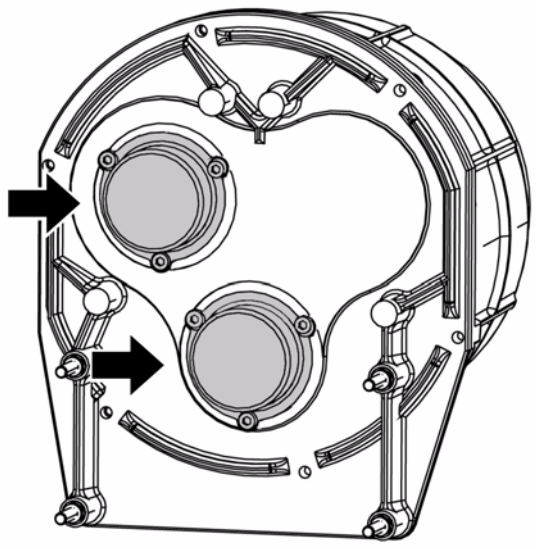
⇨ For first installation of the voltage transformer, mount the threaded rods M10 with low-design nuts (flat nuts) according to DIN 4035 on the panel connection cover montieren.

① M10 nuts acc. to DIN 4035
② Threaded rods M10



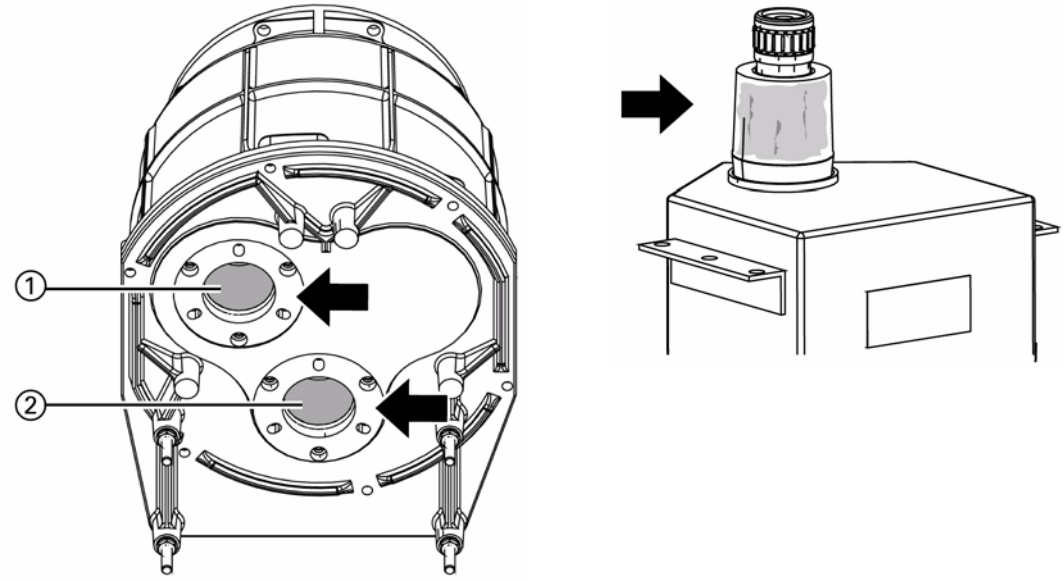
⇨ For first installation: Remove protective cap.

⇨ If available: Disassemble surge-proof caps of the inside-cone bushings. To do this, undo the two sets of three M8 bolts.



⇨ Clean the silicone adapter and the inside-cone cast-resin bushing carefully using a cleaning agent without solvents and a lint-free cloth.

⇨ Grease the silicone adapter and the inside-cone cast-resin bushing uniformly with mounting paste.



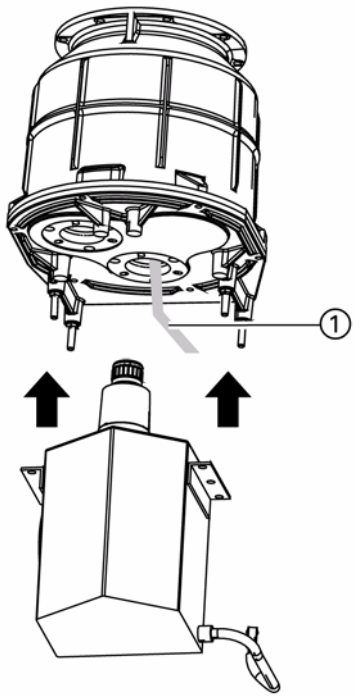
① Inside-cone bushing for plug-in cable connection

② Inside-cone bushing for primary terminal of transformer

⇨ Lower the primary terminal of the voltage transformer slowly onto the busbar housing.

	**DANGER!** Risk of injury! The voltage transformer type 4MT7 has a weight of approx. 45 kg. ⇨ Secure the voltage transformer from below against falling down. ⇨ If necessary, transport the voltage transformer with several persons or with suitable aids. ⇨ If necessary, support the voltage transformer with a suitable facility.

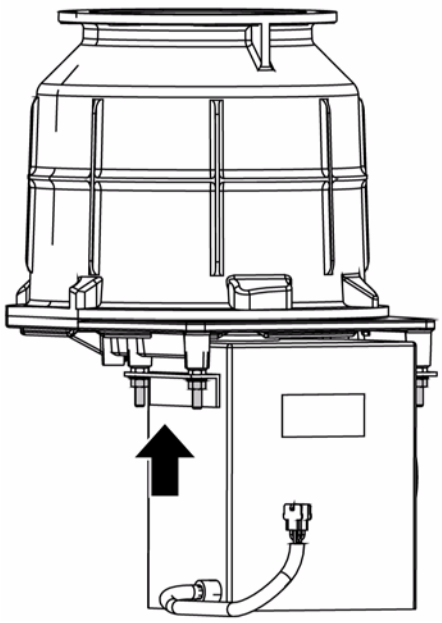
① Cable strap



⇨ To let excess air out of the plug connection while mounting the voltage transformer, fit a nylon thread or a cable strap into the inside cone of the panel connection cover.

⇨ Insert the primary terminal of the voltage transformer slowly into the inside cone panel connection cover, pulling the cable strap put at the same time.

⇨ Fit plain washers on the threaded rods of the fixing bracket stecken. Bolt the voltage transformer uniformly together with the panel connection cover using the M10 nuts. Tightening torque: 30 Nm.



⇨ Connect the low-voltage plug connector to the voltage transformer.

22 Removal and installation of voltage transformers

	**DANGER!** High voltage! Danger! Before starting installation work at the busbar voltage transformers, the busbar must have been isolated and earthed. ⇨ Isolate and earth the busbar.

	**ATTENTION!** If a power-frequency voltage test has to performed before putting the switchgear into operation, ⇨ already mounted **non-disconnectable** busbar voltage transformers which are not suitable for tests at 80% values according to IEC 60044-2 must be removed.

	**ATTENTION!** Sensitive parts of the switchgear may be damaged during installation work at the busbar and the busbar housings. ⇨ While working at the busbars or the busbar housings, prop up only on the aluminum housings and the supporting frame. ⇨ Do not prop up on sensitive parts of the switchgear like gas pipes, bursting discs, shafts, etc.

	**ATTENTION!** While working on metal-coated voltage transformers, the coating may be scratched or damaged. Then, the voltage transformers cannot be touched anymore. ⇨ Work carefully while mounting metal-coated voltage transformers. ⇨ Take care not to scratch or damage the metal coating.

22.1 Removal of voltage transformers type 4MT3

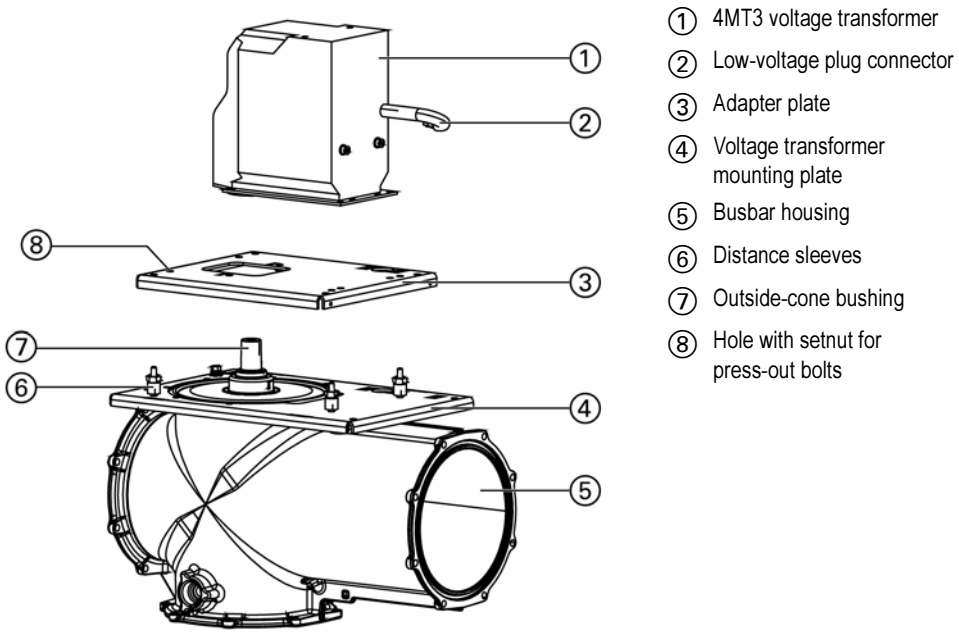


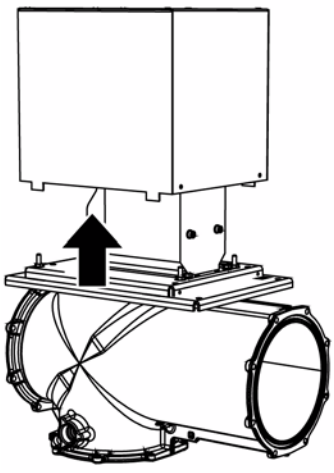
Fig. 53: 4MT3 busbar voltage transformer (shown without cover)

⇨ Isolate and earth the busbar.

⇨ Verify safe isolation from supply.

⇨ Remove the low-voltage plug connector at the voltage transformer.

⇨ Remove the cover of the voltage transformer.

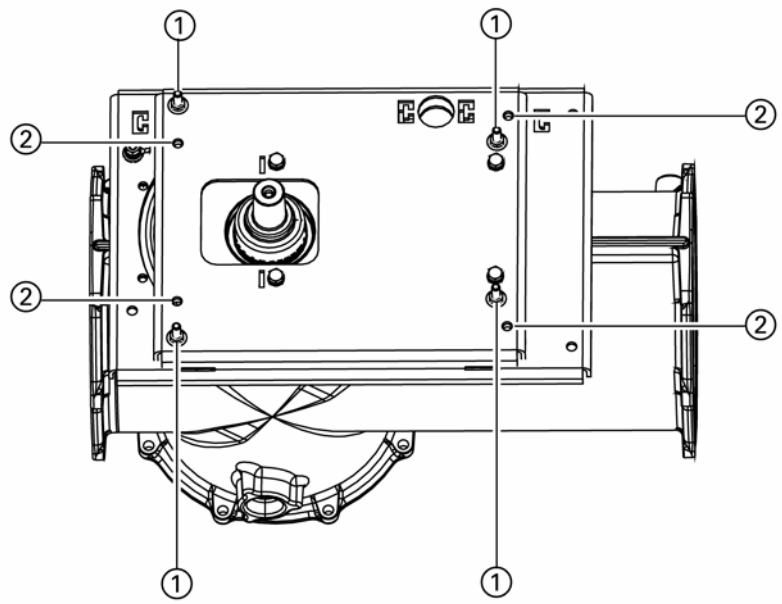


⇨ Remove the fixing bolts of the adapter plate.

⇨ Screw four press-out bolts into the holes provided for this purpose in the adapter plate.

⇨ Press the voltage transformer out of the bushing together with the adapter plate with the help of the press-out bolts. While doing so, screw the press-out bolts in uniformly, so that the transformer is not canted.

① Fixing bolts at the adapter plate
② Holes with setnut for press-out bolts



	**ATTENTION!** Risk of injury! While being removed from the bushing, the voltage transformer can detach suddenly. ⇨ Remove the voltage transformer upwards as uniformly as possible. ⇨ Do not use excessive force.

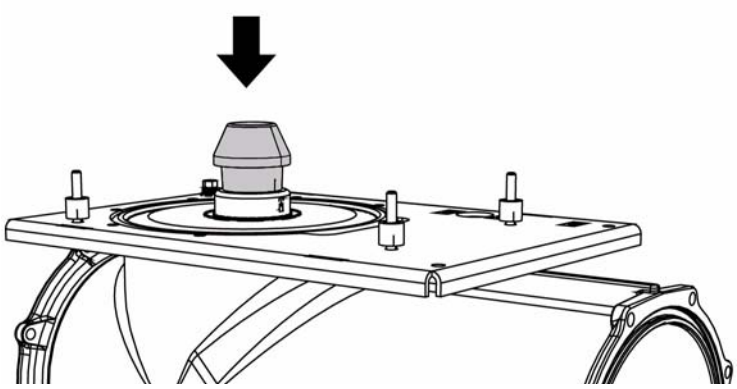
	**ATTENTION!** Risk of injury! The voltage transformer type 4MT3 has a weight of approx. 30 kg. ⇨ Secure the voltage transformer against falling down. ⇨ If necessary, transport the voltage transformer with several persons or with suitable aids.

	**NOTE!** If you remove the voltage transformer, the silicone adapter may fall out of the voltage transformer. ⇨ Keep the silicone adapter carefully for later use.

⇨ Clean the silicone adapter and the outside-cone bushing carefully using a cleaning agent without solvents and a lint-free cloth.

⇨ Protect the connection socket of the voltage transformer against damages and pollution using a suitable cover.

⇨ For voltage tests: Close the outside-cone bushing at the busbar housing with a surge-proof cap and protect it against damages and pollution.



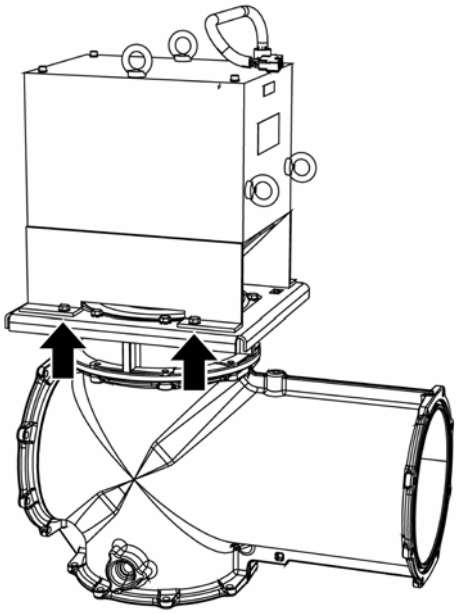
22.2 Removal of voltage transformers type 4MU4

⇨ Isolate and earth the busbar.

⇨ Verify safe isolation from supply.

⇨ Remove the low-voltage plug connector.

⇨ Remove the four M8 fixing bolts M8 of the fixing brackets at the voltage transformer mounting plate.



⇨ Lift the voltage transformer at the upper crane eyes using a suitable rod (e.g. steel rod).

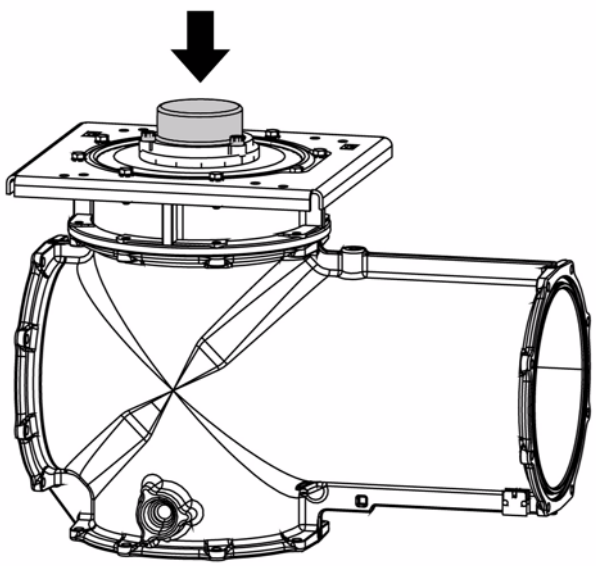
	**ATTENTION!**
	Risk of injury! While being removed from the bushing,the voltage transformer can detach suddenly. ⇨ Remove the voltage transformer upwards as uniformly as possible. ⇨ Do not use excessive force.

	**ATTENTION!** Risk of injury! The voltage transformer type 4MU4 has a weight of approx. 60 kg. ⇨ Secure the voltage transformer against falling down. ⇨ If necessary, transport the voltage transformer with several persons or with suitable aids (e.g. a supporting rod).

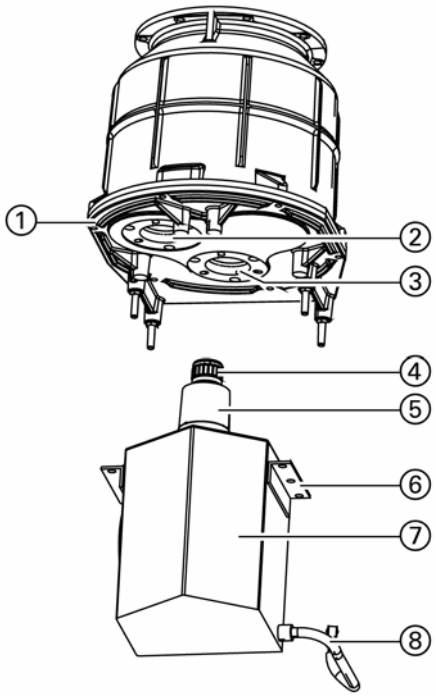
⇨ Remove the voltage transformer upwards by means of the steel rods.

⇨ Lower the transformer so that it does not lie on the primary terminal, and protect it against damages and pollution using a suitable cover.

⇨ For voltage tests: Close the inside-cone bushing at the panel with a surge-proof dummy plug size 2, and bolt tight using three M8 bolts.



22.3 Removal of voltage transformers type 4MT7

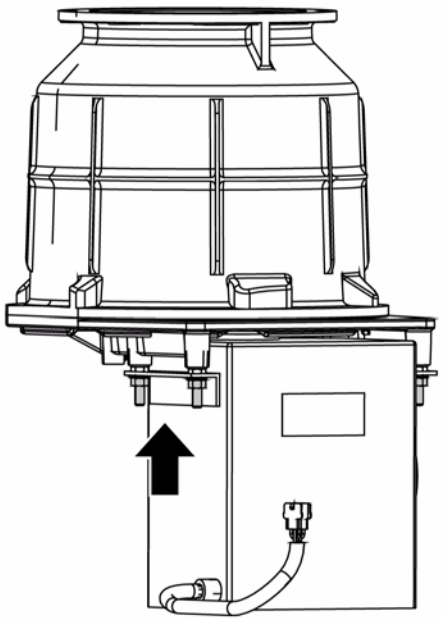


① Panel connection cover
② Inside-cone bushing for cable
③ Inside-cone bushing for primary terminal of transformer
④ Primary terminal at the voltage transformer
⑤ Silicone adapter
⑥ Fixing bracket (fastened to the voltage transformer housing)
⑦ 4MT7 voltage transformer
⑧ Low-voltage plug connector

⇨ Isolate and earth the busbar.

⇨ Verify safe isolation from supply.

⇨ Remove the voltage transformer. To do this, remove the four bolts of the fixing brackets at the panel connection cover. Bolt size M10.



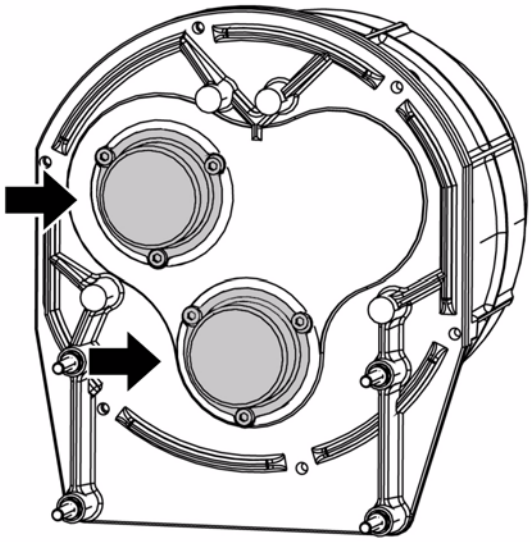
	**ATTENTION!** Risk of injury! While being removed from the bushing, the voltage transformer can detach suddenly. ⇨ Remove the voltage transformer upwards as uniformly as possible. ⇨ Do not use excessive force.

	**ATTENTION!** Risk of injury! The voltage transformer type 4MT7 has a weight of approx. 45 kg. ⇨ Secure the voltage transformer against falling down. ⇨ If necessary, transport the voltage transformer with several persons or with suitable aids. ⇨ If necessary, support the voltage transformer with a suitable facility.

⇨ Remove the voltage transformer slowly downwards.

⇨ Lower the transformer so that it does not lie on the primary terminal, and protect it against damages and pollution using a suitable cover.

⇨ For voltage tests: Close the inside-cone bushing at the panel with a surge-proof dummy plug size 2 (3), and bolt tight using three M8 bolts each.



23 Final installation work

23.1 Mounting cables with plugs



ATTENTION!

The dust-proof caps supplied on the sockets of the multiple panel connections do not provide sufficient shock protection.

⇨ Close unused sockets of multiple panel connections with dummy plugs.

⇨ Proceed according to the installation instructions of the corresponding plug manufacturer.

⇨ Fit cable strain relieves. Distance between the lower edge of the flange dome and the cable strain relief: 450 mm as a minimum.

⇨ Connect the cable shield at the cable strain relief.

23.2 Connecting low-voltage cables

⇨ Remove the metal covers from the frames.

⇨ Open the doors of the low-voltage compartments.

⇨ Fix the low-voltage cables at the holders provided for this purpose.

⇨ Connect the ends of the cables to the terminals in the low-voltage compartments according to the circuit diagram.

⇨ Close the doors of the low-voltage compartments.

23.3 Mounting the metal covers

⇨ Screw all metal covers to the supporting frames again.

24 Tests

24.1 Checking the SF_6 gas filling



DANGER!

Operation with an incorrect SF_6 gas pressure can destroy parts of the switchgear.

⇨ Do not put the switchgear into operation with too high or too low SF_6 gas pressures.

Checking the gas pressure

Before commissioning or a rated short-duration power-frequency withstand voltage test the gas pressures of **all** gas compartments must be checked.

⇨ On all gas compartments filled at site: After having filled the gas compartments, observe a temperature compensation time of **24 hours**. Do not check the gas pressure before that time.

⇨ Check the gas pressure in all gas compartments filled at site. If the limit values adjusted on the indicators are underflown or exceeded, correct the gas pressure.

Leakage test

⇨ **24 hours** after having filled the gas compartments, check all flange connections mounted at site and all SF_6 pipes for leaks.

⇨ For leak detection, use an SF_6 leak detector.

⇨ In case of gas leaks, these points must be disassembled and sealed again.

Checking the gas quality

⇨ Check the gas quality **24 hours** after filling the gas compartments.

⇨ Determine the maximum dew point with a gas hygrometer.
Dew-point temperature: -15 °C.

⇨ Check the air content in the SF_6 gas with a gas-percentage meter.
Maximum air content: 5%.

⇨ If the gas quality is not achieved, the gas filling must be cleaned with the maintenance unit.

Monitoring the gas pressure

⇨ After commissioning, check the gas pressures daily for a period of two weeks. If the gas pressures drop within this period of time, please inform the Siemens representative.

⇨ After this period of time, check the gas pressures according to the maintenance instructions.

24.2 Checking the circuits of the low-voltage equipment

⇨ Check the current transformer circuits according to the circuit diagrams.

⇨ Check the voltage transformer circuits up to the m.c.b. or the fuse for short-circuits.

⇨ Check the functions of all protection devices with a secondary test unit for relays.

24.3 Checking high-voltage connections

⇨ Check the tightening torque of the bolts of the cable plugs according to the manufacturer's instructions.

⇨ Check the earthing of the cable termination on all high-voltage cables.

24.4 Checking electrical connections

Checking device connections

⇨ Check the screw-type connections of the devices in the low-voltage compartment at random with the torque wrench.

⇨ Check the plug-in connections of the devices in the low-voltage compartment at random.

Checking auxiliary cable connections

⇨ Check auxiliary cable connections on devices and terminal blocks at random.

⇨ Check all auxiliary cable connections on current transformer terminals including slides and jumpers in the low-voltage compartment.

⇨ Check the designation labels on the terminal blocks.

⇨ Replace missing labels using the information given in the circuit diagrams.

24.5 Checking protection against environmental influences

For touching up doors and front parts there is a touch-up set (spatula and paint) available, as well as a paint pen.

⇨ Touch up surface damages.

25 Commissioning

25.1 Checking the installation work

⇨ Carry out a final check to make sure that all installation work has been performed according to these installation instructions.

25.2 Test operation

Read the operating instructions before the test operation. Test operation helps you to verify the perfect operation of the switchgear **without high voltage**.

The work described below must be performed on each panel.



DANGER!

Operating the switchgear under high voltage for test can destroy the switchgear and cause personal injuries.

⇨ Switch off high voltage before test operation.



ATTENTION!

If defective or incorrectly assembled switchgear is put into operation, this can damage or destroy parts of the switchgear.

⇨ Never put switchgear into operation if you notice during test operation that a part of it does not work as described in here.

Electrical operation of switching devices

⇨ Switch on all auxiliary and control voltages. The motor must start up immediately after in order to charge the closing spring and the circuit-breaker operating mechanism.

⇨ Close and open the circuit-breaker several times. The motor must recharge the circuit-breaker operating mechanism automatically.

⇨ Close and open the disconnectors and earthing switches several times.

Mechanical operation of switching devices



DANGER!

Charging the circuit-breaker operating mechanism by hand can cause injuries due to the suddenly starting motor.

⇨ Charge the vacuum circuit-breaker with the supplied original hand crank with freewheel only.

⇨ Switch off all auxiliary and control voltages.

⇨ Charge the circuit-breaker operating mechanism by hand.

⇨ Close and open the circuit-breaker.

⇨ Close and open the busbar earthing switch several times.

Checking interlocks and indicators

All circuit-breakers, disconnectors and earthing switches are closed and opened, checking the interlocks and indicators at the same time.

- ⇨ Switch on all auxiliary and control voltages.
- ⇨ Operate all switching devices for test to verify the perfect operation of all mechanical and electromechanical interlocks. Do not use force.
- ⇨ Check correct indication on position indicators at the front of the panels and in the control room.

Completing test operation

- ⇨ Switch the circuit-breakers, disconnectors and earthing switches to OPEN position.

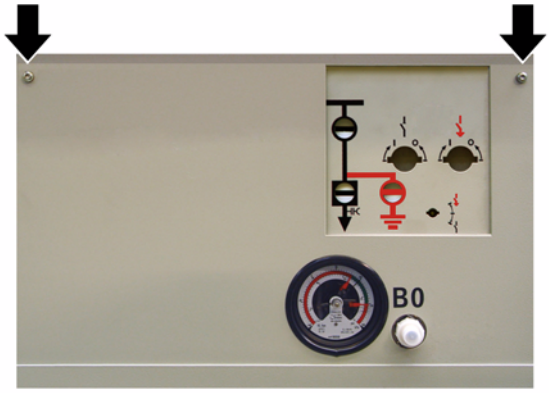
25.3 Emergency release of the electromechanical interlock in the disconnector operating mechanism

If the switchgear is equipped with an electromechanical interlock, the disconnector operating mechanism can still be operated even if the auxiliary voltage fails.

	**DANGER!**
	After removal of the disconnector cover, the mechical interlocking is not effective anymore. ⇨ Incorrect switching operations are possible!

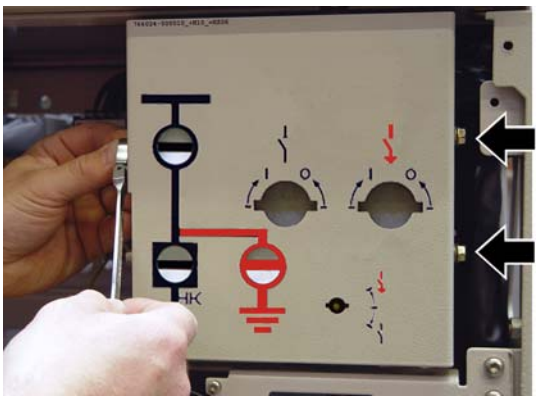
⇨ **Precondition for operating the disconnector operating mechanism:** Circuit-breaker OPEN.

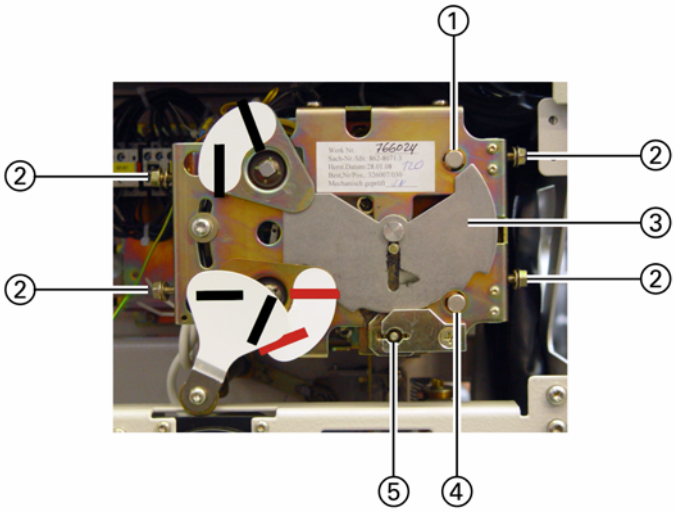
⇨ Remove the 2 fixing bolts at the front cover.



⇨ Remove the front cover.

⇨ Loosen the four bolts of the disconnector cover a little bit until the disconnector cover can be removed. Do not remove the bolts.



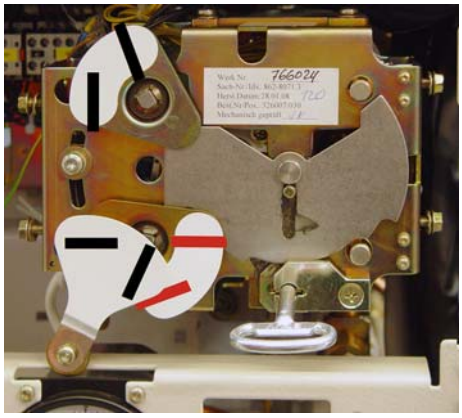


① Solenoid for DISCONNECTING function
② Bolts for the disconnector cover
③ Control gate of disconnector operating mechanism
④ Solenoid for EARTHING function
⑤ Opening for selector key (double-bit key)

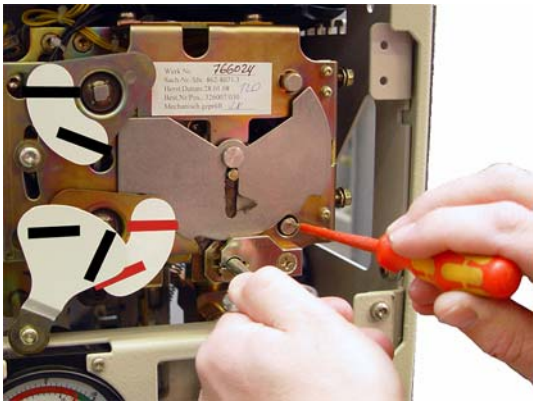
Fig. 54: Overview of the electromechanical emergency release in the disconnector operating mechanism

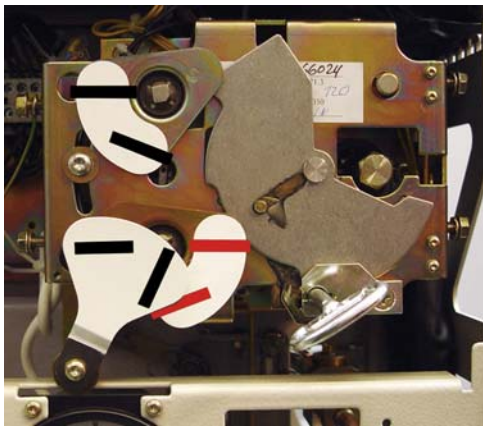
⇨ The solenoids for the disconnecting or earthing function are pressed out preventing the control gate of the disconnector operating mechanism from being operated.

⇨ Insert double-bit key.



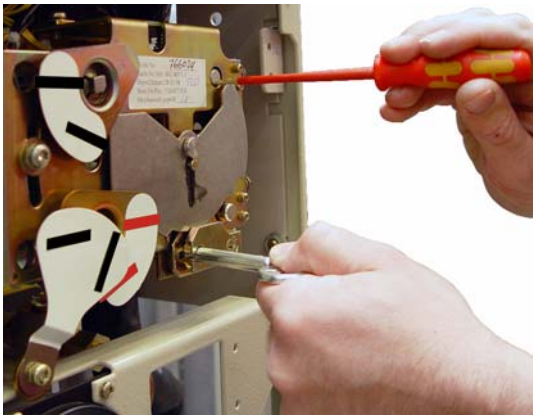
⇨ **EARTHING function:** Push the solenoid for the EARTHING function in with a screwdriver, and turn the double-bit key **counter-clockwise** as far as it will go.





⇨ Turn the double-bit key back **clockwise** and remove it.

⇨ **DISCONNECTING function:** Push the solenoid for the DISCONNECTING function in with a screwdriver, and turn the double-bit key **clockwise** as far as it will go.



⇨ Turn the double-bit key back **counter-clockwise** and remove it.

⇨ **Align the disconnector cover:** Tighten the disconnector cover with the 4 fixing bolts, avoiding gaps between the disconnector cover and the front cover.

⇨ Mount the front cover and bolt it tight.

25.4 Checking the accessories

The switchgear accessories comprise:

- Operating levers
- Keys to operate the switching devices
- Single-line diagrams
- Operating instructions
- Warning signs
- Customer-specific consignments.

⇨ Make the switchgear accessories available in the switchgear room or in a neighboring room clearly and ready to hand.

25.5 Correcting circuit diagrams

⇨ Note any modifications which may have been made during installation or commissioning in the supplied circuit diagrams.

⇨ After completion of the installation work, ask the competent Siemens office for correction of the original circuit diagrams.

25.6 Instructing the operating personnel

⇨ Hand over the operating instructions to the operating personnel before commissioning.

⇨ Make the operating personnel familiar with all technical details and operation of the switchgear before switchgear acceptance.

⇨ Hand the supplied double-bit keys for the doors over to the responsible persons.

Operation

	**DANGER!** The internal arc classification of the switchgear according to IEC 62271-200 has only been proved by tests for the switchgear sides with internal arc classification and with closed high-voltage compartments. ⇨ Determine the IAC classification of the switchgear by means of the data on the rating plate (see Page 30, "Rating plates"). ⇨ Regulations for access to switchgear areas without internal arc classification according to IEC 62271-200 must be defined by the entrepreneur or the switchgear owner.

26 Control elements and indicators

Overview

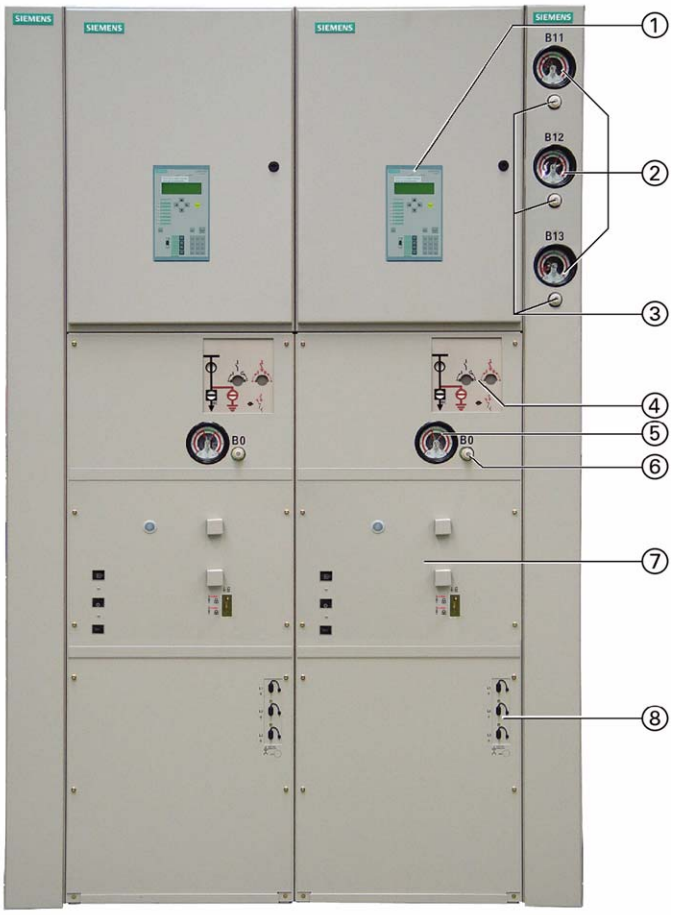


Fig. 55: Control elements and indicators of the circuit-breaker panel

① SIPROTEC bay controller (option)

② Manometer for gas compartment monitoring of busbar gas compartments L1, L2, L3

③ Filling valve for busbar gas compartments L1, L2, L3

④ Control and indication board for three-position disconnector with position indicator for circuit-breaker

⑤ Manometer for gas compartment monitoring of feeder gas compartments

⑥ Filling valve for feeder gas compartments

⑦ Control and indication board for circuit-breaker

⑧ Sockets for LRM voltage detecting system

Operating tools

The operating levers for the three-position disconnector functions DISCONNECTING and READY-TO-EARTH have a slot and a nose, which are arranged in such a way that the levers can only be used for their respective function.
The emergency operating lever only has a slot and may exclusively be used as described (see Page 112, "Emergency operation of the three-position disconnector") .



Fig. 56: Operating lever for DISCONNECTING function



Fig. 57: Operating lever for READY-TO-EARTH function (cross bar marked red)



Fig. 58: Emergency operating lever



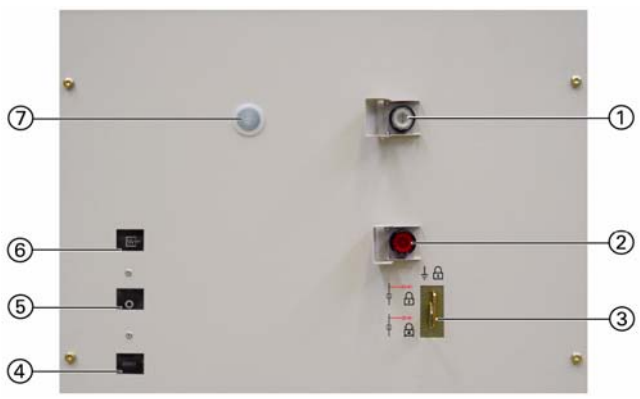
Fig. 59: Hand crank to charge the closing spring



Fig. 60: Double-bit key 5 mm

27 Circuit-breaker operation

Circuit-breaker control board



① ON pushbutton
② OFF pushbutton
③ "Feeder earthed" locking deviced
④ Operations counter
⑤ Position indicator for circuit-breaker
⑥ "Closing spring charged / not charged" indicator
⑦ Opening to charge the closing spring manuallly

Fig. 61: Circuit-breaker control board

27.1 Closing the circuit-breaker manually

Preconditions
- "Feeder earthed" locking device is open
- Closing spring is charged

⇨ Operate the ON pushbutton in the circuit-breaker control board.
✔ The position indicator changes to "I" position. The circuit-breaker is closed.

27.2 Opening the circuit-breaker manually

If the control voltage fails, the circuit-breaker can only be opened mechanically by hand.

	NOTE!
	If the feeder is earthed through the three-position disconnector and the circuit-breaker, all electrical OFF signals are ineffective.

Preconditions
- "Feeder earthed" locking device is open

	DANGER!
	If the "feeder earthed" locking device is padlocked, the circuit-breaker cannot be opened, neither electrically nor mechanically. ⇨ Padlock only if the feeder is earthed.

⇨ Operate the OFF pushbutton in the circuit-breaker control board.
✔ The circuit-breaker is open.

27.3 Recommendation for sealing the pushbuttons

	**ATTENTION!** If you close manually, all electrical and mechanical interlocks are ineffective. ⇨ To guarantee safe operation of the interlocks: Seal/lock the pushbuttons (see table below).

Recommendation for sealing/locking

Panel types	Sealing
Incoming or outgoing feeder panels	ON pushbutton
Bus sectionalizer panels	ON pushbutton and OFF pushbutton

27.4 Test operation without auxiliary voltage

	**ATTENTION!** On circuit-breakers with undervoltage release 3AX1103: If the retaining screw of the striker is not shifted back from position B to position A after the test operation without auxiliary voltage, the undervoltage release will not function. ⇨ After the test operation without auxiliary voltage, shift the retaining screw of the striker back from position B to position A.

Perform the following actions to guarantee that the circuit-breaker is ready for operation:

⇨ Charge the closing spring (see Page 107, "Charging the closing spring manually").

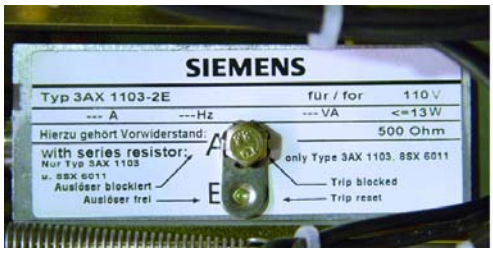
⇨ Operate the ON pushbutton in the circuit-breaker control board.

✔ The circuit-breaker is closed.

⇨ Operate the OFF pushbutton in the circuit-breaker control board.

✔ The circuit-breaker is open.

⇨ Turn the retaining screw of the striker from position A to B.





27.5 Test operation with auxiliary voltage (motor operating mechanism)

⇨ Switch on the supply voltage.

✔ The motor operating mechanism starts up and charges the closing spring.

⇨ Check whether the "closing spring charged" indication appears.



⇨ Operate the ON pushbutton in the circuit-breaker control board.

✔ The closing spring is charged by the motor.

⇨ Check whether the switch position "circuit-breaker CLOSED" appears.

⇨ Operate the OFF pushbutton in the circuit-breaker control board.

⇨ Check whether the switch position "circuit-breaker OPEN" appears.

27.6 Charging the closing spring manually

The closing spring is charged by the motor after applying the control voltage.
The energy required for the switching sequence OPEN-CLOSED-OPEN (auto-reclosing) is stored in the closing spring about 15 seconds after closing the circuit-breaker.



Fig. 62: "Closing spring charged" indication



Fig. 63: "Closing spring not charged" indication

The hand crank is required to charge the closing spring manually if the control voltage fails.

	**DANGER!**
	Risk of injury by sudden rotation of hand crank. If you use a hand crank **without a freewheel** to charge the spring, the hand crank will rotate when the control voltage is switched on again (motor starts up) and can lead to injury. ⇨ Use special hand crank **with freewheel** from the accessories.

⇨ Remove cover from cutout.

⇨ Insert hand crank.

⇨ Turn hand crank clockwise approx. 30 turns until the indication "closing spring charged" appears.

⇨ Remove hand crank.

⇨ Close cutout with cover.

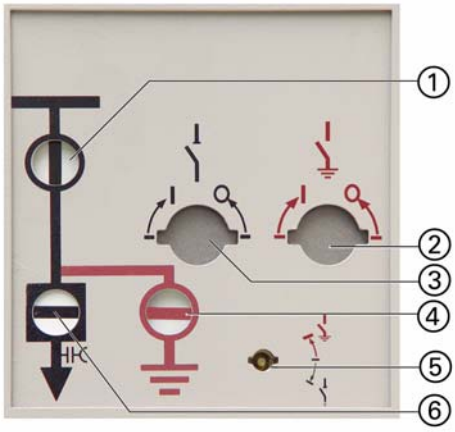
28 Three-position disconnector operation

The procedures described in this section apply to:

- Disconnectable voltage transformers or disconnectable busbar connections
- Top-mounted bus sectionalizer
- Switching operations on circuit-breaker panels
- Switching operations on bus sectionalizer panels

28.1 Control elements and indicators

Control board on the switchgear front



① Position indicator for three-position disconnector (DISCONNECTING function)
② Actuating opening for earthing switch (EARTHING/READY-TO-EARTH function)
③ Actuating opening for disconnector (DISCONNECTING function)
④ Position indicator for three-position disconnector (EARTHING/READY-TO-EARTH function)
⑤ Opening for selector key
⑥ Position indicator for circuit-breaker

Fig. 64: Control board on the switchgear front

The manual switching operations DISCONNECTING or READY-TO-EARTH must be pre-selected with a double-bit key. Pre-selection is only possible if the associated switching operation is permissible.

Position indicator at the rear

The position of the three-position disconnector is indicated both at the front and at the rear of the switchgear. The position indicator at the rear is located on the side of the outermost busbar housing, over the circuit-breaker housing.

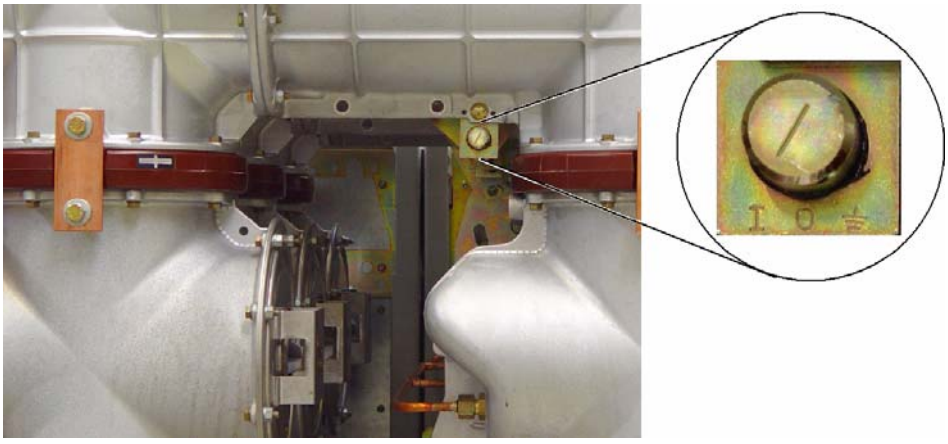


Fig. 65: Position indicator at the rear

28.2 Closing the three-position disconnector manually

	**ATTENTION!** In circuit-breaker panels, a mechanical interlock prevents the three-position disconnector from being operated under load. ⇨ Open the circuit-breaker (see Page 105, "Opening the circuit-breaker manually").

	**ATTENTION!** In disconnector panels without electromechanical/mechanical interlock, maloperation of the three-position disconnector is possible. Here, the three-position disconnector can be operated under load. Operating under load will destroy the three-position disconnector! ⇨ Do not operate the three-position disconnector under load.

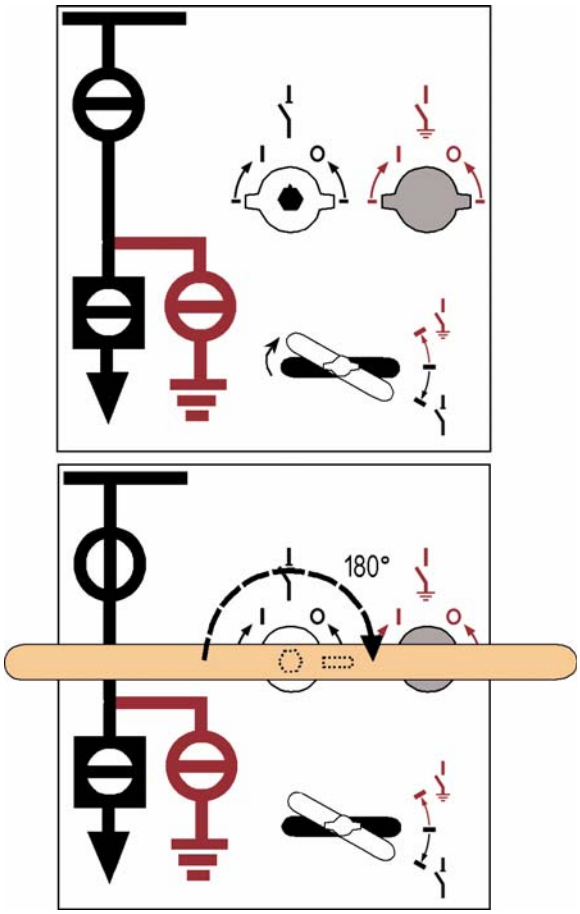


Fig. 66: Closing the three-position disconnector

⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **clockwise** as far as it will go.

✔ The opening for the DISCONNECTING function is free.

⇨ Hold the lever for the DISCONNECTING function in horizontal position (nose on the left) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the DISCONNECTING function 180° **clockwise** (nose on the right).

✔ The three-position disconnector is closed.
The position indicator changes to CLOSED position.

⇨ Remove the operating lever for the DISCONNECTING function.

⇨ Turn the double-bit key **counter-clockwise** and remove it.

✔ The opening for the DISCONNECTING function is closed.

28.3 Opening the three-position disconnector manually

⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **clockwise** as far as it will go.

✔ The opening for the DISCONNECTING function is free.

⇨ Hold the lever for the DISCONNECTING function in horizontal position (nose on the right) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the DISCONNECTING function 180° **counter-clockwise** (nose on the left).

✔ The three-position disconnector is open.
The position indicator changes to OPEN position.

⇨ Remove the operating lever for the DISCONNECTING function.

⇨ Turn the double-bit key **counter-clockwise** and remove it.

✔ The opening for the DISCONNECTING function is closed.

28.4 Activating the ready-to-earth function manually



ATTENTION!

In circuit-breaker panels, a mechanical interlock prevents the three-position disconnector from being operated under load.

⇨ Open the circuit-breaker (see Page 105, "Opening the circuit-breaker manually").



ATTENTION!

In disconnector panels without electromechanical/mechanical interlock, maloperation of the three-position disconnector is possible. Here, the three-position disconnector can be operated under load. Operating under load will destroy the three-position disconnector!

⇨ Do not operate the three-position disconnector under load.

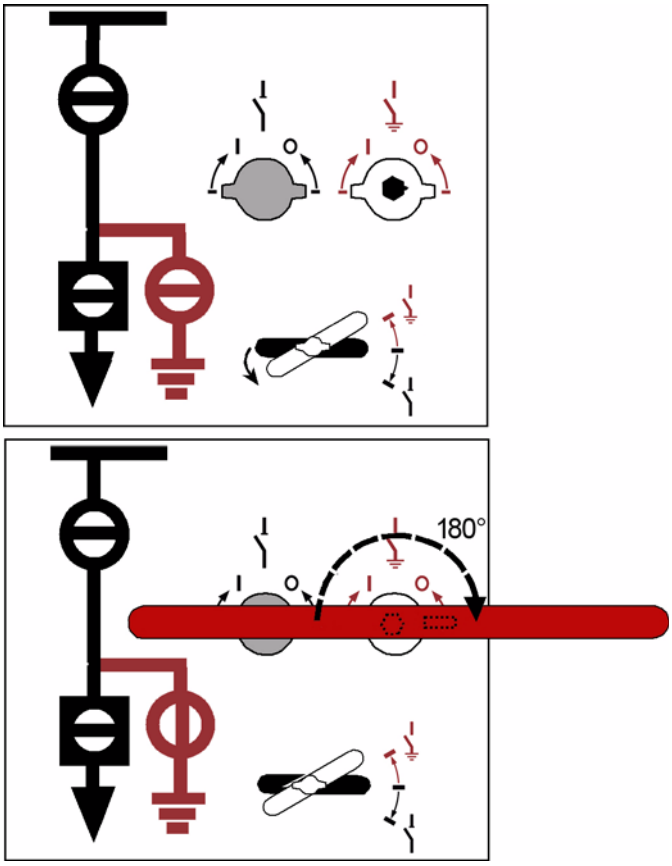


Fig. 67: Operating the three-position disconnector for the READY-TO-EARTH function

⇨ Insert the double-bit key and turn **counter-clockwise**.

✔ The opening for the READY-TO-EARTH function is free.

⇨ Hold the operating lever for the READY-TO-EARTH function in horizontal position (nose on the left) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the READY-TO-EARTH function 180° **clockwise**.

✔ The nose of the operating lever for the READY-TO-EARTH is on the right and the READY-TO-EARTH function is established. The position indicator changes to READY-TO-EARTH position.

⇨ Remove the operating lever for the READY-TO-EARTH function.

⇨ Turn the double-bit key **clockwise** and remove it.

✔ The opening for the READY-TO-EARTH function is closed.

	**DANGER!**
	Danger! High voltage! The earthing process is **not** completed until the circuit-breaker is closed. ⇨ Close the circuit-breaker after having switched the three-position disconnector to READY-TO-EARTH position.

28.5 Deactivating the ready-to-earth function

⇨ Open the circuit-breaker (see Page 105, "Opening the circuit-breaker manually").

⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **counter-clockwise** as far as it will go.

✔ The opening for the READY-TO-EARTH function is free.

⇨ Hold the operating lever for the READY-TO-EARTH function in horizontal position (nose on the right) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the READY-TO-EARTH function 180° **counter-clockwise** (nose on the left).

✔ The three-position disconnector is open. The position indicator changes to OPEN position.

⇨ Remove the operating lever for the READY-TO-EARTH function.

⇨ Turn the double-bit key **clockwise** and remove it.

✔ The opening for the READY-TO-EARTH function is closed.

28.6 Three-position disconnector with auxiliary voltage (motor operating mechanism)

Three-position disconnectors with motor operating mechanism can also be controlled from remote according to their design.

28.7 Emergency operation of the three-position disconnector

If the motor voltage of the three-position disconnector with motor operating mechanism fails, and the three-position disconnector is in no defined end position, you must operate the three-position disconnector manually with the emergency operating lever.

Emergency operation of the DISCONNECTING function

	ATTENTION!
	The emergency operating lever does not have a stop. Switching with the emergency operating lever beyond the end position of the DISCONNECTING function of the three-position disconnector will damage the three-position disconnector. ⇨ Do not turn the emergency operating lever beyond the horizontal position.

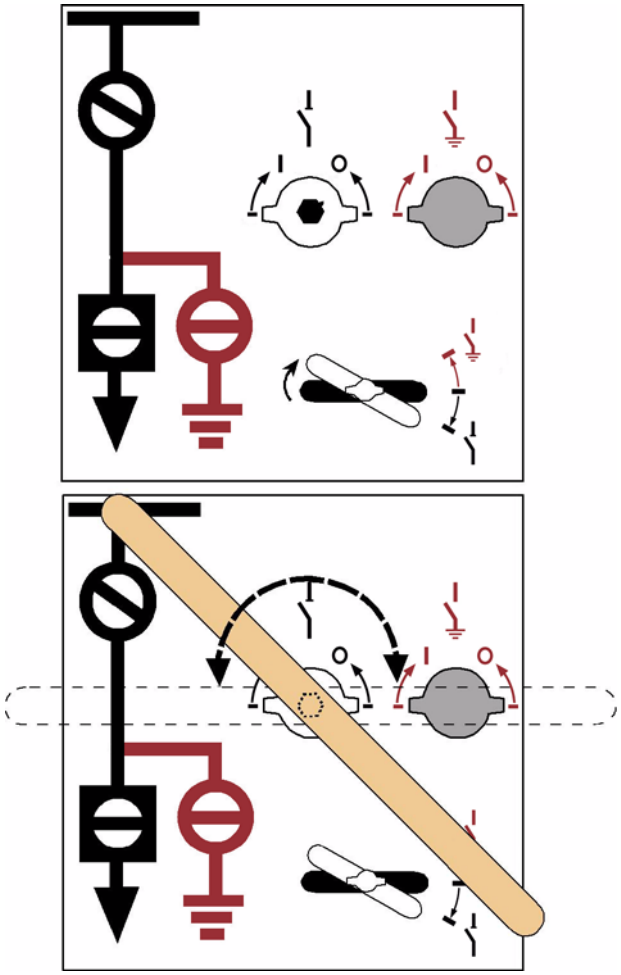


Fig. 68: Emergency operation of the DISCONNECTING function of the three-position disconnector

⇨ Insert the double-bit key.

⇨ Turn the double-bit key **clockwise** and remove it.

✔ The opening for the DISCONNECTING function is free.

⇨ Push the emergency operating lever onto the hexagonal shaft for the DISCONNECTING function so that the pin of the hexagonal shaft fits in the slot of the emergency operating lever.

To switch the DISCONNECTING function of three-position disconnector to the desired end position (CLOSED or OPEN), perform the following actions:

⇨ Turn the emergency operating lever until the position indicator changes to CLOSED or OPEN position.

✔ The emergency operating lever is in **horizontal** position, the marking of the slot is **at the bottom**: The three-position disconnector is in **CLOSED** position.
Or: The emergency operating lever is in **horizontal** position, the mark of the slot is **at the top**: The three-position disconnector is in **OPEN** position.

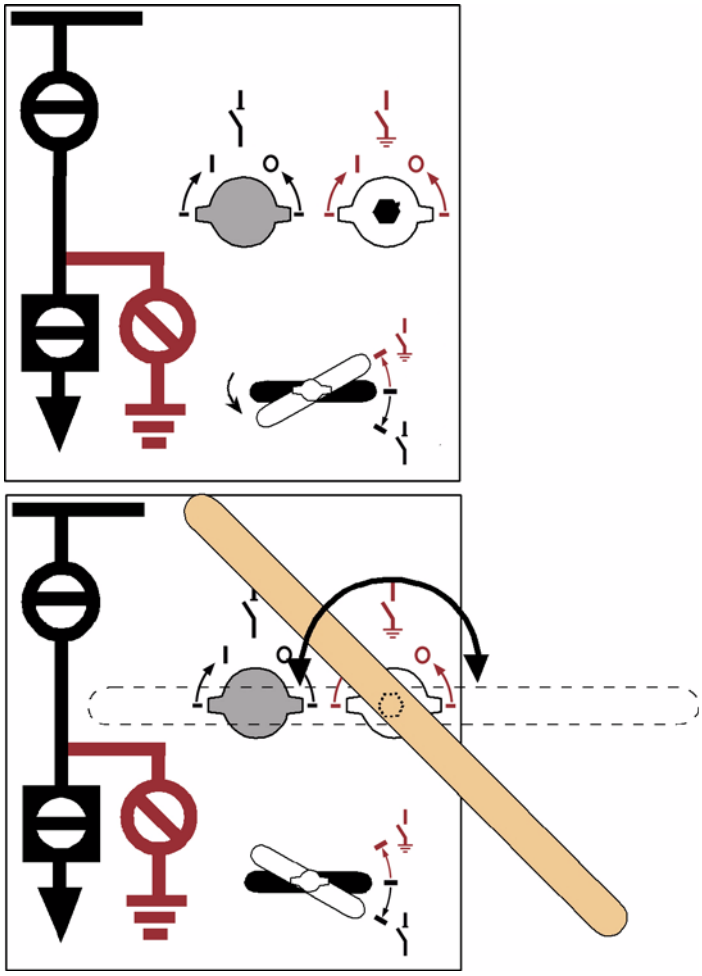
⇨ Remove the emergency operating lever.

⇨ Turn the double-bit key **counter-clockwise** and remove it.

✔ The opening for the DISCONNECTING function is closed.

Emergency operation of the READY-TO-EARTH function

	**ATTENTION!** The emergency operating lever does not have a stop. Switching with the emergency operating lever beyond the end position of the READY-TO-EARTH function of the three-position disconnector will damage the three-position disconnector. ⇨ Do not turn the emergency operating lever beyond the vertical position.



⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **counter-clockwise** as far as it will go.

✔ The opening for the READY-TO-EARTH function is free.

⇨ Push the emergency operating lever onto the hexagonal shaft for the READY-TO-EARTH function so that the pin of the hexagonal shaft fits in the slot of the emergency operating lever.

To switch the the READY-TO-EARTH function of the three-position disconnector to the desired end position (READY-TO-EARTH or OPEN), perform the following actions:

⇨ Turn the emergency operating lever until the position indicator changes to READY-TO-EARTH or OPEN position.

✔ The emergency operating lever is in **vertical** position, the marking of the slot is **on the left**: The three-position disconnector is in **READY-TO-EARTH** position.
Or: The emergency operating lever is in **vertical** position, the marking of the slot is **on the right**: The three-position disconnector is in **OPEN** position.

⇨ Remove the emergency operating lever.

⇨ Turn the double-bit key **clockwise** and remove it.

✔ The opening for the READY-TO-EARTH function is closed.

Switching operations after emergency operation

⇨ Perform further manual switching operations only with the associated operating levers for the DISCONNECTING or READY-TO-EARTH functions.

29 Feeder earthing and de-earthing

	**DANGER!** High voltage! Danger! Do always observe the Five Safety Rules: ⇨ Isolate the switchgear. ⇨ Secure against reclosing. ⇨ Verify safe isolation from supply. ⇨ Earth and short-circuit. ⇨ Cover or barrier adjacent live parts.

	**DANGER!** Danger! High voltage! The earthing process is **not** completed until the circuit-breaker is closed. ⇨ Close the circuit-breaker after having switched the three-position disconnector to READY-TO-EARTH position.

	**ATTENTION!** Earthing under load will destroy the three-position disconnector. ⇨ Open the circuit-breaker (see Page 105, "Opening the circuit-breaker manually"). ⇨ Make sure that the feeder is isolated from supply.

29.1 Feeder earthing

	**ATTENTION!** If the "feeder earthed" locking device is padlocked, the circuit-breaker cannot be opened, neither electrically nor mechanically. ⇨ Fit the padlock only if the feeder is earthed.

⇨ Switch the three-position disconnector to READY-TO-EARTH position (see Page 110, "Activating the ready-to-earth function manually").

⇨ Close the circuit-breaker (see Page 105, "Closing the circuit-breaker manually").

⇨ Pull the moving part of the "feeder earthed" locking device upwards.

⇨ Padlock the locking device.

29.2 Feeder de-earthing

⇨ Remove the padlock at the "feeder earthed" locking device.

✔ The moving part of the locking device folds downwards automatically.

	**NOTE!**
	In circuit-breaker operating mechanisms with undervoltage release, the circuit-breaker trips automatically after removing the padlock if ⇨ the panel is earthed and ⇨ auxiliary voltage is available.

⇨ Open the circuit-breaker (see Page 105, "Opening the circuit-breaker manually").

⇨ Switch the three-position disconnector to OPEN position (see Page 112, "Deactivating the ready-to-earth function").

30 Operation of the busbar earthing switch

30.1 Control elements and indicators



① Additional compartment for operating mechanism of busbar earthing switch
② Position indicator
③ Actuating opening
④ Operating spindle at the operating lever
⑤ Setscrew at the operating spindle

Fig. 69: Manual operating mechanism for busbar earthing switch



Fig. 70: Operating lever for busbar earthing switch

The busbar earthing switch is equipped with a high-speed closing facility for make -proof earthing of the busbar.

The cover of the actuating opening is padlocked mechanically or interlocked electromechanically. The opening for inserting or removing the operating lever is only released if the busbar earthing switch is in a defined end position.

If the space in the switchgear room is limited, you can undo the setscrew and change the position of the operating spindle at the operating lever by 45°.

30.2 Closing

	**DANGER!**
	High voltage! Danger! By no means may the busbar make-proof earthing switch be operated under load, as it will be destroyed in case of repetition. ⇨ Observe the Five Safety Rules. ⇨ Disconnect the incoming and outgoing feeders in all panels.

	**ATTENTION!**
	The electromechanical interlock can be deactivated if the operating lever is not removed after a switching operation. ⇨ Remove the operating lever after every switching operation.

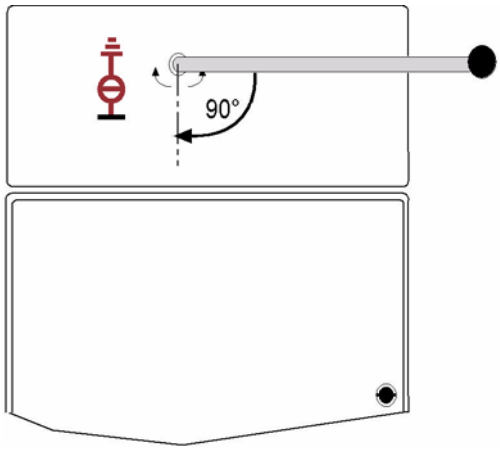


Fig. 71: Closing the busbar earthing switch

⇨ Hold the operating lever in horizontal position.

⇨ Insert the operating lever in the actuating opening as far as it will go.

⇨ Press the operating lever into the actuating opening with one hand over the operating spindle, and move it downwards by 90° with the other hand as far as it will go.

⇨ Remove the operating lever.

⇨ In case of mechanical interlock: Fit a padlock.

✔ The busbar earthing switch is closed.

30.3 Opening

	**DANGER!** Avoid any intermediate position of the busbar make-proof earthing switch during the opening process. Reversal will not be possible! ⇨ Perform the opening operation continuously and up to the end position. ⇨ Do not use force (torque approx. 140 Nm).

	**ATTENTION!** The electromechanical interlock can be deactivated if the operating lever is not removed after a switching operation. ⇨ Remove the operating lever after every switching operation.

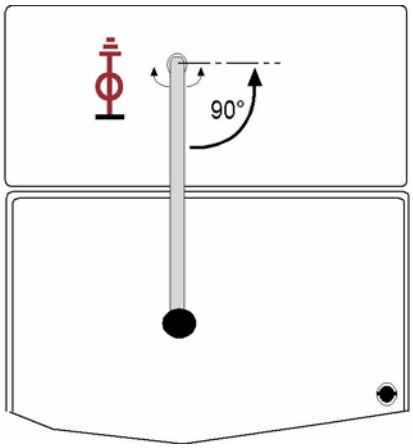


Fig. 72: Opening the busbar earthing switch

⇨ Hold the operating lever in vertical position.

⇨ Insert the operating lever in the actuating opening as far as it will go.

⇨ Press the operating lever into the actuating opening with one hand over the operating spindle, and move it upwards by 90° with the other hand as far as it will go.

⇨ Remove the operating lever.

⇨ In case of mechanical interlock: Fit a padlock.

✔ The busbar earthing switch is open.

31 Interlocks

Switching devices may only be controlled and operated in logical dependence on the switch position of other devices. Unpermissible switching operations must be blocked in order to:

- Provide full protection for the personnel.
- Prevent switchgear damages and power failures.

The interlocks are mainly of the mechanical type.

Interlocking conditions

Feeder and circuit-breaker panel of bus sectionalizer		
Switching operation	Switching operation only possible if	Type
Disconnector CLOSED/OPEN	circuit-breaker OPEN / earthing switch OPEN	mechanical / mechanical
Earthing switch CLOSED/OPEN	circuit-breaker OPEN / disconnector OPEN	mechanical / mechanical
Circuit-breaker CLOSED	disconnector or earthing switch not in intermediate position (shutter closed)	mechanical
Circuit-breaker OPEN	not locked by a locking device	mechanical
Additionally, electromechanical interlocks may be fitted for disconnectors and earthing switches or for earthing switches.		

Bus riser of bus sectionalizer / Disconnectable busbar connection / Top-mounted busbar sectionalizer		
Switching operation	Switching operation only possible if	Type
Disconnector CLOSED/OPEN	associated circuit-breaker OPEN / earthing switch OPEN	electromechanical / mechanical
Earthing switch CLOSED/OPEN	associated circuit-breaker OPEN / disconnector OPEN	electromechanical / mechanical
Additionally, electromechanical interlocks may be fitted for disconnectors and earthing switches or for earthing switches.		

Disconnectable busbar voltage transformer		
Switching operation	Switching operation only possible if	Type
Disconnector CLOSED/OPEN	earthing switch OPEN	mechanical
Earthing switch CLOSED/OPEN	disconnector OPEN	mechanical
Additionally, electromechanical interlocks may be fitted for disconnectors and earthing switches or for earthing switches.		

Make-proof busbar earthing switch		
Switching operation	Switching operation only possible if	Type
Earthing switch CLOSED/OPEN	opening for operating lever open	optionally mechanical or electromechanical

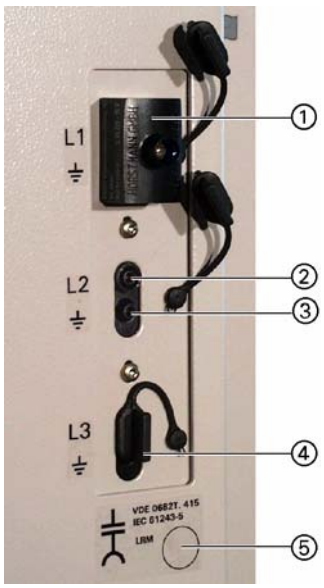
32 Verification of safe isolation from supply

The panels are equipped with voltage detecting systems.

Use voltage indicators according to IEC 61 243-5 or DIN VDE 0682-415 only.

The function of the voltage indicator must have been checked:
- with test unit according to IEC 61 243-5 or DIN VDE 0682-415
- on live equipment

The function of the coupling section must have been checked:
- IEC 61 243-5 or DIN VDE 0682-415



① Voltage indicator type LRM, make Horstmann
② Interface (capacitive test socket) for L2
③ Earth socket
④ Cover for test sockets
⑤ Documentation to repeat test of interface condition

Fig. 73: Verification of safe isolation from supply

⇨ Remove covers from interface (capacitive test sockets L1, L2, L3).

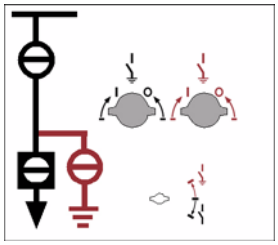
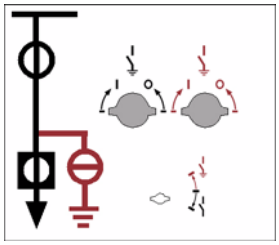
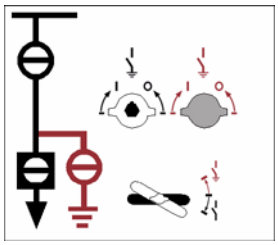
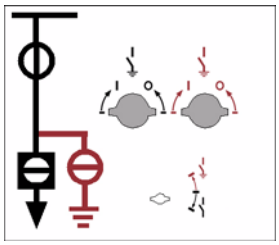
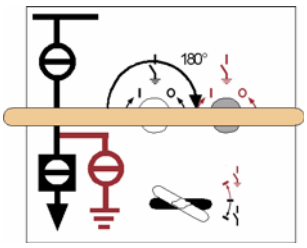
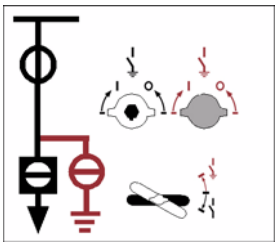
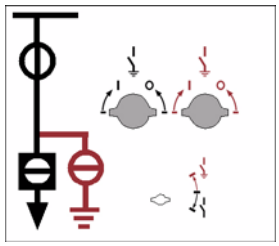
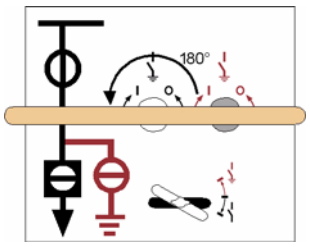
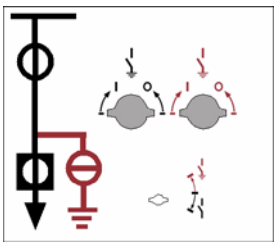
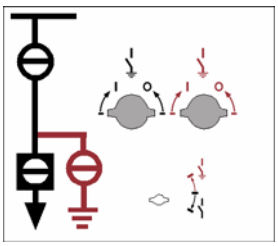
⇨ Plug voltage indicator in all three phases L1, L2, L3 of the interface.

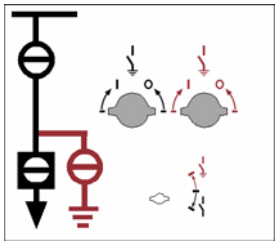
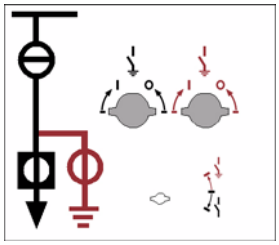
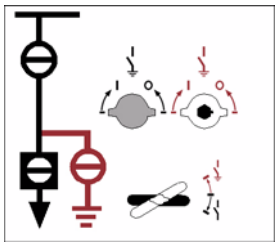
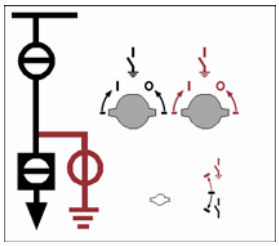
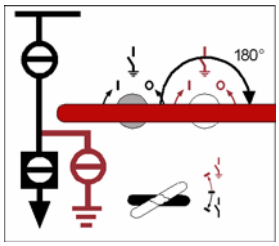
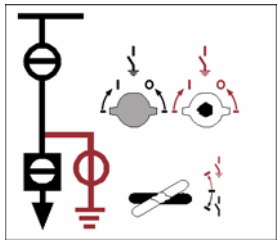
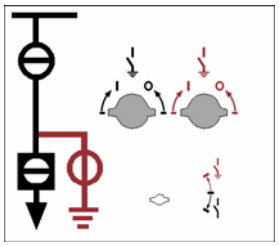
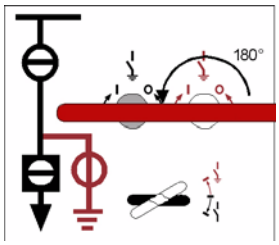
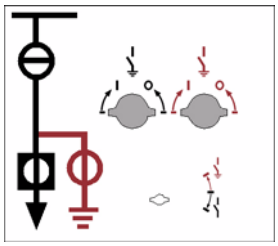
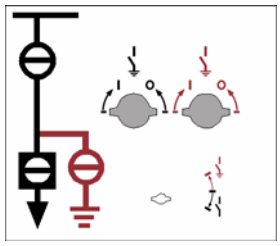
✔ If the indicator does **not** flash or light up in any of the three phases, the phases are not live.

⇨ Replace the covers on the interface.

33 Overview of switching operations

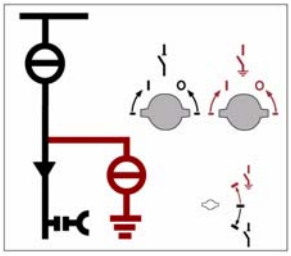
33.1 Switching operations in the circuit-breaker panel

Connecting feeder with busbar		Disconnecting feeder from busbar	
1	 Initial situation	1	 Initial situation
2	 1. Insert double-bit key. 2. Turn clockwise. Opening for DISCONNECTING function is free.	2	 1. Open the circuit-breaker.
3	 1. Hold operating lever for DISCONNECTING function in horizontal position (nose on the left) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever for DISCONNECTING function 180° clockwise.	3	 1. Insert double-bit key. 2. Turn clockwise. Opening for DISCONNECTING function is free.
4	 1. Remove operating lever for DISCONNECTING function. 2. Turn double-bit key counter-clockwise and remove it. Opening for DISCONNECTING function is closed.	4	 1. Hold operating lever for DISCONNECTING function in horizontal position (nose on the right) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever for DISCONNECTING function 180° counter-clockwise.
5	 1. Close the circuit-breaker. The feeder is connected with the busbar.	5	 1. Remove operating lever for DISCONNECTING function. 2. Turn double-bit key counter-clockwise and remove it. Opening for DISCONNECTING function is closed. The feeder is disconnected from the busbar.

Feeder earthing	Feeder de-earthing
1  Initial situation	**1**  Initial situation
2  1. Insert double-bit key. 2. Turn counter-clockwise. Opening for READY-TO-EARTH function is free.	**2**  1. Remove padlock at “feeder earthed“ locking device. 2. Open the circuit-breaker.
3  1. Hold operating lever for READY-TO-EARTH function in horizontal position (nose on the left) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever for READY-TO-EARTH function 180° clockwise.	**3**  1. Insert double-bit key. 2. Turn counter-clockwise. Opening for READY-TO-EARTH function is free.
4  1. Remove operating lever for READY-TO-EARTH function. 2. Turn double-bit key clockwise and remove it. Opening for READY-TO-EARTH function is closed.	**4**  1. Hold operating lever for READY-TO-EARTH function in horizontal position (nose on the right) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever for READY-TO-EARTH function 180° counter-clockwise.
5  1. Close the circuit-breaker. 2. Padlock “feeder earthed“ locking device.  Opening for READY-TO-EARTH function is closed. The feeder is earthed.	**5**  1. Remove operating lever for READY-TO-EARTH function. 2. Turn double-bit key clockwise and remove it. Opening for READY-TO-EARTH function is closed. The feeder is de-earthed.

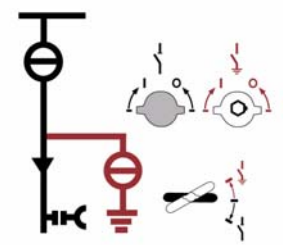
Earthing feeder with make-proof busbar earthing switch

1



Initial situation

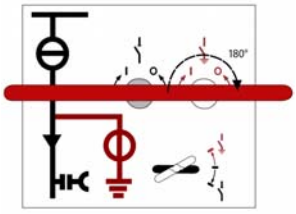
2



1. Insert double-bit key.
2. Turn counter-clockwise.

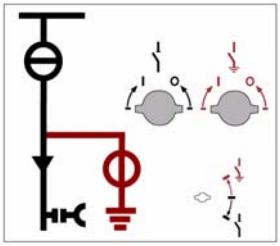
Opening for READY-TO-EARTH function is free.

3



1. Hold operating lever for READY-TO-EARTH function in horizontal position (nose on the left) and push onto hexagonal shaft as far as it will go.
2. Turn operating lever for READY-TO-EARTH function 180°clockwise.

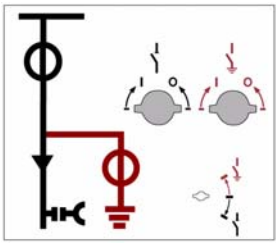
4



1. Remove operating lever for READY-TO-EARTH function.
2. Turn double-bit key clockwise and remove it.

Opening for READY-TO-EARTH function is closed.

5



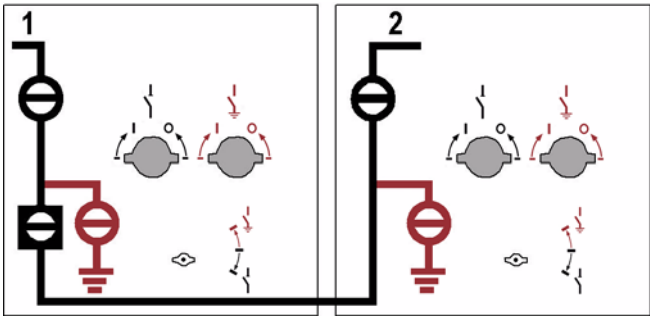
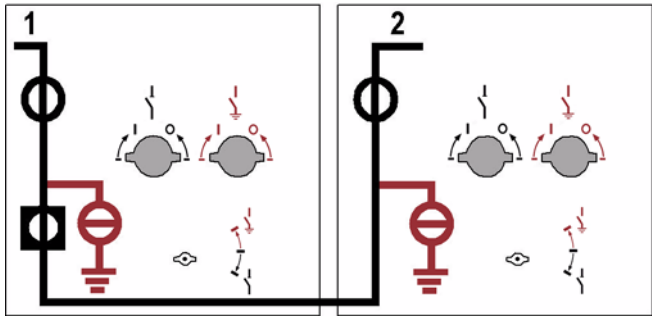
1. Close the circuit-breaker.
2. Padlock "feeder earthed" locking device.



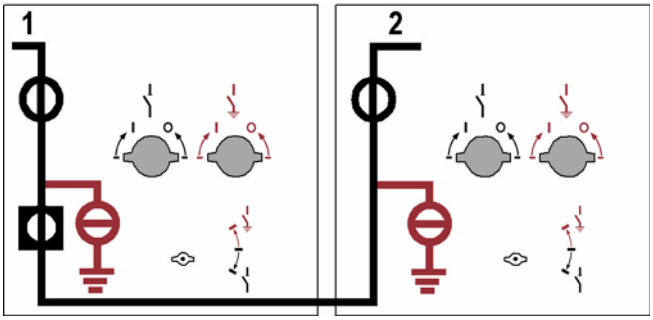
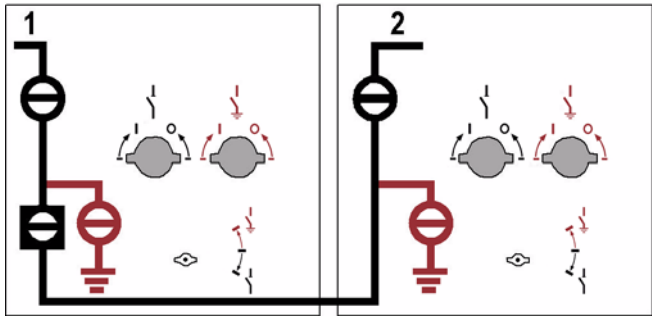
Opening for READY-TO-EARTH function is closed. The feeder is earthed.

33.2 Switching operations in the bus sectionalizer

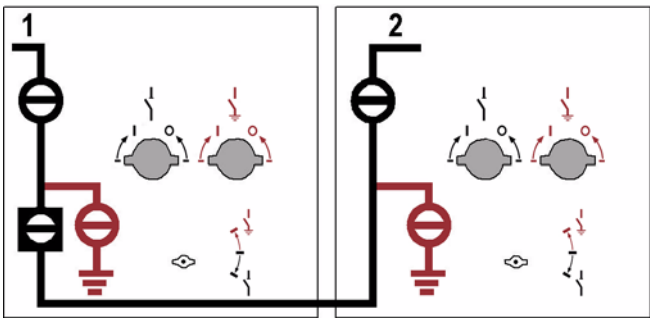
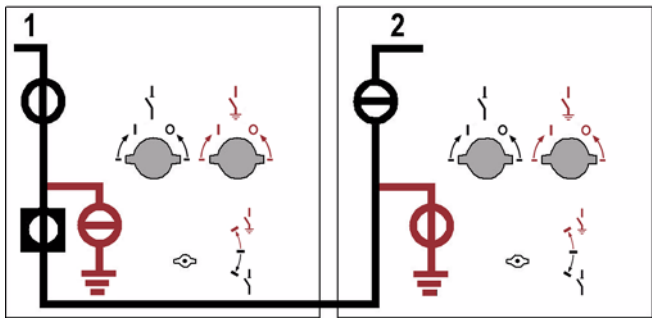
Coupling busbar sections

1	2
	
Initial situation	1. "CLOSE“ disconnector in circuit-breaker panel. 2. "CLOSE" disconnector in bus riser panel. 3. "CLOSE" circuit-breaker in circuit-breaker panel.

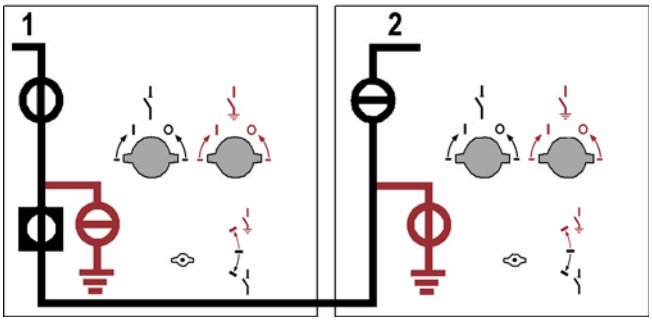
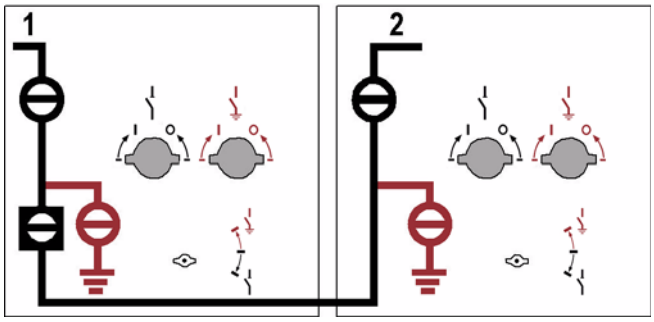
Decoupling busbar sections

1	2
	
Initial situation	1. "OPEN" circuit-breaker in circuit-breaker panel. 2. "OPEN" disconnector in circuit-breaker panel. 3. "OPEN" disconnector in bus riser panel.

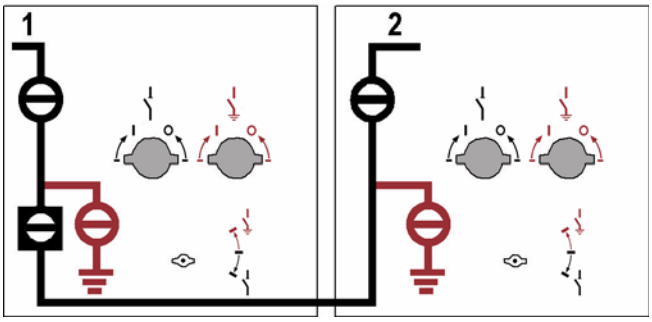
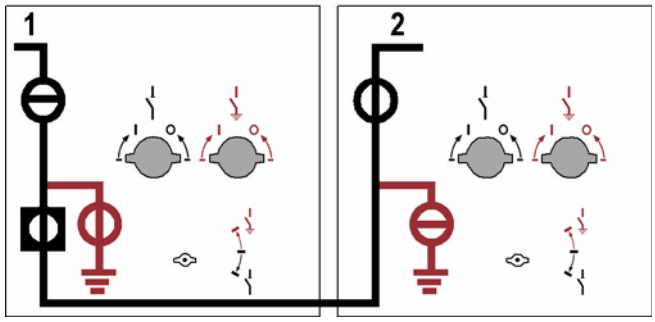
Earthing busbar section 1

1	2
	
Initial situation	1. "CLOSE“ disconnector in circuit-breaker panel 2. "CLOSE" earthing switch in bus riser panel. 3. "CLOSE" circuit-breaker in circuit-breaker panel. 4. Padlock "feeder earthed“ locking device.

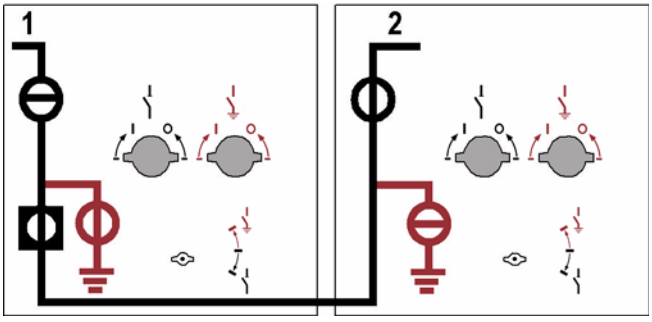
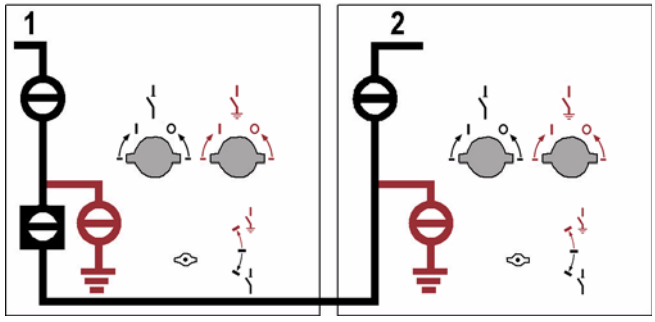
De-earthing busbar section 1

1	2
	
Initial situation	1. Locking device: Remove padlock. 2. "OPEN" circuit-breaker in circuit-breaker panel. 3. "OPEN" earthing switch in bus riser panel. 4. "OPEN" disconnector in circuit-breaker panel.

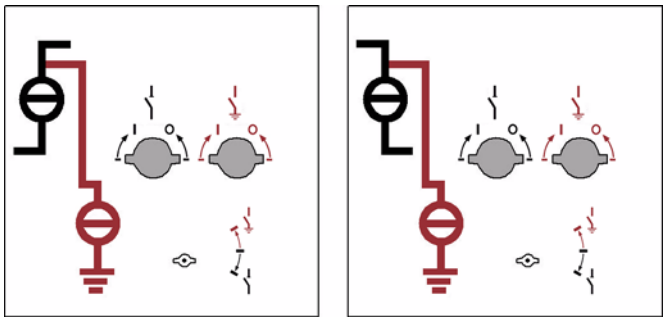
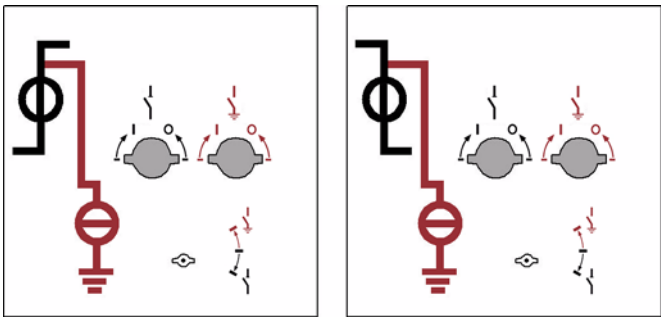
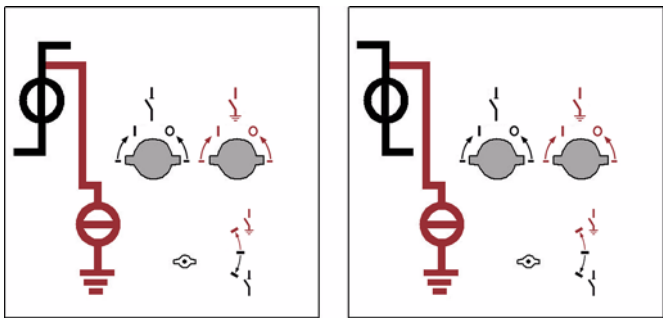
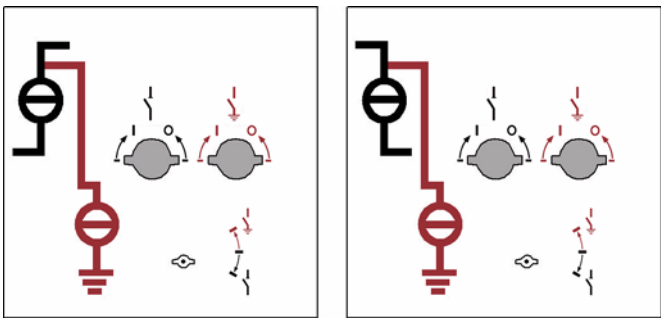
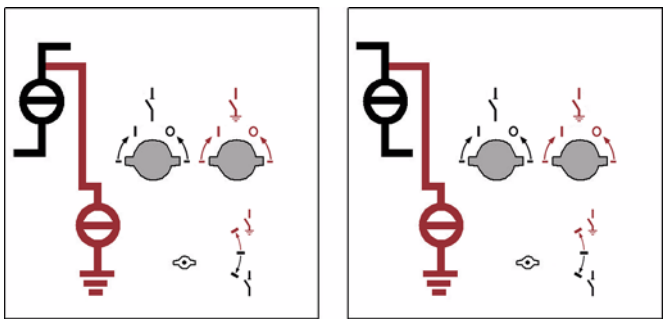
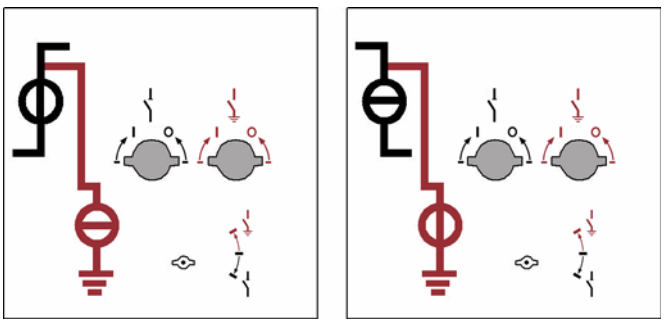
Earthing busbar section 2

1	2
	
Initial situation	1. "CLOSE" disconnector in bus riser panel. 2. "CLOSE" earthing switch in circuit-breaker panel. 3. "CLOSE" circuit-breaker in circuit-breaker panel. 4. Padlock "feeder earthed" locking device.

De-earthing busbar section 2

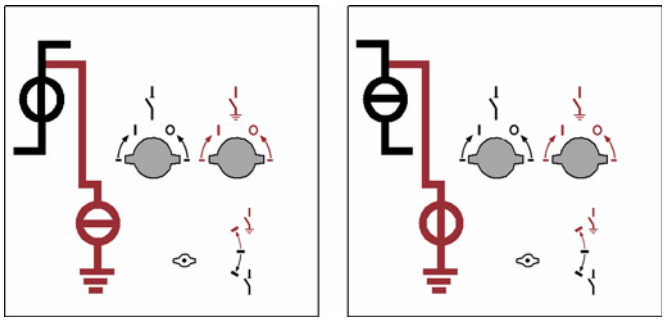
1	2
	
Initial situation	1. Locking device: Remove padlock. 2. "OPEN" circuit-breaker in circuit-breaker panel. 3. "OPEN" earthing switch in circuit-breaker panel. 4. "OPEN" disconnector in bus riser panel.

33.3 Switching operations in top-mounted bus sectionalizer

Coupling busbar sections	
1  Initial situation	**2**  1. "CLOSE" disconnector in left-hand busbar section 2. "CLOSE" disconnector in right-hand busbar section
Decoupling busbar sections	
1  Initial situation	**2**  1. "OPEN" disconnector in left-hand busbar section 2. "OPEN" disconnector in right-hand busbar section
Earthing busbar section 1	
1  Initial situation	**2**  1. "CLOSE" earthing switch in right-hand busbar section 2. "CLOSE" disconnector in left-hand busbar section

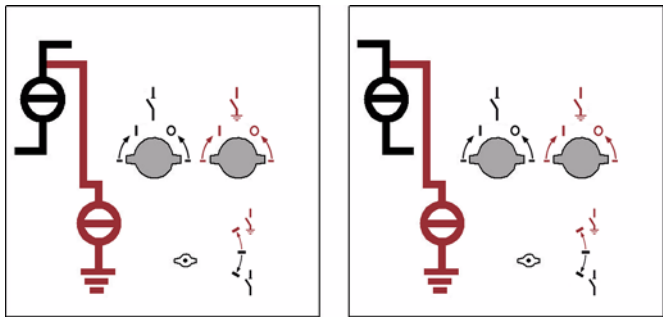
De-earthing busbar section 1

1



Initial situation

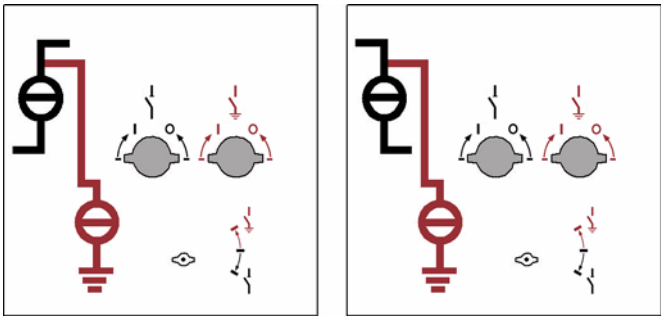
2



1. "OPEN" disconnector in left-hand busbar section
2. "OPEN" earthing switch in right-hand busbar section

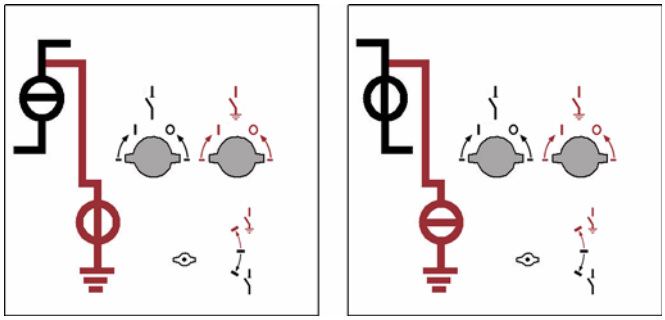
Earthing busbar section 2

1



Initial situation

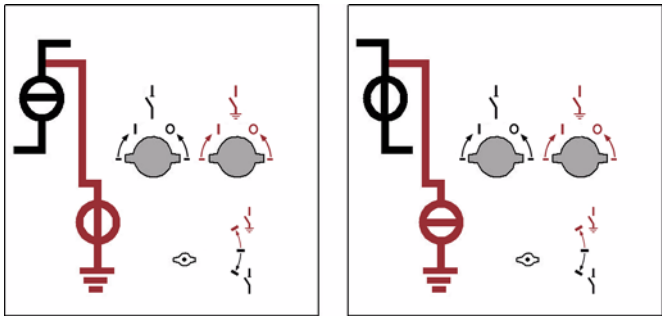
2



1. "CLOSE" earthing switch in left-hand busbar section
2. "CLOSE" disconnector in right-hand busbar section

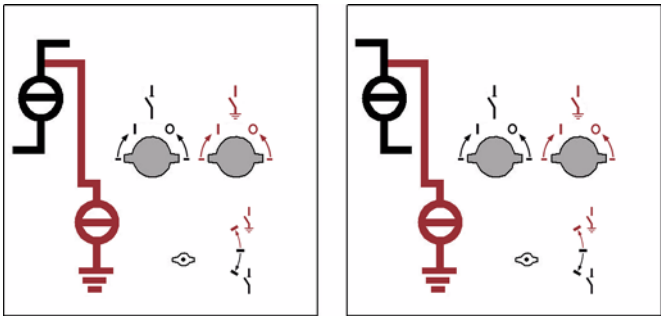
Sammelschienenabschnitt 2 von der Erde trennen

1



Initial situation

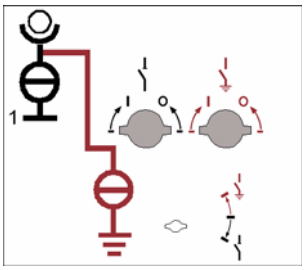
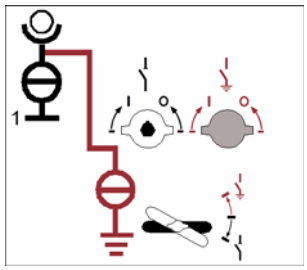
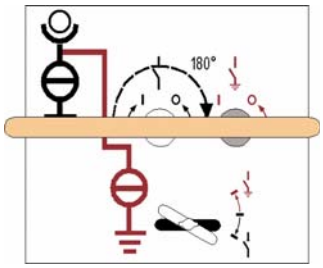
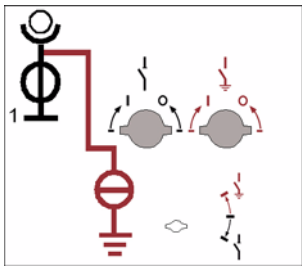
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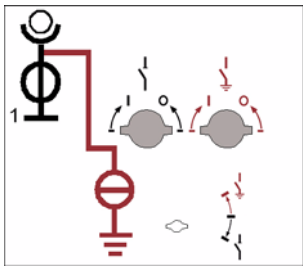
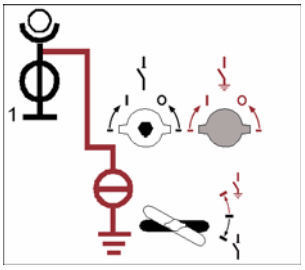
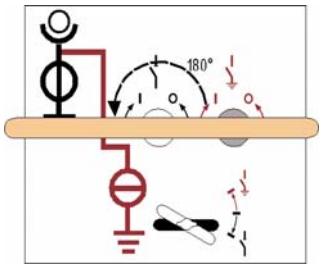
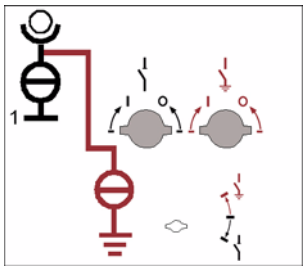
1. "OPEN" disconnector in right-hand busbar section
2. "OPEN" earthing switch in left-hand busbar section

33.4 Switching operations for disconnectable voltage transformers

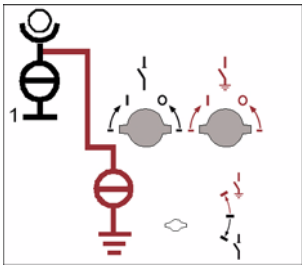
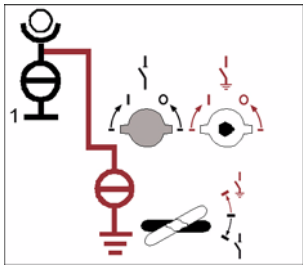
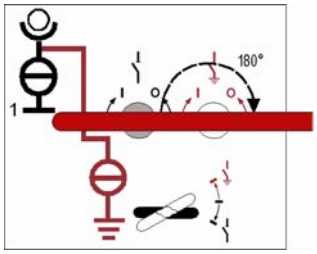
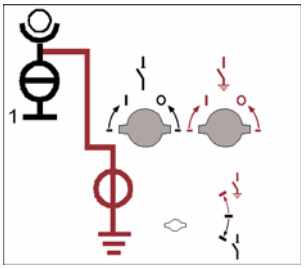
Connecting voltage transformers with busbar

1	2	3	4
			

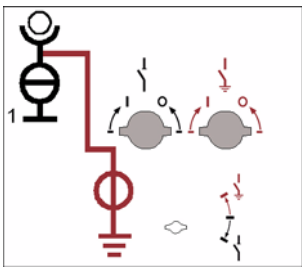
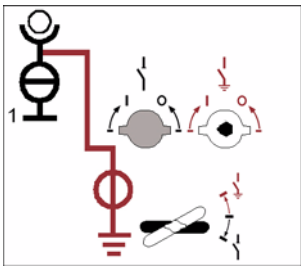
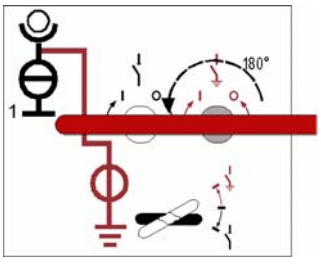
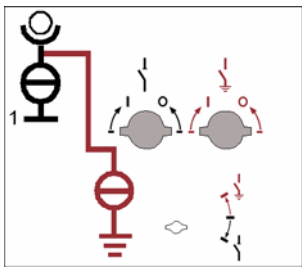
Disconnecting voltage transformers from busbar

1	2	3	4
			

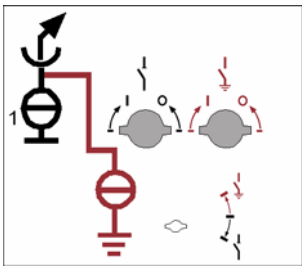
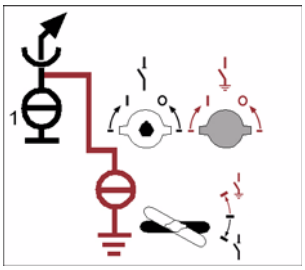
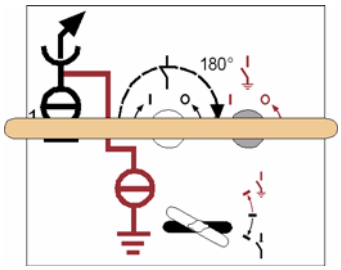
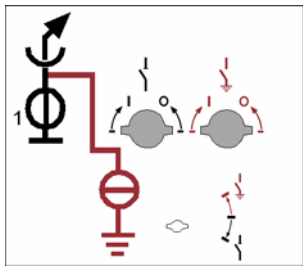
Earthing voltage transformers

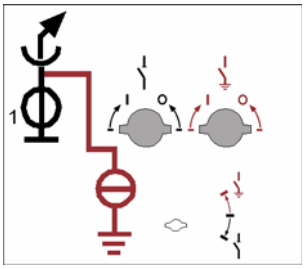
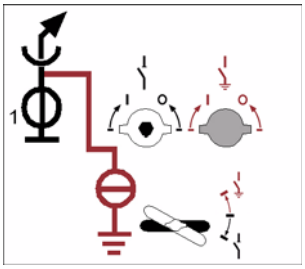
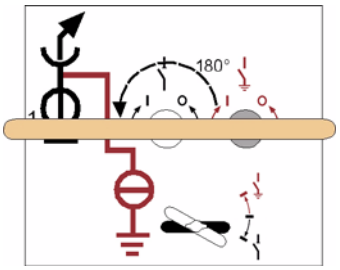
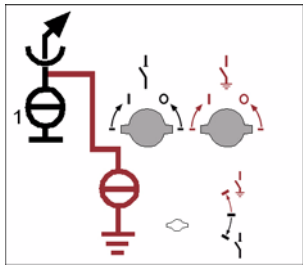
1	2	3	4
			

De-earthing voltage transformers

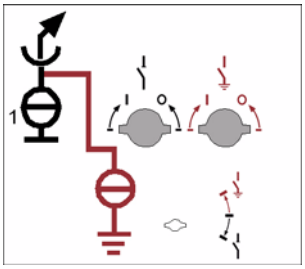
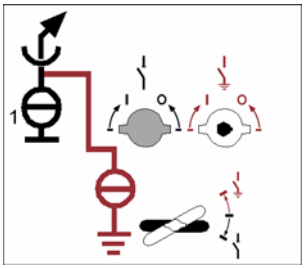
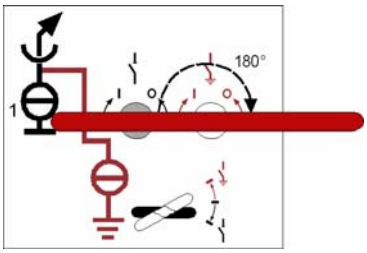
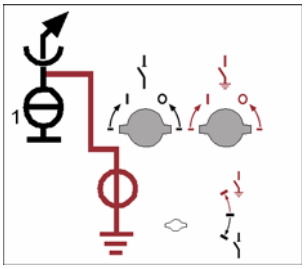
1	2	3	4
			

33.5 Switching operations for disconnectable busbar connection

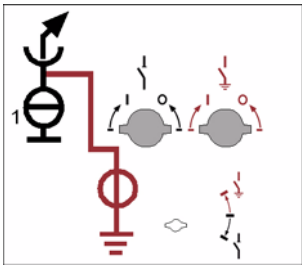
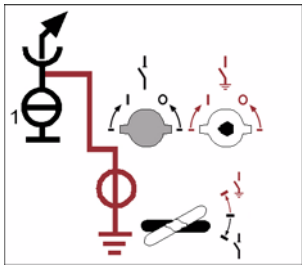
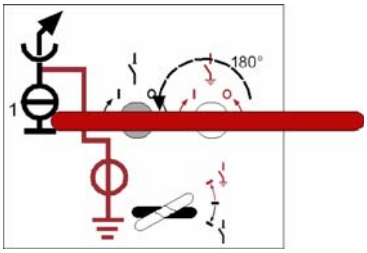
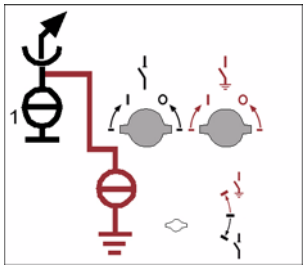
Connecting busbar with feeder			
1	2	3	4
			

Disconnecting busbar from feeder			
1	2	3	4
			

Feeder earthing

1	2	3	4
			

Feeder de-earthing

1	2	3	4
			

34 Cable testing

34.1 Function test

Before commissioning, a high DC voltage is applied to the cables for test. A possibility for cable testing is described hereafter.

The following table contains the maximum values for the DC test voltage:

Rated voltage of switchgear [kV]	DC test voltage,maximum value [kV]	AC test voltage 0.1 Hz, maximum value [kV]
12	48	19
24	72	38
36	72	57
40.5	72	57

34.2 Safety instructions



DANGER!

High voltage! Danger! Cable testing may produce flashovers which can cause death or serious bodily injuries.

- ⇨ Cable testing may only be performed by qualified personnel who is familiar with the danger involved.
- ⇨ The permissible test voltages must not be exceeded.
- ⇨ Keep safety distances.
- ⇨ Install barriers.
- ⇨ Switch on warnings.



ATTENTION!

If the voltage transformer is energized, or if it is of the non-disconnectable type, the test voltage can destroy the voltage transformer and cause personal injuries.

- ⇨ Earth disconnectable voltage transformers before cable testing.
- ⇨ Remove non-disconnectable voltage transformers.



ATTENTION!

The voltage indicators CAPDIS-S1+ and CAPDIS-S2+ may be damaged during power-frequency voltage tests.

- ⇨ Short-circuit voltage indicators with the earthing points of the test sockets.

34.3 Procedure

Cable testing with dismantled cable

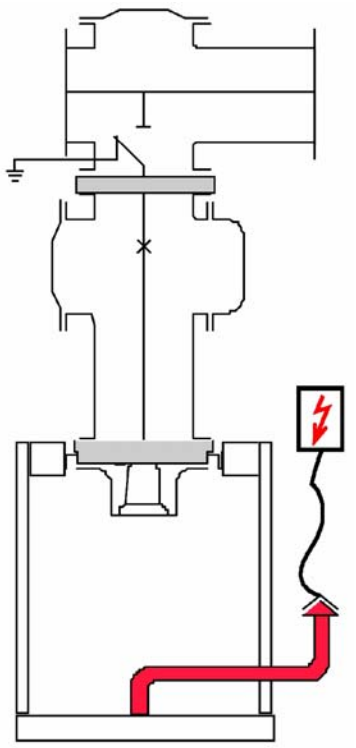


Fig. 74: Test arrangement with dismantled cable

- ⇨ Earth the feeder (see Page 116, "Feeder earthing").
- ⇨ Earth the voltage transformers (see Page 116, "Feeder earthing") or remove non-disconnectable voltage transformers.
- ⇨ Remove cable to be tested.
- ⇨ Screw test adapter onto cable termination.
- ⇨ Connect test lead.
- ⇨ Perform voltage test.

Cable testing with connected cable

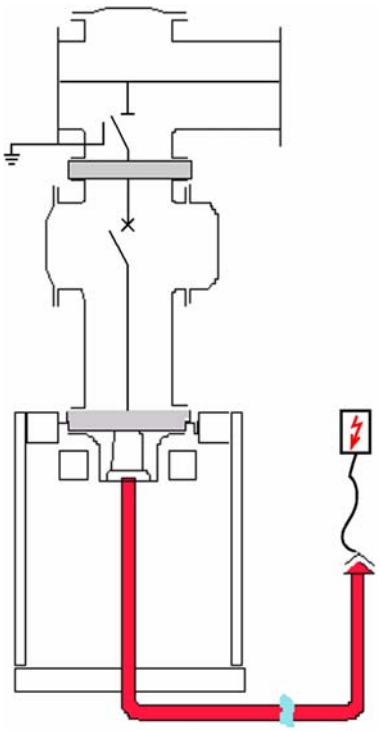


Fig. 75: Test arrangement with connected cable

- ⇨ Earth the feeder (see Page 116, "Feeder earthing").
- ⇨ Earth the voltage transformers (see Page 116, "Feeder earthing") or remove non-disconnectable voltage transformers.
- ⇨ Short-circuit capacitive test sockets and test sockets on integrated voltage detecting systems (e. g. CAPDIS).
- ⇨ Open the circuit-breaker (see Page 105, "Opening the circuit-breaker manually").
- ⇨ Switch three-position disconnector to OPEN position (see Page 110, "Opening the three-position disconnector manually ").
- ⇨ Close the circuit-breaker (see Page 105, "Closing the circuit-breaker manually").
- ⇨ Screw test adapter onto cable termination.
- ⇨ Connect test lead.
- ⇨ Perform voltage test.

Servicing

35 Maintenance

35.1 Switchgear maintenance

Under normal operating conditions the fixed-mounted circuit-breaker switchgear 8DA and the 3AH49 circuit-breaker are maintenance-free. We recommend to inspect the switchgear according to the following maintenance recommendation. To prevent any danger during maintenance, please observe the following safety instructions.

35.2 Safety instructions

	**DANGER!** High voltage! Danger! Do always observe the Five Safety Rules: ⇨ Isolate the switchgear. ⇨ Secure against reclosing. ⇨ Verify safe isolation from supply. ⇨ Earth and short-circuit. ⇨ Cover or barrier adjacent live parts.

	**DANGER!** High voltage! Danger! Touching live parts will cause death or serious injuries. ⇨ Switchgear maintenance may only be performed by qualified personnel who is familiar with the danger involved.

35.3 Maintenance recommendation

The switchgear should be inspected at the following intervals:

Visual inspection	every 5 years
State inspection	every 10 years
Maintenance	after 1000 operating cycles of the disconnectors and earthing switches or after 10000 operating sycles of the circuit-breaker, see Page 138, "Maintenance of the vacuum circuit-breaker operating mechanism"
These intervals are guidelines which have to be adjusted to the different operating conditions (e.g. dusty environment, frequent condensation, etc.). The maintenance actions with the associated test and maintenance operations are shown in the following table.	

	**DANGER!**
	Danger of suffocation! SF_6 gas is heavier than air and concentrates first near to the floor and in floor openings. ⇨ Do not let SF_6 gas get into the environment. ⇨ While working with SF_6 gas, provide for sufficient ventilation. ⇨ After working with SF_6 gas, vent the cable basement and any hollows in the floors with special care. ⇨ Observe the safety data sheet for SF_6 gas. ⇨ Cover or barrier adjacent live parts. ⇨ To be done generally before working with SF_6 gas: Check and document reusability (dew-point, gas quality) of the SF_6.

Maintenance recommendation

Visual inspection	Status inspection	Maintenance	
X	X	X	Check and document SF_6 gas pressure (see Page 23, "Insulating gas SF_6")
	X	X	Check and document dew-point (humidity content) (≤ –15° C)
	X	X	Check and document gas quality (air content) (SF_6 share ≥ 95 %)
		X	Check operating mechanism and interlocking of disconnector and earthing switch (if required, grease linkage and bearings)
		X	Vacuum circuit-breaker operating mechanism
		X	**In all gas compartments - if gas has to be exchanged -, or upon reaching the number of operating cycles:** ⇨ Evacuate SF6 gas. ⇨ Replace desiccant bags. ⇨ Replace O-rings. ⇨ Fill in SF_6 gas. ⇨ Check and document gas pressure. ⇨ Check tightness.
		X	**Check additionally in all compartments with three-position disconnector:** ⇨ Operate disconnector and earthing switch for test and verfiy that the switch positions are reached correctly. ⇨ Check contact surfaces, rotary insulators and operating linkages for signs of wear. ⇨ If required, clean the insulating bushings with a vacuum cleaner. ⇨ Grease contact surfaces and joints of the operating linkages.

35.4 Procedure for bolted joints and seals

Please observe the following procedure for maintenance of switchgear parts with bolted joints:

⇨ Recommendation: Always replace the spring elements on loosened bolted joints.

Please observe the following procedure for maintenance of switchgear parts with seals:

⇨ Always replace removed O-rings with new ones. O-rings are available at your regional Siemens representative.

⇨ Clean the sealing surfaces and grooves in the flanges with a lint-free cloth.

⇨ Check the sealing surfaces before installation.

⇨ Grease the O-rings and place them in the grooves of the flanges.

⇨ If required, place desiccant bags in the cover.

⇨ Fit the cover.

⇨ Bolt the flanges tight cross-wise with the hexagonal bolts M8 with new spring elements. Tightening torque: 20 Nm.

35.5 Maintenance of the vacuum circuit-breaker operating mechanism

Under normal operating conditions the fixed-mounted circuit-breaker switchgear 8DA and the 3AH49 circuit-breaker are maintenance-free.

After 10.000 operating cycles or depending on the respective operating conditions (e. g. dusty environment, frequent condensation, etc.) we recommend to clean the external parts and, if necessary, to renew the anti-corrosion protection greasing.
To do this, you may only use the materials specified hereafter on the individual functional parts of the circuit-breaker.

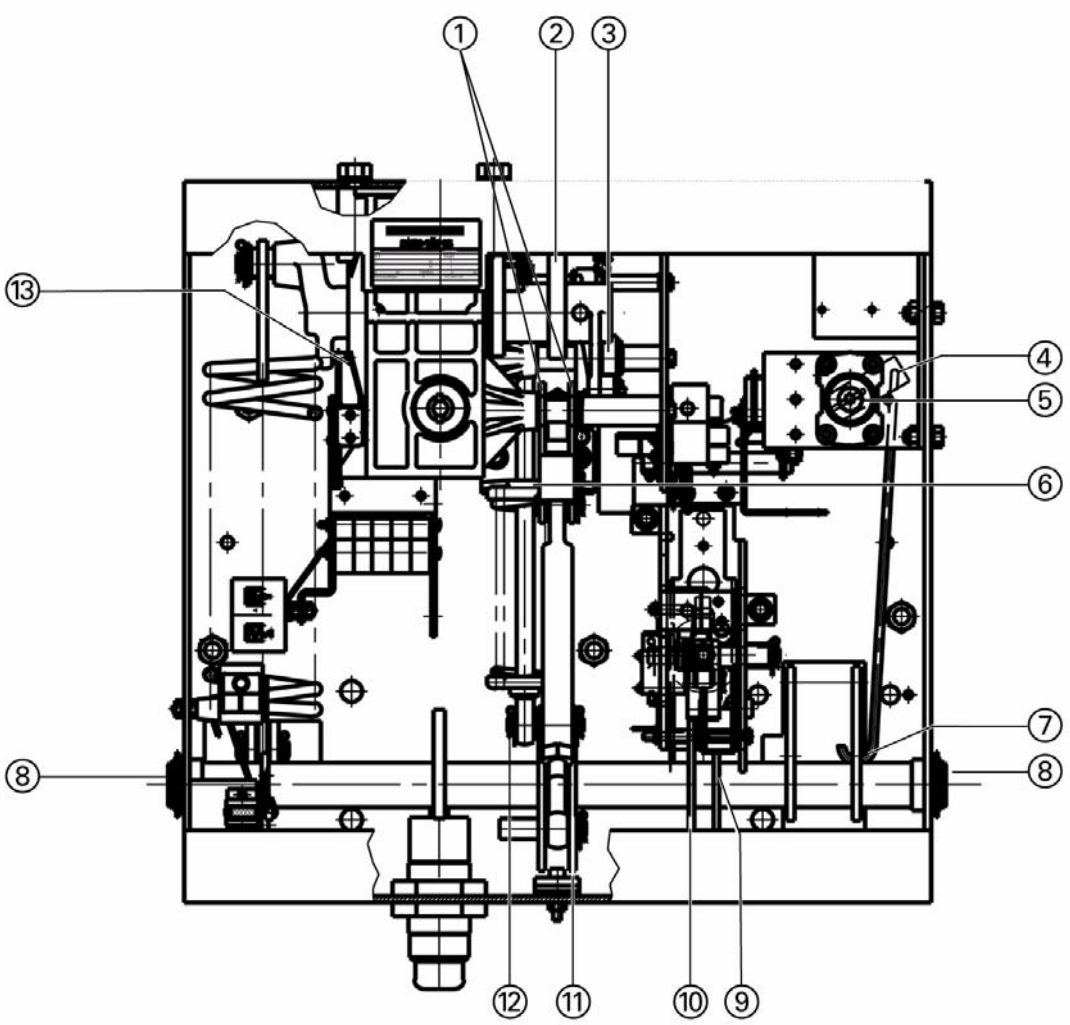


Fig. 76: Greasing plan for 3AH49 operating mechanism

Isoflex Topas L 32

② Curve contour
③ Closing latch
④ Deflection of auxiliary switch
⑥ Guide of opening spring
⑦ Deflecton of auxiliary switch
⑨ Opening latch
⑩ Curve for opening latch
⑪ End stop
⑬ Crank pin for pushbutton operation

Shell Tellus Oil 32

① Bearing for deflection lever
⑤ Auxiliary switch
⑧ Bearing of operating shaft
⑫ Opening spring

Permissible lubricants:

For bearings, sliding surfaces:

Isoflex Topas L 32
Klüber - Lubrication KG
Geisenhauer Str. 7
Postfach 70 10 47
D-81310 München

For bearings that are inaccessible for grease, and bearings of the auxiliary switch S1:

Tellus Oil 32
Shell Direct GmbH
Suhrenkamp 71
D-22335 Hamburg



ATTENTION!

Parts of the switchgear that cannot be dismantled may be damaged if they come into contact with cleaning agents.

⇨ Do **not** wash joints and bearings which cannot be dismantled with a cleaning agent.

⇨ Renew the anti-corrosion protection greasing.

⇨ Operate the circuit-breaker several times mechanically by hand for test.

35.6 Cleaning agents and cleaning aids



DANGER!

For protection of personnel and environment:

⇨ Read the instructions for use of cleaning agents carefully.

⇨ Observe the warnings (e.g. inflammable!, corrosive!, etc.)

Cleaning agents	HAKU 1025-920	Contains carbon hydrogen!
	Household cleaner	For cleaning electrostatically stressed insulation (e.g. epoxy resin)
Cleaning aids	Lint-free cleaning paper	For applying and cleaning liquid cleaning agent (single use)
	Brush	
	Cleaning rag	
	Vacuum cleaner	

35.7 Lubricants

Designation	Manufacturer	Application	Remark
Polylub GLY 801	Siemens	Current-carrying fixed-mounted connections (current conductors and earthing bars, connections), flanges with O-rings	No greasing effect; used as mounting aid for O-rings; mounting paste for flanges
Barrierta GTE 403	Klüber	Contact blades and contact pieces of the three-position disconnectors	Observe the designation "GTE 403" in order to avoid mistakes with other Barrieta products
Longtherm 2+	Molykote	Bearings of the operating linkage	Not suitable for greasing points on the circuit-breaker operating mechanism

35.8 Switchgear extension and replacement of panels and components

For switchgear extension and replacement of components, please contact the local Siemens representative.

Information required for spare part orders of single components and devices:

- Type and serial number of the switchgear and the circuit-breaker (see rating plates)
- Precise designation of the device or component, if applicable on the basis of the information and illustrations in the associated instructions, a drawing, sketch or circuit diagram

35.9 Spare parts

Due to the fact that all parts of this switchgear type have been optimised to last the normal service life, it is not possible to recommend particular spare parts.

36 End of service life

Service life

The maximum permissible number of mechanical operating cycles of the built-in circuit-breakers is 30,000. The current number of operating cycles can be checked on the mechanical operations counter.

SF_6 gas

	NOTE!
	The equipment contains the fluorized greenhose gas SF_6 registrated by the Kyoto Protocol with a global warming potential (GWP) of 22 200. SF_6 has to be reclaimed and must not be released into the atmosphere. ⇨ For use and handling of SF_6, IEC 62271-303 has to be observed: High-voltage switchgear and controlgear - Part 303 Use and handling of sulphur hexafluoride (SF_6).

Before recycling the materials, evcuate the SF_6 gas professionally and prepare it for further use.

Recycling

The switchgear is an environmentally compatible product.

The components of the switchgear can be recycled in an environmentally compatible way by dismantling into sorted scrap and residual mixed scrap.

After evacuating the SF_6 gas, the switchgear mainly consists of the following materials:

- Steel
- Copper
- Aluminum
- Cast-resin
- Fiber-reinforced plastics
- Rubber materials
- Ceramic materials
- Lubricants

The switchgear can be recycled in ecological manner in compliance with existing legislation.

Auxiliary devices such as short-circuit indicators have to be recycled as electronic scrap.

Batteries have to be recycled professionally.

As delivered by Siemens, the switchgear does not contain hazardous materials as per the Hazardous Material Regulations applicable in the Federal Republic of Germany. For operation in other countries, the locally applicable regulations must be followed.

For further information please contact your regional Siemens representative.

37 Index

Non-disconnectable busbar voltage transformers, removal 86

4

4MT3 voltage transformer, installation 74

4MT3 voltage transformer, removal 87

4MT7 voltage transformer, installation 82

4MT7 voltage transformer, removal 91

4MU4 voltage transformer, installation 79

4MU4 voltage transformer, removal 89

A

Accessories 31

Accessories, others 32

Accessories, standard 31

Application 7

Auxiliary means, installation 39

B

Bus sectionalizer, switching operations 126

Busbar assembly, preparing 51

Busbar voltage transformer, installation 73

Busbar, evacuating 65

Busbar, gas filling 63

C

Cable testing 133

Center of gravity 29

Circuit-breaker operation 105

Circuit-breaker panel 9

Circuit-breaker panel, frame 9

Circuit-breaker panel, function 9

Circuit-breaker panel, low-voltage compartment 9

Circuit-breaker panel, switching operations 123

Circuit-breaker panel, switchpanel 10

Circuit-breaker panel, switchpanel pole 9

Circuit-breaker, charging the closing spring manually 107

Circuit-breaker, design 11

Circuit-breaker, manual closing 105

Circuit-breaker, manual opening 105

Circuit-breaker, mechanical interlock 11

Circuit-breaker, sealing the pushbuttons 106

Circuit-breaker, test operation with auxiliary voltage 107

Circuit-breaker, test operation without auxiliary voltage 106

Cleaning agents and cleaning aids 140

Closing solenoid, vacuum circuit-breaker 3AH, ... 22

Closing spring, manual charging 107

Commissioning 96

Control elements 103

Control elements, three-position disconnector 108

Current transformers 16, 16

D

Description 7

Desiccant bags, replacing 67

Dimensions, switchgear room 34

Disconnectable busbar connection, switching operations 131

Disconnectable voltage transformers, switching operations 130

Disposal 142

Due application 6

E

Earthing busbar, installation 61

Emergency operation, three-position disconnector ... 112

Emergency release, disconnector operating mechanism 98

Emergency release, electromechanical interlock 98

End of service life 142

Evacuating 68

Evacuating with maintenance unit 69

F

Features 7

Feeder de-earthing 117

Feeder earthing 116

Feeder earthing and de-earthing 116

Fixing material 39

Fixing points 34

Floor opening 34

Floor openings 36

G

Gas compartment, evacuating 68

Gas compartment, filling 69

Gas compartments 17

Gas filling of busbar 63

Gas filling, checking 94
Gas leakage rate 29
Gas pressure, checking..... 41, 94
Gas pressure, moitoring 94
Gas quality, checking 94

H

High-voltage connections, checks 95

I

Indicators 103
Information to Siemens before delivery..... 33
Installation dimensions 34
Installation material..... 39
Installation with gas work 62
Installation work, checks..... 96
Installation, 4MT3 voltage transformer 74
Installation, 4MT7 voltage transformer 82
Installation, 4MU4 voltage transformer 79
Installation, auxiliary means 39
Installation, busbar voltage transformer..... 73
Installation, cables with plugs..... 93
Installation, earthing busbar..... 61
Installation, final work 93
Installation, low-voltage cables 93
Installation, panel connections 67
Installation, preparing..... 33
Installation, solid-insulated bars 70
Installation, tests..... 94
Installation, tools..... 39
Installation, voltage transformers..... 86
Insulating gas SF6..... 23
Integrated varistor..... 23
Interlocks 121

L

Leakage test 94
Lubricants 141

M

Maintenance 136
Maintenance recommendation..... 136
Maintenance unit..... 69
Maintenance, bolted joints and seals 138
Maintenance, safety instructions..... 136
Maintenance, vacuum circuit-breaker operating mechanism..... 138
Make-proof earthing switch..... 118
Make-proof earthing switch, closing 119
Make-proof earthing switch, control elements and indicators..... 118
Make-proof earthing switch, opening..... 120
Manual closing, three-position disconnector..... 109
Manual opening, Three-position disconnector 110
Motor operating mechanism, vacuum circuit-breaker 3AH 22

O

Operating mechanism box, design..... 13
Operating mechanism box, function 13
Operating times..... 21
Operation..... 102

P

Packing 40
Panel connections 18
Panel earthing..... 61
Partition class 26
Phase sequence 28
Power-frequency voltage test 62
Power-frequency voltage test on site 71

Q

Qualified personnel 6

R

Rating plates..... 30
Re-assembling the busbars 52
Ready-to-earth function, activating 110
Ready-to-earth function, deactivating 112
Recycling 142
Removal, 4MT3 voltage transformer 87
Removal, 4MT7 voltage transformer 4MT7 91
Removal, 4MU4 voltage transformer 89
Removal, non-disconnectable busbar voltage transformers 86

S

Safety instructions..... 5
Seaworthy crate, preparing storage 37
Servicing..... 136
Short instructions 123
Signal terms and definitions 5

Spare parts 141
Standards, electromagnetic compatibility, EMC 26
storage 24
Storage room/space, preparing 37
Substation earth 61
Switchgear extension and replacement of components 141
Switchgear maintenance 136
Switchgear room, preparing for installation 33
Switchgear, assembling 50
Switchgear, type classification 8

T

Technical data 20
Test operation 96
Test operation with auxiliary voltage 107
Test operation with motor operating mechanism 107
Test operation without auxiliary voltage, circuit-breaker 106
Three-position disconnector, manual opening 110
Three-position disconnector, with motor operating mechanism 112
Three-position disconnector, activating ready-to-earth function 110
Three-position disconnector, control elements 108
Three-position disconnector, deactivating ready-to-earth function 112
Three-position disconnector, emergency operation ... 112
Three-position disconnector, function 14
Three-position disconnector, manual closing 109
Three-position disconnector, operation 108
Tools, installation 39
Top-mounted bus sectionalizer, switching operations 128
Transport damage 40
Transport regulations 27
Transport unit 40
Transport unit, erecting 40
Transport unit, installation 55
Transport unit, unloading 40
Typical uses 7

V

Vacuum circuit-breaker 3AH, c.t.-operated release 23
Vacuum circuit-breaker 3AH, closing solenoid 22
Vacuum circuit-breaker 3AH, motor operating mechanism 22
Vacuum circuit-breaker 3AH, shunt release 22
Vacuum circuit-breaker 3AH, tripping signal 22
Vacuum circuit-breaker 3AH, undervoltage release 22
Vacuum interrupters 11
Vacuum pump 65
Verification of safe isolation from supply 122
Voltage transformers 16, 16
Voltage transformers, installation 86

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