

SIEMENS

Medium-Voltage Switchgear

Type 8DH10

up to 24 kV, Gas-Insulated, Extendable



Medium-Voltage
Switchgear

INSTALLATION AND OPERATING INSTRUCTIONS

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Siemens AG
Power Transmission and Distribution
Medium Voltage

since
1992

Evaluation of the **Technical Testing Station** by DATech (German Accreditation Body for Technology) in accordance with **DIN EN 45 001** and accreditation of the **Technical Testing Station** for the testing areas High-Voltage Switching Devices and Switchgear by DATech as **Testing Laboratory Switchgear Factory Frankfurt/M., Siemens AG** DAR (German Accreditation Council) registr. number: DAT-P-013/92-03 and as **PEHLA Testing Laboratory Frankfurt/M.** DAR registr. number: DAT-P-013/92-53

since
1995

Introduction and application of a quality and environmental management system for the **Medium-Voltage Switchgear and Systems Division** in accordance with **DIN EN ISO 9001** and **DIN EN ISO 14001** Quality and environmental systems - Model for quality assurance in design, development, production, installation and serving. Certification of the quality and environmental management system by DQS (German Association for the Certification of Quality and Environmental Management Systems) DQS registr. number: 3473-02

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.

For details about technical design and equipment like e.g. technical data, secondary equipment, circuit diagrams, please refer to the order documents.

The switchgear is subject to continuous technical development within the scope of technical progress. If not stated otherwise on the individual pages of these instructions, we reserve the right to modify the specified values and drawings. All dimensions are given in mm.

For further details, e.g. about additional equipment and information about other switchgear types, please refer

to catalogues HA 41.11 and HA 40.1 (Switchgear 8DJ and 8DH: General Part).

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

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty.

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Safety instructions

1 Signal terms and definitions

	DANGER!
	<p>as used in these instructions, this means that personal injuries can occur if the relevant precautionary measures are not taken.</p> <p>⇒ Observe the safety instructions.</p>

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

	NOTE!
	<p>as used in these instructions, this points at facilitations of work, particularities for operation or possible maloperation.</p> <p>⇒ Observe the notes.</p>

- 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!
	<p>The perfect and safe operation of this switchgear is conditional on:</p> <ul style="list-style-type: none"> ⇒ 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 instructed 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 applicable 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 Features

Typical uses Extendable fixed-mounted switchgear 8DH10 is mainly used in consumer and transfer substations for power supply through ring-main cables, as well as in industrial distribution systems.

It is available for rated voltages up to 24 kV and rated currents up to 630 A.

- Technology**
- Factory-assembled, type-tested and metal-enclosed switchgear for indoor installation
 - Partition class PM
 - Loss of service continuity category: LSC 2
 - Individual panels and/or panel blocks can be freely combined to a switchgear assembly

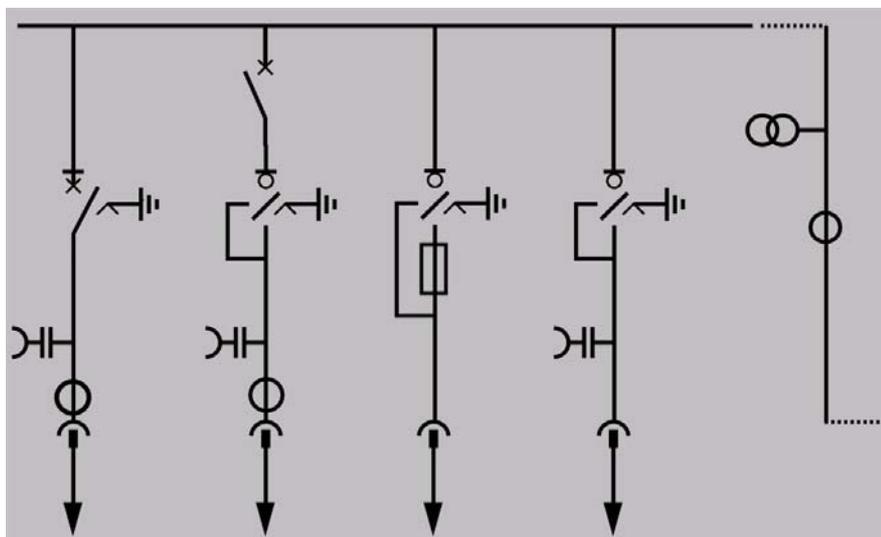
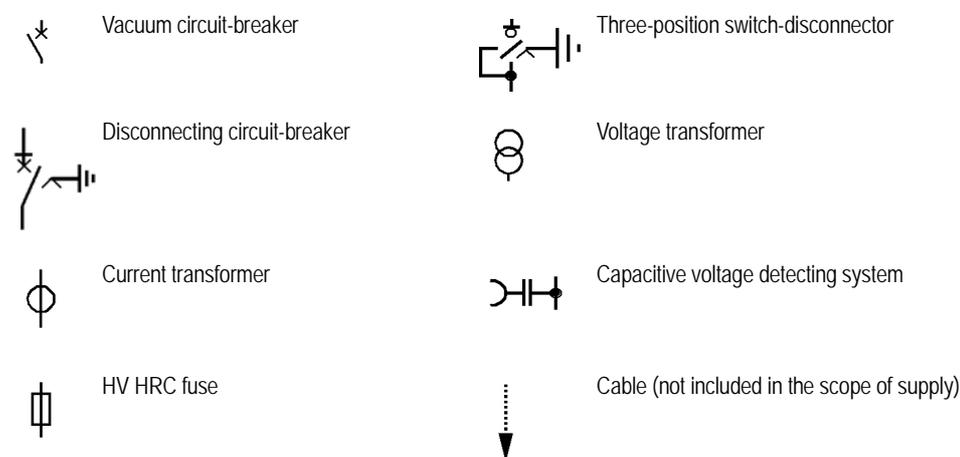


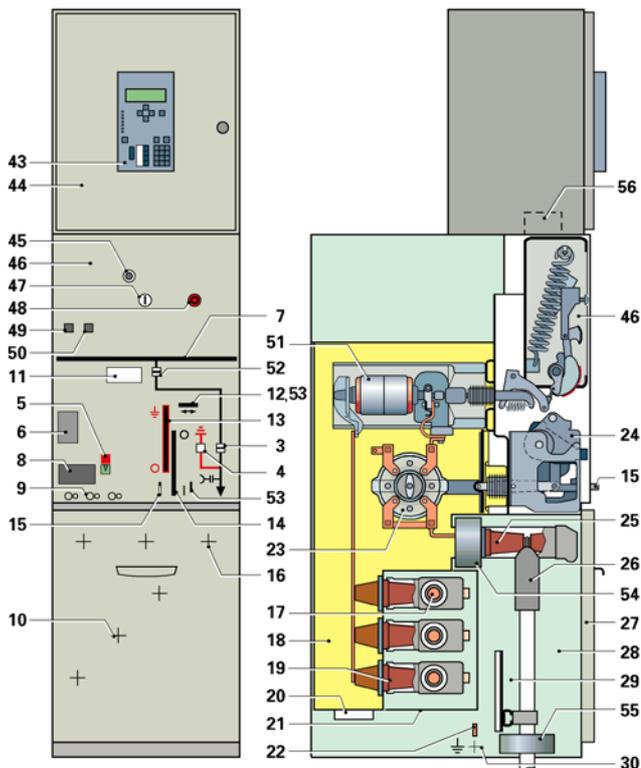
Fig. 1: Disconnecting circuit-breaker panel type LST, circuit-breaker panel type LS1, transformer panel type TR, ring-main panel type RK, billing metering panel type ME1



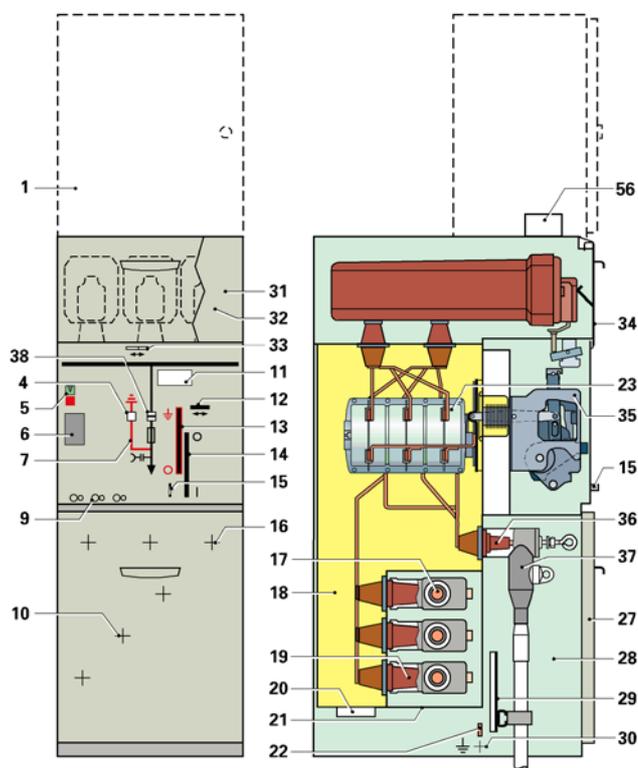
Description

- Circuit-breaker panels with maintenance-free three-pole indoor vacuum circuit-breakers 3AH for rated voltages from 7.2 to 24 kV
 - Disconnecting circuit-breaker panels (type LST) for rated voltages from 7.2 to 24 kV
 - Installation and extension without gas work
 - Solid-insulated busbar system
 - Cable connection for outside cone
 - Ecological production and disposal
- Personal safety**
- Safe-to-touch due to metal enclosure of live parts
 - Clear mimic diagram
 - HV HRC fuses and cable sealing ends are only accessible when the feeders are earthed
 - Operation is possible only when the enclosure is closed
 - Logical mechanical interlocking
 - Capacitive voltage detection system for verification of safe isolation from supply
 - Earthing of outgoing feeders by means of make-proof earthing switches
- Security of operation and availability**
- Hermetically sealed primary enclosure, independent of environmental effects such as dirt, moisture and small animals
 - Welded switchgear vessel, sealed for life
 - Switch operating mechanisms accessible outside the switchgear vessel
 - Switchgear interlocking by means of logical mechanical interlocking
- Cost-efficiency** Extremely low "life-cycle costs" and maximum availability as a result of:
- Maintenance-free concept
 - Climatic independence
 - Minimum space requirement
 - Long service life

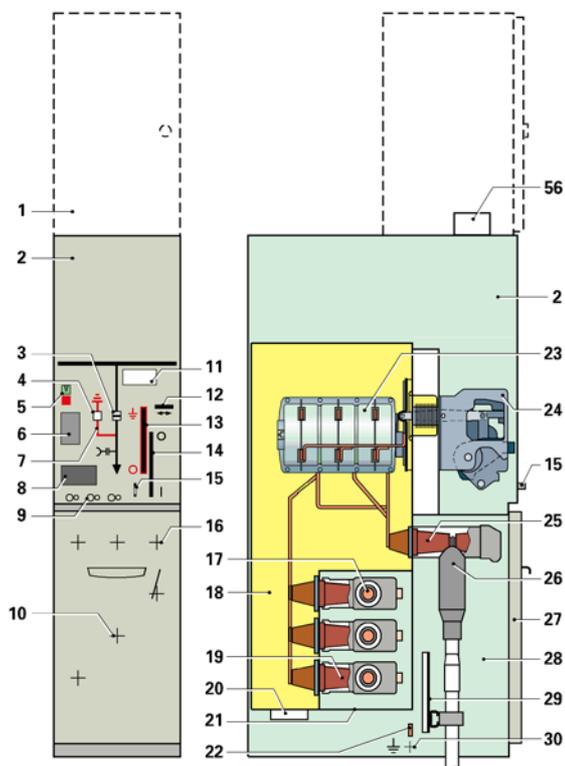
6 Panel versions (examples)



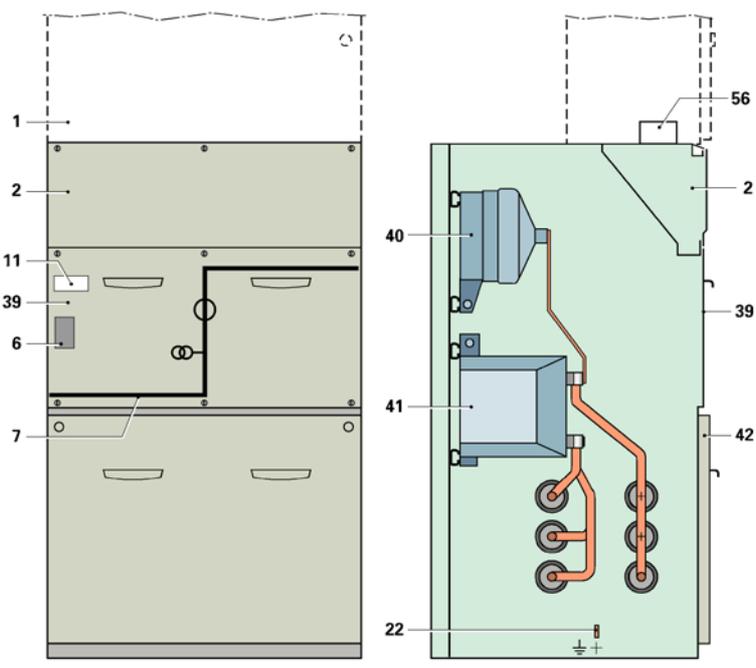
Circuit-breaker panel type LS1



Transformer panel type TR

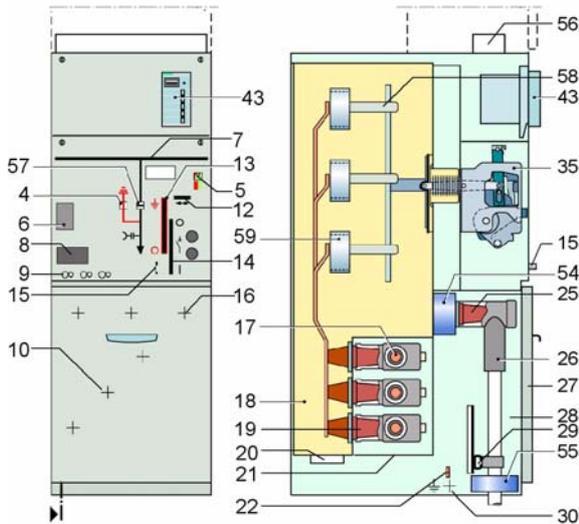


Ring-main panel type RK

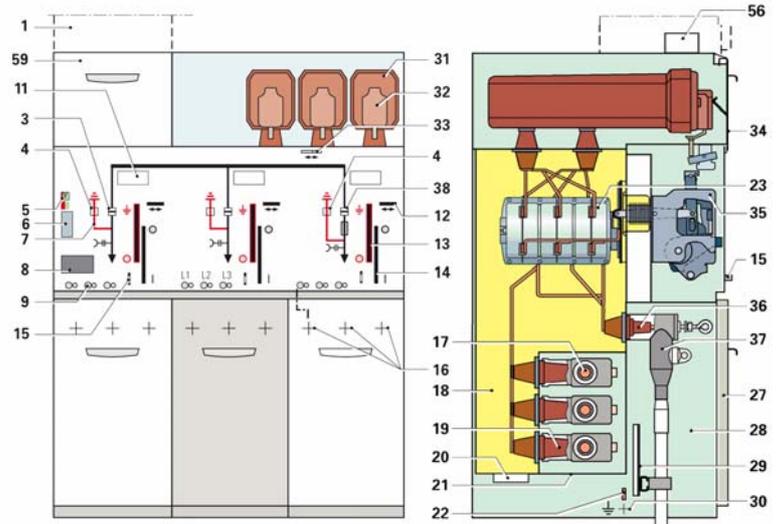


Billing metering panel

Description



Circuit-breaker panel type LST1 with disconnecting circuit-breaker



Design of block versions (here: ring-main/transformer block type 2RT-B3)

Legend:

- | | |
|---|--|
| 1 Option: Low-voltage compartment | 2 Niche for customer-side low-voltage equipment, removable cover |
| 3 Position indicator for load-break function "CLOSED-OPEN" | 4 Position indicator for earthing function "OPEN-EARTHED" |
| 5 Ready-for-service indicator | 6 Rating and type plate |
| 7 Mimic diagram | 8 Option: Short-circuit/earth-fault indicator |
| 9 Sockets for voltage detecting system | 10 Arrangement of the busbars |
| 11 Feeder designation label | 12 Option: Locking device for three-position switch-disconnector or three-position disconnecting circuit-breaker (type LST1) |
| 13 Manual operation for the mechanism of the earthing function | 14 Manual operation for the mechanism of the load-break function or the circuit disconnecting/breaking function |
| 15 Interlock of the cable compartment cover | 16 Arrangement of the cable connections |
| 17 Busbar system | 18 Switchgear vessel, filled with insulating gas |
| 19 Busbar connection | 20 Pressure relief device |
| 21 Partition for busbar | 22 Earthing busbar |
| 23 Three-position switch-disconnector | 24 Spring-operated mechanism |
| 25 Bushing for cable plug with bolted contact (M16) | 26 Option: Cable T-plug |
| 27 Cable compartment cover | 28 Cable compartment |
| 29 Cable bracket | 30 Earthing connection |
| 31 HV HRC fuse assembly, cover removed | 32 Handle for replacing the HV HRC fuse-link |
| 33 Interlock for HV HRC fuse assembly | 34 Cover for HV HRC fuse compartment |
| 35 Spring-operated/stored-energy mechanism | 36 Bushing for cable plug with plug-in contact |
| 37 Option: Cable elbow plug with plug-in contact | 38 Position indicator for load-break function "CLOSED-OPEN", if applicable with "HV HRC fuse tripped" or "shunt release tripped" |
| 39 Cover to the busbar connection and to the instrument transformers, screwed on | 40 Voltage transformer type 4MR |
| 41 Current transformer type 4MA7 | 42 Cover to busbar compartment, screwed on |
| 43 Option: SIPROTEC bay controller | 44 Low-voltage compartment (standard) |
| 45 Opening for the hand crank - for closing with manual operating mechanism, - for emergency operation with motor operating mechanism | 46 Mechanism box with operating mechanism |
| 47 Mechanical ON pushbutton (not supplied with spring-operated mechanism) | 48 Mechanical OFF pushbutton |
| 49 Operations counter | 50 "Spring charged" indicator |
| 51 Vacuum interrupter | 52 Position indicator |

53	Option: Interlock between vacuum circuit-breaker and three-position switch-disconnector	54	Option: Three-phase current transformer
55	Cable-type current transformer	56	Wiring duct, removable, for control cables and/or bus wires
57	Position indicator for circuit disconnecting/breaking function "CLOSED-OPEN", if applicable with "protection system tripped" or "shunt release tripped"	58	Circuit-breaker with disconnecting function and earthing function as three-position switch (circuit-breaker module LST)
59	Niche for customer-side low-voltage equipment		

7 Components

7.1 Circuit-breaker

Design

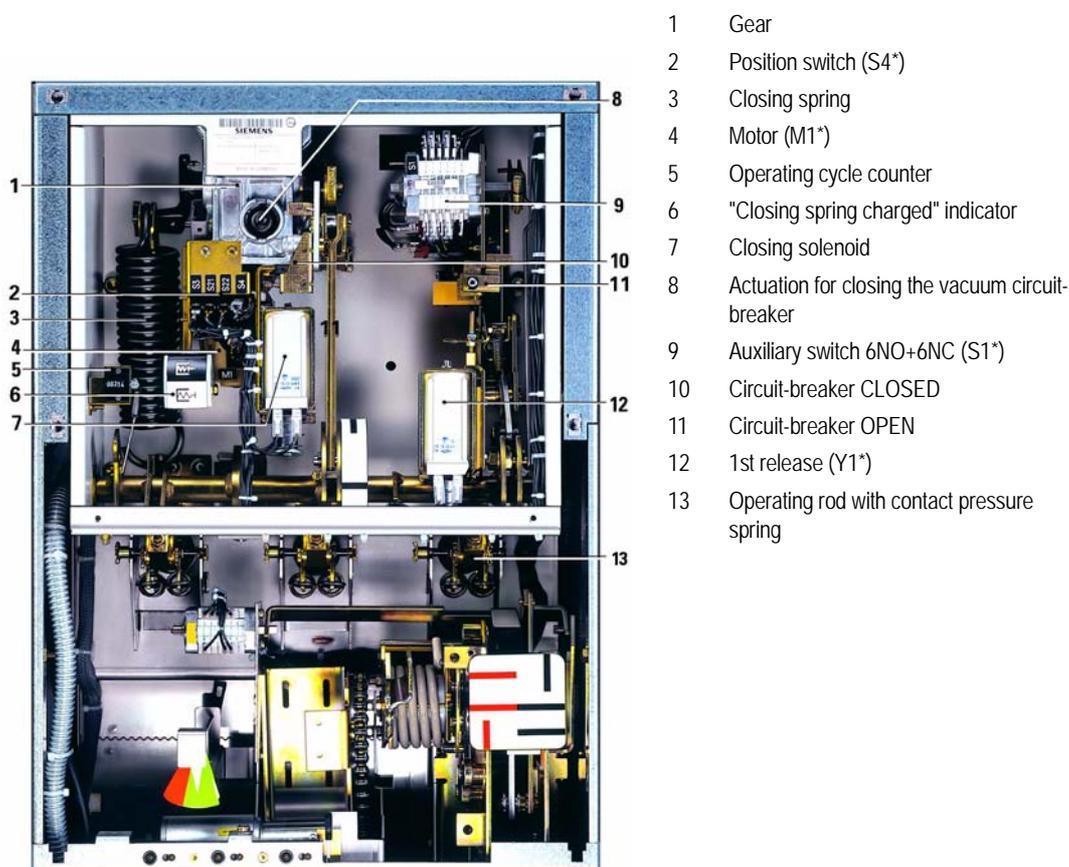


Fig. 2: Operating mechanism of the vacuum circuit-breaker

The Siemens vacuum circuit-breaker type 3AH is a three-pole indoor circuit-breaker for rated voltages of 7.2 kV up to 24 kV.

The circuit-breaker consists of the following components:

- Operating mechanism box with stored-energy spring mechanism and control elements
- Three breaker poles with vacuum interrupters
- Mounting plate
- Operating rods for contact operation, sealed towards the container front (mounting plate) in a movable and gas-tight way via metal bellows.

The operating mechanism box accommodates all electrical and mechanical components required for closing and opening the circuit-breaker.

3AH circuit-breakers need no opening spring, as the contact pressure springs have an opening effect in this pole version.

The operating mechanism box is closed by a removable cover containing openings for the control elements and indicators.

The circuit-breaker is closed by pressing the ON-pushbutton. The transmission of motions to the breaker poles is performed by metal bellows. The motor recharges the closing spring immediately after.

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

The operating cycle counter shows the number of charging processes.

The rating plate is mounted on the operating mechanism box.

Types of operating mechanisms

The following operating mechanism versions are available:

- Manual spring-operated mechanism
- Manual operating stored-energy mechanism
- Motor operating stored-energy mechanism

Equipment:

- Electrical operating mechanism (charging motor) with mechanical and electrical anti-pumping device (M1)
- Closing solenoid (Y9)
- Shunt release (Y1)
- Low-voltage plug connector with 10-pole wiring (X09)
- Auxiliary switch (S1)
- Position switch for "closing spring charged" indication (S4)
- Circuit-breaker tripping signal, cutout switches (S6, S7)
- Operating cycle counter
- Mechanical interlock

Additional equipment:

- Extended auxiliary switch (S1)
- Shunt release (Y2)
- Undervoltage release (Y7)

In addition to the series shunt release (Y1), 3AH circuit-breakers can be equipped with a maximum of two releases.

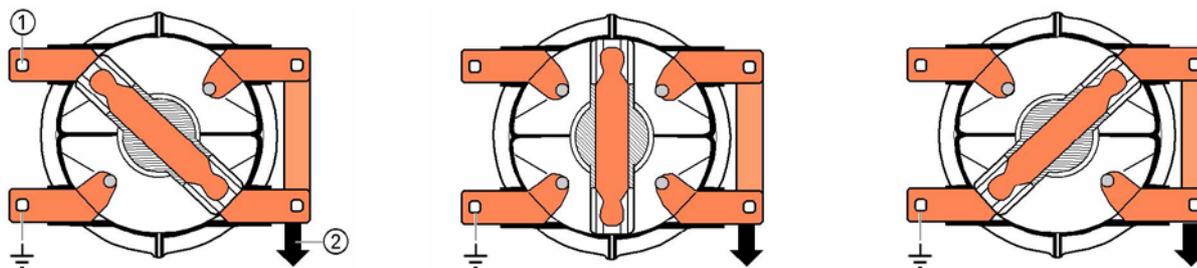
7.2 Three-position switch-disconnector

Features

- Designed as a multi-chamber switch incorporating the functions of a switch-disconnector and a make-proof earthing switch with the switch positions: "CLOSED - OPEN - EARTHED"
- Operation via gas-tight, welded metal bellows bushing at the front of the switchgear vessel

Mode of operation The switch shaft with the moving contacts rotates inside the chamber containing the fixed contacts. Compression vanes, which rotate in conjunction with the switch shaft, divide the arcing chamber into two subchambers, each of which changes in conjunction with the rotation. During the switching movement, the compression vanes generate a pressure difference between the subchambers. The SF₆ gas flows through a nozzle, causes a directional blow-out of the breaking arc and quenches it rapidly. Interlocking is not necessary as the "CLOSED" and "EARTHED" functions cannot be implemented simultaneously.

Switch positions of the three-position switch-disconnector



CLOSED position

OPEN position

EARTHED position

1 Busbar connection

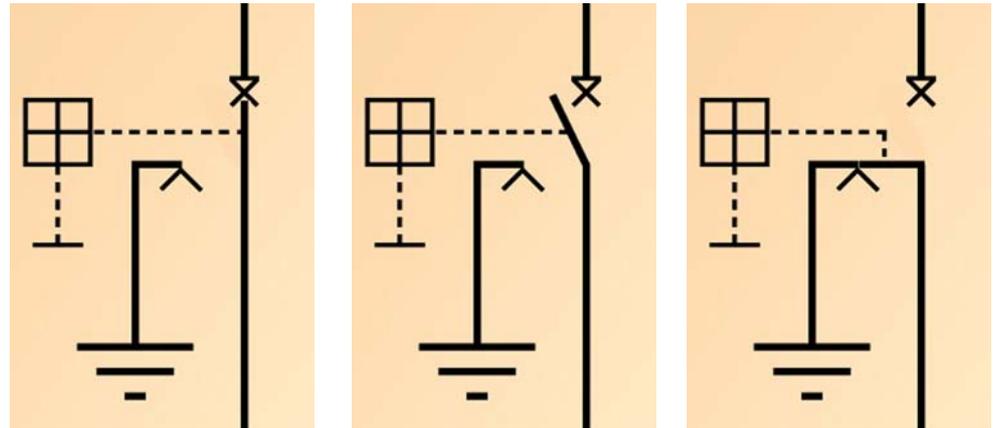
2 Ring-main cable connection

7.3 Three-position disconnecting circuit-breaker (type LST)

- Features**
- Three-position disconnecting circuit-breaker (type LST) with the switch positions CLOSED-OPEN-EARTHED
 - Operated via gas-tight welded metal bellows bushing at the front of the switchgear vessel

Mode of operation In a gas-tight welded stainless-steel vessel without seals, the disconnecting circuit-breaker breaks rated currents up to 630 A and short-circuit currents up to 20 kA. The rot-arc principle breaks short-circuit currents safely. For example, the disconnecting circuit-breaker (type LST) can be used in feeder panels for transformer ratings above 630 kVA or in feeder or transfer panels in secondary distribution systems.

Switch positions of the three-position disconnecting circuit-breaker (type LST)



CLOSED position

OPEN position

EARTHED position

7.4 Operating mechanisms for three-position switch-disconnector and three-position disconnecting circuit-breaker (type LST)

The three-position switch-disconnector or three-position disconnecting circuit-breaker (type LST) is operated from the switchgear front:

Detachable lever mechanism

- Spring-operated mechanism for three-position switch-disconnector
 - with "spring-operated CLOSED" and "spring-operated OPEN"



- Spring-operated / stored-energy mechanism for transformer panels
 - with "spring-operated CLOSED" and "spring-operated OPEN" mechanism for installation in the three-position switch-disconnector
 - with additional energy store for the function "stored-energy OPEN" after tripping by HV HRC fuse (striker pin tripping) or shunt release

- Spring-operated / stored-energy mechanism for circuit-breaker panels (type LST)
 - with "spring-operated CLOSED" and "spring-operated OPEN" for installation in the three-position disconnecting circuit-breaker
 - with additional energy store for the function "stored-energy OPEN" after tripping by protection relay (striker pin tripping) or shunt release

Options • Motor operating mechanism for the switching functions CLOSE and OPEN:

Operation:

- Remote operation (standard) applied to terminal
- Local operation by momentary-contact rotary control switch (option)
- Switching to EARTH and emergency operation with normal operating lever by hand

• Shunt release (f-release)

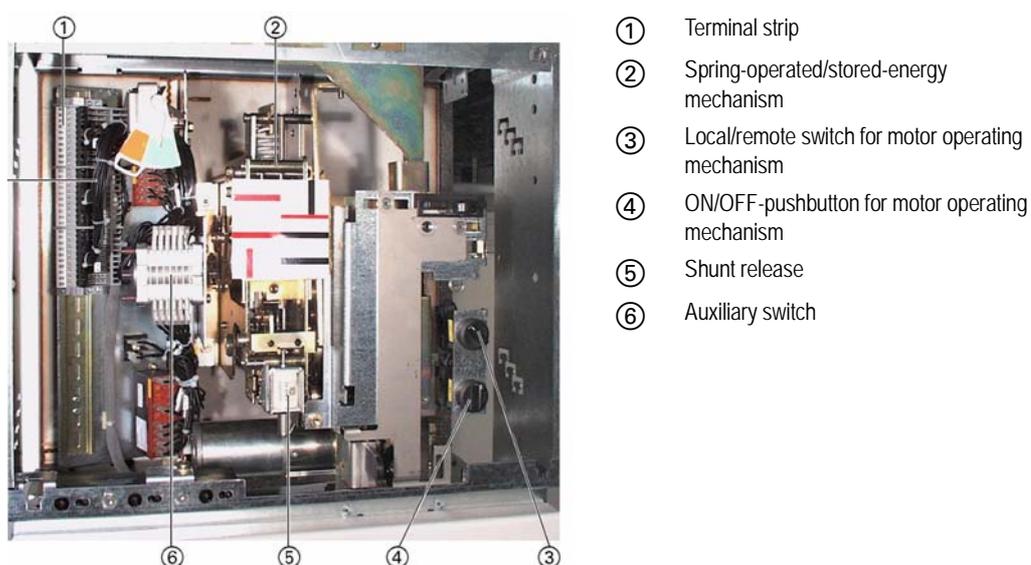
- Spring-operated/stored-energy mechanisms can be equipped with a shunt release. Remote electrical tripping of the three-position switch-disconnector / disconnecting circuit-breaker (type LST) is possible via the magnetic coil of the shunt release, e.g. transformer overtemperature tripping.

• Auxiliary switch

- Each operating mechanism of the three-position switch-disconnector / disconnecting circuit-breaker (type LST) can optionally be equipped with an auxiliary switch for the switch position indication.

• Wiring

- Auxiliary switches, motor operating mechanisms or shunt-releases are wired to terminal strips. These are feeder-related and located next to the operating mechanism module of the feeder concerned. Customer-side cable routing is made from the side, if required from above to the terminal strip arranged at the operating mechanism module.



- ① Terminal strip
- ② Spring-operated/stored-energy mechanism
- ③ Local/remote switch for motor operating mechanism
- ④ ON/OFF-pushbutton for motor operating mechanism
- ⑤ Shunt release
- ⑥ Auxiliary switch

Fig. 3: Transformer panel

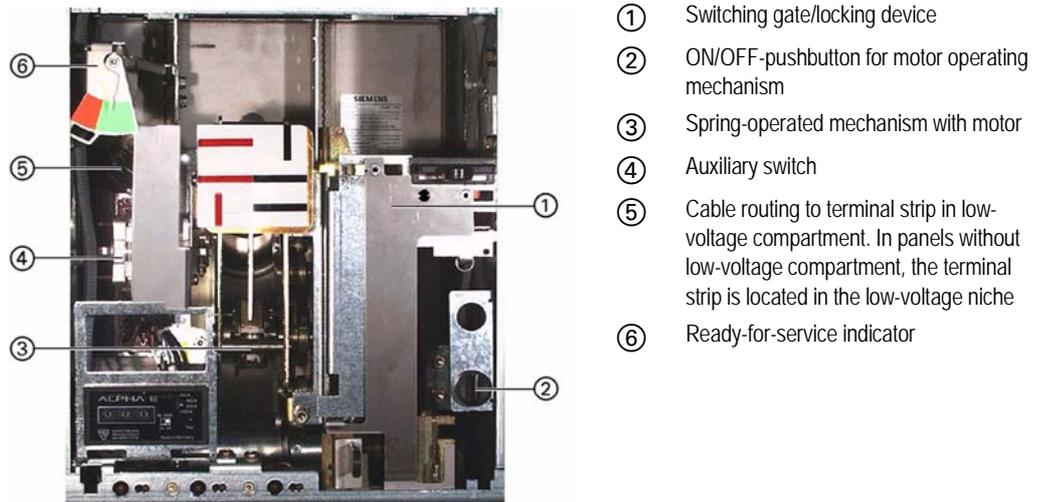


Fig. 4: Ring-main panel

7.5 Current and voltage transformers

Current transformers

- According to IEC 60 044-1

Voltage transformers

- According to IEC 60 044-2

Technical data

The technical data of the current and voltage transformers must be taken from the associated project documentation.

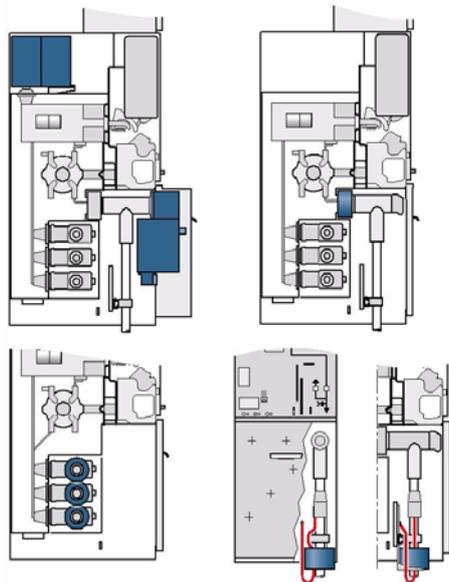


Fig. 5: Different mounting locations of instrument transformers

7.6 Protection and control equipment

Protection and control equipment is equipped according to the customer's specifications. The devices are normally installed in the low-voltage compartment or in the low-voltage niche. For details please refer to the relevant circuit documentation.

7.7 HV HRC fuse assembly

- Features**
- HV HRC fuse-links according to DIN 43 625 (main dimensions) with striker in "medium" version according to IEC 60 282-1
 - as short-circuit protection before transformers,
 - with selectivity to upstream and downstream connected equipment,
 - single-phase insulated
 - Requirements according to IEC 62 271-105 fulfilled by combination of HV HRC fuses with the three-position switch-disconnector
 - Thermal striker tripping when the corresponding HV HRC fuse-link is used
 - Climate-independent and maintenance-free, with fuse boxes made of cast resin
 - Fuse assembly arranged above the switchgear vessel
 - Fuse assembly connected to the three-position switch-disconnector via welded bushings and connection bars
 - Fuses can only be replaced if feeder is earthed
 - Option: "Tripped indication" of the transformer switch for remote electrical indication with 1NO contact



Fig. 6: Inserting an HV HRC fuse-link

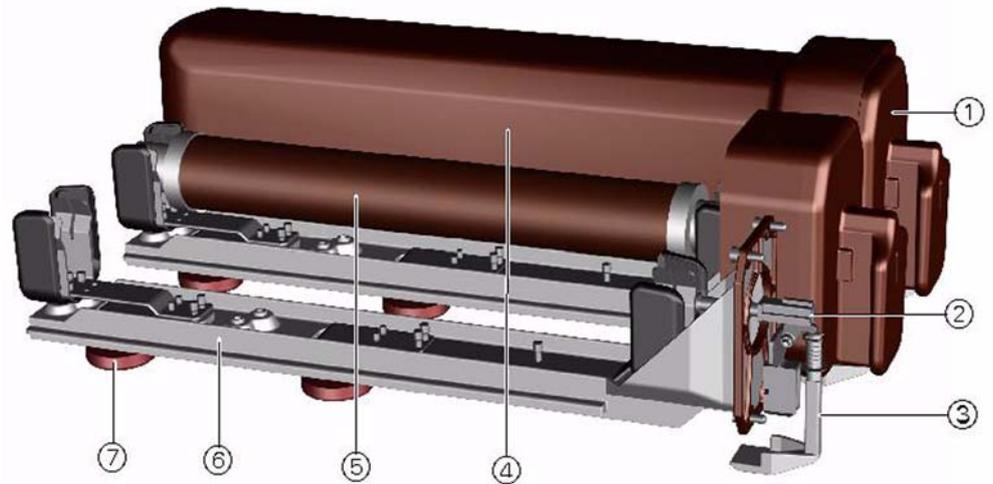


Fig. 7: HV HRC fuse assembly

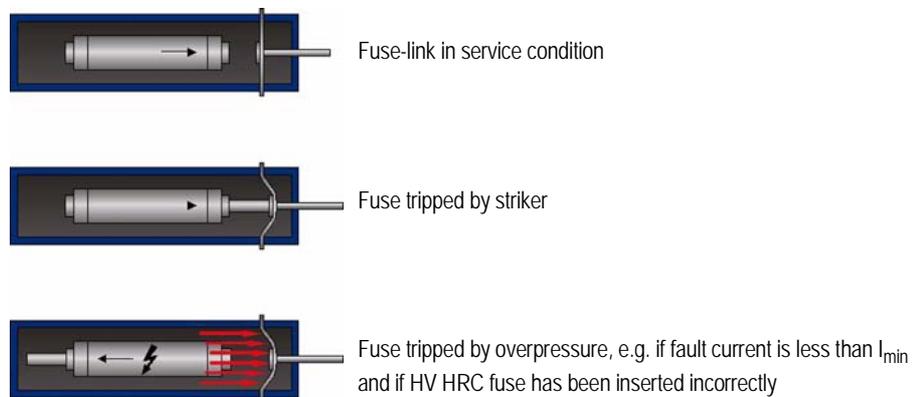
- | | |
|---|---------------|
| ① Cover with seal | ④ Fuse box |
| ② Striker of the HV HRC fuse-link and articulation for tripping the spring-operated/stored-energy mechanism | ⑤ HV HRC fuse |
| ③ Tripping pin for spring-operated/stored-energy mechanism | ⑥ Fuse slide |
| | ⑦ Bushing |

Mode of operation

In the event that a HV HRC fuse-link has tripped, the switch is tripped via an articulation which is integrated into the cover of the fuse box.

In the event that fuse tripping fails, e.g. if the fault current is less than I_{min} or if the fuse has been inserted incorrectly, the fuse box is protected by thermal protection. The overpressure generated by overheating trips the switch via a diaphragm in the cover of the fuse box and via the articulation. This breaks the current before the fuse box incurs irreparable damage. The above thermal protection works independently of the type and design of the HV HRC fuse used. Like the fuse itself it is maintenance-free and independent of any outside climatic effects.

Schematic sketches for fuse tripping



Furthermore, the specified HV HRC fuses release the striker depending on the temperature and trip the switch-disconnector as early as in the fuse overload range. Impermissible heating of the fuse box can be avoided in this way.

7.8 Interlocks

- The switching gate of the three-position switch-disconnector or the three-position disconnecting circuit-breaker (type LST) prevents switching straight from CLOSED to EARTHED and vice-versa. The operating lever must be re-inserted in the OPEN position.
- The HV HRC fuse compartment cover can only be removed if the transformer feeder is earthed and the operating lever is removed. The three-position switch-disconnector can only be switched from the EARTHED position to the OPEN position if the HV HRC fuse compartment cover is closed and locked.
- Interlock between the 3AH5 circuit-breaker and the three-position switch disconnector (option). Circuit-breaker with:
 - Spring-operated mechanism:

Circuit-breaker in OPEN position: The three-position switch-disconnector can be closed and opened. The circuit-breaker is interlocked against closing.

Circuit-breaker in CLOSED position: No operations possible with the three-position switch-disconnector.

- Spring-operated/stored-energy mechanism with closing solenoid and pushbutton:

Circuit-breaker in OPEN position: The three-position switch-disconnector can be closed and opened. The circuit-breaker is interlocked mechanically and electrically against closing.

Circuit-breaker in CLOSED position: No operations possible with the three-position switch-disconnector.

- The cable compartment covers can only be removed if the associated feeder is earthed.



- A closing lock-out (option) prevents the three-position switch-disconnector / disconnecting circuit-breaker from being switched to the CLOSED position if the cable compartment cover is removed.
- A de-earthing lock-out (option) prevents the three-position switch-disconnector / disconnecting circuit-breaker of the transformer panel or the disconnecting circuit-breaker panel from being switched from EARTHED to OPEN if the cable compartment cover is removed.

7.9 Busbars

- Features**
- Safe-to-touch as a result of the use to metal covers
 - Plug in type, isolated
 - Insensitive to pollution and condensation
 - Switchgear extension or panel replacement possible without gas work
 - Special busbar connections to air-insulated metering panels
 - Option: Screened busbar: - Field control by means of electrically conductive layers on the silicone-rubber insulation - Installation of busbar current transformers possible
 - Option: Capacitive voltage detection system for the busbar

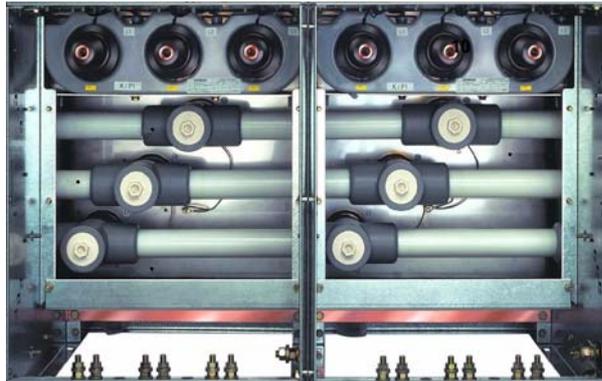
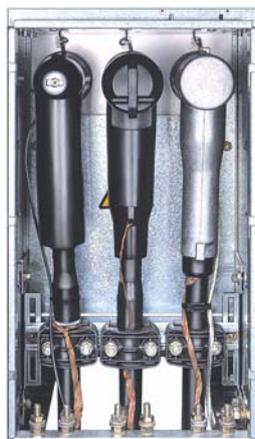


Fig. 8: Busbar joints (metal cover removed)

7.10 Cable connection

Ring-main cable connection

- Features**
- Bushings with bolted contact (M16) as interface type "C" according to EN 50 181
 - For rated normal currents 250/400/630 A
 - Cable routing to the bottom, cable connection at the front
 - For thermoplastic-insulated cables with cross-sections up to 300 mm² (standard)
 - For cable T-plugs or cable elbow plugs
 - For paper-insulated mass-impregnated cables with adapter systems
 - For conventional cable sealing ends via elbow adapter AKE 20/630 (make Siemens)
- Options**
- Suitable for connection of surge arresters
 - Mounted cable clamps
 - Double cable connection with deep cable compartment cover



Transformer cable connection

- Features**
- Bushings with plug-in contact as interface type "A" according to EN 50 181
 - For rated normal currents 200 A
 - For thermoplastic-insulated cables with cross-sections up to 120 mm² (standard)
 - For cable elbow plugs or straight cable plugs with plug-in contact



Selection table for cable sets

Manufacturer	Plug type for ring-main or circuit-breaker feeders	Plug type for transformer feeders
Euromold	(K) 400 TB (S)	(K) 158 LR
	(K) 400 LB	(K) 151 SR
	AGT (L)10(20)	AGW (L) 10 (20); AGG (L) 10 (20)
nkt cables	AV 20	EASW 10/250
	EAVI 20	EASW 20/250
Südkabel (ABB)	SEH DT 13 (23)	SEHDG 11.1 (21.1)
	SEHDT 13.1 (23.1)	SEHDW 11.1 (21.1)
Prysmian Kabel (Pirelli)	FMCTs(m)-400	FMCE(m)-250
Siemens	AKE 20/630	-
Tyco-Electronic/Raychem	RICS 51...	RSES; RSSS
Cooper	DT 400 P	DE 250; DS 250
Other plug types on request		

7.11 Ready-for-service indicator

The switchgear is filled with insulating gas at a relative pressure. The ready-for-service indicator at the switchgear front shows through the red/green indication if the gas density is in order.

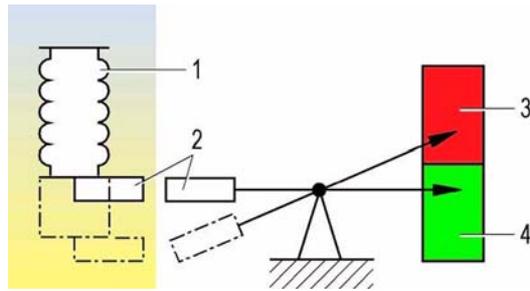


Fig. 9: Ready-for-service indicator

Description

- Features**
- Self-monitoring, easy to read
 - Independent of temperature and external pressure variations
 - Only responds to changes in gas density
 - Option: Signalling switch for remote electrical indication
 - Option (only for three-position disconnecting circuit-breaker (type LST)):
 - Signalling switch for remote electrical indication
 - Interruption of tripping circuits of protection relay

Mode of operation



Principle of gas monitoring with ready-for-service indicator

- ① Measurement box in filled stainless-steel vessel
- ② Magnetic coupling
- ③ Red indication: not ready for service
- ④ Green indication: ready for service

For the ready-for-service indicator, a gas-tight measurement box is installed on the inside of the switchgear vessel.

A coupling magnet, which is fitted to the bottom end of the measurement box, transmits its position to an outside armature through the non-magnetizable switchgear vessel. This armature moves the ready-for-service indicator of the switchgear.

While changes in the gas density during the loss of gas, which are decisive for the insulating capacity, are displayed, changes in the gas pressure dependent on temperature and external pressure variations are not. The gas in the measurement box has the same temperature as that in the switchgear.

The temperature effect is compensated via the same pressure change in both gas volumes.

7.12 Voltage detecting systems

For voltage detection according to IEC 61243-5/VDE 0682-415 with:

- HR system (standard)
- LRM system (option)
- Integrated voltage detecting system CAPDIS-S1+/-S2+ (option)

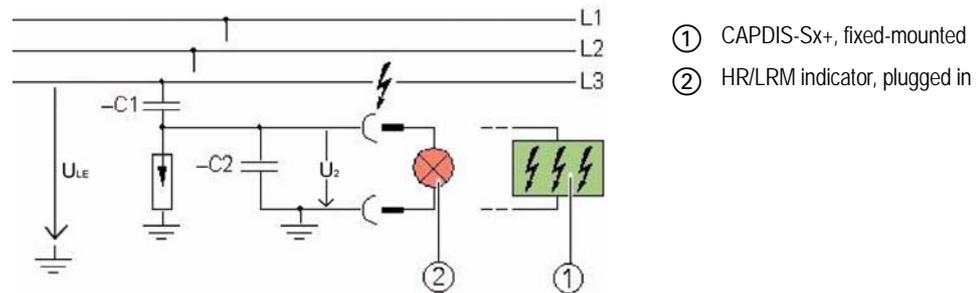
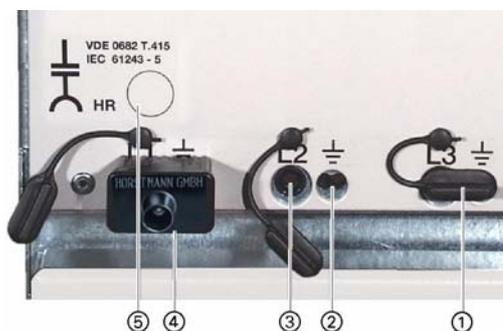


Fig. 10: Voltage detection via capacitive voltage divider (principle)

- -C1: Capacitive coupling electrode integrated into bushing
- -C2: Capacity of the coupling section (as well as connection leads of the voltage detection system) to earth
- $U_{LE} = U_N / \sqrt{3}$ during rated operation in the three-phase system
- $U_2 = U_A =$ Voltage at the interface (for plug-in voltage detection system) or at the test socket (for integrated voltage detection system)

Features of HR/LRM system



- ① Cover of test sockets
② Earthing socket
③ Capacitive test socket for L2
④ Voltage indicator type HR, make Horstmann
⑤ Documentation to repeat test of interface condition

- With voltage indicator
 - HR system (standard) or
 - LRM system (option)
- Verification of safe isolation from supply phase by phase through insertion in each socket pair
- Voltage indicator flashes if high voltage is present
- Indicator suitable for continuous operation
- Safe-to-touch
- Measuring system and voltage indicator can be tested

Features of CAPDIS -S1+/-S2+

- Maintenance free
- Integrated repeat test of the interfaces (self-monitoring)
- Without auxiliary power
- Option: CAPDIS S2+ with remote indication of voltage state (auxiliary power required)
- With test sockets (LRM system) for phase comparison behind the cover



Fig. 11: CAPDIS-S2+: Cover closed



Fig. 12: CAPDIS-S2+: Cover open

- ① LC display
- ② Button "Display Test"
- ③ Cover
- ④ Test socket L1
- ⑤ Test socket L2
- ⑥ Test socket L3
- ⑦ Earthing socket
- ⑧ Short instruction

**Display of CAPDIS -S1+/-
S2+**

CAPDIS-S1+				CAPDIS-S2+		
L1	L2	L3		L1	L2	L3
			Operating voltage not present (CAPDIS-S2+)	000		
⚡ ⚡ ⚡			Operating voltage present	⚡ ⚡ ⚡		
[Blank]			- Operating voltage not present - Auxiliary power not present (CAPDIS-S2+)	[Blank]		
	⚡ ⚡		Earth fault or failure in phase L1, operating voltage at L2 and L3	⚡ ⚡		
⚡ ⚡ ⚡			Voltage (not operating voltage) present	⚡ ⚡ ⚡		
⚡ ⚡ ⚡			Indication "Device-Function-Test" passed	⚡ ⚡ ⚡		
[Blank]			Indication "ERROR", e.g. in case of missing auxiliary voltage (CAPDIS-S2+)	⚡ ⚡ ⚡ ERROR		

7.13 Short-circuit/earth-fault indicators

All ring-main feeders can **optionally** be equipped with a 3-phase short-circuit or earth-fault indicator.

- Features**
- Indication at the switchgear front
 - Factory-assembled including sensor mounted on ring-main cable bushing
 - Short-circuit pickup values: see table
 - Optical signals when a pre-selected pickup value is exceeded
 - Option: remote electrical indication via passing contact (changeover contact), connected to terminals (rear side of device).

Selection of short-circuit/earth-fault indicators

Make Horstmann ¹⁾



Fig. 13: Alpha E indicator

Indicator type	Reset	Short-circuit current ²⁾ [A]	Earth-fault current ³⁾ [A]
ALPHA M	manually	400, 600, 800, 1000	–
ALPHA E	manually/automatically after 2 or 4 h	400, 600, 800, 1000	–
GAMMA 4.0 ³⁾	manually/after return of power supply/after 2 or 4 h	400, 600, 800, 1000	–
ALPHA automatic	manually (by pushbutton), remote reset (by auxiliary voltage), automatically after 3 h	Change of current DI= 150 A – 300 A (depending on the load current) at t=20 ms	–
Earth-fault/short-circuit indicator			
EKA - 3 ³⁾	after return of power supply	450	40, 80, 160
DELTA M	manually	400, 600, 800, 1000	200
DELTA E	manually, automatically after 2 or 4 h	400, 600, 800, 1000	200
Earth-fault indicator			
EKA - 3/1 ³⁾	after return of power supply	–	40, 80, 160

¹⁾ Further types and other makes available on request.

²⁾ Standard values. Other values on request.

³⁾ External auxiliary voltage AC 240 V required.

7.14 Accessories

Standard accessories

- Operating and installation instructions
- Operating lever for the three-position switch-disconnector/disconnecting circuit-breaker
- Hand crank for circuit-breaker 3AH
- Double-bit key (option)

Other accessories According to order documents/purchase order (selection):

- HV HRC fuse-links
- Cable plugs / adapter systems
- Surge arresters
- Test fuses for mechanical simulation of the striker of HV HRC fuse-links in transformer feeders



Fig. 14: Test fuse with extension tube

- HR/LRM voltage indicators
- Test units to check the capacitive interface and the voltage indicators (e.g. make Horstmann).



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



8 Technical data

8.1 Complete switchgear

General technical data

		Standard panels	Panels type LST	
			up to 12 kV	> 12 kV
Rated functional level p_{re} (absolute) at 20 °C	for insulation	1500 hPa	1750 hPa	1950 hPa
Minimum functional level (absolute) at 20 °C	for insulation	1300 hPa	1550 hPa	1750 hPa
Ambient air temperature T^1	Panels without secondary equipment	Class "Minus 25 Indoor" (-40 °C to +70 °C ¹⁾)		
	Panels with secondary equipment, circuit-breaker panels	Class "Minus 5 Indoor" (-5 °C to +55 °C ¹⁾)		
Partition class		Class PM (partitions metallic)		
Loss of service continuity	LSC	LSC 2		

¹⁾ Temperature range, reduced normal currents at > +40 °C

Electrical data

The technical data of the switchgear supplied is shown on the rating plate.								
Rated voltage		U_r	kV	7.2	12	15	17.5	24
Rated insulation level	Rated short-duration power-frequency withstand voltage	U_d	kV	20	28/42*	36	38	50
	Rated lightning impulse withstand voltage	U_p	kV	60	75/95*	95	95	125
Rated frequency		f_r	Hz	50/60	50/60	50/60	50/60	50/60
Rated normal current	Incoming/outgoing feeders	I_r	A	250/400/630	250/400/630	250/400/630	250/400/630	250/400/630
	Transformer feeders	I_r^{**}	A	200	200	200	200	200
Rated short-time withstand current	for switchgear with $t_k = 1s$	I_k	up to kA	25	25	25	25	20
	for switchgear with $t_k = 3s$	I_k	up to kA	20	20	20	20	20
Rated peak withstand current		I_p	up to kA	63	63	63	63	50
Rated short-circuit breaking current	Circuit-breaker 3AH	I_{ma}	up to kA	50/63	50/63	50/63	50/63	50
		I_{sc}	up to kA	20/25	20/25	20/25	20/25	20
	Circuit-breaker LST	I_{ma}	up to kA	50	50	40	40	40
		I_{sc}	up to kA	20	20	16	16	16
Electrical service life	Circuit-breaker 3AH	at rated normal current	10 000 operating cycles					
	Circuit-breaker LST	at rated normal current	2000 operating cycles					

* Insulation level 42 kV/95 kV according to national requirements, for $I_k = 20$ kA

** Depending on fuse type used

*** Maximum let-through current of fuse

Dimensions and weights For binding switchgear dimensions, please refer to the order documentation (dimension drawing, front view).

Description

Individual panel, panel block or combinations thereof for standard switchgear (without pressure absorber system)	Type	Panel or panel combination		Transport unit for standard panels (without pressure absorber system)			
		Width B1 [mm]	Width B2 [m]	Height without / with LVC* [m]	Depth T2 [m]	Net weight without / with LVC* [kg]	
Transport of individual panels							
Ring-main panel (standard)	RK	350	0.70	1.60/2.20	1.10	150/210	
	RK1	500	0.70	1.60/2.20	1.10	180/240	
Cable panel (standard)	K	350	0.70	1.60/2.20	1.10	145/205	
Transformer panel	TR	500	0.70	1.60/2.20	1.10	180/240	
Circuit-breaker panel (standard)	LS1	500	0.70	-/2.20	1.10	-/260	
	LS2	500	0.70	-/2.20	1.10	-/380	
	LST1	500	0.70	1.60/2.20	1.10	280/340	
Bus sectionalizer panel	LT1	500	0.70	-/2.20	1.10	-/280	
	LT1-V	500	0.70	-/2.20	1.10	-/380	
	LT2	500	0.70	1.60/2.20	1.10	150/210	
Busbar earthing panel	SE1	500	0.70	1.60/2.20	1.10	150/210	
	SE2	500	0.70	1.60/2.20	1.10	250/310	
Busbar voltage metering panel	ME3	500	0.70	1.60/2.20	1.10	250/310	
Billing metering panels, air-insulated	low structure	ME1	850	1.08	1.60/2.20	1.10	250/310
	with combined transformers	ME2	600	1.08	1.60/2.20	1.10	390/450
Transport of panel blocks							
Ring-main panel block	R-B2	700	1.08	1.60/2.20	1.10	280/400	
	R-B3	1050	1.40	1.60/2.20	1.10	400/580	
Ring-main/circuit-breaker panel block	R LST-B2	700	1.08	1.60/2.20	1.10	400/520	
	2R LST-B3	1050	1.40	1.60/2.20	1.10	510/690	
	3R LST-B4	1400	2.03	1.60/2.20	1.10	610/850	
Transformer panel block	T-B2	1000	1.40	1.60/2.20	1.10	320/440	
	T-B3	1500	2.03	1.60/2.20	1.10	480/660	
Ring-main/transformer panel block	R T-B2	700	1.08	1.60/2.20	1.10	300/420	
	2R T-B3	1050	1.40	1.60/2.20	1.10	450/630	
	3R T-B4	1400	2.03	1.60/2.20	1.10	580/820	
	T 2R T-B4 ²⁾	1400	2.03	1.60/2.20	1.10	590/830	
Cable connection/transformer panel block	K T-B2	700	1.08	1.60/2.20	1.10	300/420	
Cable connection/circuit-breaker panel block	K LST-B2	700	1.08	1.60/2.20	1.10	400/520	

¹⁾ The net weight depends on the extent to which it is equipped (e.g. current transformers, motor operating mechanisms, deep cable compartment cover) and is therefore given as a mean value.

²⁾ On request

* Low-voltage compartment, 600 mm high, weight approx. 60 kg depending on the panel type and the extent to which it is equipped

Transport of combinations of different individual panels or panel blocks						
without pressure absorber system						
Comprising	Overall width B3 [mm]	Width B2 [m]	Height without / with LVC [m]	Depth T2 [m]	Volume without / with LVC [m ³]	Weight [kg]
- a number of individual panels or	≤ 850	1.08	1.60/2.20	1.10	1.90/2.61	1) + 60***
- 1 panel block or	≤ 1200	1.40	1.60/2.20	1.10	2.46/3.39	1) + 70***
- a number of panel blocks or	≤ 1800	2.03	1.60/2.20	1.10	3.57/4.91	1) + 85***
- individual panels with panel blocks	≤ 2350	2.53	1.60/2.20	1.10	4.49/6.17	1) + 100***
with pressure absorber system for wall-standing arrangement						
Comprising						
- a number of individual panels or	≤ 850	1.08	2.10*/2.50	1.10	2.49/2.97	1) + 140** + 60***
- 1 panel block or	≤ 1200	1.40	2.10*/2.50	1.10	3.23/3.85	1) + 150** + 70***
- a number of panel blocks or	≤ 1800	2.03	2.10*/2.50	1.10	4.69/5.58	1) + 340** + 85***
- individual panels with panel blocks	≤ 2000	2.53	2.10*/2.50	1.10	5.84/6.96	1) + 370** + 100***
with pressure absorber system for free-standing arrangement						
Comprising						
- a number of individual panels or	≤ 850	1.08	2.50/2.50	1.10	2.97/2.97	1) + 180** + 60***
- 1 panel block or	≤ 1200	1.40	2.50/2.50	1.10	3.85/3.85	1) + 205** + 70***
- a number of panel blocks or	≤ 1800	2.03	2.50/2.50	1.10	5.58/5.58	1) + 380** + 85***
- individual panels with panel blocks	≤ 2000	2.53	2.50/2.50	1.10	6.96/6.96	1) + 420** + 100***

1) Sum of the net weights of individual panels and/or panel blocks

* If there is an ME1 available in connection with pressure absorber system for wall-standing arrangement, the same heights as with low-voltage compartment apply

** Additional weight of pressure absorber system

*** Packing weight

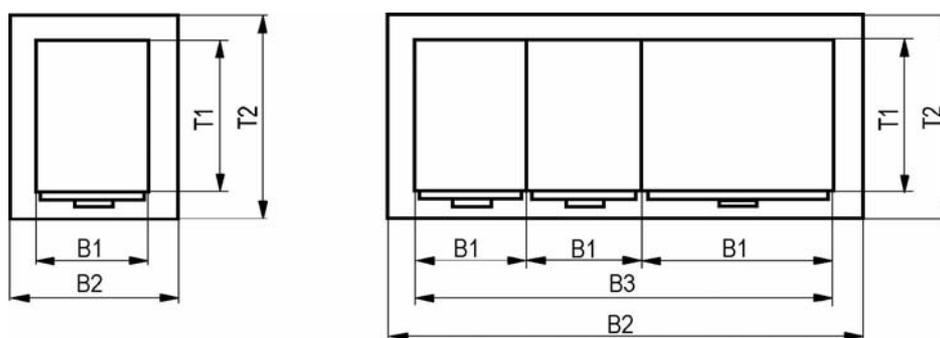


Fig. 15: Transport units for shipping (top view)

Dielectric strength

- The dielectric strength is verified by testing the switchgear with rated values of short-duration power-frequency withstand voltage and lightning impulse withstand voltage according to IEC 62 271-1 / VDE 0670-1.
- The rated values are referred to sea level and to normal atmospheric conditions (1013 hPa, 20 °C, 11g/m³ humidity according to IEC 60071 and VDE 0111).
- The dielectric strength decreases with increasing altitude. For site altitudes above 1000 m (above sea level) the standards do not provide any guidelines for the insulation rating, but leave this to the scope of special agreements.

Description

All parts housed inside the switchgear vessel which are subjected to high voltage are SF₆-insulated against the earthed enclosure. This insulation permits switchgear installation at any desired altitude (above sea level), without the dielectric strength being adversely affected. This also applies to the cable connection when using cable T-plugs or cable elbow plugs (screened version) and to the busbar for 8DH switchgear (screened version).

Dielectric strength for switchgear with HV HRC fuses

- When HV HRC fuses are used, the conductors are led out of the gas insulation through the bushing. For these connections in air, the rated values (rated lightning impulse withstand voltage, rated short-duration power-frequency withstand voltage) of the dielectric strength are referred to normal atmospheric conditions (1013 hPa, 20 °C, 11 g/m³humidity), hence to sea level, in accordance with IEC 60071 / VDE 0111.

Site altitude

For site altitudes above 1000 m, the correction factor K_a is recommended, independently of the site altitude above sea level.

Rated voltage (r.m.s. value)	[kV]	7.2	12	15	17.5	24
Rated short-duration power-frequency withstand voltage (r.m.s. value)						
- Across isolating distances	[kV]	23	32	39	45	60
- Between phases and to earth		20	28	36	38	50
Rated lightning impulse withstand voltage (peak value)						
- Across isolating distances	[kV]	70	85	105	110	145
- Between phases and to earth		60	75	95	95	125

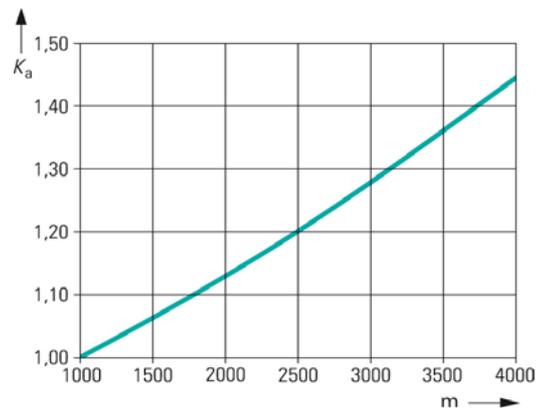


Fig. 16: Correction factor K_a as a function of the site altitude in m above sea level

Rated short-duration power-frequency withstand voltage to be selected for site altitudes > 1000 m

≥ Rated short-duration power-frequency withstand voltage up to ≤ 1000 m * K_a

Rated lightning impulse withstand voltage to be selected for site altitudes > 1000 m

≥ Rated lightning impulse withstand voltage up to ≤ 1000 m * K_a

Example

3000 m site altitude above sea level

17.5 kV switchgear rated voltage

95.0 kV rated lightning impulse withstand voltage

Rated lightning impulse withstand voltage to be selected

95 kV * 1.28 = 122 kV

Result

According to the above table, a switchgear for a rated voltage of 24 kV with a rated lightning impulse withstand voltage of 125 kV is to be selected.

8.2 Standards, specifications, guidelines

Standards The switchgear for indoor installation complies with the following prescriptions and standards:

		IEC/EN standard	VDE standard
Switchgear		62 271-1	0670-1
		62 271-200	0671-200
Switching devices	Circuit-breakers	62 271-100	0671-100
	Disconnectors/earthing switches	62 271-102	0671-102
	Switch-disconnectors	60 265-1	0670-301
	Switch-disconnector/fuse combination	62 271-105	0671-105
Voltage detecting systems		61 243-5	0682-415
Surge arresters		60 099	0675
Degree of protection		60 529	470-1
Instrument transformers	Current transformers	60 044-1	0414-1
	Voltage transformers	60 044-2	0414-2
	Combined transformers	60 044-3	0414-3
SF ₆		60 376	0373-1
		60 480	0373-2
Installation and earthing		61 936-1 / HD 637 -S1	0101
Environmental conditions		60 721-3-3	DIN EN 60 721-3-3

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 have 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 requirements of the EMC guideline.

The switchgear operator / owner must keep the technical documents supplied 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 - EMC Guideline for Switchgear; A&D ATS SR/PTD M SP)

Protection against solid foreign objects, electric shock and water

The medium-voltage switchgear fulfils the following degrees of protection according to IEC 62271-1, IEC 62271-200 and IEC 60529:

Degree of protection	Type of protection
IP 2X (standard)	Parts under high voltage in switchgear with HV HRC fuses
IP3X (option)	Enclosure of parts under high voltage in switchgear with locking device
IP3XD (on request)	Parts under high voltage in switchgear with locking device
IP65	Parts under high voltage in switchgear without HV HRC fuses

Transport regulations According to "Annex 1 of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) dated September 30th, 1957" Siemens gas insulated medium-voltage switchgear does not belong to the category of dangerous goods regarding transportation, and is exempted from special transport regulations according to ADR, Clause 1.1.3.1 b) .

8.3 3AH vacuum circuit-breaker

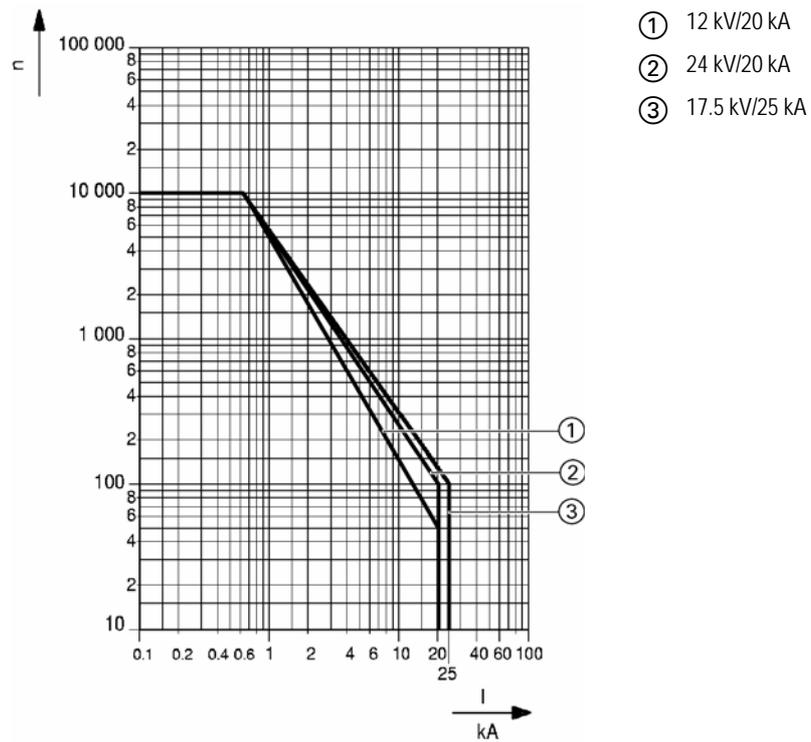


Fig. 17: Permissible number of operating cycles [n] as a function of the breaking current (r.m.s. value) [I_a]

Permissible number of operating cycles

At rated normal current		10 000
At short-circuit breaking current	12 kV/20 kA	50
	24 kV/20 kA	100
	17.5 kV/25 kA	100

Classes for switching device

Function	Class	Standard	Property
BREAKING	M2	IEC 62271-100	10000 times mechanically without maintenance
	E2	IEC 62271-100	10000 times rated normal current without maintenance
	C2	IEC 62271-100	Very low probability of restrikes

Switching times

Switching times	Component		Duration	Unit
Closing time			75	ms
Charging time			<15	s
Opening time	Shunt release	(Y1)	<65	ms
	Additional release 3AX 11	(Y2), (Y4),(Y7)	<50	ms
Arcing time			<15	ms
Breaking time	Shunt release	(Y1)	<80	ms
	Additional release 3AX 11	(Y2), (Y4),(Y7)	<65	ms
Dead time			300	ms
Close-open contact time	Shunt release	(Y1)	<80	ms
	Additional release 3AX 11	(Y2), (Y4),(Y7)	<50	ms
Minimum command duration				
CLOSE	Closing solenoid	(Y9)	45	ms
OPEN	Shunt release	(Y1)	40	ms
OPEN	Additional release 3AX 11	(Y2), (Y4),(Y7)	<50	ms
Short-time impulse duration of the circuit-breaker tripping signal			10	ms

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.

Breaking time The interval of time between the initiation (command) of the opening operation and the instant of final arc extinction in the last quenching pole (= 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 the subsequent opening process.

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

Rated switching sequences:

- Rapid load transfer (U): O-t-CO-t'-CO (t, t' = 3 min)
- Auto-reclosure (K): O-t-CO-t'-CO (t = 0,3 s, t' = 3 min)
- Multiple auto-reclosure: O-t-CO-t'-CO-t'-CO-t'-CO (t = 0,3 s, t' = 15 s)

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

Rated supply voltage	Recommended rated current for the protection equipment*
V	A
DC 24	8
DC 48	6
DC 60	4
DC/AC 110 50/60 Hz	2
DC 220/AC 230 50/60 Hz	1.6
*) M.c.b. assembly 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 up to 60 Hz	up to 230	10		
DC	24	Resistive load	Inductive load	
		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-energised internally. It is available for DC or AC voltage. Power consumption: 140 W or 140 VA.

Shunt releases 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, a latching mechanism and an electromagnetic system. Rated tripping current: 0.5 A/1 A
- The c.t.-operated release **3AX1104** (low-energy release) is suitable 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.

Varistor module

	ATTENTION!
	<p>Switching overvoltages can damage electronic control devices.</p> <p>⇒ Do not switch off inductive consumers in DC circuits.</p>

With the varistor module 3AX1526, the inductances of the circuit-breaker operating mechanism and the circuit-breaker control system (motor, closing solenoid, shunt release and auxiliary contactor) can be operated with DC. The module limits the overvoltage to approx. 500 V and is available for rated operating voltages from 60 V (DC) up to 220 V (DC). It contains two separate varistor circuits.

Type approval according to German X-ray regulations (RöV)

The vacuum interrupters fitted in the vacuum circuit-breakers 3AH 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 from July 25th 1996, Federal Law Gazette (BGBl) I Page 1172, §8 and Annex III, Section 5 up to rated short-duration power-frequency voltage stipulated in accordance with IEC/DIN VDE.

8.5 Three-position disconnecting circuit-breaker (type LST)

Electrical data

Rated													
voltage	U_r	kV	7.2	12	15	17.5	24						
short-duration power-frequency withstand voltage	U_d	kV	20	28	36	38	50						
lightning impulse withstand voltage	U_p	kV	60	75	95	95	125						
frequency	f_r	Hz	50	50	50	50	50						
normal current	I_r	A	250/630										
short-time withstand current	at $t_k=1$ s	I_k	up to kA	16	20	16	20	16	-	16	-	16	-
	at $t_k=3$ s	I_k	up to kA	-	20	-	20	16	-	16	-	16	-
peak withstand current	I_p	up to kA	40	50	40	50	40	-	40	-	40	-	
short-circuit making current	I_{ma}	kA	40	50	40	50	40	-	40	-	40	-	
short-circuit breaking current	I_{SC}	kA	16	20	16	20	16	-	16	-	16	-	
cable-charging breaking current	I_C	A	63										

Endurance classes and number of operating cycles

Number of electrical operating cycles "n" for circuit-breaker at:	Rated voltage U_r	kV	7.2	12	15	17.5	24						
	Rated normal current I_r	n	2000	2000	2000	2000	2000						
	Rated short-circuit making current I_{ma}	n	4	4	4	4	4	-	4	-	4	-	
	Rated short-circuit breaking current I_{SC}	n	6	6	6	6	6	-	6	-	6	-	
	Option		20		20		20		20		20		
Class	E2 (IEC 62271-100)												
Number of mechanical operating cycles "n" for circuit-breaker	n	2000											
	Class	M1 (IEC 62271-100)											
Number of mechanical operating cycles "n" for disconnecter function	n	2000											
	Class	M1 (IEC 62271-102)											
Number of electrical operating cycles "n" for earthing switch at rated short-circuit making current I_{ma}	n	5											
	Class	E2 (IEC 62271-102)											
Number of mechanical operating cycles "n" for make-proof earthing switch	n	1000											
	Class	M0 (IEC 62271-102)											
Classification "C" for circuit-breaker: Low probability of restrikes for capacitive currents	Class	C1 (IEC 62271-100)											

Description

Rated operating sequence Rated operating sequence according to IEC 62271-100 (T 100 s):

O - t - CO - t' - CO, t=t'=3 min

Operating times	Component		Duration	Unit	
Closing time	Spring-operated/stored energy mechanism	(manual operation)	< 2	s	
Charging time	Spring-operated/stored energy mechanism	(manual operation)	< 2	s	
Opening time	Low-energy release	(Y6)	< 50	ms	
	Shunt release	(Y3)	< 30	ms	
Arcing time			< 20	ms	
Breaking time	Low-energy release	(Y6)	< 70	ms	
	Shunt release	(Y3)	< 50	ms	
Dead time			3	min	
Close-open contact time	Low-energy release	(Y6)	< 230*	ms	
	Shunt release	(Y3)	< 75	ms	
Minimum command duration					
CLOSE	Spring-operated/stored energy mechanism	(manual operation)	< 2	s	
OPEN	Low-energy release	(Y6)	7SJ45	100	ms
			WIC 1	50	ms
OPEN	Shunt release	(Y3)	7SJ46	500	ms
			WIC 1	150	ms

* Tested via test input of WIC relay

8.6 Selection of HV HRC fuse links

Allocation of HV HRC fuses and transformers

The three-position switch-disconnector in the transformer feeder (transformer switch) was combined with HV HRC fuse-links and tested in accordance with IEC 62 271-105.

The transformer protection table below shows HV HRC fuse-links recommended for transformer protection. Furthermore, the switchgear also permits fuse protection of transformers up to ratings of 2000 kVA. Please contact us for such applications.

The **protection table** applies to:

- Maximum ambient air temperature in the switchgear room of 40°C according to IEC 62 271-1 considering the influence of the switchgear enclosure
- Requirements according to IEC 62271-105
- Protection of distribution transformers according to IEC 60787
- Rated power of transformer (no overload operation)

The specified HV HRC fuses make SIBA are type-tested partial range fuses according to IEC 60 282-1. The dimensions correspond to DIN 43625. The HV HRC fuses have a thermal protection in form of a temperature-limiting striker tripping operating in case of defective HV HRC fuse-links or high overload currents.

Please contact us if you want to use HV HRC fuses from other manufacturers.

Basis for selection of HV HRC fuse-links:

- IEC 60282-1
- IEC 62271-105

- IEC 60787
- Recommendations and data sheets of fuse manufacturers
- Permissible power loss in the switchgear enclosure at an ambient air temperature of 40° C

Transformer protection table: Recommendation for allocation of HV HRC fuse-links make SIBA and transformers

Transformer				HV HRC fuse			
U [kV]	S _N [kVA]	u _k [%]	I ₁ [A]	I _S [A]	U _S [V]	e [mm]	Order No.
6 - 7,2	50	4	4,8	10	3 - 7,2	292	30 098 13.10
				10	6 - 12	292	30 004 13.10
				10	6 - 12	442	30 101 13.10
	75	4	7,2	16	3 - 7,2	292	30 098 13.16
				16	6 - 12	292	30 004 13.16
				16	6 - 12	442	30 101 13.16
	100	4	9,6	16	3 - 7,2	292	30 098 13.16
				16	6 - 12	292	30 004 13.16
				16	6 - 12	442	30 101 13.16
				20	3 - 7,2	292	30 098 13.20
	125	4	12	20	3 - 7,2	292	30 098 13.20
				20	6 - 12	292	30 004 13.20
				20	6 - 12	442	30 101 13.20
				25	3 - 7,2	292	30 098 13.25
	160	4	15,4	25	3 - 7,2	292	30 098 13.25
				25	6 - 12	292	30 004 13.25
				25	6 - 12	442	30 101 13.25
				31,5	3 - 7,2	292	30 098 13.31,5
	200	4	19,2	31,5	6 - 12	292	30 004 13.31,5
				31,5	6 - 12	442	30 101 13.31,5
				31,5	6 - 12	442	30 101 13.31,5
	250	4	24	40	3 - 7,2	292	30 098 13.40
				40	6 - 12	292	30 004 13.40
				40	6 - 12	442	30 101 13.40
				50	3 - 7,2	292	30 098 13.50
	315	4	30,3	50	6 - 12	292	30 004 13.50
				50	6 - 12	442	30 101 13.50
				50	6 - 12	442	30 101 13.50
63				6 - 12	292	30 012 43.63	
400	4	38,4	63	6 - 12	292	30 012 43.63	
			80	6 - 12	292	30 012 43.80	
			80	6 - 12	442	30 102 43.80	
			63	3 - 7,2	292	30 099 13.63	
			63	6 - 12	292	30 012 13.63	
				63	6 - 12	442	30 102 13.63

Transformer				HV HRC fuse				
U [kV]	S _N [kVA]	u _k [%]	I ₁ [A]	I _S [A]	U _S [V]	e [mm]	Order No.	
6 - 7,2	500	4	48	80	6 - 12	292	30 012 43.80	
				80	6 - 12	442	30 102 43.80	
				80	3 - 7,2	292	30 099 13.80	
				80	6 - 12	292	30 012 13.80	
				80	6 - 12	442	30 102 13.80	
				100	6 - 12	292	30 012 43.100	
				100	6 - 12	442	30 102 43.100	
				630	4	61	100	6 - 12
	10 - 12	50	4	2,9	10	6 - 12	292	30 004 13.10
					10	6 - 12	442	30 101 13.10
					10	10 - 17,5	292	30 255 13.10
10					10 - 17,5	442	30 231 13.10	
10					10 - 24	442	30 006 13.10	
75		4	4,3	10	6 - 12	292	30 004 13.10	
				10	6 - 12	442	30 101 13.10	
				10	10 - 17,5	292	30 255 13.10	
				10	10 - 17,5	442	30 231 13.10	
				10	10 - 24	442	30 006 13.10	
100	4	5,8	16	6 - 12	292	30 004 13.16		
			16	6 - 12	442	30 101 13.16		
			16	10 - 17,5	292	30 255 13.16		
			16	10 - 17,5	442	30 231 13.16		
125	4	7,2	16	10 - 24	442	30 006 13.16		
			16	6 - 12	292	30 004 13.16		
			16	6 - 12	442	30 101 13.16		
			16	10 - 17,5	292	30 255 13.16		
160	4	9,3	16	10 - 17,5	442	30 231 13.16		
			16	10 - 24	442	30 006 13.16		
			20	6 - 12	292	30 004 13.20		
			20	6 - 12	442	30 101 13.20		
			20	10 - 17,5	292	30 221 13.20		
200	4	11,5	20	10 - 17,5	442	30 231 13.20		
			20	10 - 24	442	30 006 13.20		
			25	6 - 12	292	30 004 13.25		
			25	6 - 12	442	30 101 13.25		
			25	10 - 17,5	292	30 221 13.25		
				25	10 - 17,5	442	30 231 13.25	
				25	10 - 24	442	30 006 13.25	

Transformer				HV HRC fuse						
U [kV]	S _N [kVA]	u _K [%]	I ₁ [A]	I _S [A]	U _S [V]	e [mm]	Order No.			
10 - 12	250	4	14,5	25	6 - 12	292	30 004 13.25			
				25	6 - 12	442	30 101 13.25			
				25	10 - 17,5	292	30 221 13.25			
				25	10 - 17,5	442	30 231 13.25			
				25	10 - 24	442	30 006 13.25			
				31,5	6 - 12	292	30 004 13.31,5			
				31,5	6 - 12	442	30 101 13.31,5			
				31,5	10 - 17,5	292	30 221 13.31,5			
				31,5	10 - 17,5	442	30 231 13.31,5			
				31,5	10 - 24	442	30 006 13.31,5			
				315	4	18,3	31,5	6 - 12	292	30 004 13.31,5
							31,5	6 - 12	442	30 101 13.31,5
31,5	10 - 17,5	292	30 221 13.31,5							
31,5	10 - 17,5	442	30 231 13.31,5							
31,5	10 - 24	442	30 006 13.31,5							
40	6 - 12	292	30 004 13.40							
40	6 - 12	442	30 101 13.40							
40	10 - 17,5	292	30 221 13.40							
40	10 - 17,5	442	30 231 13.40							
40	10 - 24	442	30 006 13.40							
400	4	23,1	40				6 - 12	292	30 004 13.40	
			40				6 - 12	442	30 101 13.40	
			40	10 - 17,5	292	30 221 13.40				
			40	10 - 17,5	442	30 231 13.40				
			40	10 - 24	442	30 006 13.40				
500	4	29	50	6 - 12	292	30 004 13.50				
			50	6 - 12	442	30 101 13.50				
			50	10 - 17,5	292	30 221 13.50				
			50	10 - 17,5	442	30 232 13.50				
			50	10 - 24	442	30 014 13.50				
			63	6 - 12	292	30 012 43.63				
			63	10 - 24	442	30 014 43.63				
630	4	36,4	63	6 - 12	292	30 012 43.63				
			80	10 - 24	442	30 014 43.80				
			63	6 - 12	292	30 012 13.63				
			63	6 - 12	442	30 102 13.63				
			63	10 - 17,5	442	30 232 13.63				
			80	6 - 12	292	30 012 43.80				
			80	6 - 12	442	30 102 43.80				
800	5 - 6	46,2	80	6 - 12	292	30 012 43.80				
			80	6 - 12	442	30 102 43.80				
1000	5 - 6	58	100	6 - 12	442	30 102 43.100				

Transformer				HV HRC fuse							
U [kV]	S _N [kVA]	u _K [%]	I ₁ [A]	I _S [A]	U _S [V]	e [mm]	Order No.				
13,8	50	4	2,1	6,3	10 - 17,5	442	30 231 13.6,3				
				6,3	10 - 24	442	30 006 13.6,3				
				75	4	3,2	6,3	10 - 17,5	442	30 231 13.6,3	
				100	4	4,2	10	10 - 17,5	442	30 231 13.10	
				125	4	5,3	10	10 - 17,5	442	30 231 13.10	
				160	4	6,7	16	10 - 17,5	442	30 231 13.16	
				200	4	8,4	16	10 - 17,5	442	30 231 13.16	
				250	4	10,5	20	10 - 17,5	442	30 231 13.20	
				315	4	13,2	25	10 - 17,5	442	30 231 13.25	
				400	4	16,8	31,5	10 - 17,5	442	30 231 13.31,5	
							31,5	10 - 24	442	30 006 13.31,5	
				500	4	21	40	10 - 17,5	442	30 231 13.40	
							40	10 - 24	442	30 006 13.40	
				630	4	26,4	50	10 - 17,5	442	30 232 13.50	
							50	10 - 24	442	30 014 13.50	
				800	5 - 6	33,5	63	10 - 24	442	30 014 43.63	
				1000	5 - 6	41,9	80	10 - 24	442	30 014 43.80	
				15 - 17,5	50	4	1,9	6,3	10 - 17,5	442	30 231 13.6,3
								6,3	10 - 24	442	30 006 13.6,3
								75	4	2,9	6,3
100	4	3,9	10					10 - 17,5	442	30 231 13.10	
125 ¹⁾	4	4,8	16					10 - 17,5	442	30 231 13.16	
			16					10 - 24	442	30 006 13.16	
160	4	6,2	16					10 - 17,5	442	30 231 13.16	
200 ¹⁾	4	7,7	20					10 - 17,5	442	30 231 13.20	
			20					10 - 24	442	30 006 13.20	
250 ¹⁾	4	9,7	25					10 - 17,5	442	30 231 13.25	
			25					10 - 24	442	30 006 13.25	
315 ¹⁾	4	12,2	31,5					10 - 17,5	442	30 231 13.31,5	
			31,5					10 - 24	442	30 006 13.31,5	
400	4	15,5	31,5	10 - 17,5	442	30 231 13.31,5					
			31,5	10 - 24	442	30 006 13.31,5					
500	4	19,3	31,5	10 - 17,5	442	30 231 13.31,5					
			31,5	10 - 24	442	30 006 13.31,5					
630	4	24,3	40	10 - 17,5	442	30 231 13.40					
			40	10 - 24	442	30 006 13.40					
800 ¹⁾	5 - 6	30,9	63	10 - 24	442	30 014 43.63					
1000 ¹⁾	5 - 6	38,5	80	10 - 24	442	30 014 43.80					
1250 ¹⁾	5 - 6	48,2	100	10 - 24	442	30 022 43.100					

Description

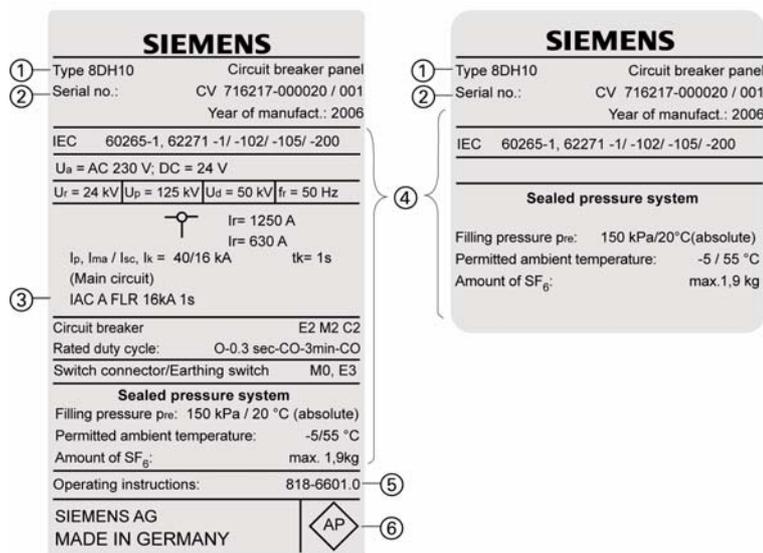
Transformer				HV HRC fuse			
U [kV]	S _N [kVA]	u _K [%]	I ₁ [A]	I _S [A]	U _S [V]	e [mm]	Order No.
20 - 24	50	4	1,5	6,3	10 - 24	442	30 006 13.6,3
	75	4	2,2	6,3	10 - 24	442	30 006 13.6,3
	100	4	2,9	6,3	10 - 24	442	30 006 13.6,3
	125	4	3,6	10	10 - 24	442	30 006 13.10
	160	4	4,7	10	10 - 24	442	30 006 13.10
	200	4	5,8	16	10 - 24	442	30 006 13.16
	250	4	7,3	16	10 - 24	442	30 006 13.16
	315	4	9,2	16	10 - 24	442	30 006 13.16
				20	10 - 24	442	30 006 13.20
	400	4	11,6	20	10 - 24	442	30 006 13.20
				25	10 - 24	442	30 006 13.25
	500	4	14,5	25	10 - 24	442	30 006 13.25
				31,5	10 - 24	442	30 006 13.31,5
	630	4	18,2	31,5	10 - 24	442	30 006 13.31,5
40				10 - 24	442	30 006 13.40	

Transformer				HV HRC fuse			
U [kV]	S _N [kVA]	u _K [%]	I ₁ [A]	I _S [A]	U _S [V]	e [mm]	Order No.
	800	5 - 6	23,1	31,5	10 - 24	442	30 006 13.31,5
	1000	5 - 6	29	50	10 - 24	442	30 014 13.50
	1250	5 - 6	36	50	10 - 24	442	30 014 13.50
	1600 ¹⁾	5 - 6	46,5	100	10 - 24	442	30 022 43.100
	2000	5 - 6	57,8				on request
	U	Rated system voltage					
S _N	Rated power						
u _K	Relative impedance voltage						
I ₁	Rated current						
I _S	Rated current of fuse						
U _S	Rated voltage of fuse						
e	Reference dimension						

1) Mechanical time delay required (for switchgear ordered with 17.5 kV, this time delay is installed automatically)

	NOTE!
	<ul style="list-style-type: none"> - For switchgear with rated voltages up to 12 kV, a fuse slide for HV HRC fuse-links with dimension 292 mm is normally provided. - 7.2 kV fuse-links with dimension 192 mm as well as 24 kV fuse-links with dimension 292 mm are not permissible.

8.7 Rating plates



Rating plate at the front (example)

Rating plate inside the operating mechanism box (example)

- | | |
|---|---|
| ① Switchgear type and year of manufacture | ④ Technical data |
| ② Serial number | ⑤ Number of operating instructions |
| ③ Internal arc classification (option) | ⑥ Test mark for the performed acceptance test (German: Abnahme-Prüfung) (pressure test) of the vessel |

IAC classification This data (see item ③) describes the internal arc classification of the panel according to IEC 62271-200. The entries **IAC A FL 16 kA 1 s** in the example shown mean:

- **IAC:** Internal Arc Classification
- **A:** Degree of accessibility A; for authorised personnel only; switchgear in closed service location; access for expert personnel only.
- **F:** Internal arc classification for the front side (Front)
- **L:** Internal arc classification for the lateral surfaces (Lateral)
- **R:** Internal arc classification for the rear side (Rear)
- **16 kA:** Tested short-circuit current
- **1 s:** Test duration

The IAC classification is referred to each panel. The data on the rating plate (see item ③) describes the areas classified for the corresponding panel.

9 Switchgear maintenance

Maintenance Under normal conditions, medium-voltage switchgear 8DH10 is maintenance-free. Exception: Air-insulated metering panels type ME1. Here, visual inspections are required under normal operating conditions. If necessary, clean the high-voltage parts.

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

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

- Type and serial number of the switchgear (see rating plates)
- Description/identification of the device or component on the basis of a sketch/photo or a circuit diagram.

10 End of service life

SF₆ gas

	NOTE!
	<p>The equipment contains the fluorized greenhouse gas SF₆ registered by the Kyoto Protocol with a global warning potential (GWP) of 22 200. SF₆ has to be reclaimed and must not be released into the atmosphere.</p> <p>⇒ For use and handling of SF₆, IEC 62271-303 has to be observed: High-voltage switchgear and controlgear - Part 303 Use and handling of sulphur hexafluoride (SF₆) zu beachten.</p>

Before recycling the materials, evacuate the 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 SF₆ gas, the switchgear mainly consists of the following materials:

- Sheet-steel, galvanized (enclosure and operating mechanisms)
- Stainless steel (vessel)
- Copper (conductor bars)
- Silver (contacts)
- Cast-resin based on epoxy resin (bushings and fuse boxes)
- Plastic material (arcing chamber and fuse slide)
- Silicone rubber

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.

Installation

11 Before installation

11.1 Preliminary clarifications

In order to load the transport units in a suitable installation order, the local 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...)
- 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.

11.2 Switchgear room

Please observe the following points when selecting and setting up 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

11.3 Intermediate storage

	DANGER!
	<p>Risk of injury and damage to the stored goods if the storage space is overloaded.</p> <p>⇒ Observe the load-bearing capacity of the floor.</p> <p>⇒ Do not stack the transport units.</p> <p>⇒ Do not overload lighter components by stacking.</p>

	ATTENTION!
	<p>Fire risk. The transport unit is packed in flammable materials.</p> <p>⇒ No smoking.</p> <p>⇒ Keep fire extinguishers in a weatherproof place.</p> <p>⇒ Mark the location of the fire extinguisher.</p>

	ATTENTION!
	<p>Supplied desiccant bags lose their effectiveness if they are not stored in the undamaged original packings.</p> <p>⇒ Do not damage or remove packing of desiccant bags.</p> <p>⇒ Do not unpack desiccant bags before use.</p>

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
- If packed in seaworthy crates, the switchgear can be stored for a maximum of 6 months (desiccant bags).
- Store transport units in such a way that they can be taken out later in the correct order for installation.

Switchgear storage in closed rooms

As a rule, the switchgear should be stored in a closed room. The storage room must have the following characteristics:

- Floor with adequate load-bearing capacity (weights as per delivery note)
- Even floor to enable stable storage
- Well-ventilated and free of dust as far as possible
- Dry and protected against humidity and vermin (e.g. insects, mice, rats)
- Check humidity in the packings every 4 weeks (condensation)
- Do not unpack small parts to avoid corrosion and loss.

Outdoor storage of switchgear packed in seaworthy crates

If the switchgear or parts thereof are delivered in seaworthy crates, these can be stored up to 6 months in other rooms or outdoors. The storage place must have the following characteristics:

- Floor with adequate load-bearing capacity (weights as per delivery note)
- Protected against humidity (rain water, flooding, melting water from snow and ice), pollution, vermin (rats, mice, termites, etc.) and unauthorized access
- Place all crates on planks and square timber for protection against floor humidity
- After 6 months of storage, have the desiccant agent regenerated professionally. To do this, ask for expert personnel via your regional Siemens representative.

11.4 Tools / Auxiliary means

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

- Angular screwdriver 10 DIN 911 (Allen screwdriver)
- Torx screwdriver Tx30
- Torque wrench 40 - 70 Nm
- Ratchet, reconnectable DIN 3122
- Extension DIN 3123 40 - 125
- Socket spanner inserts DIN 3124
- Socket spanner insert 10 mm with magnetic insert, extension > 360 mm
- Compensation shims for floor unevenness 0.5 – 1,0 mm
- Cleaning agent type ARAL 4005 oder type HAKU 1025/40
- Lifting truck
- Reinforcing bars, roller crowbars
- Transport rollers

11.5 Installation and fixing material

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

12 Unloading and erecting the switchgear

12.1 Transport unit and packing

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 (e.g. latticed crate, cardboard cover for air freight)

Transport unit On the customer's request, transport units may consist either

- of individual panels with separate low-voltage compartment

or

- of pre-assembled "panel groups" with mounted busbars

and accessories.

12.2 Completeness and transport damage

Checking for completeness

- ⇒ Check whether the delivery is complete and correct using the delivery notes and packing lists.
- ⇒ Compare the serial numbers of the switchgear panels on the delivery note with those on the packing and the rating plates of the panels.
- ⇒ Check whether the accessories are complete.

Checking for transport damages

- ⇒ Temporarily open the packing in a weatherproof place to detect hidden damages. Do not remove the PE foil until reaching the final mounting position in order to keep the switchgear as clean as possible.
- ⇒ Check the gas pressure indicator (SF₆-gas) (see Page 53, "Checking the ready-for-service indicator").
- ⇒ 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 local Siemens representative immediately.
- ⇒ Have the transport damages repaired, otherwise you may not start installation.
- ⇒ Refit the packing.

	ATTENTION!
	<p>The transport units may be damaged during unloading.</p> <ul style="list-style-type: none"> ⇒ Attach ropes far enough on the hoisting tackle so that they cannot exert any forces on the switchpanel walls under load. ⇒ Do not climb onto the roof of the switchpanels. ⇒ Observe the instructions on the packing. ⇒ Unload the transport units in packed condition and leave packed for as long as possible. ⇒ Do not damage the PE protective foil.

- ⇒ Attach ropes far enough on the hoisting tackle so that they cannot exert any forces on the switchpanel walls under load.
- ⇒ Wind the ropes around the ends of the wooden pallets.
- ⇒ 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.
- ⇒ Remove foil only in the building, right before assembling the transport units, and temporarily to check for transport damages.

12.3 Transport to the place of installation (switchgear room)

- ⇒ Thoroughly clean the switchgear room, since extreme cleanliness is required during installation.
- ⇒ Move the transport units on their wooden pallets as far as possible.
- ⇒ Move the transport units to the switchgear room in the order of installation.
- ⇒ Move the transport units inside the building to the place of installation using a lifting truck, fork-lift truck or rollers.
- ⇒ Set the transport units down in the correct sequence directly in front of the place of installation.

Removing the switchgear from the wooden pallets

The transport units are screwed on the wooden pallets with transport angles.

- ⇒ Remove the PE foil.
- ⇒ Remove the fixing screws from the transport angles / pallet.

If the switchgear cannot be lifted directly from the wooden pallet onto its mounting position, please proceed as follows:

- ⇒ Lower the transport units by means of the lateral transport angles onto roller pads (reinforced rollers) or tubes.
- ⇒ Lift the switchgear at the side edges with roller crowbars and slowly lower it onto the mounting position.

Switchgear transport by means of transport eyes

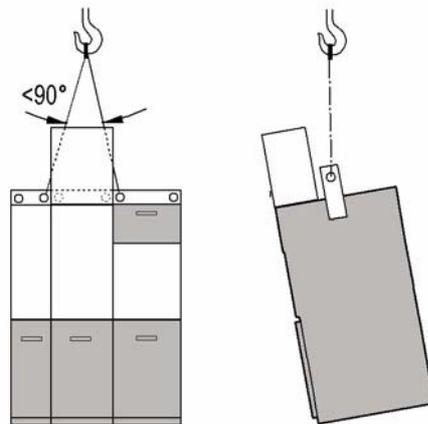


Fig. 18: Switchgear transport with crane

	ATTENTION!
	<p>Danger due to switchgear falling down if the fixing gear is overloaded.</p> <p>⇒ The spreading angle of the fixing gear must always be $< 90^\circ$ sein.</p>

	ATTENTION!
	<p>Danger due to swinging switchgear. The centre of gravity is not always located under the fixing point.</p> <p>⇒ Lift the switchgear slowly.</p> <p>⇒ Keep the safety distances.</p>

⇒ Fix panel groups always at the crane eyes of the joint between the two exterior panels and the next interior panel (see illustration).



- ⇒ Lift or lower just slowly, as the switchgear will swing into the centre of gravity when it is lifted.
- ⇒ While lifting, observe parts laid inside such as e.g. cable-type transformers, connecting cables.

Installing transport units

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 "Fundamentalschienen 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.
- The dimensions of the floor opening and the fixing points of the switchgear frame are given in the switchgear documentation.
- Determine level differences between the installation surfaces of the panels using a measuring sheet, and compensate them with shims.

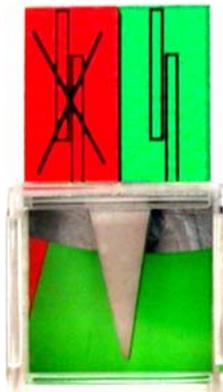
You may only start installing the transport units when

- all transport damages have been repaired
- the base frame has been levelled (1 mm/m), see DIN 43661
- the gas filling of the switchgear vessels has been checked
- the accessories and the required material are complete

12.4 Checking the ready-for-service indicator

The switchgear is filled with insulating gas at a relative pressure. Before starting installation, please verify that the gas filling of the switchgear is sufficient on the ready-for-service indicator located on the left side of the control board.

⇒ Read the ready-for-service indicator.



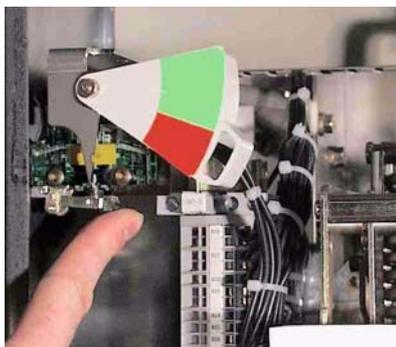
If the indicator is in the green area, the gas density is in order. If the indicator is in the red area:

⇒ Check the auxiliary switch of the ready-for-service indicator.

Checking the auxiliary switch (option) of the ready-for-service indicator

The auxiliary switch (option) of the ready-for-service indicator can latch tight due to extreme shocks during transport. Then, the pointer is in the red area.

⇒ Remove the front plate of the switchgear. Push the lever of the auxiliary switch carefully until it trips.



✓ The pointer must jump back into the green area. If not, please stop installation and contact the regional Siemens representative.

13 Assembling the switchgear

13.1 Floor openings and fixing points

The switchgear must be fastened to the foundation so as to guarantee sufficient pressure resistance. We recommend to fasten the switchgear with at least 4 bolts size M8 in each end panel; for intermediate panels with a width of 350 mm, at least 2 bolts size M8 per panel, and intermediate panels with a width of more than 350 mm, 4 bolts size M8 per panel.

Precondition: Operating mechanism in "EARTHED" position.

	ATTENTION!
	<p>Please observe the following for room planning and switchgear installation:</p> <ul style="list-style-type: none"> ⇒ Dimensions of floor openings according to the dimension drawing in the switchgear documentation. ⇒ Direction of pressure relief according to the height of the cable basement in accordance with the cable bending radius. ⇒ Relief rooms according to the dimension drawing in the switchgear documentation.

- ⇒ Remove the front cable compartment cover from the subframe of the panels. To do this, undo the bolted joints of the cable compartment cover (option). Then push the unlocking lever down and keep it in this position, lift the cover and remove it to the front.
- ⇒ For direct fastening to the concrete, drill holes into the foundation and insert dowels.
- ⇒ Place shims in the spaces between the switchgear frame and the foundation in the area of the fastening cutouts, so that the switchgear is not distorted when it is screwed tight.
- ⇒ Bolt the switchgear onto the foundation or the foundation rails.
- ⇒ As for dimensions and floor openings, please refer to the dimension drawing in the switchgear documentation.

Installing switchgear with pressure absorber



Fig. 19: Pressure absorber

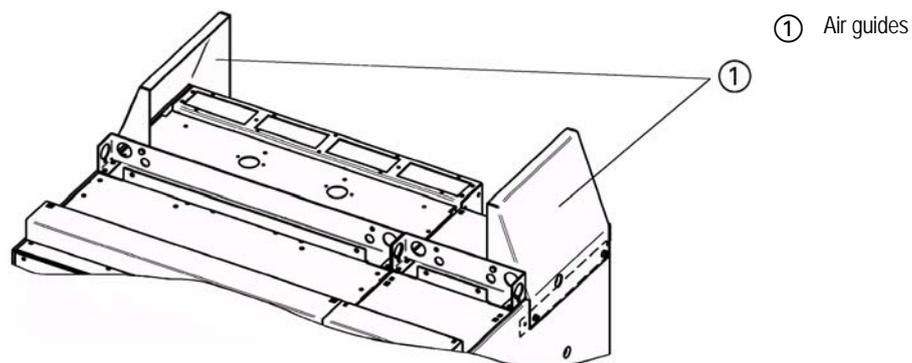
The switchgear can be equipped with a pressure absorber which is either pre-assembled at the factory or supplied separately.

If the pressure absorber is supplied separately, it must be bolted onto the foundation or foundation rails first. Then, the switchgear is set down on the pressure absorber and

bolted together. The fixing points of the absorber and the switchgear are described in the dimension drawings of the switchgear documentation.

- ⇒ Set the pressure absorber onto the foundation or the foundation rails, align it and bolt it tight.
- ⇒ Set the switchgear onto the pressure absorber and bolt the two units together.
- ⇒ In the pressure absorber was pre-assembled: Set the switchgear with the pressure absorber onto the foundation or the foundation rails, align it and bolt it tight.

For switchgear with pressure absorber in wall-standing arrangement (without ME1):



- ⇒ Fasten the air guides at the prepared retaining points of the left and right end wall.

13.2 Extending existing switchgear or replacing components

In the instructions given in the following sections it is assumed that a new switchgear is being installed which has not yet been connected to the mains, and that it is therefore not live.

If you are going to extend an existing switchgear assembly or replace components, you have to take the following additional measures in advance:

Switching off high voltage

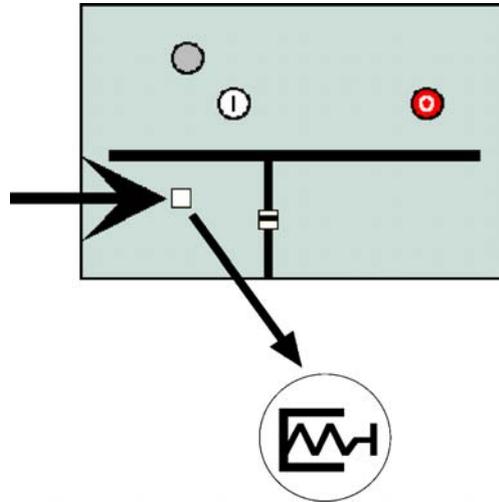
- ⇒ Isolate the switchgear.
- ⇒ Secure the switchgear against reclosing.
- ⇒ Verify safe isolation from supply of the switchgear (see Page 117, "Verification of safe isolation from supply").
- ⇒ Earth all feeders (see Page 103, "Operating the three-position switch-disconnector/ disconnecting circuit-breaker (type LST)").

Switching off auxiliary voltage

- ⇒ Switch off auxiliary voltage.
- ⇒ Secure auxiliary voltage against reclosing.
- ⇒ Verify safe isolation from supply.

Discharging the stored-energy spring mechanism

- ⇒ Switch all circuit-breakers type 3AH to the OPEN, CLOSED and again to the OPEN position one after the other (see Page 108, "Circuit-breaker panels: Operating vacuum circuit-breaker type 3AH").
- ⇒ Verify that the springs are discharged. The "spring not charged" indication must be visible.



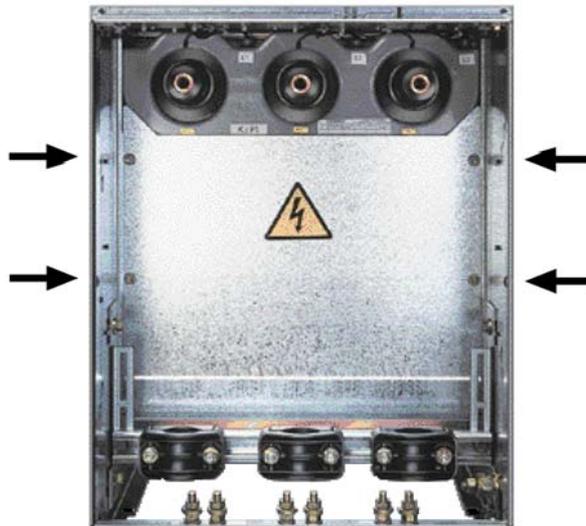
Preparing extension

	DANGER!
	High voltage! Installation work on switchgear in operation is dangerous to life. ⇒ Make sure that high voltage and auxiliary voltage are off.

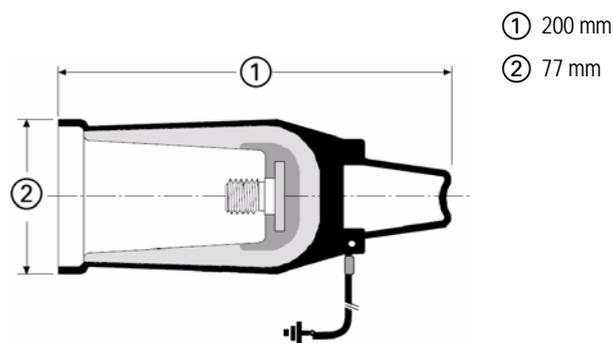
	ATTENTION!
	Risk of getting jammed while unlatching charged stored-energy spring mechanisms. ⇒ Make sure that all stored-energy spring mechanisms are discharged.

- ⇒ Remove the side wall of the panel provided for switchgear extension.
- ⇒ Operating mechanism in "EARTHED" position
- ⇒ Remove the cable compartment covers of the panel provided for extension and the adjacent panel. To do this, push the unlocking lever down and keep it in this position, then lift the cover and remove it to the front.
- ⇒ Dismantle the cable connections of the two panels.

- ⇒ Unscrew the front plate of the control board, the cable brackets and the busbar partition of the two panels (see illustration).



Surge-proof cap



- ⇒ In block versions without connected busbar: Make sure that unused bushings are equipped with surge-proof caps.
- ✓ Now you can extend the switchgear or replace components as described hereafter.

13.3 Bolting transport units together

The first transport unit is on its mounting position and the others are placed at a small distance.

- ⇒ Align the first transport unit laterally.
- ⇒ Lay shims under the panel according to the measuring sheet of the base frame.
- ✓ All switchpanels must be in vertical position and at the same height.

Approaching and aligning transport units

- ⇒ Put 11 spacing discs $\varnothing 10.5$ into the felt strips on the right connection side at the joint.
- ⇒ Carefully approach the next transport unit completely to the one that has already been aligned.
- ⇒ Align the approached transport unit, and make sure that it is vertical and at the necessary height using shims.

- Joining transport units**
- ⇒ Remove the rear top plates of the panels at the point where the transport units touch (joint).
 - ⇒ Remove the cable compartment covers of all panels. To do this, switch the three-position switch-disconnector to the "EARTHED" position (see Page 115, "Three-position switch-disconnector in circuit-breaker panel (with type 3AH): Switch position EARTHED (with optional interlock)"), push the unlocking lever down and keep it in this position, then lift the cable compartment cover and remove it to the front.
 - ⇒ Unscrew the front plate of the control board, the cable brackets and the busbar partition of all panels.
 - ⇒ Push 11 fixing bolts through the frame of the left-hand panel and the partition, and screw them into the frame of the right-hand panel. and screw them into the frame of the right-hand panel. The associated nuts are permanently pressed in there.
 - ⇒ Refit the top plates.
 - ⇒ Check whether the bolted transport units are in vertical position. If not, align them using shims.
 - ⇒ Interconnect low-voltage compartments (see Page 78, "Installing low-voltage compartments").

13.4 Fastening the switchgear to the foundation

The panels can be fastened to the foundation in the following ways:

- Bolted to foundation rails.
- Welded to foundation rails.
- Screwed into the concrete using size 10 dowels if there are no foundation rails available.

The base pieces of the panel frames contain cutouts for fastening the switchgear (see dimension drawing).

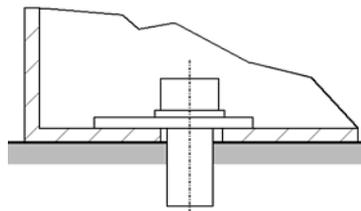


Fig. 20: Fastening the switchgear to the foundation

Fasten each panel to the foundation as follows:

- ⇒ For direct fastening to the concrete, drill holes in the foundation and insert size 10 dowels.
- ⇒ Place shims in the spaces between the panel frame and the foundation in the area of the fastening cut-outs, so that the switchgear is not distorted when it is bolted on, and the seam does not cover any air-filled gaps when the switchgear is welded on.
- ⇒ Bolt or weld the switchgear to the foundation.
- ⇒ Remove any dirt, as extreme cleanliness is required during installation.
- ⇒ Paint welding seams to protect them against corrosion.

13.5 Assembling the busbars

Normally, the busbars are already assembled within the transport units. Assembly work is only required at the joints of the transport units.

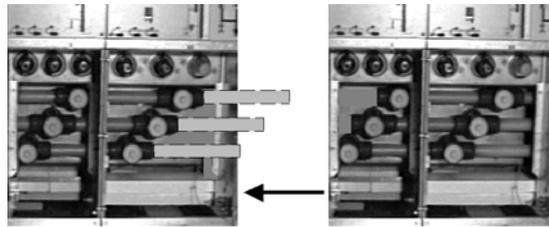


Fig. 21: Interconnecting busbars between transport units

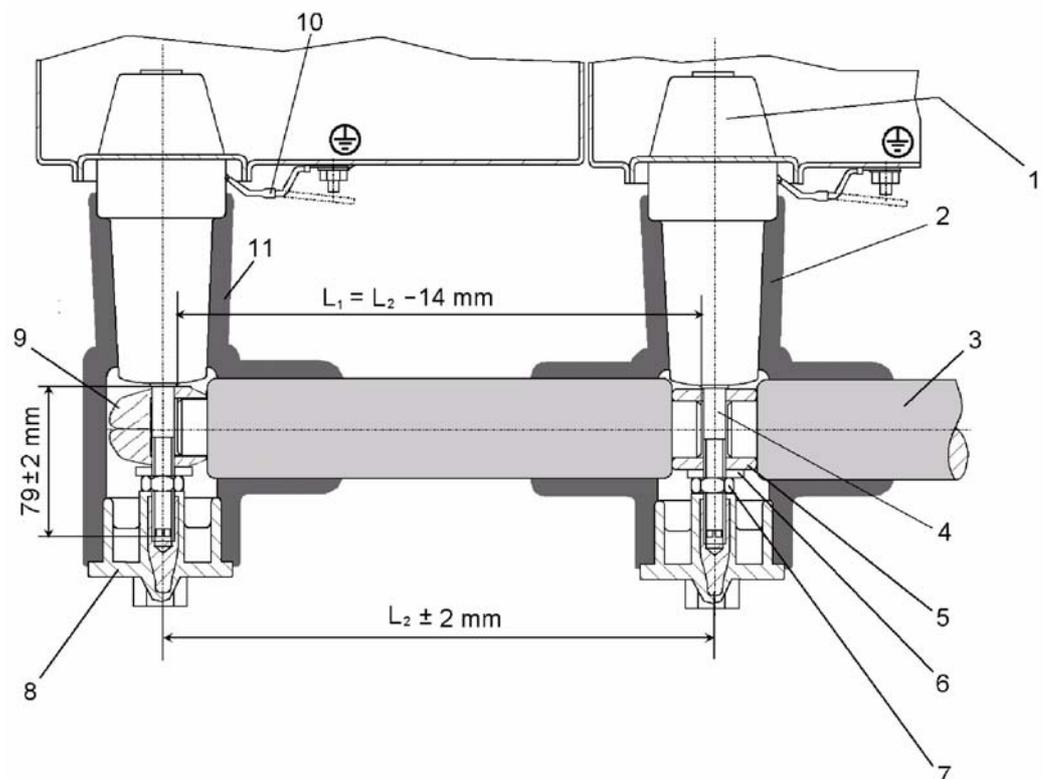


Fig. 22: Busbar, unshielded version: L_1 = Reference dimension for panel width, L_2 = Reference dimension for panel spacing

- | | | | |
|---|---------------------------|----|--------------------------------|
| 1 | Bushing | 7 | Hexagonal nut ISO 4032-M12 |
| 2 | Cross adapter | 8 | Stopper |
| 3 | Busbar with insulation : | 9 | Contact shells for end adapter |
| | 630A: ECu ; 32 x 4 | 10 | Capacitive tap |
| | 800A to 1250A: ECu ; 32 | 11 | End adapter |
| 4 | Threaded bolt M12/M16 | | |
| 5 | Contact shells | | |
| 6 | Strain washer DIN 6796-12 | | |

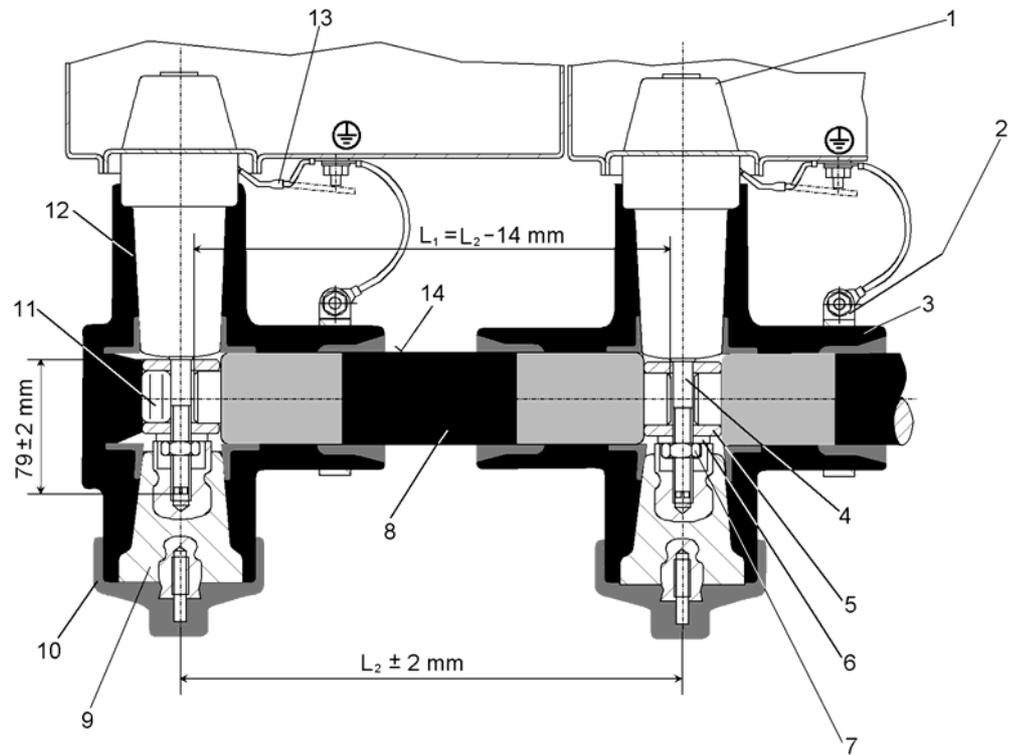


Fig. 23: Busbar, screened version (i.e. with additional earthed conductive layer around the insulation): L_1 = Reference dimension for panel width, L_2 = Reference dimension for panel spacing

- | | | | |
|---|----------------------------|----|----------------------|
| 1 | Bushing | 9 | Screw insert type SE |
| 2 | Earthing connection | 10 | Cap |
| 3 | Cross adapter | 11 | Fit component |
| 4 | Threaded bolt M12/M16 | 12 | End adapter |
| 5 | Contact shells | 13 | Capacitive tap |
| 6 | Strain washer DIN 6796-12 | 14 | Control layer |
| 7 | Hexagonal nut ISO 4032-M12 | | |
| 8 | Busbar with insulation: | | |
| | 630A: ECu ; 32 x 4 | | |
| | 800A to 1250A: ECu ; 32 | | |

The busbar components for the individual panels, respectively for the joint of panel groups are delivered separately with the accessories.

- ⇒ Do not unpack busbar components until right before assembly.
- ⇒ Before assembling the busbars, perform all panel interconnection work (see Page 57, "Bolting transport units together").

Interconnection of adjacent transport units/individual panels

	<p>ATTENTION!</p> <p>If the electrical contact is insufficient, the busbars will be damaged during operation.</p> <ul style="list-style-type: none"> ⇒ All busbar assembly work must be carried out with particular care. Above all, avoid damaging the contact surfaces. ⇒ Observe extreme cleanliness. ⇒ No smoking. ⇒ Brush oxidised copper surfaces bright before connection.
---	--

Preparing busbars

- ⇒ Make sure that all busbar components supplied are complete.
- ⇒ Brush oxidised copper surfaces bright before connection.
- ⇒ Clean dirty busbar components dry with a lint-free cloth.

Do not grease the cross/end adapters in the area of the stoppers until right before inserting the stoppers, as they might get dirty during the assembly work.

- ⇒ Grease the push-on surfaces of insulating parts (high-quality joints) in the cross/end adapters, stoppers or screw inserts, as well as the ends of the busbar insulation with the mounting paste supplied in order to make sure that the parts will still be detachable after longer periods of time.



If there are no cross/end adapters mounted on a panel yet:

- ⇒ Screw the threaded bolt M12/M16 into the bushings at the busbar connection by hand with a screwdriver size 10x1.6. Do not damage the bushings while doing this (maximum tightening torque 10 Nm). If necessary, rework the thread observing the reference dimension 79 ± 2 mm.
- ⇒ Mount the components of the cross/end adapters on the bushings according to the illustration. Make loose screwed connections only.

When the cross/end adapters are mounted:

- ⇒ If available, remove the caps from the busbar cross/end adapters in all panels.
- ⇒ Remove the stoppers or the screw inserts of the cross/end adapters from all panels.
- ⇒ On the two exterior panels loosen the M12 nuts and screw them out approx. 5 mm.
- ⇒ On the central panel, undo the M12 nuts completely. Take out the strain washers and the upper contact shells (only with unscreened busbar).
- ⇒ On the central panel, take out the cross adapters approx. 100 mm by turning and pulling uniformly.

Connection to an existing switchgear:

- ⇒ Remove the existing end adapters of the end panel completely.
- ⇒ Put the cross adapters in the central panel loosely on the bushings.

Interconnecting busbar units

Isolated busbar (unscreened)

- ⇒ If the busbars are not pre-assembled: Determine the dimension of the panel spacing and select suitable busbar units.
- ⇒ Push the missing busbar unit into the cross adapter of panel A, then thread it into the cross/end adapter of panel B (to do this turn and pull the cross/end adapter).
- ⇒ Push the second busbar unit into the cross/end adapter of panel C and thread it into the cross/end adapter of panel B as well.
- ⇒ Push and turn the cross adapter of panel B completely on the bushing until it reaches its final position.
- ⇒ Proceed in the same way with the other two phases.

Screened busbar

- ⇒ Lay the contact shells (with fit component in case of end adapter) on the ends of the busbar and hold them.
- ⇒ Push the cross/end adapter on the busbar.



- ⇒ Push the missing busbar unit into the cross adapter of panel A, then push the cross/end adapter of panel B onto the bushing.
- ⇒ Push the second busbar unit into the cross/end adapter of panel C and thread it into the cross/end adapter of panel B as well.
- ⇒ Push and turn the cross adapter of panel B completely on the bushing until it reaches its final position.
- ⇒ Proceed in the same way with the other two phases.

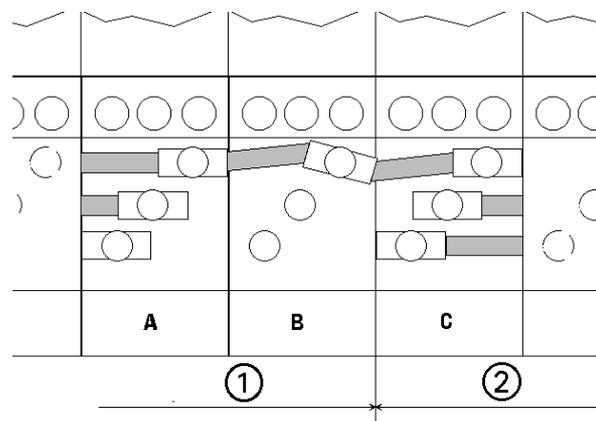


Fig. 24: Example of a joint between two transport units ① and ②

Fixing busbars

- ⇒ Align each busbar unit centrally between the panels by shifting.
- ⇒ Refit the contact shells and strain washers on the central panel.
- ⇒ Refit M12 nuts in all panels, tightening torque 50 Nm.
- ⇒ Refit stoppers or screw inserts in all panels laying a nylon thread between the cross/end adapter and the stopper or the insert in order to let excess air out. Pull out the nylon thread after screwing tight. Tightening torque 30 Nm.
- ⇒ In case of screened busbars, push caps on the cross/end adapters.

Final work ⇒ Remove residual mounting paste.

	ATTENTION!
	Risk of flashover on unused, live bushings. ⇒ Cover unused bushings with surge-proof caps.

⇒ Clean the busbars with a soft, lint-free, dry cloth.

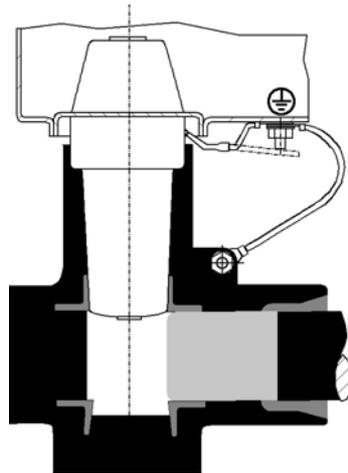


Fig. 25: Screened busbar

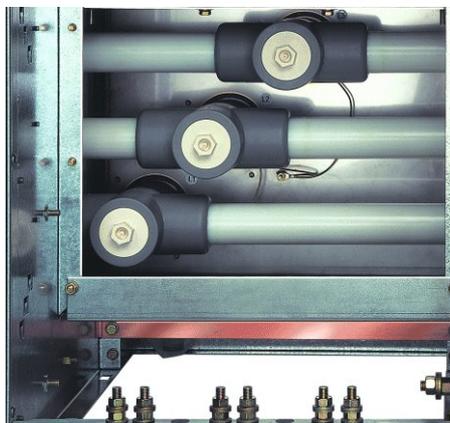


Fig. 26: Unscreened (isolated) busbar

⇒ Connect the earthing cable of all end/cross adapters to the earthing bolts of the switchgear frame. Tightening torque 5 Nm.

✓ Now the busbar units of the switchgear are completely interconnected.

13.6 Installing metering panels type ME1

There are several types and designs of metering panels available, which are executed in different ways:

- Metering panel type ME2: Design with combined transformers
- Metering panel type ME3: Design with voltage transformers and three-position switch

	NOTE!
	Installation (e.g. busbars) of ME2 and ME3: ⇒ Same as for standard panel types (see Page 59, "Assembling the busbars").

Installing transformers in an air-insulated metering panel (type ME1)

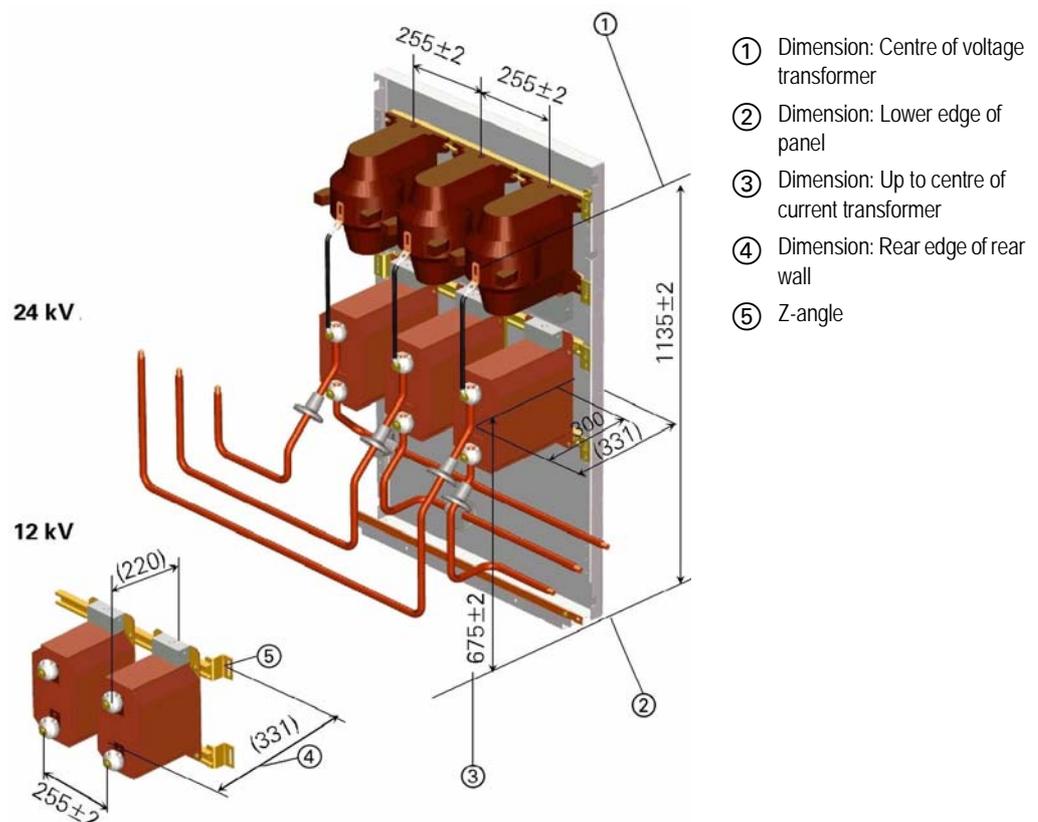


Fig. 27: Dimensions and mounting positions of transformers in an air-insulated metering panel type ME1 (dimensions in mm)

- ⇒ Bolt current and voltage transformers for phase L2 centrally onto the C-rails. For 12 kV versions: Z-angle ⑤ for fixing the C-profile turned to the front. For 24 kV: Z-angle ⑤ for fixing the C-profile turned to the back.
- ⇒ Bolt the other transformers onto the C-profiles at a distance of 255 ± 2 mm.
- ⇒ Align voltage transformers at a height of 1135 ± 2 mm and bolt tight
- ⇒ Align current transformers at a height of 675 ± 2 mm and bolt tight.
- ✓ Now the current and voltage transformers are installed. The following section describes how to continue with the connection of the metering panel busbars.

Connecting metering panel busbars

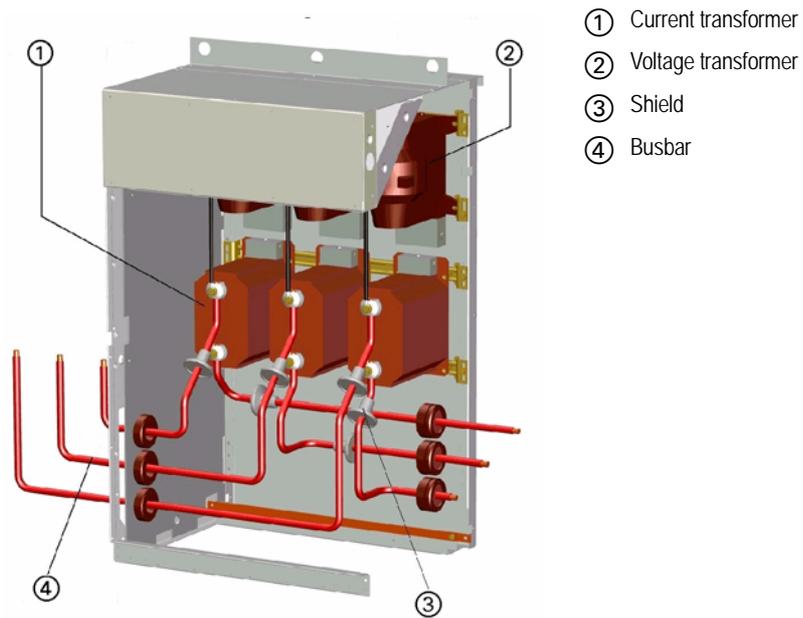


Fig. 28: Air-insulated metering panel type ME1 (shown without front cover)

The cable brackets and the busbar cover of the adjacent panels must be removed.

Preparing busbars

- ⇒ In screened versions, remove the caps from the busbar cross/end adapters of the adjacent panels.
- ⇒ Remove the stoppers or screw inserts of the busbar adapters.
- ⇒ Undo M12 nuts.
- ⇒ Remove strain washers and upper contact shells.

Preparing metering panel busbars

The metering panel busbars have different designs, depending on whether there is a transfer panel located on the left or on the right of the metering panel:

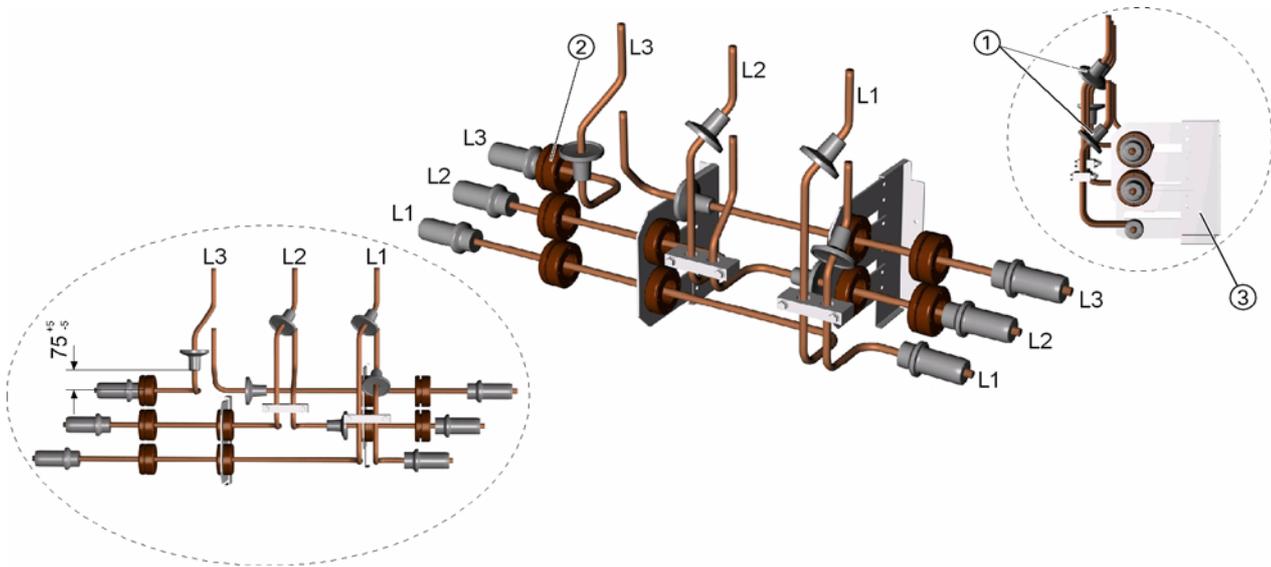


Fig. 29: Metering panel busbars: For connection to busbars on both sides (metering panel in run of busbar)

- ① Shields arranged centrally on slope
- ② Remove neoprene ring and screw-type bushing
- ③ Bracing (for 25 kA/1s only)

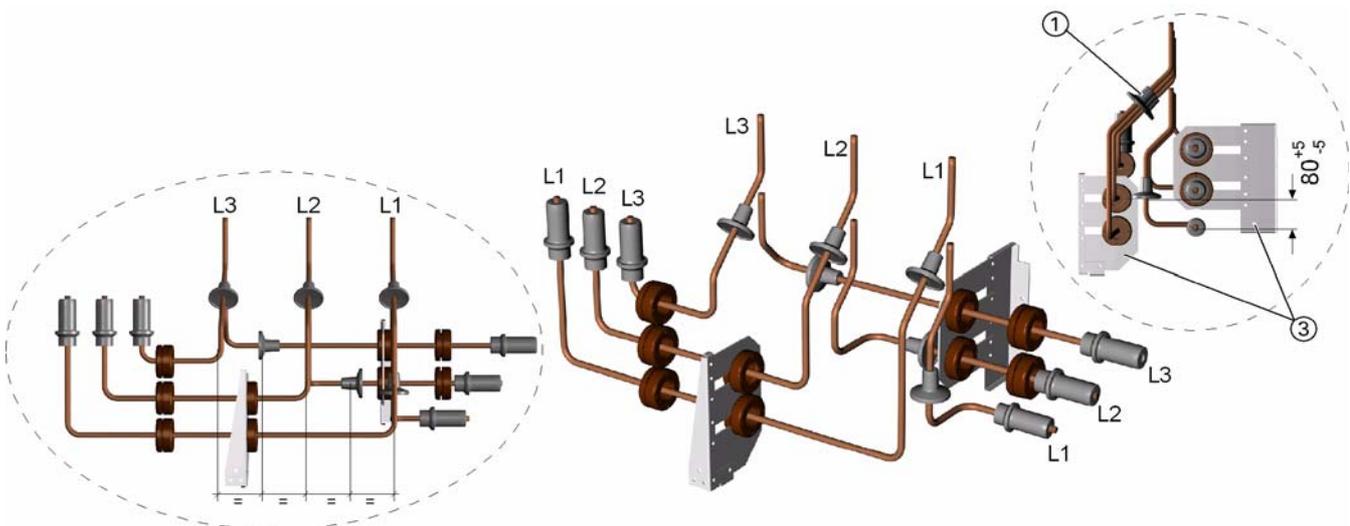


Fig. 30: Metering panel busbars: Left side for connection to transfer panel, right side for connection to busbar (transfer panel located on the left of the metering panel ME1)

- ① Shields arranged centrally on slope
- ② Remove neoprene ring and screw-type bushing
- ③ Bracing (for 25 kA/1s only)

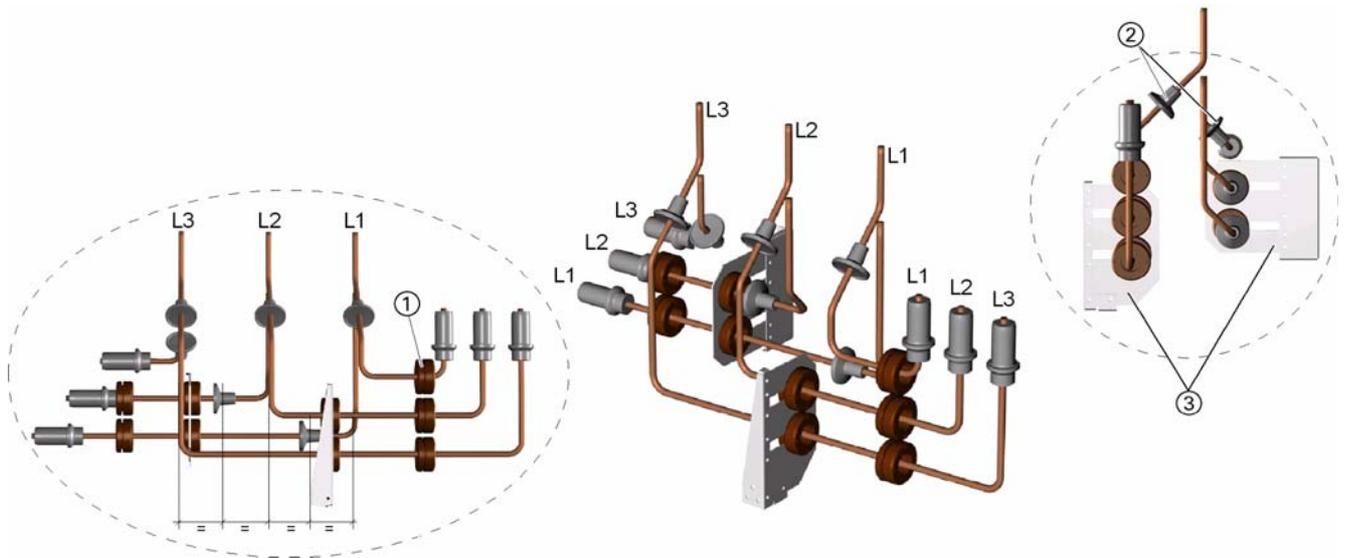


Fig. 31: Metering panel busbars: Left side for connection to busbar, right side for connection to transfer panel (transfer panel located on the right of the metering panel ME1)

- ① Remove neoprene ring and screw-type bushing
- ② Shields arranged centrally on slope
- ③ Bracing (for 25 kA/1s only)

	ATTENTION!
	<p>Risk of flashover due to damaged insulation of metering panel busbars.</p> <p>⇒ Do not damage the insulation, avoid contact of insulation with metal edges.</p>

- ⇒ Find out the suitable units of the metering panel busbars according to the illustration corresponding to the mounting position.
- ⇒ Push the shields onto the metering panel busbars according to the illustration. Arrange the shields centrally on the inclined metering panel busbars, and position them at the same distance to the transformer connections on the parallel metering panel busbars. Observe the position.
- ⇒ Remove the screw-type bushing marked in the illustration in the side wall of the metering panel .
- ⇒ Push the screw-type bushing and the neoprene ring onto the bars marked in the illustration (only for panels with 25 kA/1s).
- ⇒ Route the metering panel busbars through the screw-type bushings in the side wall of the metering panel.

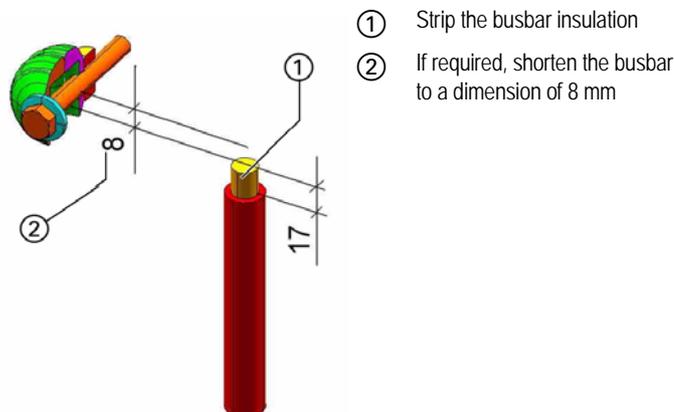
Connecting metering panel busbars

- ⇒ Thread the screw-type bushing with the neoprene ring onto the metering panel busbar.
- ⇒ Push reduction pieces onto the ends of the metering panel busbars protruding from the metering panel.

- ⇒ Fit the clamping ring on the busbar. Later, the pin must lie in the partition level of the contact shells.



- ⇒ In case of current transformers with a small depth, increase the distance between the contact shell and the transformer using spacing rings, so that the busbars can be mounted without mechanical stress.
- ⇒ Insert the metering panel busbar with reduction piece and clamping ring into cross/end adapter and align it.
- ⇒ If you have mounted the transformers yourself: Align metering panel busbars starting from the connecting point in the adjacent panel and, if required, shorten them and strip the insulation according to the position of the transformer connections.
- ⇒ Connect the busbar bracing with the screw-type bushing and fasten it to the panel at the specified positions (for 25 kA/1s only).



- ① Strip the busbar insulation
- ② If required, shorten the busbar to a dimension of 8 mm

Fixing busbars

- ⇒ Push the contact shells and strain washers onto the busbar cross/end adapters.
- ⇒ Refit M12 nuts. Tightening torque 50 Nm.
- ⇒ Refit the stoppers or screw inserts laying a nylon thread between the cross/end adapter and the stopper or the insert in order to let excess air out. Pull out the nylon thread after screwing tight. Tightening torque 30 Nm.
- ⇒ Mount the screw-type bushing with the neoprene ring into the insulating plate.
- ⇒ Tighten the metering panel busbars at the ball terminals of the current transformers. Tightening torque 70 Nm.



Minimum distances for cable connections

The following minimum distances must be adhered to for connection of high-voltage cables in metering panels.

The following illustration shows the minimum distances required:

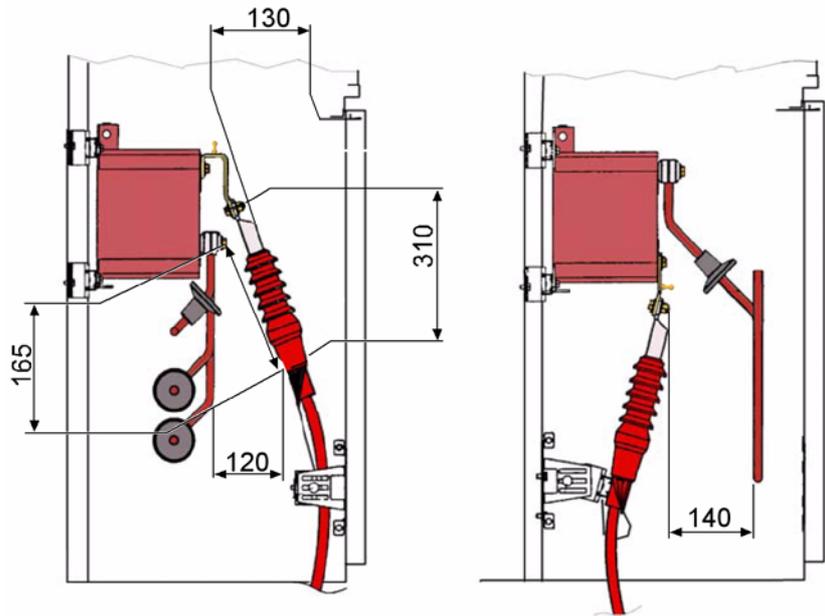


Fig. 32: Minimum distances of cable connections in metering panel type ME1-K

	<p>ATTENTION!</p> <p>Risk of flashover if the minimum distances between high-voltage cables and live or earthed parts are too small.</p> <p>⇒ Observe and check minimum distances during installation.</p>
---	---

⇒ Connect high-voltage cables at the upper and lower current transformer terminal.

13.7 Connecting voltage transformers in metering panels type ME1

The voltage transformers are pre-assembled in the metering panels above the current transformers at the factory.

The voltage transformers must be connected to the current transformers at site with the connecting cables supplied with the voltage transformers.

The voltage transformers can be connected either at the lower or upper terminals of the current transformers, depending on the circuit diagrams.

Standard voltage transformer connection

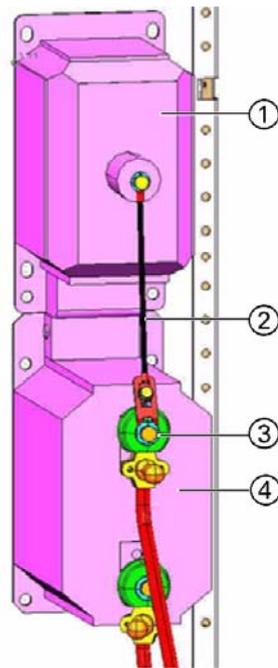


Fig. 33: Connection to the upper current transformer terminal

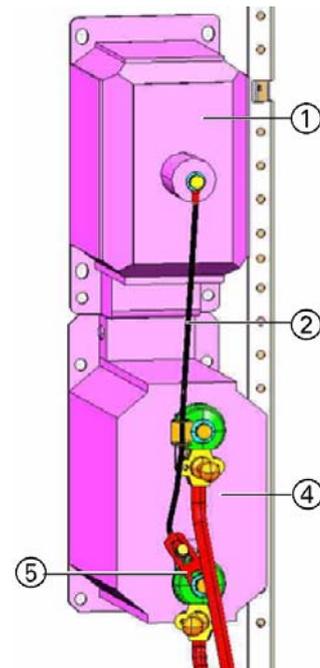


Fig. 34: Connection to the lower current transformer terminal

- ① Voltage transformer
- ② Connecting cable
- ③ Upper current transformer terminal

- ④ Current transformer
- ⑤ Lower current transformer terminal

Voltage transformer connection in metering panels with pressure relief duct

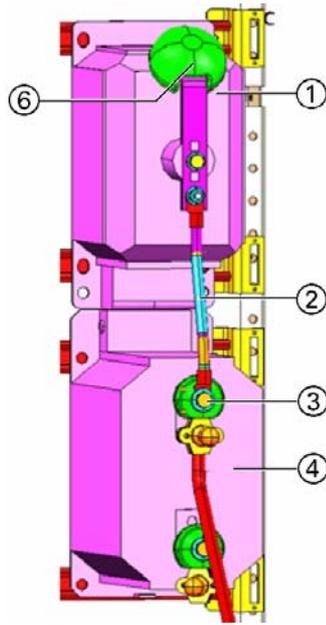


Fig. 35: Connection to the upper current transformer terminal

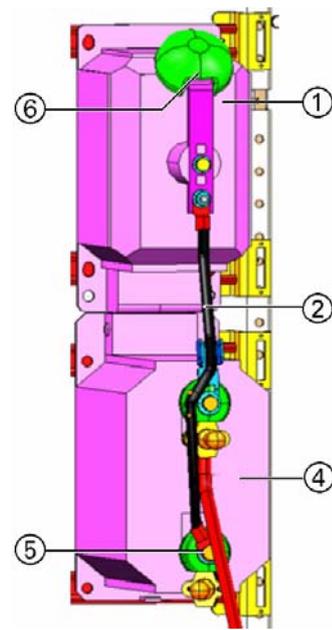


Fig. 36: Connection to the lower current transformer terminal

- | | |
|--------------------------------------|--------------------------------------|
| ① Voltage transformer | ④ Current transformer |
| ② Connecting cable | ⑤ Lower current transformer terminal |
| ③ Upper current transformer terminal | ⑥ Connecting bar with control cap |

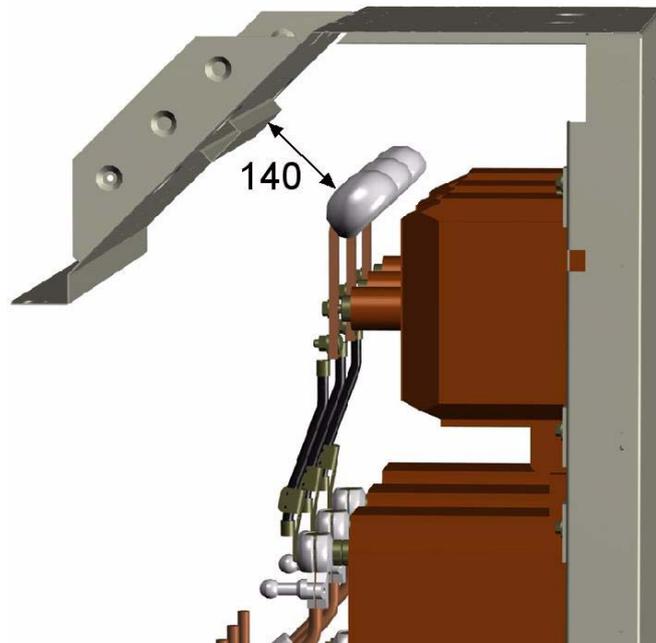


Fig. 37: Minimum distance between control caps and enclosure: min. 140 mm

Connection of two-pole voltage transformers

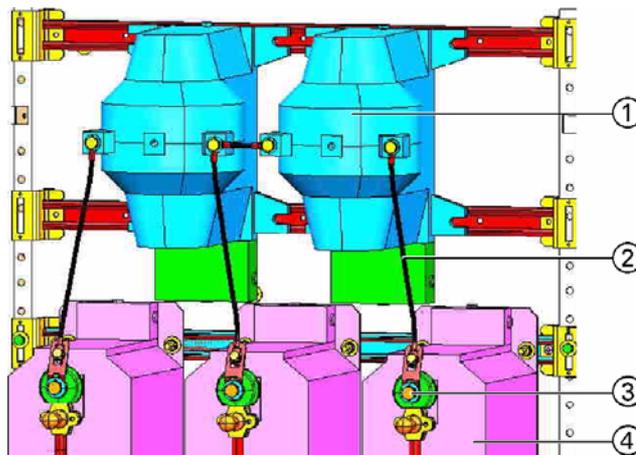


Fig. 38: Connection to the lower current transformer terminal

- ① Voltage transformer, two-pole
- ② Connecting cable
- ③ Upper current transformer terminal
- ④ Current transformer

Connecting voltage transformers

	ATTENTION!
	<p>Risk of flashover if the minimum distances between the connecting cables of the current and voltage transformers are too small.</p> <p>⇒ Cut the connecting cables between the current and voltage transformers in a suitable way, so that the minimum distances required are guaranteed during operation.</p>

	ATTENTION!
	<p>Risk of flashover if the minimum distances between live parts and the flexible steel tubes for cable routing are too small.</p> <p>⇒ If flexible steel tubes are used in the cable connection compartment for cable routing: Lay the flexible steel tube keeping enough minimum distance to live parts.</p>

- ⇒ Cut the connecting cable to suit the distance between the current and voltage transformer terminal.
- ⇒ Strip the insulation of the connecting cable and press the cable lug on.
- ⇒ Connect the connecting cable to the current and voltage transformer according to the circuit diagrams.

13.8 Mounting earthing bolts in metering panels type ME1

To earth the metering panel busbars or the high-voltage cables when the current transformers are removed, earthing bolts must be mounted on the busbars or the cable connection links. The earthing bolts are available as accessories.

Minimum distances for mounting earthing bolts

	ATTENTION!
	<p>Risk of flashover if the minimum distances between the earthing bolts and live parts are too small.</p> <p>⇒ Observe and check minimum distances during installation.</p>

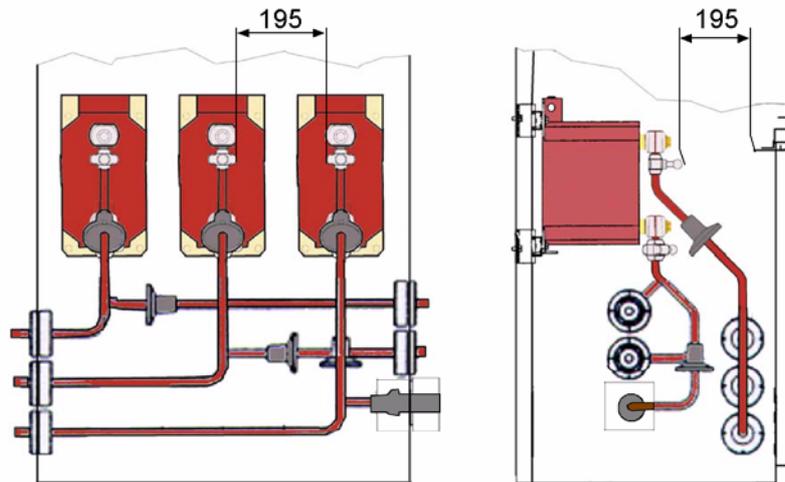


Fig. 39: Minimum distances of earthing bolts on metering panel busbars

Mounting earthing bolts on metering panel busbars

The earthing bolts are mounted on the current transformer terminals, directly below the ball terminals.

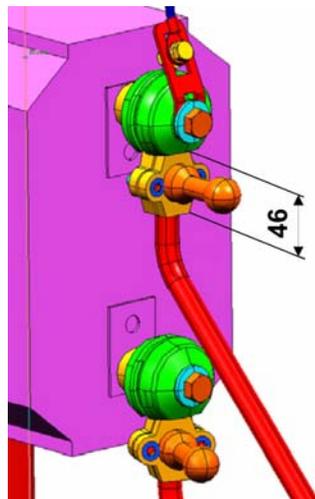


Fig. 40: Earthing bolts below ball terminals

- ⇒ Strip the insulation of the metering panel busbar below the ball terminal at a length of 46 mm.
- ⇒ Mount the earthing bolts directly below the ball terminal.

	NOTE!
	<p>At the lower current transformer terminal, the earthing bolts must be mounted on the busbars turned by 20°.</p> <p>⇒ Mount the earthing bolts at the lower current transformer terminal according to the following illustration.</p>

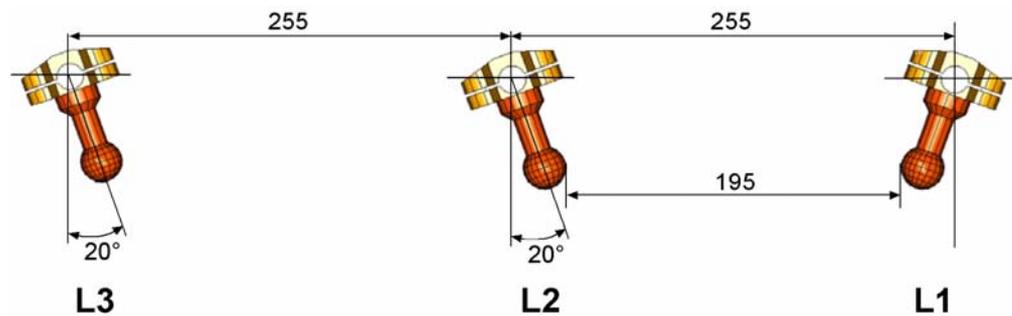


Fig. 41: Alignment of earthing bolts at the lower current transformer terminal

Mounting earthing bolts at the cable connection

The earthing bolts are mounted directly on the cable connection links at the current transformer.

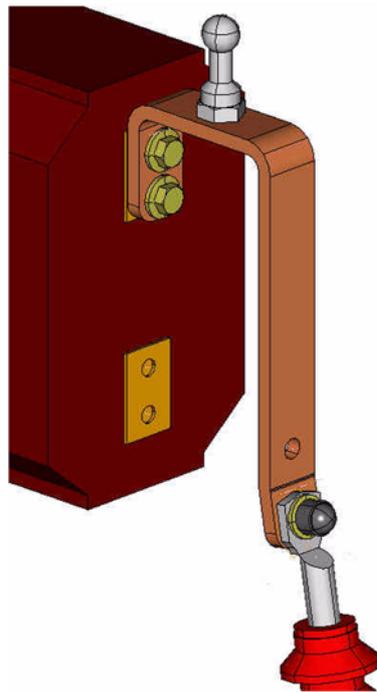


Fig. 42: Earthing bolts at the upper cable connection

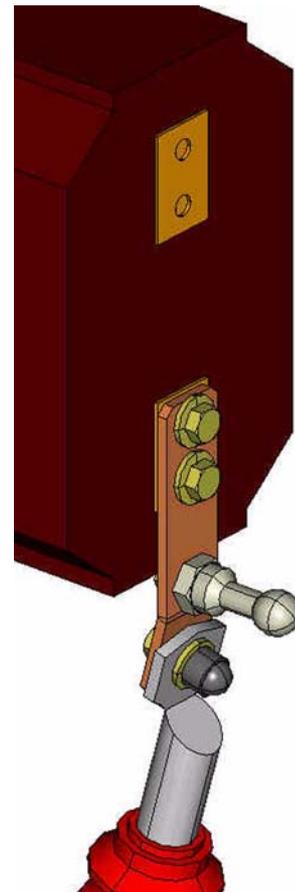


Fig. 43: Earthing bolts at the lower cable connection

⇒ Fasten the earthing bolts at the upper or lower cable connection link.

13.9 Mounting earthing accessories in the metering panel type ME1

⇒ Mount the earthing accessories on the earthing connection in metering panel ME1 as shown below.



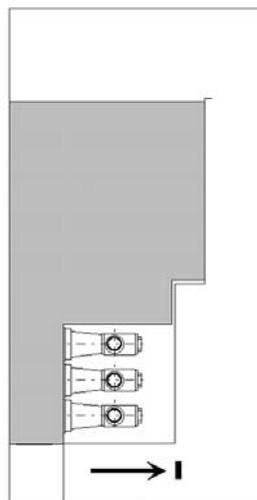
13.10 Switchgear earthing

- ⇒ Connect the earthing terminal (bolt M12) of one panel to the station earth. For switchgear assemblies with more than five panels, connect at least every fifth panel to the station earth.



13.11 Installing the earthing busbar

The units of the earthing busbar must be interconnected at the joints of the transport units.



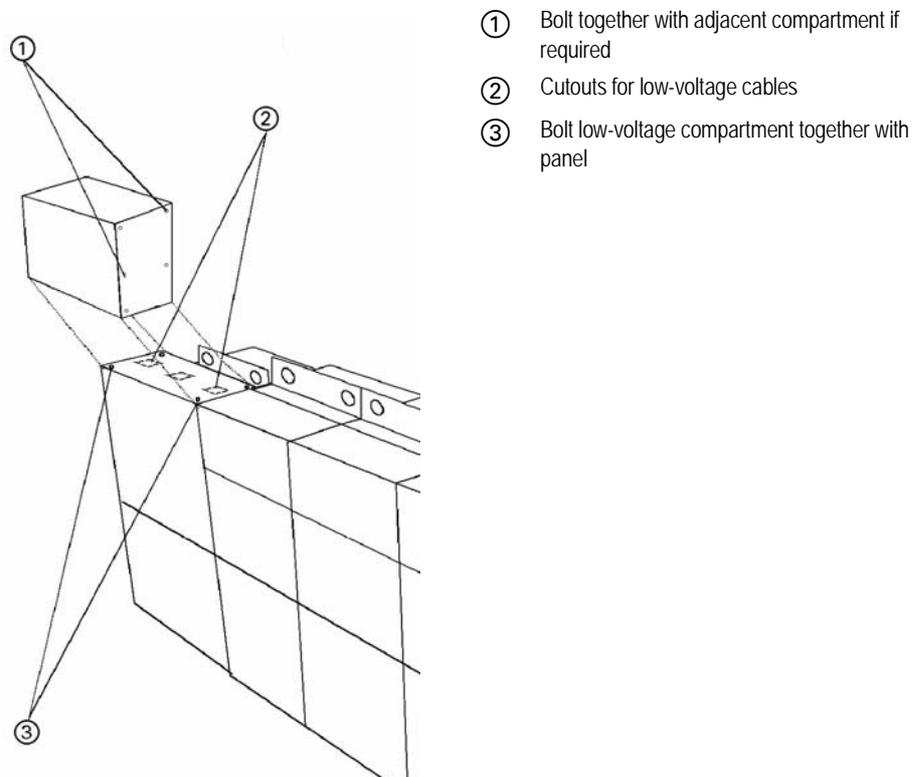
- ⇒ Detach the pre-assembled link provided at the joint.



- ⇒ Brush oxidised copper surfaces and apply a thin film of mounting paste.
- ⇒ Push the link through the opening in the side wall of the subframe, and bolt it together with the adjacent unit of the earthing busbar.
- ⇒ Proceed in the same way with the other joints.
- ✓ Now the units of the earthing busbar of the complete switchgear are interconnected.
- ⇒ After that, refit the busbar compartmentalisation and the cable brackets on all panels. Do not mount the front plate of the control board before connecting the auxiliary circuits (see Page 92, "Connecting auxiliary circuits").

13.12 Installing low-voltage compartments

All 3AH circuit-breaker panels are equipped with low-voltage compartments to accommodate the secondary equipment; other panel types just according to their design.



Normally, the low-voltage compartments are already mounted on the associated panel. After joining the panels, bolt the low-voltage compartments together at the joint - at 2 points (for a compartment height of 600mm) or at 4 points (for a compartment height of 900mm).

Low-voltage compartments supplied separately

- ⇒ Put the low-voltage compartment on top of the associated panel.
- ⇒ Bolt the base plate of the low-voltage compartment together with the panel at its four corners.
- ⇒ Proceed in the same way with the other low-voltage compartments.
- ⇒ Bolt the low-voltage compartments of adjacent panels together.
- ⇒ Establish the electrical connection according to the circuit manual.

14 Electrical connections

The operations described in this section are listed by logical content and are therefore not always in the actual order of execution. Please read this section before starting and decide by yourself in which order you want to perform the operations.

In the instructions given in the following sections it is assumed that a new switchgear is being installed which has not yet been connected to the mains, and that it is therefore not live.

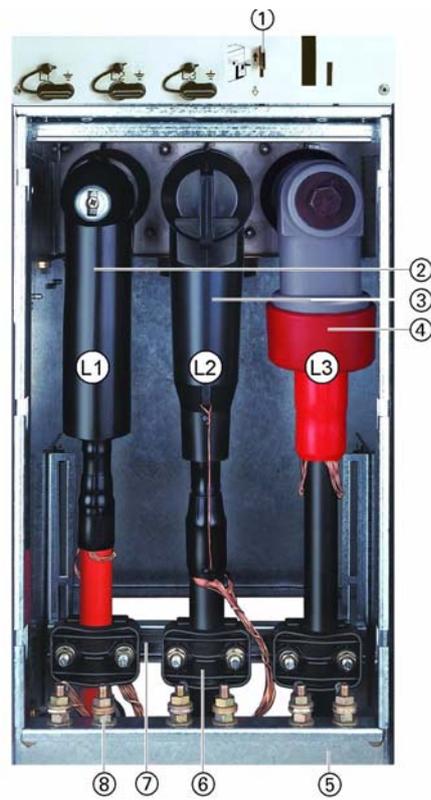
14.1 Connecting high-voltage cables

	ATTENTION!
	<p>Surfaces of high-quality joints can easily be damaged by incorrect handling.</p> <ul style="list-style-type: none"> ⇒ Observe extreme cleanliness. ⇒ Avoid damages caused by the threaded bolt when pushing on.

	ATTENTION!
	<p>In case of spare feeders without connected cables, please observe the following:</p> <ul style="list-style-type: none"> ⇒ Switch the three-position switch-disconnector to "EARTHED" position and lock it. ⇒ Alternatively: Mount surge-proof caps.

	ATTENTION!
	<p>During metal working, please ensure the following:</p> <ul style="list-style-type: none"> ⇒ Do not drill into the vessel. ⇒ Do not leave any metal cuttings on the vessel in order to avoid rust layers.

Connecting feeder cables



- ① Unlocking lever
- ② Phase L1: Make Euromold, type K400 LB as cable elbow plug
- ③ Phase L2: Make Euromold, type K400 TB as cable T-plug
- ④ Phase L3: Elbow adapter, make Siemens, type AKE 20/630
- ⑤ Cross member
- ⑥ Cable clamp
- ⑦ Cable bracket
- ⑧ Earthing connection for the cable shield and the plug housing

Fig. 44: Cable connection in ring-main panel type RK

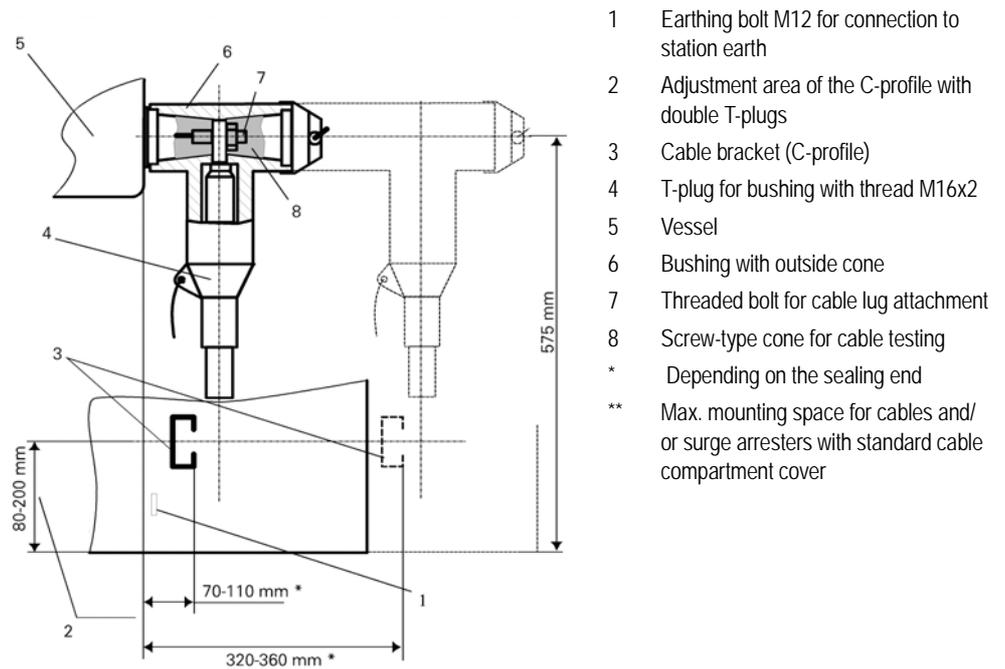


Fig. 45: Ring-main cable connection (side view)

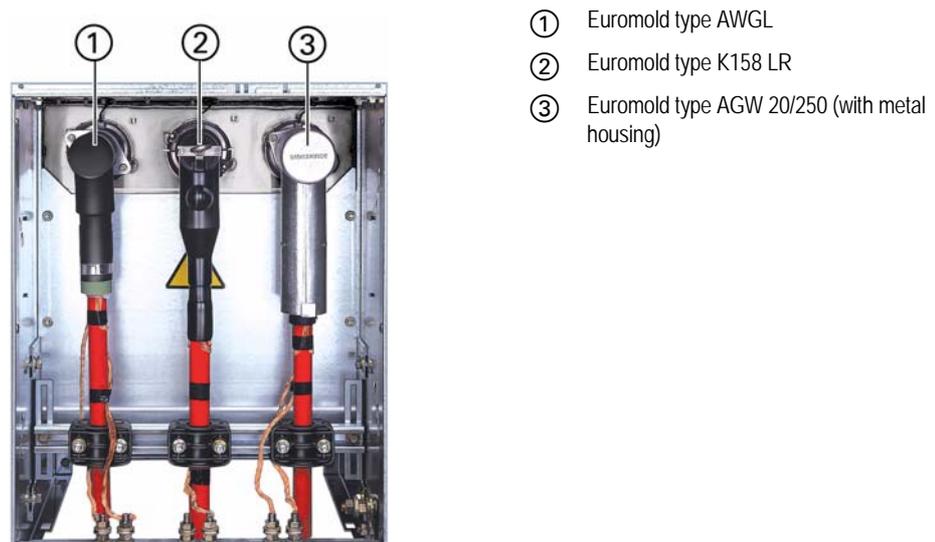


Fig. 46: Cable connection in transformer panel type TR

Work operations

Precondition: The feeder must be earthed (see Page 115, "Three-position switch-disconnector in circuit-breaker panel (with type 3AH): Switch position EARTHED (with optional interlock)").

- ⇒ Undo the screwed joints of the cable compartment cover (optional). Then push the unlocking lever ① of the cable compartment cover down, lift the cable compartment cover and remove it to the front.
- ⇒ If necessary, detach the cross-members ⑤ to swing in the cables.
- ⇒ Pre-adjust the cable bracket ⑦ and the lower part of the cable clamps.
- ⇒ If provided: Mount cable-type current transformers (see Page 84, "Cable connection with cable-type current transformers").
- ⇒ Fit the cable plugs on the conductor ends according to the manufacturer's instructions.
- ⇒ Carefully coat the push-on surfaces (high-quality joints) in the plug sets and the bushing cone with mounting paste (scope of supply of the plug set).
- ⇒ Push the plug sets ② to ④ onto the bushing and fix them according to the manufacturer's instructions. Observe the phase sequence!
- ⇒ Mount the upper part of the cable clamps ⑥, align the cable bracket and bolt it tight.
- ⇒ Connect the cable shield and the earthing of the plug housing at the front cross member.

Cable installation in switchgear with pressure absorber

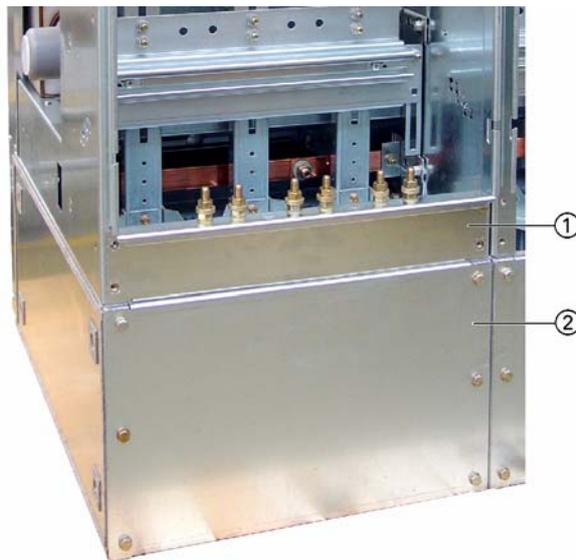
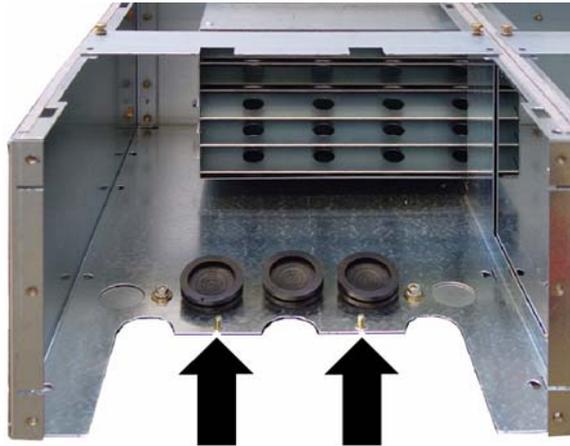


Fig. 47: Switchgear with pressure absorber

- ⇒ Remove the cross member ① and the front plate ② of the pressure absorber.

- ⇒ Undo the two fixing nuts and take the front floor cover out.



- ⇒ Lead the high-voltage cables into the cable connection compartment.
- ⇒ Push rubber sleeves over the high-voltage cables.
- ⇒ Push the high-voltage cables with the rubber sleeves into the cutouts provided for this purpose in the floor cover.
- ⇒ Hang the front floor cover in again, observing that the floor covers are correctly seated in the slots of the rubber sleeves.
- ⇒ Bolt the floor covers together using two fixing nuts.
- ⇒ Refit the cross member and the front plate of the pressure absorber.

Three elongated holes are provided in the front floor cover for fastening to the foundation.

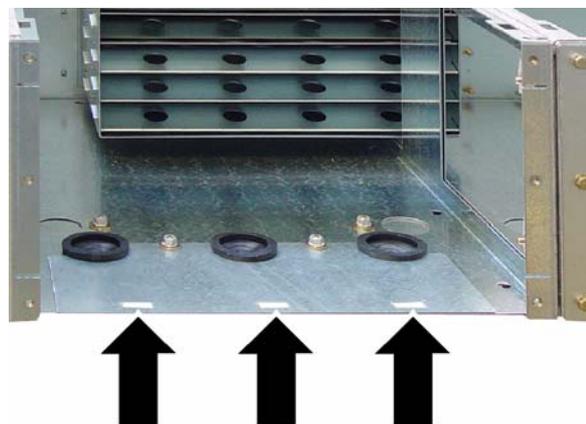


Fig. 48: Elongated holes for fastening to the foundation

- ⇒ Fasten the front floor plate to the foundation together with the front plate of the pressure absorber using three screws.

14.2 Connecting double cables and surge arresters

Double cables and surge arresters can be connected to ring-main feeders using adequate plug-in cable systems.

Please observe the following:

- Depending on their type, double cable connections require a deep cable compartment cover and larger floor openings.
- Depending on their type, surge arresters also require a deep cable compartment cover.

For details please refer to the order documents.

14.3 Cable connection with cable-type current transformers

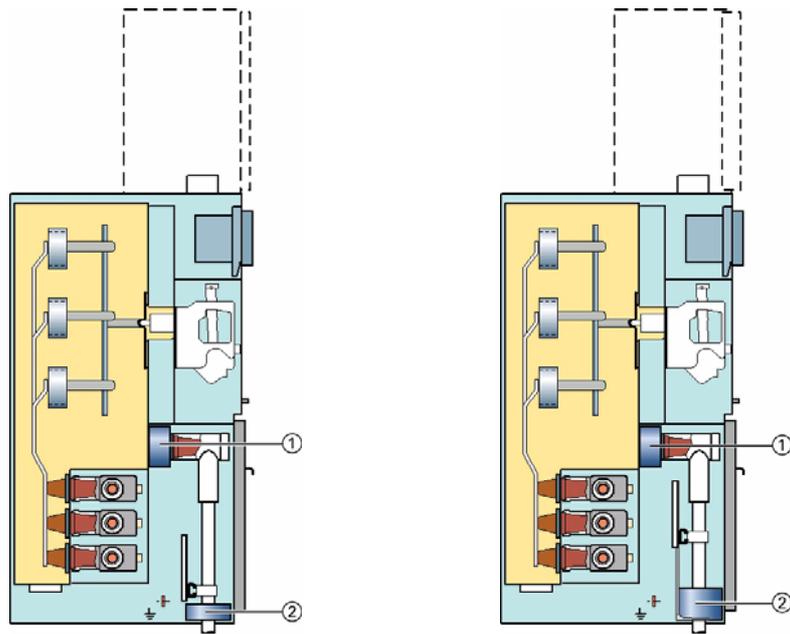
Mounting position of cable-type current transformers

The transformer mounting plates are pre-assembled on the cable bracket at the factory. The cable-type current transformers are supplied in the cable compartment and must be mounted on the high-voltage cables at site.

Depending on the design or overall height of the cable-type current transformers, the transformers are mounted in the cable compartment or partly underneath the cable compartment.

Standard

Option



① Three-phase current transformer type 4MC63

② Cable-type current transformer type 4MC7033

Principle of installation for cable-type current transformers

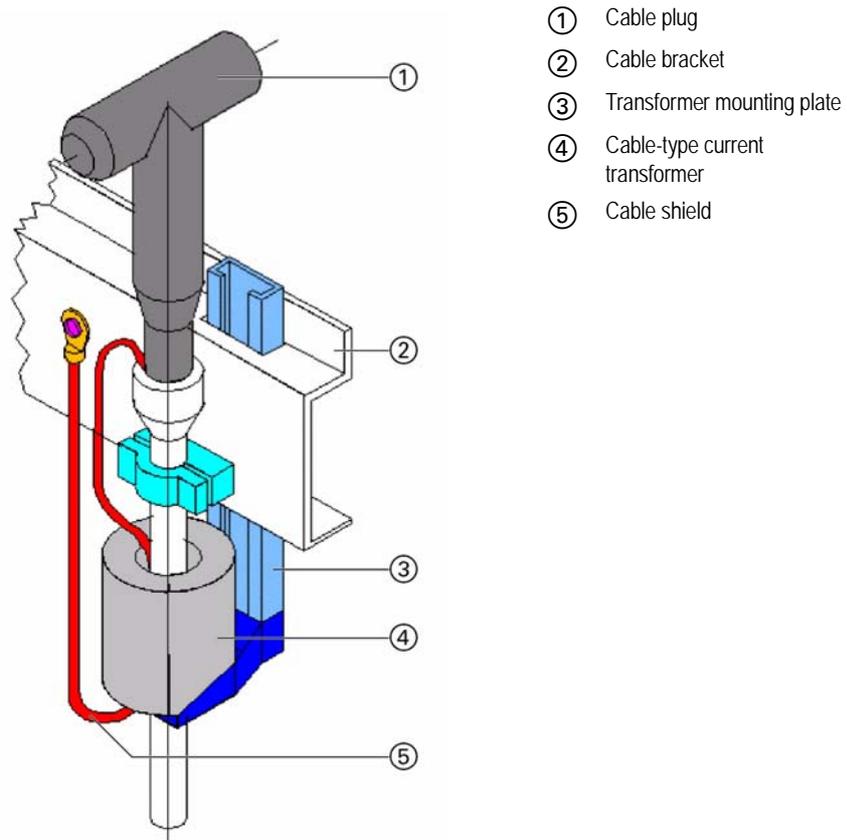


Fig. 49: Cable connection with cable-type current transformers type 4MC7033

Installation of cable-type current transformers

- ⇒ Remove the cable compartment cover.
- ⇒ If necessary, remove the lower cross member of the switchgear frame.
- ⇒ Take the supplied cable-type current transformers out of the cable connection compartment.
- ⇒ Lead the high-voltage cables into the cable connection compartment.
- ⇒ Push the cable-type current transformers on the high-voltage cables.
- ⇒ Mount the cable plugs according to the manufacturer's instructions.
- ⇒ Position the pre-assembled transformer mounting plates at the cable bracket in such a way that all three cable-type current transformers can be mounted.
- ⇒ Swing the high-voltage cables in together with the cable-type current transformers, and connect the cable plugs to the cable feeder see Page 79, "Connecting high-voltage cables".

14.4 Connecting voltage transformers at the cable feeder

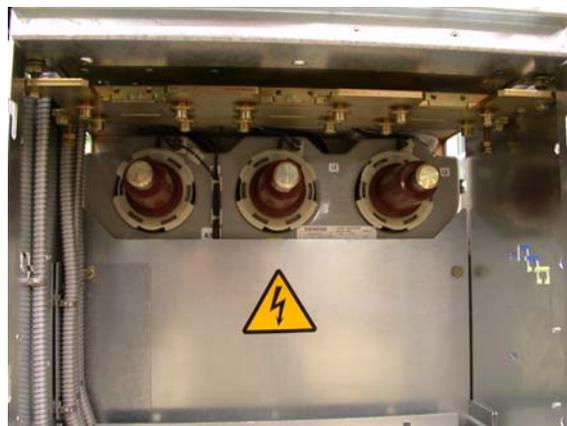
To connect voltage transformers at the cable feeder, the transformer mounting plate must first be adjusted to the necessary height. This height adjustment must be performed with removed cables.

	ATTENTION!
	<p>While working on metal-coated voltage transformers, the coating may be scratched or damaged. Then, the voltage transformers are not safe-to-touch anymore.</p> <p>⇒ Work carefully while mounting metal-coated voltage transformers.</p> <p>⇒ Take care not to scratch or damage the metal coating.</p>

Preparations

The cable compartment cover of the feeder must be removed, and there must not be any cables connected.

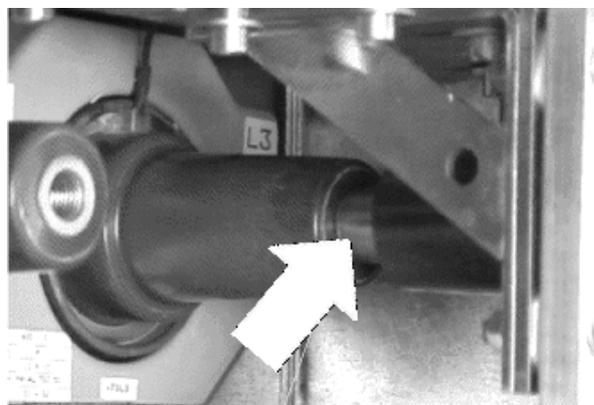
The fixing facilities for the transformers are located right over the cable connections.



- ⇒ Undo the transport fixing of the transformer connection leads.
- ⇒ Remove the transformer fixing bolts and protective covers of the bushings.

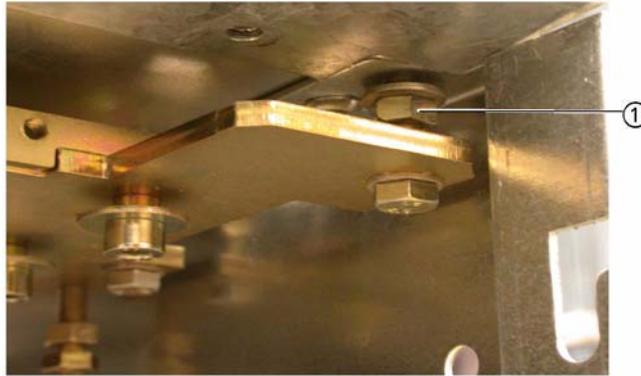
Adjusting transformer mounting plate

- ⇒ Screw the centring bolt into the left-hand bushing (L1).
- ⇒ Push the transformer together with its support onto the guide bolts.



- ✓ The centring bolt must penetrate easily into the connection socket of the transformer.

- ⇒ If required, correct the position of the transformer mounting plate by adjusting the upper and lower nut ①. Check again.

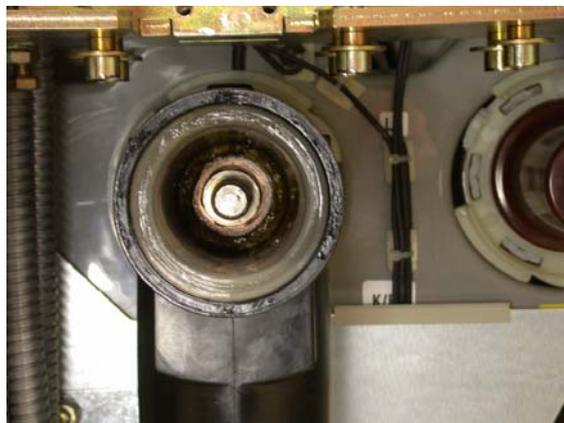


- ⇒ Screw the centring bolt into the right-hand bushing (L3) and adjust in the same way.
- ⇒ Screw the centring bolt into the central bushing (L2) and adjust in the same way.
- ⇒ Remove the centring bolt.
- ✓ Now the transformer fixing is adjusted for transformer installation. The cables can be connected to the feeder.

Connecting transformers

If a power-frequency voltage test is planned at site after installation (see Page 98, "Preparing the power-frequency voltage test"), do not mount the voltage transformers yet.

The height of the transformer mounting plate must have been adjusted before connecting the cables (see above). The cables are connected to the feeder, the stoppers of the cable plugs must be removed.



- ⇒ Push the transformer onto the guide bolts in front of the left-hand cable plug (L1) together with its support. The transformer cone must be completely inserted in the T-plug .



- ⇒ Tighten the transformer fixing bolts by turns and uniformly.
- ⇒ Mount the right-hand transformer (L3) in the same way, then the intermediate one (L2).
- ⇒ Plug the low-voltage connector into the transformers according to the phase designation.



- ✓ Now the voltage transformers are now connected to the cable feeder.

14.5 Installing/removing busbar voltage transformers

	ATTENTION!
	<p>While mounting metal-coated voltage transformers, the coating may be scratched or damaged. Then, the voltage transformers are not safe-to-touch anymore.</p> <ul style="list-style-type: none"> ⇒ Work carefully while mounting metal-coated voltage transformers. ⇒ Take care not to scratch or damage the metal coating.

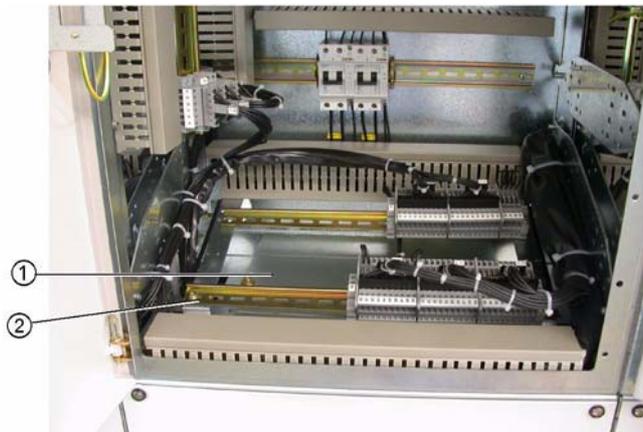
If a power-frequency voltage test is performed before commissioning (see Page 98, "Preparing the power-frequency voltage test"), the voltage transformers must be removed.

To replace busbar voltage transformers, the panels concerned must be accessible from the rear and from above.

The panel to be equipped with voltage transformers must also be equipped with a low-voltage compartment.

Preparing removal or installation

- ⇒ Open the low-voltage compartment, unscrew the base plate ① and take it out. In highly equipped low-voltage compartments, undo the front DIN-rail ②.



- ⇒ Remove the crane eye ① and the top plate ②, and remove the rear wall ③ upwards.

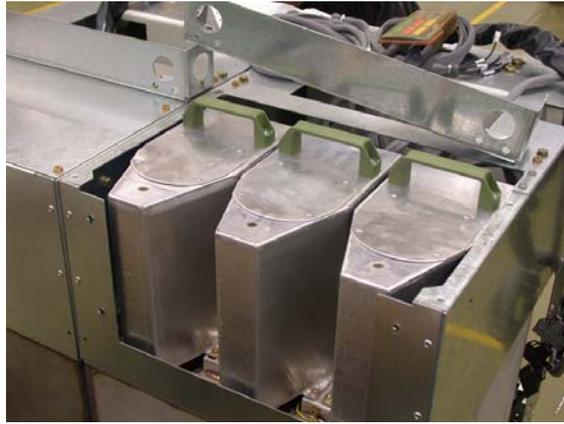


- ⇒ If there are no transformers mounted yet: Take the surge-proof caps off the busbar bushings.

Removing transformers

- ⇒ Detach the low-voltage connectors at the transformers.
- ⇒ Mount the handles supplied.
- ⇒ Undo the transformer fixing bolts. Tools required:
- Socket spanner extension
 - SW 10 insert with magnet

To hold the bolt in the insert, grease may also be used.



- ⇒ Remove the voltage transformer upwards.
- ⇒ If the voltage transformers are not going to be mounted again, the bushings must be closed with surge-proof covers.

Preparing transformer installation

- ⇒ Screw the handle on the transformer and remove the transformer type plate.
- ⇒ Coat the inside cone of the transformer with mounting paste.



- ⇒ Insert the transformer cone.



Mounting and connecting transformers

- ⇒ To let excess air out, put a nylon thread or cable strap into the inside cone and fix it on the outside of the transformer (adhesive tape).



- ⇒ Take the transformer by the handle and mount it onto the bushing from above. Take care that the nylon thread does not get out of place.
- ⇒ Bolt the transformer tight four times and pull the nylon thread out carefully. Tools required:
- Socket spanner extension
 - SW 10 insert with magnet



- ⇒ Mount the two other transformers in the same way.

Final work

- ⇒ Lead the low-voltage plug connector of the transformers through the base plate of the low-voltage compartment, and connect it to the mating socket according to the phase designation.
- ⇒ Bolt the base plate of the low-voltage compartment on again and close the low-voltage compartment.
- ⇒ Bolt the cover of the transformer assembly on again. Fix loose DIN-rail again, if required.
- ✓ Now the voltage transformers are now connected to the busbar.

14.6 Connecting auxiliary circuits

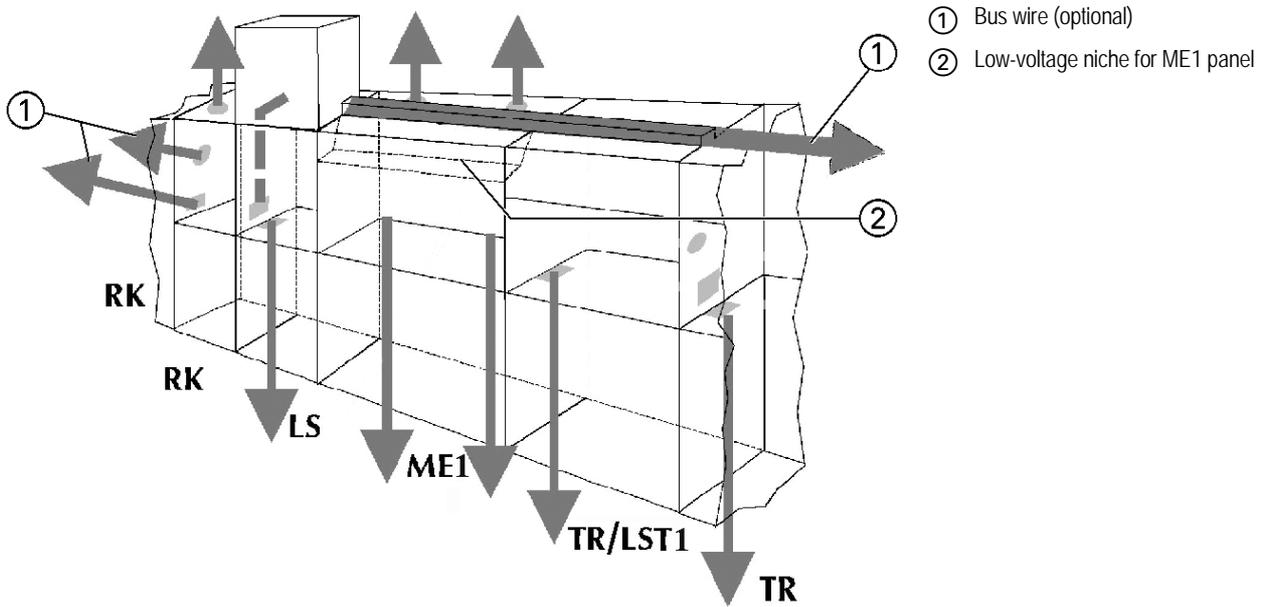


Fig. 50: Openings between the panels for auxiliary circuits

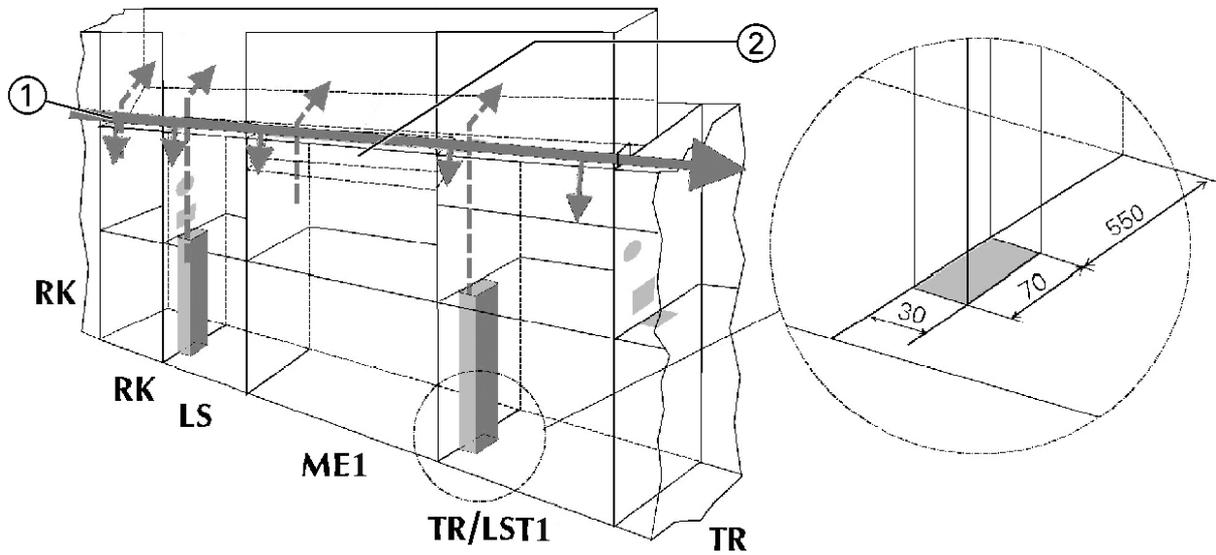
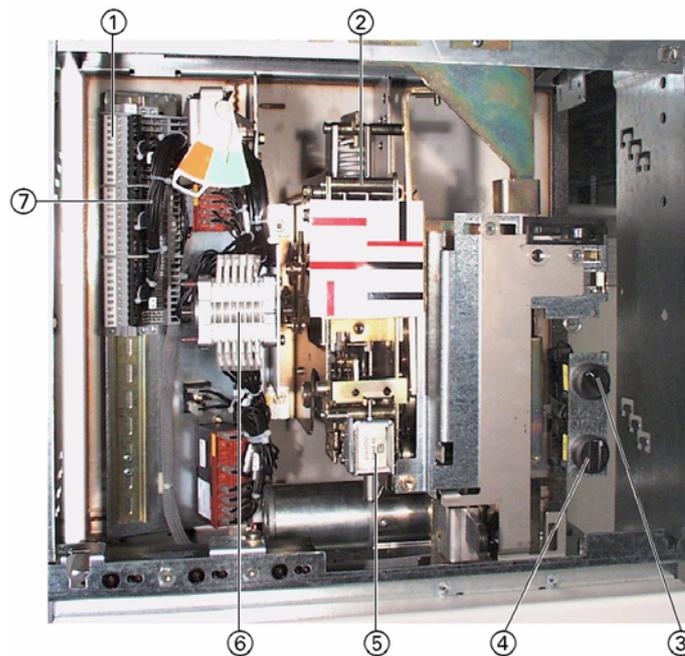


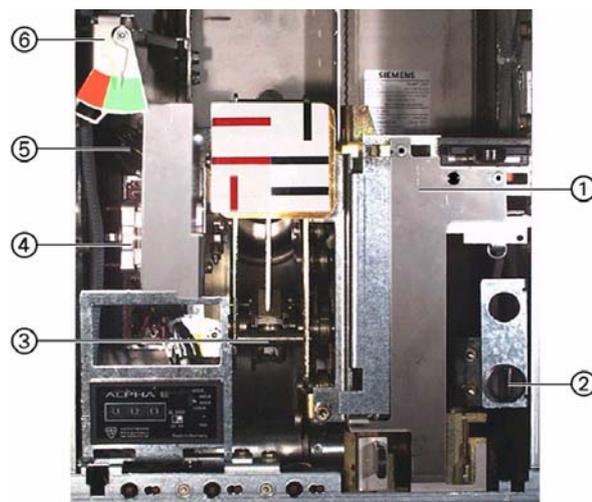
Fig. 51: Position of wiring ducts

- ① Bus wire (optional)
- ② Low-voltage niche for ME1 panel



- ① Terminal strip
- ② Spring-operated/stored-energy mechanism with motor
- ③ Local/remote switch for motor operating mechanism
- ④ ON/OFF-pushbutton for motor operating mechanism
- ⑤ Shunt release
- ⑥ Auxiliary switch
- ⑦ Control cables

Fig. 52: Transformer panel



- ① Switching gate / locking device
- ② ON/OFF-pushbutton for motor operating mechanism
- ③ Spring-operated mechanism with motor
- ④ Auxiliary switch
- ⑤ Cable routing to terminal strip in low-voltage compartment. In panels without low-voltage compartment, the terminal strip is located in the low-voltage niche
- ⑥ Ready-for-service indicator

Fig. 53: Ring-main panel

You will require the circuit diagrams supplied.

Work operations

	<p>ATTENTION!</p>
	<p>The transmission linkage of the ready-for-service indicator must move freely in order to show service readiness.</p> <p>⇒ Lay the cables in such a way that they do not touch the linkage of the ready-for-service indicator.</p>

- ⇒ Remove the front plate of the switchgear.
- ⇒ Following the circuit diagrams, connect the wires ⑦ to the terminal strip ① or directly to equipment terminals (e. g. CAPDIS S2+, short-circuit indicator) and lay them cleanly.
- ⇒ Do not switch on auxiliary voltage yet.

	<p>DANGER!</p>
	<p>If the ready-for-service indicator does not operate properly and the switch-disconnector is operated without the switchgear being ready for service, this can cause an arc fault that will damage the switchgear and endanger the life of the people present.</p> <p>⇒ Make sure that the operating linkage of the ready-for-service indicator keeps on moving freely.</p>

- ⇒ Open the low-voltage compartments.
- ⇒ Connect the cables according to the circuit diagrams and lay them cleanly. Use the existing wiring ducts and the specified openings only. Observe polarisation.
- ⇒ Do **not** switch on auxiliary voltage yet.

14.7 Correcting circuit diagrams

- ⇒ Note any modifications which may have been made during installation or commissioning in the supplied circuit diagrams.
- ⇒ Send the corrected documentation to the local Siemens representative so that the modifications can be included.

15 Commissioning

	DANGER!
	<p>Mortal danger due to live parts.</p> <ul style="list-style-type: none"> ⇒ Isolate the switchgear. ⇒ Secure against reclosing. ⇒ Verify safe isolation from supply. ⇒ Earth and short-circuit. ⇒ Cover or barrier adjacent live parts.

	DANGER!
	<p>Mechanical components may move quickly, even remotely controlled.</p> <ul style="list-style-type: none"> ⇒ Do not remove covers. ⇒ Do not reach into openings.

	DANGER!
	<p>Risk of flashover on unused, live bushings.</p> <ul style="list-style-type: none"> ⇒ Cover unused bushings with surge-proof caps.

15.1 Final work

Rating plate / type plate	⇒ Check the data on the rating plate and the auxiliary voltage of the control and end devices as against the requirements.
Checking ready-for-service indicator	⇒ Check ready-for-service indicator (see Page 53, "Checking the ready-for-service indicator").
Switchgear fixing	⇒ Check switchgear fixing.
Checking bolted joints	<ul style="list-style-type: none"> ⇒ Check the tightening torques of the earthing connections. ⇒ Check the tightening torques of the bolted joints of the low-voltage equipment at random. ⇒ Check all parts of the switchgear that have been disassembled and assembled again at site during installation or that have been installed subsequently, in order to verify correct assembly and completeness.
Checking auxiliary cable connections	<ul style="list-style-type: none"> ⇒ Check correct wiring according to the circuit diagrams. ⇒ Check clamping and plug-in connections at random (perfect contact, labels, etc.).
Checking high-voltage connections	<ul style="list-style-type: none"> ⇒ Check earthing of cable terminations on all connected high-voltage cables. ⇒ If required, test cables (see Page 121, "Cable testing"). ⇒ Cover unused high-voltage connections with surge-proof caps.

Feeder without cables

⇒ Switch the switch-disconnector to EARTHED position and lock it, or cover the bushings with surge-proof caps.

Tying up and visual inspection

⇒ Remove any attached instruction labels or documents that are not required anymore for operation.

⇒ Remove any tools, materials etc. that are not required anymore from the area of switchgear.

⇒ Remove any dirt from the area of the switchgear (cleaning agent ARAL 4005 or HAKU 1025/90 and lint-free rag/brush).

⇒ Fit all covers.

⇒ Put the caps on the capacitive test sockets.

⇒ Touch up scratches and impacts in the surface painting. Available kit: Touch-up set (spatula and paint) and paint pen.

15.2 Checking accessories

Make sure that the following accessories are ready to hand:

- Operating instructions
- Operating levers for three-position switches
- Hand crank for 3AH circuit-breaker
- Panel keys (double-bit keys)
- Circuit diagrams
- Warning signs

15.3 Instructing operating personnel

⇒ Instruct operating personnel in theory and practice of switchgear operation.

15.4 Function test / Test operation

	DANGER!
	<p>Putting defective switchgear into operation can endanger the life of people and damage the switchgear.</p> <p>⇒ Never put switchgear into operation if you notice during test operation that a part of it does not work as described in here.</p> <p>⇒ Perform test operations with auxiliary voltage only!</p>

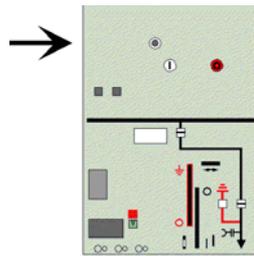
	DANGER!
	<p>Inadequate handling of the vacuum circuit-breaker can cause injuries by the motor starting suddenly when auxiliary voltage is applied.</p> <p>⇒ Charge the vacuum circuit-breaker with the original hand crank only.</p>

- Mechanical function test**
- ⇒ Switch the three-position switch-disconnector / disconnecting circuit-breaker (type LST) and the vacuum circuit-breaker type 3AH several times to CLOSED, OPEN and EARTHED position, observing the correct indication of the associated switch position indicators.
 - ⇒ Test fuse tripping with test fuse.
 - ⇒ Check HV HRC fuse links.
 - ⇒ Check mechanical interlocks and covers to verify easy operation.

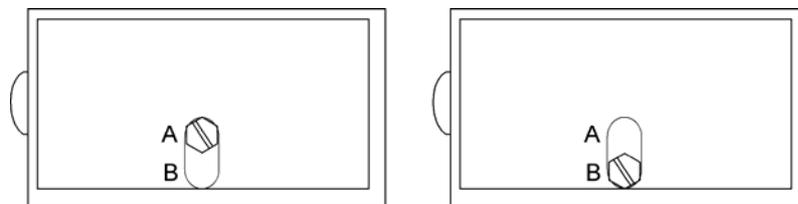
Adjusting undervoltage release to vacuum circuit-breaker type 3AH

All undervoltage releases mounted in circuit-breakers type 3AH must still be adjusted to the associated circuit-breaker.

The circuit-breaker operating mechanism is located in the upper part of the panel behind the ON/OFF pushbuttons.



- ⇒ Remove the front cover of the circuit-breaker.
- ⇒ Shift the retaining bolt of the striker pin from position A to position B.



- ⇒ Close the operating mechanism box and refit the cover.
- ✓ Now the circuit-breaker operating mechanism is ready for operation with undervoltage release.

Electrical function test Test operation helps you to verify the perfect operation of the switchgear without high voltage before commissioning.

- ⇒ Switch on all auxiliary and control voltages and verify correct polarity.
- ✓ The motor of the circuit-breaker operating mechanism (type 3AH) starts up and charges the closing spring.

- ⇒ Test panels with electromagnetically interlocked three-position switch only with applied auxiliary voltage.
- ⇒ Check whether the mechanical and/or electrical interlocking conditions are fulfilled without using excessive force.
- ⇒ Check whether the switch positions of the three-position switches are displayed correctly.
- ⇒ Switch the three-position switch-disconnector / disconnecting circuit-breaker (type LST) and the vacuum circuit-breaker type 3AH several times to CLOSED, OPEN and EARTHED position for test at the panel and from remote. At the same time, check whether the switch positions are displayed correctly at the panel and, if applicable, in the control room, and if the auxiliary switches and position switches operate correctly.
- ⇒ Check the operation of the existing shunt closing and shunt opening releases electrically.

Malfunction during test operation

If there are any faults that cannot be cleared at site:

- ⇒ Do not put the switchgear into operation.

Completing test operation

- ⇒ Switch all switching devices to OPEN position.

15.5 Preparing the power-frequency voltage test

On request, a power-frequency voltage test can be performed at site on the ready-assembled switchgear. In this case, prepare the test as follows:

- ⇒ Remove voltage transformers (see Page 86, "Connecting voltage transformers at the cable feeder" and see Page 88, "Installing/removing busbar voltage transformers") as well as surge arresters and surge limiters.
- ⇒ Protect bushings of transformers, surge arresters and surge limiters in a surge-proof way using suitable sealing caps.
- ⇒ Earth the capacitive test sockets.
- ✓ Now you can carry out the test.

15.6 Applying operational voltage (high voltage)

	DANGER!
	<p>Mortal danger due to live parts.</p> <ul style="list-style-type: none"> ⇒ Observe the Five Safety Rules of Electrical Engineering. ⇒ Observe the specifications for prevention of accidents. ⇒ Observe the operating and working instructions of the switchgear owner.

The operating personnel must have been instructed, the installation work checked, and test operation must have been performed without faults.

- ⇒ Close all covers.
- ⇒ Make sure that the capacitive test sockets are covered with caps.
- ⇒ Switch the three-position switch-disconnectors / disconnecting circuit-breakers (type LST) of all panels to "O" position. (If there is a feeder without connected cables, earth this feeder and padlock it, if possible).
- ⇒ Open all 3AH circuit-breakers (see Page 108, "Circuit-breaker panels: Operating vacuum circuit-breaker type 3AH").
- ⇒ Reset short-circuit indicators.
- ⇒ Make sure that all consumers connected to all feeders are switched off and that the three-position switch-disconnector / disconnecting circuit-breaker (type LST) of the incoming feeder is in OPEN position.
- ✓ Now you can apply operational high voltage and put the switchgear into operation as described hereafter.

Verification of correct terminal-phase connections / Connecting incoming feeder

	DANGER!
	<p>Short-circuit in case of different phase sequence of the incoming feeders.</p> <ul style="list-style-type: none"> ⇒ Make sure that all incoming feeders have the same phase sequence. ⇒ To check the phase sequence, use only phase comparison test units which are adequate for HR or LRM test sockets.

- ⇒ Connect tested incoming feeder.

The three-position switch-disconnector / disconnecting circuit-breaker (type LST) of the feeder to be tested must be in "OPEN" position. The opposite substation must be de-earthed and live.

Verify correct terminal-phase connections using a phase comparison test unit at the capacitive test sockets of the panel to be tested and a panel that has already been connected.

- ⇒ Plug the measuring cables of the phase comparison test unit into the "L1" test sockets of the two panels.



- ⇒ Read the display.
- ⇒ Proceed in the same way with the test sockets of the two other phases ("L2" and "L3").
- ✓ If the test unit shows "coincidence" in any case, the phase sequence of the tested feeder is correct.

Applying voltage to the busbar

- ⇒ First, apply voltage from opposite substation.
- ⇒ Connect incoming feeders in respective opposite substation.
- ⇒ Connect one incoming feeder to the busbar (see Page 103, "Operating the three-position switch-disconnector/disconnecting circuit-breaker (type LST)").
- ✓ Now the busbar of the switchgear is live.

Connecting consumer feeders

When all incoming feeders are connected:

- ⇒ One after the other, switch on all outgoing feeders with connected consumers only.
- ✓ Now all feeders are connected; the switchgear is completely in operation.

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 of the switchgear by means of the data on the rating plate (see Page 45, "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.

16 Indicators and control elements



Fig. 54: **8DH**

- | | | | |
|----|--|----|---|
| 1 | Cover of niche for customer-side low-voltage equipment | 12 | Manual operation for earthing switch mechanism |
| 2 | Operating cycle counter for 3AH circuit-breaker | 13 | Interlock of cable compartment cover |
| 3 | "Spring charged" indication for 3AH circuit-breaker | 14 | Cable compartment cover |
| 4 | Manual charging for 3AH circuit-breaker | 15 | Rating plate |
| 5 | ON-pushbutton for 3AH circuit-breaker | 16 | Sockets of voltage detection system |
| 6 | OFF-pushbutton for 3AH circuit-breaker | 17 | Short-circuit/earth-fault indicator |
| 7 | HV HRC fuse compartment cover | 18 | Local/remote switch for motor-operated mechanism (option) |
| 8 | Interlock for HV HRC fuse assembly | 19 | Switch position indicator of the three position switch-disconnector/disconnecting circuit-breaker |
| 9 | Feeder designation labels | 20 | Switch position indicator of the earthing switch |
| 10 | Locking device (option for three-position switch-disconnector/disconnecting circuit breaker) | 21 | Ready-for-service indicator |
| 11 | Manual operation for switch-disconnector/disconnecting circuit-breaker mechanism | | |

17 Operating the three-position switch-disconnector/ disconnecting circuit-breaker (type LST)

	DANGER!
	<p>During operation of electrical equipment and switchgear, parts of this equipment are under dangerous electrical voltage. Mechanical components may move quickly, even remotely controlled.</p> <p>⇒ Do not remove covers. ⇒ Do not reach into openings.</p>

	DANGER!
	<p>If the gas filling is insufficient, this can cause personal injuries and material damages.</p> <p>⇒ Check ready-for-service indicator before performing any switching operation: the ready-for-service indicator must be in the green area.</p> <div style="text-align: center; margin: 10px 0;">  </div> <p>⇒ If the indicator is in the red area:</p> <ul style="list-style-type: none"> - Do not switch - Isolate the switchgear and put it out of service

	ATTENTION!
	<p>Earthing a live incoming cable will trip the upstream circuit-breaker.</p> <p>⇒ Verify safe isolation from supply of the feeder before earthing.</p>

17.1 Operations

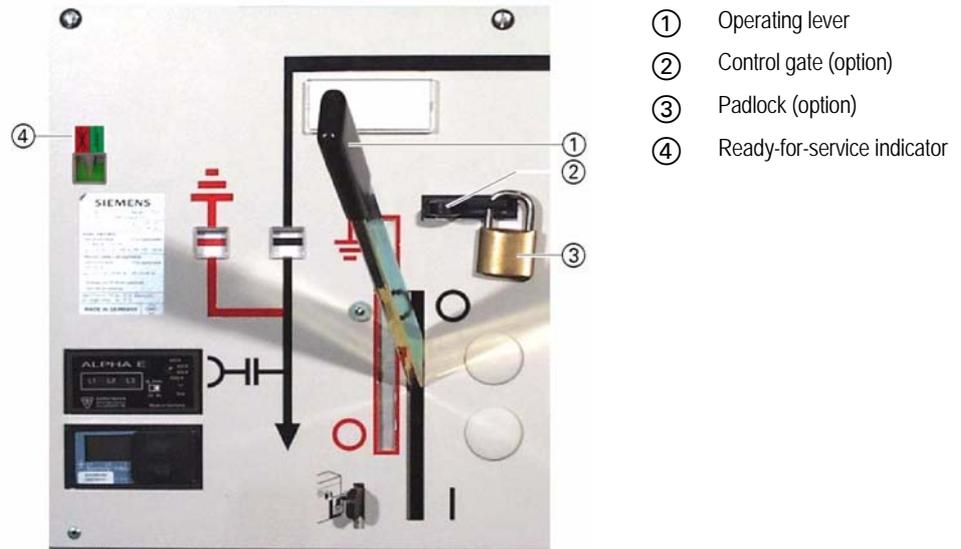
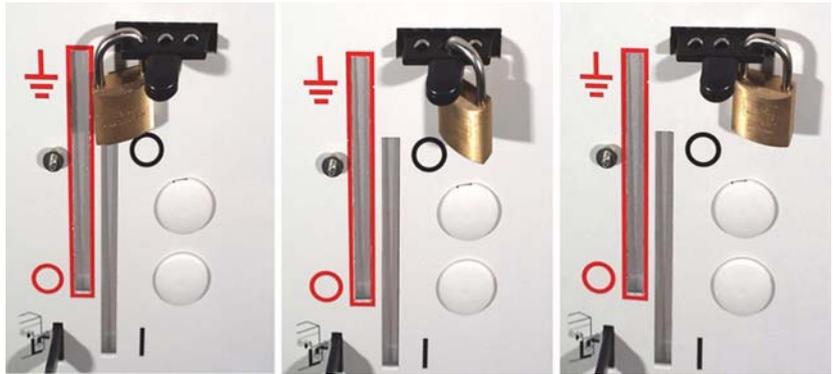


Fig. 55: Control board of three-position switch-disconnector/
disconnecting circuit-breaker



Fig. 56: Operating lever with red handle for earthing and de-earthing, with black handle for load breaking / circuit-breaking/disconnecting. Alternatives: One-lever operation and anti-reflex lever (reversing the switching direction requires re-inserting the operating lever).

- ⇒ Check ready-for-service indicator ④.
- ⇒ Remove padlock ③ (optional).
- ⇒ Operate control gate ② (optional) to release the switching gate and hold it tight.
- ⇒ Insert operating lever ① and move straight to the desired switch position.
- ⇒ Remove operating lever. Control gate will automatically return to central position.
- ⇒ Refit padlock at desired position.
- ✓ The locking device (option) of the switching gate can be padlocked in all three switch positions.



Padlock	left	centre	right
Lever positions	right or centre	centre	left or centre
Possible switching operation	only "EARTHING" and "DE-EARTHING" possible	no switching operations possible	only switch-disconnector/ disconnecting circuit-breaker "CLOSED" and "OPEN" possible

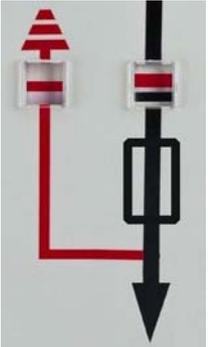
17.2 Protection tripping for the three-position switch-disconnector with spring-operated/ stored-energy mechanism



NOTE!

If the opening spring of the transformer switch was tripped by a shunt release or a fuse-link:

- ⇒ The switch position indicator of the switch-disconnector shows an additional red bar.
- ⇒ The operating lever at the operating mechanism is still in CLOSED position.
- ⇒ The motor operating mechanism (option) is out of operation.



Re-establishing service readiness

- ⇒ Insert the operating lever and switch the operating mechanism from CLOSED to OPEN. The opening spring is recharged and earthing is prepared.
- ⇒ If required, replace fuse-links, otherwise the operating mechanism will immediately be tripped again as the tripping command is still active through the striker.

17.3 Protection tripping with the three-position disconnecting circuit-breaker (type LST)

	<p>NOTE!</p> <p>Manual operating mechanism: If the opening spring of the three-position disconnecting circuit-breaker (type LST) was tripped by the protection relay or the shunt release:</p>
	<p>⇒ The switch position indicator of the disconnecting circuit-breaker (type LST) shows an additional red bar</p> <p>⇒ The operating lever at the operating mechanism is still in CLOSED position.</p> <div style="text-align: center;">  </div>

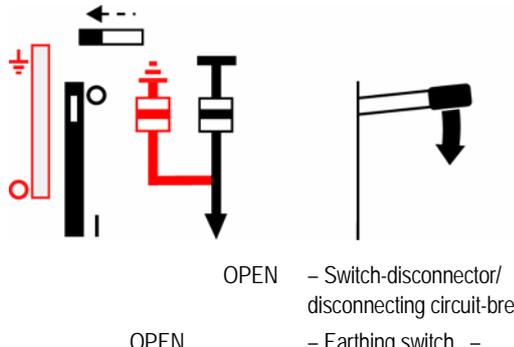
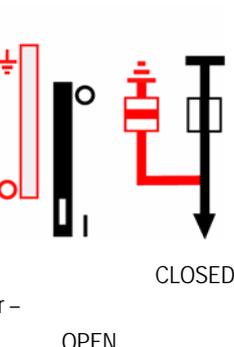
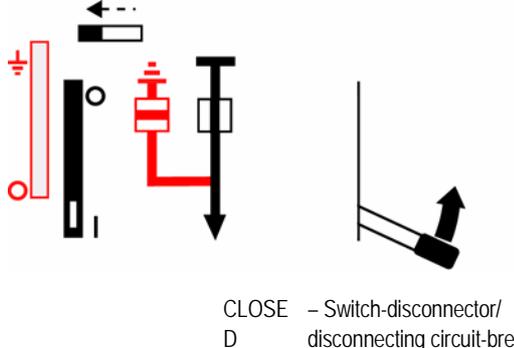
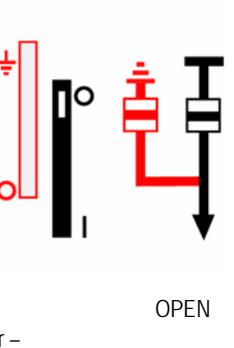
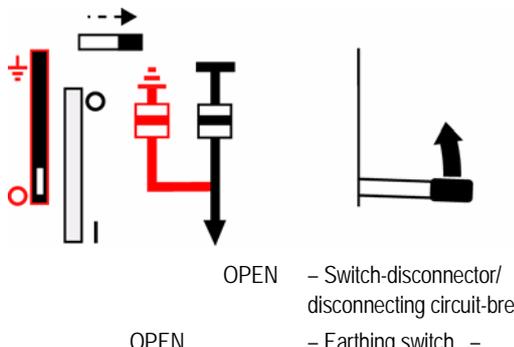
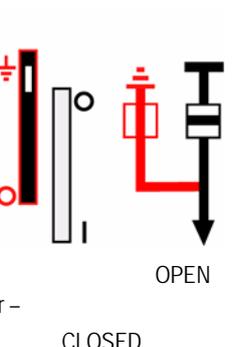
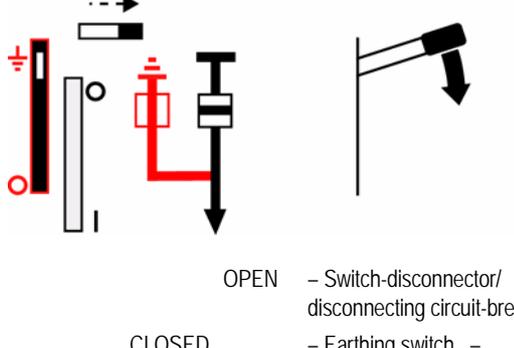
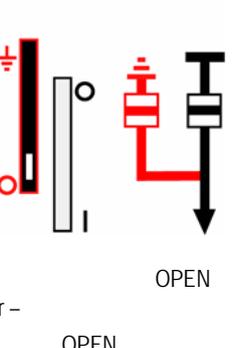
Re-establishing service readiness

- ⇒ Insert the operating lever and switch the operating mechanism from CLOSED to OPEN position. The opening spring is recharged when the operating mechanism is operated.
- ✓ The disconnecting circuit-breaker (type LST) is ready for the next closing operation.

	<p>NOTE!</p> <p>Motor operating mechanism: If the opening spring of the three-position disconnecting circuit-breaker (type LST) was tripped by the protection relay or the shunt release:</p>
	<p>⇒ The faulty position indication is cleared automatically by the motor operating mechanism.</p> <p>⇒ The operating mechanism is immediately reset to OPEN position, recharging the stored-energy spring at the same time.</p> <div style="text-align: center;">  </div>

- ⇒ Check the switch position indicator.
- ✓ The disconnecting circuit-breaker (type LST) is ready for the next CLOSE operation again.

17.4 Ring-main panels, transformer panels and disconnecting circuit-breaker panels (type LST): Operating the three-position switch

Switching operation	Switching state before operation	Switching state after operation
Closing switch-disconnector/disconnecting circuit breaker	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>OPEN</p>	 <p>CLOSED</p> <p>OPEN</p>
Opening switch-disconnector/disconnecting circuit breaker	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>OPEN</p>	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>OPEN</p>
Earthing	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>OPEN</p>	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>CLOSED</p>
De-earthing	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>CLOSED</p>	 <p>OPEN</p> <p>– Switch-disconnector/ disconnecting circuit-breaker –</p> <p>– Earthing switch –</p> <p>OPEN</p>

18 Circuit-breaker panels: Operating vacuum circuit-breaker type 3AH

Possible switching operations:

- Manual and local operation, i.e. at the panel itself
- Manual operation from remote, e.g. from the control room
- Automatic operation by the protection equipment installed

If the circuit-breaker panel is equipped with a motor-operating stored-energy mechanism, the closing spring is charged automatically after applying auxiliary voltage. The energy required for the switching sequence "OPEN - CLOSE - OPEN" (auto-reclosing) is available 15 seconds after closing the circuit-breaker.

If the circuit-breaker is equipped with a manual operating stored-energy mechanism, the closing spring has to be charged by hand (see Page 110, "Charging the stored-energy spring mechanism manually").

If the circuit-breaker is equipped with a manual spring-operated mechanism, it can only be closed manually at the panel.

The opening spring is always charged during the closing process.

The control elements of the circuit-breaker type 3AH are located at the panel front, in the upper area of the control board.

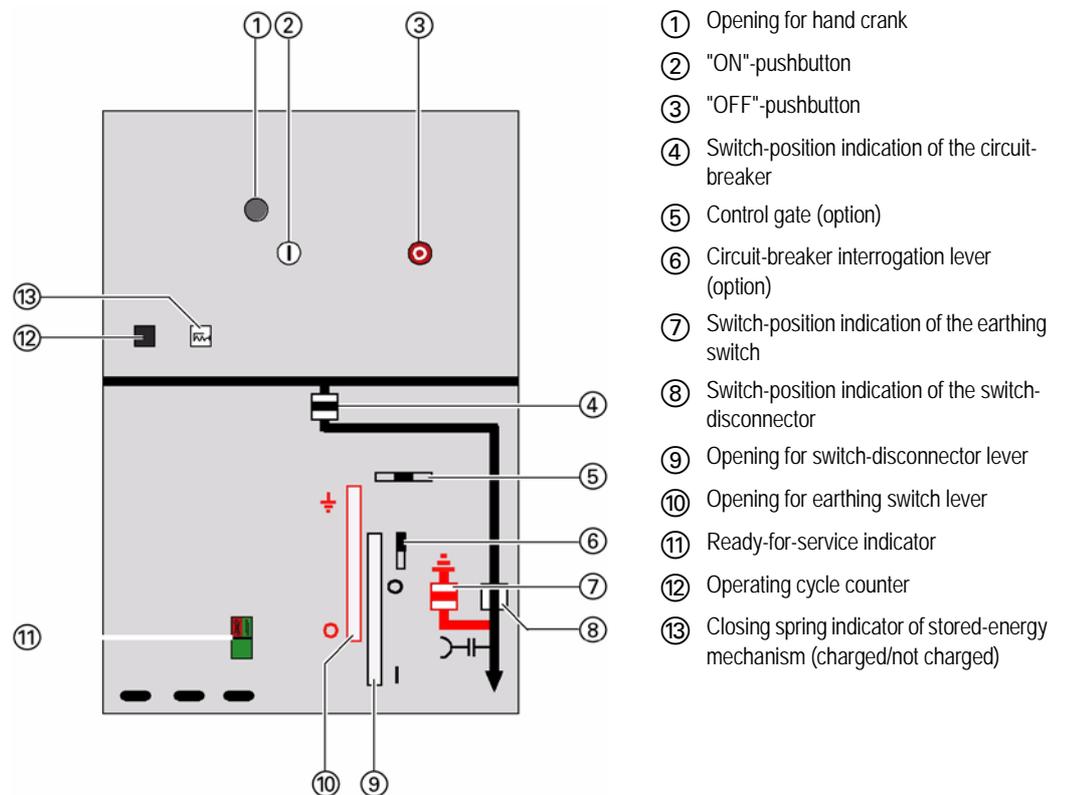


Fig. 57: Control board of circuit-breaker panel

	<p>ATTENTION!</p> <p>Due to the different number of operating cycles of the switching devices, load breaking operations should preferably be performed with the circuit-breaker. The maximum service life of the circuit-breaker panel depends on the permissible number of operating cycles of the switching devices used (see Page 34, "3AH vacuum circuit-breaker" and see Page 38, "Three-position switch-disconnector").</p> <p>⇒ Perform load breaking operations preferably with the circuit-breaker.</p>
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18.1 Closing the circuit-breaker locally

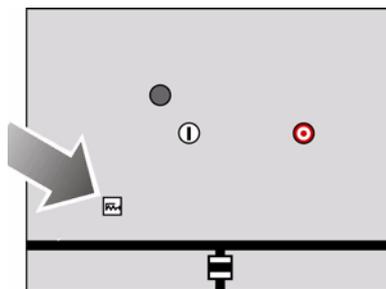
The method for closing the 3AH circuit-breaker depends on the panel equipment.

There are three different versions of the circuit-breaker operating mechanism available:

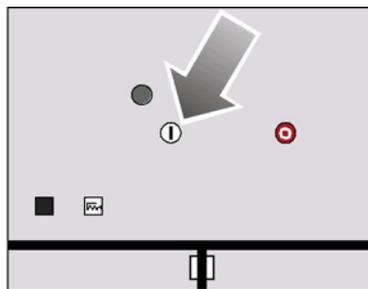
- Stored-energy spring mechanism
- Stored-energy spring mechanism with motor (option)
- Manual spring-operated mechanism

Closing with stored-energy mechanism

⇒ Make sure that the closing spring of the stored-energy mechanism is charged.



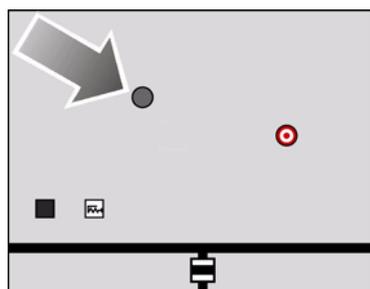
⇒ Operate the "ON"-pushbutton.



✓ In circuit-breakers with stored-energy mechanism, the motor (option) recharges the closing spring automatically. The energy required for the switching sequence OPEN-CLOSED-OPEN (auto-reclosure) is available after 15 seconds.

Closing with manual spring-operated mechanism

⇒ Remove the cover from the hand crank opening.

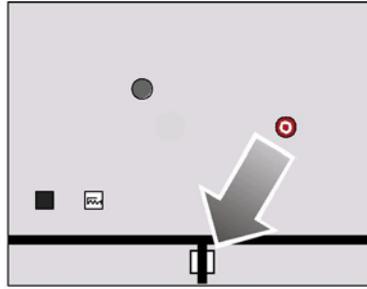


⇒ Insert the hand crank (standard accessories).

⇒ Turn the hand crank clockwise until the circuit-breaker closes (approx. 20 turns).

⇒ Remove the hand crank.

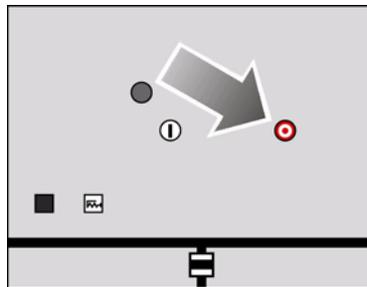
⇒ Refit the cover.



✓ The switch position indicator of the circuit-breaker in the mimic diagram shows CLOSED position.

18.2 Opening the circuit-breaker locally

⇒ Operate the "OFF"-pushbutton.



✓ The switch-position indicator of the circuit-breaker in the mimic diagram shows OPEN position.

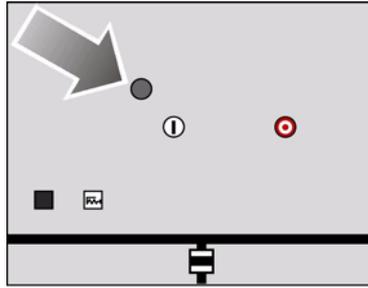
18.3 Charging the stored-energy spring mechanism manually

With manual operation or if the auxiliary voltage (motor operating mechanism) fails, the stored-energy spring mechanism must be charged manually. The closing spring is charged automatically after applying control voltage. The energy required for the switching sequence OPEN-CLOSED-OPEN (auto-reclosure) is stored in the closing spring 15 seconds after closing the circuit-breaker.

Tool required: Hand crank.



The opening for the hand crank is located top-left on the control board.

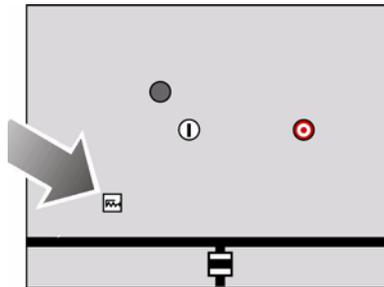


ATTENTION!

If the motor starts up suddenly, e.g. due to recovery voltage, the inserted hand crank can cause injuries if it is not provided with a freewheel.

⇒ Use the original hand crank only.

- ⇒ Remove the cover from the hand crank opening.
- ⇒ Insert the hand crank.
- ⇒ Turn the hand crank clockwise until the "spring charged" indication appears in the inspection window (black field with spring symbol).

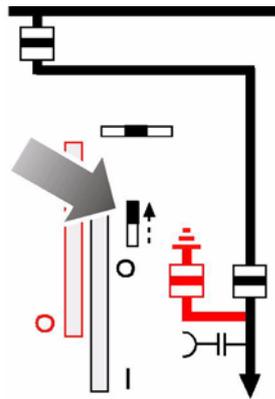


- ⇒ Remove the hand crank.
- ⇒ Refit the cover.
- ✓ The closing spring of the circuit-breaker is charged. The circuit-breaker can be closed and opened again.

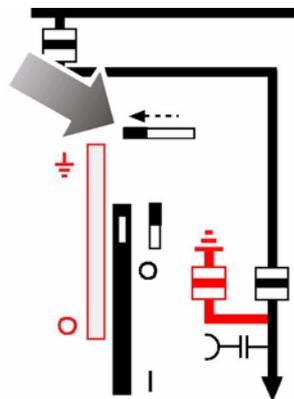
18.4 Closing the three-position switch-disconnector in the circuit-breaker panel (with type 3AH) (with optional interlock)

	<p>ATTENTION!</p> <p>Due to the different number of operating cycles of the switching devices, load breaking operations should preferably be performed with the circuit-breaker. The maximum service life of the circuit-breaker panel depends on the permissible number of operating cycles of the switching devices used (see Page 34, "3AH vacuum circuit-breaker" and see Page 38, "Three-position switch-disconnector").</p> <p>⇒ Perform load breaking operations preferably with the circuit-breaker.</p>
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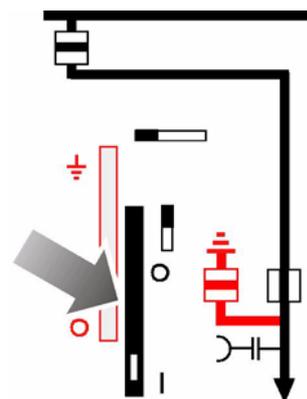
⇒ Push the circuit-breaker interrogation lever up.



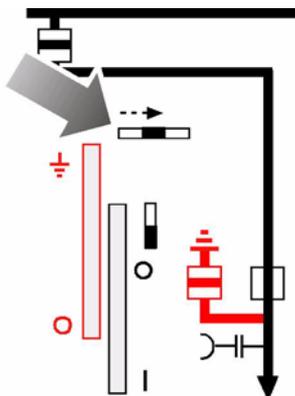
⇒ Push the control gate to the left. The actuating opening is free.



⇒ Insert the operating lever and push it down. The switch-disconnector is closed.



- ⇒ Remove the operating lever.
- ⇒ The control gate returns to the centre position automatically. The circuit-breaker interrogation lever goes down. The actuating opening is closed.

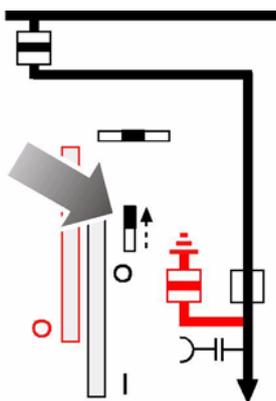


18.5 Opening the three-position switch-disconnector in the circuit-breaker panel (with type 3AH) (with optional interlock)

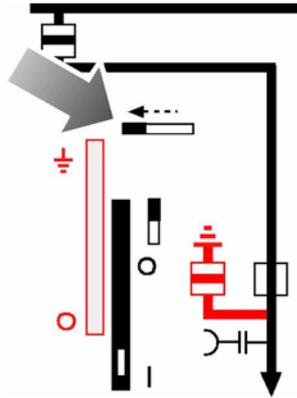
	<p>ATTENTION!</p>
	<p>Due to the different number of operating cycles of the switching devices, load breaking operations should preferably be performed with the circuit-breaker. The maximum service life of the circuit-breaker panel depends on the permissible number of operating cycles of the switching device used (see Page 34, "3AH vacuum circuit-breaker" and see Page 38, "Three-position switch-disconnector").</p>

- ⇒ Perform load breaking operations preferably with the circuit-breaker.

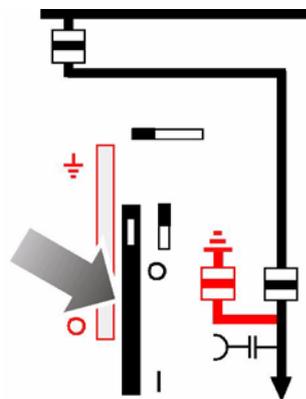
- ⇒ Push the circuit-breaker interrogation lever up.



⇒ Push the control gate to the left. The actuating opening is free.

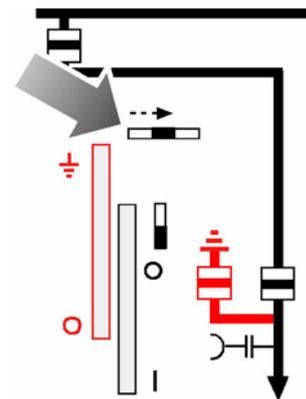


⇒ Insert the operating lever and push it up. The switch-disconnector is open.



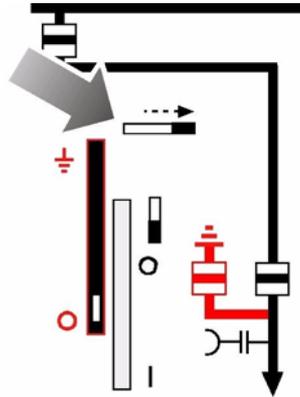
⇒ Remove the operating lever.

⇒ The control gate returns to the centre position automatically. The circuit-breaker interrogation lever goes down. The actuating opening is closed.

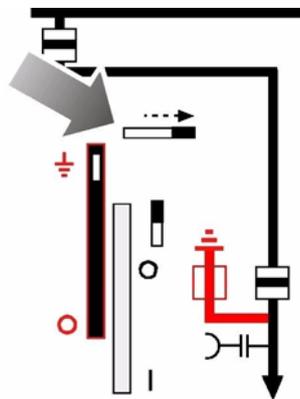


18.6 Three-position switch-disconnector in circuit-breaker panel (with type 3AH): Switch position EARTHED (with optional interlock)

⇒ Push the control gate to the right. The actuating opening is free.

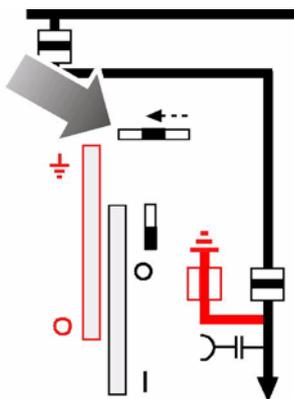


⇒ Insert the operating lever and push it up. The circuit-breaker panel is earthed.



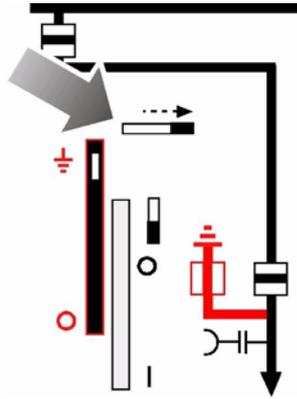
⇒ Remove the operating lever.

⇒ The control gate returns to the centre position automatically. The actuating opening is closed.

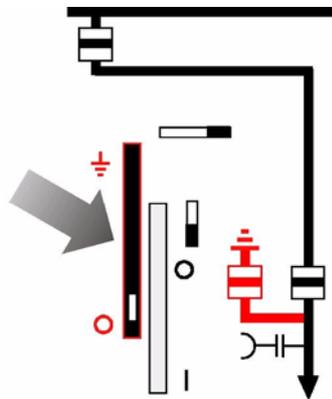


18.7 Three-position switch-disconnector in circuit-breaker panel (with type 3AH): Switch position DE-EARTHED (with optional interlock)

⇒ Push the control gate to the right. The actuating opening is free.

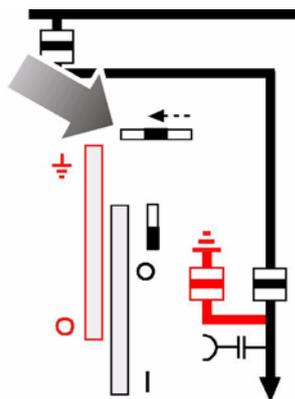


⇒ Insert the operating lever and push it down. The circuit-breaker panel is de-earthed.



⇒ Remove the operating lever.

⇒ The control gate returns to the centre position automatically. The actuating opening is closed.

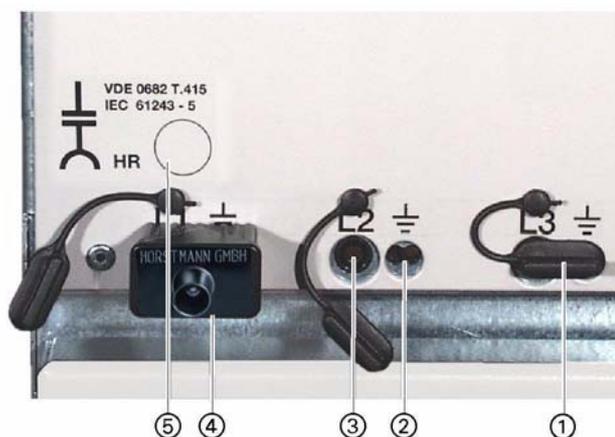


19 Verification of safe isolation from supply

	DANGER!
	<p>Mortal danger if safe isolation from supply is verified incorrectly!</p> <ul style="list-style-type: none"> ⇒ Verify the perfect function of the voltage indicator and the coupling section in accordance with national standards <ul style="list-style-type: none"> - on live equipment - with a test unit according to IEC 61243-5/EN 61243-5 - on all poles ⇒ Use only voltage indicators or devices to test the function of the coupling section according to EN 61 243-5 / IEC 61 243-5 / VDE 0682-415. (There have been no changes as against the old standard VDE 0681 Part 7 regarding the interface conditions, so that the corresponding indicators can still be used.) ⇒ Perform repeat test of interface conditions at the capacitive interfaces, as well as on the indicators according to the customer's specifications or national standards. ⇒ Do not use short-circuiting jumpers as separate plugs. The function of the surge arrester installed is not guaranteed anymore if short-circuiting jumpers are used (see Page 22, "Voltage detecting systems").

Safe isolation from supply can be verified either with an HR or LRM voltage indicator or with a CAPDIS system.

HR/LRM system



- ① Cover of capacitive test sockets
- ② Earthing socket
- ③ Capacitive test socket for L2
- ④ Voltage indicator type HR, make Horstmann
- ⑤ Documentation to repeat test of interface condition

- ⇒ Remove cover from capacitive interface.
- ⇒ Insert voltage indicators in the test sockets of the capacitive interface. If the indicator does not flash or light up in any case, the feeder is not live. The feeder can be earthed. If the indicator flashes or lights up, the feeder is live.
- ⇒ Refit covers of capacitive test sockets to protect them from pollution.

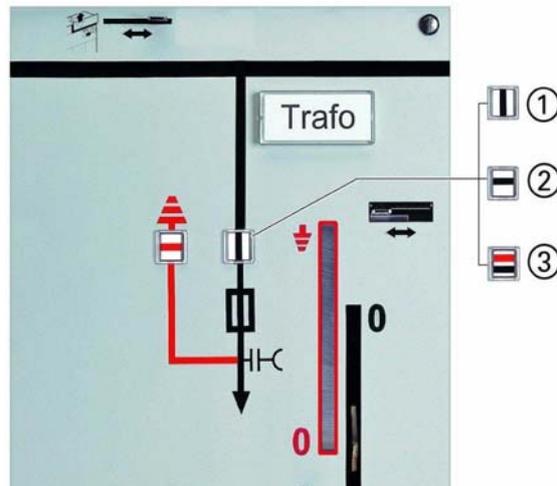
Indicators CAPDIS-S1+/-S2+

- ⇒ Verify safe isolation from supply on the display of CAPDIS-S1+/-S2+ (see Page 22, "Voltage detecting systems").

20 Replacing HV HRC fuse links

An overview of suitable HV HRC fuse links is given on (see Page 17, "HV HRC fuse assembly" and see Page 40, "Selection of HV HRC fuse links").

Trip indication for HV HRC fuse / shunt release (f-release)



- ① CLOSED indication, manual or motor operation
- ② OPEN indication
- ③ Indication "HV HRC fuse tripped" or "shunt release tripped"; via tripping of stored-energy mechanism.

Removing the cover of the HV HRC fuse compartment

The HV HRC fuse compartment cover can only be released if the earthing switch is in EARTHED position.

When the HV HRC fuse compartment cover is released, the earthing switch is interlocked in EARTHED position.

In case of motor operation (option) the electrical voltage supply must be interrupted.

Work operations

- ⇒ Isolate and earth transformer feeder.
- ⇒ Push unlocking lever of HV HRC fuse compartment cover to the left, unhinge cover and remove upwards.



Withdrawing the fuse slide

	ATTENTION!
	<p>HV HRC fuse links may be hot!</p> <p>⇒ Let HV HRC fuse links cool down or wear gloves to withdraw the fuse slide.</p>

⇒ Withdraw the fuse slide with the HV HRC fuse link.



Replacing HV HRC fuse links

If one HV HRC fuse has tripped, always replace the fuses in all three phases.

	ATTENTION!
	<p>Incorrectly selected or mounted fuse links and extension tubes can damage the fuse box or the switchgear.</p> <p>⇒ 7.2 kV fuse links with dimension 192 mm and 24 kV fuse links with dimension 292 mm are not permissible.</p>

⇒ Take HV HRC fuse links out of the contact springs.



⇒ Fit new HV HRC fuse links into the contact springs observing the striker pin position. The arrow on the HV HRC fuse points to the housing cover.

⇒ If extension tubes are necessary, these must always be mounted on the opposite side of the housing cover.

Inserting the HV HRC fuse slide

	ATTENTION!
	<p>Incorrectly selected or mounted fuse links and extension tubes can damage the fuse box or the switchgear.</p> <p>⇒ 7.2 kV fuse links with dimension 192 mm and 24 kV fuse links with dimension 292 mm are not permissible.</p>

- ⇒ Push the HV HRC fuse slide into the guide slot of the HV HRC fuse box until it latches tight.



Closing the HV HRC fuse compartment cover

- ⇒ Fit the HV HRC fuse compartment cover from above and let it slip down. The cover will protrude approx. 3 cm at the bottom.
- ⇒ Press the lower part of the HV HRC fuse compartment cover against the switchgear. Due to the rail provided at the rear, the cover can only be closed if the HV HRC fuse slides have latched in correctly.
- ⇒ Push the locking bar at the control board to the right. In this way, the cover is locked again and the interlock of the earthing switch is released.

21 Cable testing

21.1 Cable testing via plug-in cable systems

	<p>DANGER!</p> <p>Cable testing with connected cables always represents a special stress for the isolating distance. If the busbar of the switchgear under test or the opposite substation are live with operating voltage, adequate measures must be taken in order to prevent overvoltages. Normally, the switch-disconnector is not interlocked during the cable test.</p> <p>⇒ Fit switching prohibition signs.</p> <p>⇒ Secure closing lock-out (option) with a lock.</p>
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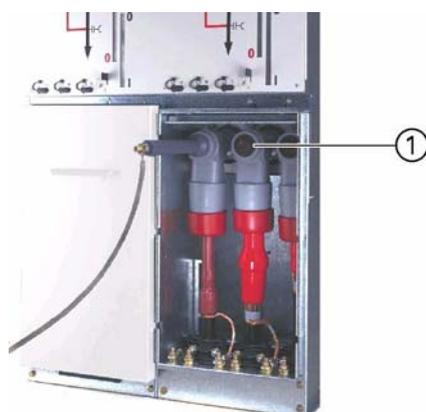
	<p>DANGER!</p> <p>In cable panels type K, the switching operation for the EARTHED position has no influence on the voltage state of the radial cable behind the screwed-on cable compartment cover.</p> <p>⇒ Before removing the screwed-on cable compartment cover, isolate and earth the radial cable in the opposite substation.</p>
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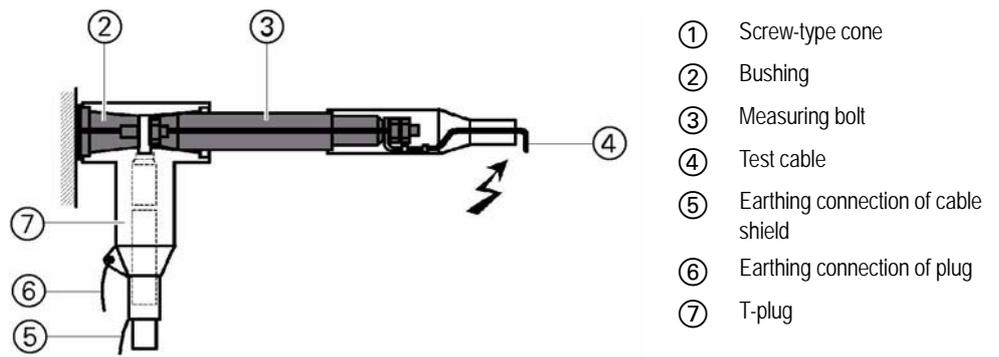
Isolating and earthing the feeder under test

- ⇒ Disconnect the feeder under test.
- ⇒ Make sure that the feeder in the opposite substation has also been isolated and secured against reclosing.
- ⇒ Verify safe isolation from supply.
- ⇒ Earth the feeder.

Preparations

- ⇒ Remove the cable compartment cover.
- ⇒ Undo the screw-type cone ① at the T-plug or at the adapter.
- ⇒ Fit cable test equipment (e.g. measuring bolts) according to the operating instructions of the plug manufacturers.





- ① Screw-type cone
- ② Bushing
- ③ Measuring bolt
- ④ Test cable
- ⑤ Earthing connection of cable shield
- ⑥ Earthing connection of plug
- ⑦ T-plug

Testing Maximum values for the test voltage:

Rated voltage of the switchgear [kV]	DC test voltage, maximum value [kV]	AC test voltage VLF* 0.1 Hz, maximum value [kV]
12	48	19
24	70	38
* Very Low Frequency		

	ATTENTION!
	<p>Cables, cable plugs and voltage detecting systems may be damaged by too high test voltages.</p> <p>⇒ Observe the manufacturer's instructions for the cables, cable plugs and voltage detecting systems (maximum test values).</p>

- ⇒ De-earth.
- ⇒ Perform the test in accordance with the cable manufacturers' recommendations or the customers' specifications.

After completion of test

- ⇒ Earth the feeder under test
- ⇒ Remove cable test elements.
- ⇒ Clean the screw-type cone, apply mounting paste and mount it on the T-plug according to the manufacturer's instructions.
- ⇒ Fit and lock the cable compartment cover.
- ⇒ De-earth the feeder in the switchgear and in the opposite substation and switch the feeder on again.

21.2 Cable sheath testing

	DANGER!
	<p>Normally, the switch-disconnector panel is not interlocked during the cable sheath test. Prevent switching from EARTHED to OPEN or CLOSED position as follows:</p> <ul style="list-style-type: none"> ⇒ Fit switching prohibition signs. ⇒ Secure the locking device (option) with a lock.

	DANGER!
	<p>In cable panels type K, the switching operation for the EARTHED position has no influence on the voltage state of the radial cable behind the screwed-on cable compartment cover.</p> <ul style="list-style-type: none"> ⇒ Before removing the screwed-on cable compartment cover, isolate and earth the radial cable in the opposite substation.

- Work operations**
- ⇒ Isolate and earth the feeder under test.
 - ⇒ Remove the cable compartment cover.
 - ⇒ De-earth the cable shield at the cross member of the subframe as well as in the opposite substation.
 - ⇒ Perform the cable sheath test according to the manufacturer's instructions or the customer's specifications.
 - ⇒ Earth the cable shield again at the cross member of the subframe as well as in the opposite substation.
 - ⇒ Refit and lock the cable compartment cover.
 - ⇒ De-earth the feeder in the switchgear and in the opposite substation and switch the feeder on again.

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