Uniswitch Medium Voltage Switchgear

12 kV, 17.5 kV, 24 kV
630 A and 1250 A

Operation and Maintenance Manual

TABLE OF CONTENTS

1 Summary

1.1 General

Product definition

The Uniswitch is an air-insulated, metal-enclosed, three-phase, medium voltage (MV) switchgear and controlgear. The system includes several standardised cubicles which can be delivered either as a complete switchgear and controlgear or as individual cubicles.

Assembly structure

The Uniswitch switchgear and controlgear system uses standard components such as switch-disconnectors, SF_6- or vacuum circuit-breakers, earthing switches, instrument transformers and secondary apparatus. The units are designed as fixed or withdrawable modules and are fitted with a single busbar system. The withdrawable parts are always with circuit-breakers.

By combining the standard components, a system which offers a wide range of different device arrangements can be made.

Applications

The Uniswitch switchgear and controlgear system is designed for use in general and industrial applications in 3.6 – 24 kV electrical distribution networks.

References

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

1.2 Standards and specifications

IEC standards

The system complies with the following IEC standards:

IEC 62271-200	A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (1990), Am1 (1994)
IEC 60694	Common specifications for high-voltage switchgear and controlgear standards (1996)
IEC 60044-1	Instrument transformers - Part 1: Current transformers
IEC 60044-2	Instrument transformers - Part 2: Inductive voltage transformers
IEC 62271-100	Part 100: High-voltage alternating-current circuit-breakers (2003-05)
IEC 60129	Alternating current disconnectors and earthing switches (1984), Am1 (1992), Am2 (1996)
IEC 60265-1	High-voltage switches - Part 1: Switches for rated voltages above 1 kV and less than 52 kV (1998)
IEC 60420	High-voltage alternating current switchfuse combinations (1990)
IEC 60529	Degrees of protection provided by enclosures (IP Code) (2001-02) • IP 2XC for enclosure and IP 2X for partitions

Additional regulations

All other corresponding IEC publications, national or local safety-at-work regulations and safety regulations for production materials must be adhered to during the installation and operation of these systems.

Above and beyond these, the order-related data from ABB must be taken into account.

1.3 Service conditions

1.3.1 Normal service conditions

Normal service conditions

The switchgear is intended for use in normal indoor service conditions as defined in Table 1.1 from the relevant IEC standards. If the conditions where the switchgear are to be installed deviate from the normal service conditions defined in the IEC standards (IEC 60694), it has to be agreed separately with the manufacturer.

Table 1.1 Normal indoor service conditions according to IEC standards.

Ambient air temperature	
Maximum	+ 40°C
Maximum 24 h average temperature	+ 35°C
Minimum 24 h average temperature	- 5°C
Recommended (minimum)	+ 5°C
Altitude above sea level	
Maximum	1000 m
Conditions of humidity	
Average value of relative humidity (24 h)	≤ 95 %
Average value of relative humidity (1 month)	≤ 90 %
Pollution	
The ambient air must not be significantly polluted by dust, smoke, corrosive and/or flammable gases, vapors or salt.	

1.3.2 Special service conditions

Special service conditions

At site altitudes above 1000 m, the effects of the reduction in dielectric strength of the air on the insulation level must be taken into account (please refer to IEC standard 60694).

Increased ambient temperatures must be compensated for in the design of the busbars and branch conductors as well as for the components, otherwise the current carrying capacity will be limited.

! When switchgears are operated in areas with high humidity and/or major rapid temperature fluctuations, there is a risk of dew deposits which must remain an exception in normal service conditions for indoor switchgear.

! Preventive action (e.g. fitting electric heaters) must be taken in consultation, with the manufacturer, to avoid this condensation phenomenon and any resulting corrosion or other adverse effects. The control of the heaters depends on the relevant project and details must be taken from the order documents.

2 Technical data

2.1 Electrical data

Table 2.1 Electrical data

Rated voltage U_r	**kV**	**12**	**17.5**	**24**
Rated lightning impulse withstand voltage U_p	kV			
Common value		75	95	125
Across the isolating distance		85	110	145
Rated power-frequency withstand voltage U_d	kV			
Common value		28 [1]	38 [1]	50
Across the isolating distance		32 [1]	45 [1]	60
Rated frequency	Hz	50/60	50/60	50/60
Rated current I_r	A			
Busbar		630/1250	630/1250	630/1250
Feeder		630/1250	630/1250	630/1250
Rated short-time withstand current [2]	kA			
Main circuit		25	20	20
Earthing circuit		25	20	20
Rated duration of short circuit	s	1	1	1
Rated peak withstand current	kA	65	50	50
Degree of protection (IP-code)				
For the enclosure		IP 2XC	IP 2XC	IP 2XC
For the partitions		IP 2X	IP 2X	IP 2X
Mechanical endurance of switch-disconnector	Times			
Closed/Open		1000	1000	1000
Open/Earthed		1000	1000	1000
SF6-gas in switch-disconnector	Bar			
Rated filling pressure		1,4	1,4	1,4
Minimum operating pressure		1,3	1,3	1,3

[1] Higher values are possible if required by other national standards.

[2] The short-circuit withstand capacity of the instrument transformers must be taken into account separately.

2.2 Internal arc classification

Data

Resistance to internal arc faults is as follows:

Table 2.2 Fault withstand capacity.

12 kV	20 kA	1s
17.5 kV	20 kA	1s
24 kV	20 kA	1s

Standards

The switchgear units have been tested according to IEC 62271-200 Standards (appendix AA, class A, criteria 1 to 6).

! Uniswitch switchgear has to be installed in closed rooms suitable for electrical equipment. This means the accessibility must be restricted to authorised personnel only.

The rear side of the switchgear is not accessible. Rear-side accessibility must be discussed with the manufacturer.

3 Design and construction

3.1 Construction of the switchgear and main components

General

In the design of the Uniswitch cubicle, special attention has been paid to increased reliability of use and improved personnel safety in the possible event of an arc-fault.

The exterior parts of the cubicle are made from 2 mm sheet of steel hot-dip Al/Zn-coated, and they are joined together with screws.

In order to improve personnel safety and maintainability, the cubicles are divided into separate compartments. The compartments are designed so that they withstand the very rapid rise in temperature and pressure caused by a possible arc-fault condition.

3.2 Cubicle design and equipment

3.2.1 Compartments of fixed type switchgear

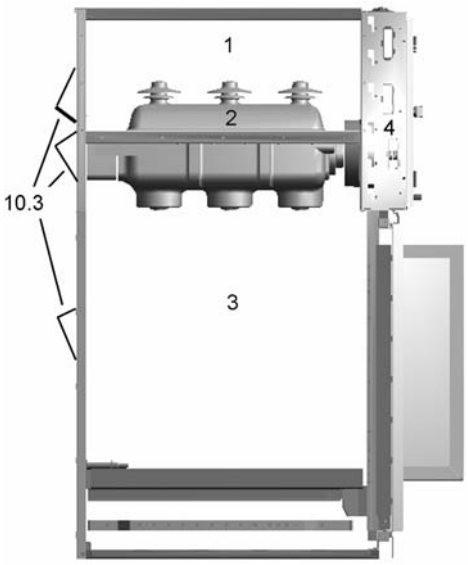


Figure 3.1
Compartments in fixed type switchgear.

Compartments

The cubicle is divided into the following compartments (see Figure 3.1):

1) Busbar compartment

The air-insulated busbar compartment is situated in the top of the cubicle and usually runs through the whole switchgear. A measuring or sectionalising cubicle situated in the middle of the switchgear divides the main busbar compartment.

The busbar compartment requires tools for opening. It is designated a “tool-based accessible compartment”.

When opening, the user should take measures to ensure safety (ie. Busbar must be dead).

2) Gas filled compartment

The three position switch-disconnector is located between the main busbar and cable compartments. Its epoxy resin shell forms an SF_6-gas filled space in which the electrical parts of the switches are situated.

This compartment is designated a "non-accessible compartment". It must not be opened.

3) Cable compartment

About 75 % of the cubicle volume is reserved for the incoming/feeder cable connections, fuses, earthing switches or instrument transformers.

The circuit-breaker (SF6 or vacuum) is located to the left of the cable comparment.

If the cubicles are equipped with switch-disconnectors, there are interlocks to ensure that live parts inside are dead and earthed before opening. Such a compartment is then designated an "interlock-controlled accessible compartment".

If the cubicles are **not** equipped with switch-disconnectors, the comparments are provided with facilities for padlocking. Such a compartment is then designated a "procedure-controlled accessible compartment".

4) Control and Secondary Apparatus Compartment

The compartment includes space for switch-disconnector and earthing switch operating mechanisms, and mechanical interlocks with position indicators. Other components, such as auxiliary contacts, trip coils, voltage indicators and relays, can be fitted in this compartment. It is also usual to fit secondary wiring, terminal blocks and cable channels here.

Pressure relief flaps

The pressure relief flaps (**10.3**) (Figure 3.1) in the rear plate of the cubicles open and divert the excess pressure and gases behind the switchgear. This way, the risk of injury to the operator has been minimized during a possible arc-fault condition.

Each cubicle rear plate has three arc-pressure relief devices:

- The upper arc-pressure relief flap is for the busbar compartment.
- The switch-disconnector has its own arc-pressure relief device.
- The lower arc-pressure relief flap is for the circuit-breaker and cable compartment.

! A separate exhaust duct at the rear of the switchgear is also available.

3.2.2 Compartments of withdrawable type switchgear

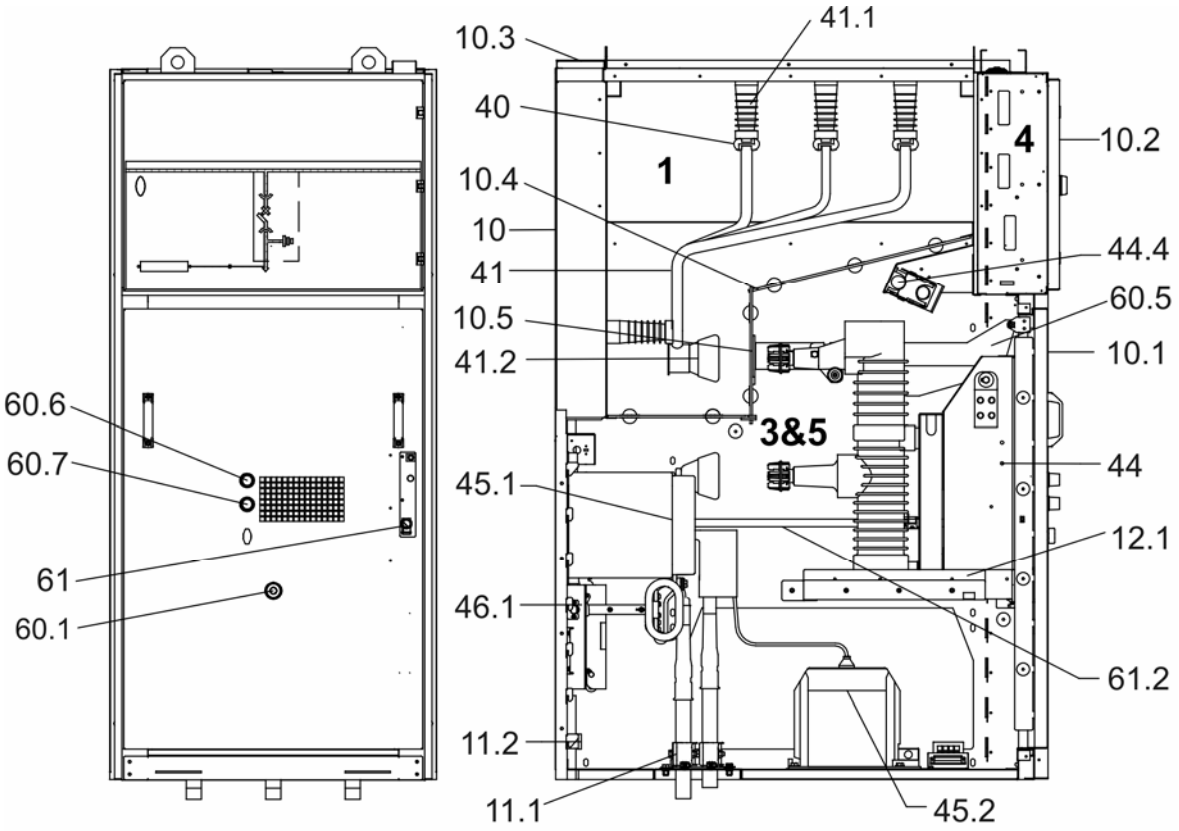


Figure 3.2
Withdrawable type switchgear (front and left views).

10	Enclosure	**10.4**	Non-metallic partition
10.3	Pressure relief flap	**10.5**	Non-metallic shutter
10.2	Door of LV-compartment	**44.4**	Control wiring plug connector
10.1	Door of HV-compartments	**44**	Withdrawable part
41	Branch conductor	**61**	Earthing switch operating mechanism
40	Busbar	**61.2**	Operating shaft for earthing switch
41.1	Post insulators for branch bars	**60.1**	Moving mechanism for withdrawable part
41.2	Fixed contact	**60.5**	Lever (shutter lifting)
46.1	Earthing switch	**60.6**	Opening pushbutton
45.1	Current transformers	**60.7**	Closing pushbutton
11.2	Main earthing bar	**45.2**	Voltage transformers
11.1	Cable clamp	**12.1**	Track for withdrawable part

The enclosure is completed by the top-mounted pressure relief flap which is common for the two high-voltage compartments. This flap will open in the case of overpressure due to an internal arc fault.

Compartments

The cubicle is divided into the following compartments (for all compartments, see Figure 3.2):

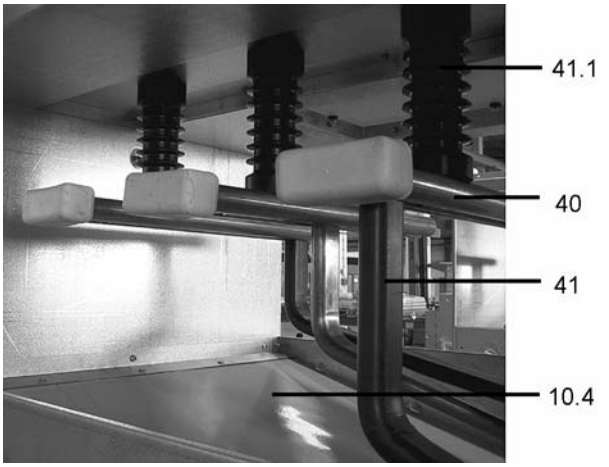


Figure 3.3
View into the busbar compartment.

1) Busbar compartment (1) (see Figure 3.3).

The busbars (**40**) have a profile cross-section made of copper and are laid in sections from cubicle to cubicle. The partition is non-metallic in accordance with IEC 62271-200 standards.

The busbar compartment requires tools for opening. It is designated a "tool-based accessible compartment".

When opening, the user should take measures to ensure safety (ie. Busbar must be dead).

If the sectionalizing cubicle and bus riser cubicles are included in the switchboard, the busbar compartment is divided into two different sections by means of metallic partition.

2) Circuit-breaker & cable compartment (3 & 5) (see also Figure 3.2 and Figure 3.9)

There are interlocks to ensure that live parts inside are dead and earthed before opening. This compartment is designated an "interlock-controlled accessible compartment".

- The common circuit-breaker & cable compartment contains all the necessary equipment for reciprocal operation of the withdrawable part and the cubicle.
- The compartment is constructed for the installation of three current transformers. Should all three current transformers (**45.1**) not be required, dummies will be installed in their place, using the same installation and connection procedures.
- The non-metallic shutters (**10.5**), cover the insertion openings to the busbar compartment. The shutters are opened by means of shutter rolls of the withdrawable circuit-breaker part, using a lever when inserting into the service position, and are closed when the with-drawable part moves to the disconnected position.

In the test/disconnected position of the withdrawable part, partitioning by separation is established in the main current circuit. Connection of the control wiring, required for test purposes, need not be interrupted when in the test/disconnected position.

- In the test/disconnected position, the withdrawable part is still completely inside the cubicle with the door closed. The ON/OFF pushbutton located on the circuit-breaker, and the mechanical indicators for ON/OFF and CHARGED/DISCHARGED can be observed through an inspection window.
- The socket (**50.1**) (Figure 4.8) for the control wiring is mounted in the circuit-breaker compartment.
- Current transformers (**45.1**) (Figure 3.2), fixed and voltage transformers (**45.2**), and earthing switch (**46.1**), are fitted according to individual operating requirements in each case.
- The voltage transformers mounted fixed are connected on the primary side with flexible, fully-insulated cables which are inserted into the transformers.
- The EM type earthing switch can be used with a manually-operated mechanism. Its switching position will be indicated both mechanically and electrically by means of the auxiliary switch.
- In the cubicle, up to two parallel plastic cables can be connected with single-core cable protection and push-on sealing ends.

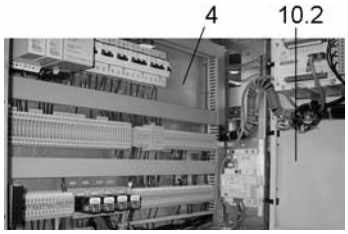


Figure 3.4
Low-voltage compartment, internal view.

3) Control and Secondary Apparatus Compartment (4)
(see Figure 3.4)

The control cabinet is for all control and protection aspects, suitable for both conventional or microprocessor control technology.

If the secondary devices are not intended for door installation, they are mounted on the bottom of the LV-compartment.

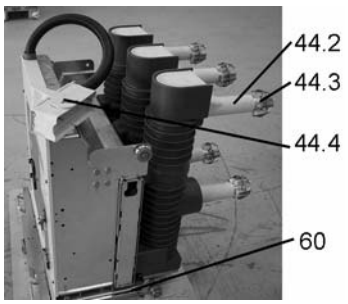


Figure 3.5
HD4 type circuit-breaker - side view.

4) Withdrawable parts (see Figure 3.5)

The withdrawable circuit-breaker forms a complete module consisting of:

- HD4/US (SF6) circuit-breaker or VD4/US type (vacuum) circuit-breaker
- isolated contact arm (**44.2**) with contact system (**44.3**)
- control wiring plug (**44.4**).
- the withdrawable assembly (**60**)

The withdrawable assembly (**60**) and the circuit-breaker are coupled via a multi-pole control wiring plug connector (**44.6**) (Figure 3.6).

The withdrawable assembly establishes the mechanical connection between the cubicle and the circuit-breaker. The fixed part is connected to the cubicle by forking (**60.8**), which is form-coded on both sides.

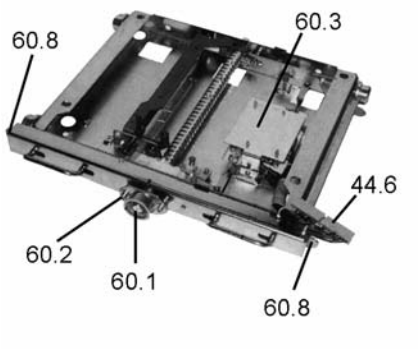


Figure 3.6
Withdrawable assembly for circuit-breaker, with auxiliary switches.

The moving part with the circuit-breaker is moved manually by means of a spindle (**60.1**), between the service or test/disconnected positions with the front doors closed. Service and test/disconnected positions are indicated precisely by means of auxiliary switches (**60.3**), which indicate the final position reached and the angular position of the spindle.

The rollers and travel rails (**12.1**) (Figure 3.10), which are bolted onto the cubicle, establish the earthing connection between the withdrawable part and the cubicle.

Withdrawable parts of the same design are interchangeable.

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

3.2.3 Service continuity

LSC Category

For switchgear the Loss of Service Continuity Category (LSC) describes the extent to which other compartments and/or functional units may remain energised when a main circuit compartment is opened.

According to IEC 62271-200 the Loss of Service Continuity (LSC) of Uniswitch switchgear is LSC2A-PI. The PI denotes that partition and shutters are insulation.

Table 3.1 Accessibility to compartments (according to IEC 62271-200).

		Part of the switchgear that can be left energised	
		Cable corresponding to the functional unit	**All other functional units**
Compartment to be opened	Fuse/cable	No	Yes
	Busbar	Not relevant: non-accessible	Not relevant: non-accessible
	Circuit-breaker (fixed)	No	Yes
	Circuit-breaker (withdrawable)	No	Yes
	Low voltage	Yes	Yes

3.3 Enclosure and partitioning

Material

The enclosure and internal partitions of the cubicles are made of 2 mm thick high-quality aluminum-zinc coated steel sheet.

Doors and end plates are thoroughly cleaned and treated against corrosion before receiving a high-quality coating of paint. The finishing coat is in the standard RAL 7035 colour (special colours by agreement).

The doors of the cable compartments are pressure resistant and are equipped with inspection windows.

The low-voltage compartment for secondary equipment is completely protected from the high-voltage area, thanks to its steel-sheet partition.

High-voltage compartments

The two high-voltage compartments (busbar compartment, circuit-breaker & cable connection compartment) are equipped with inspection windows. Neighbouring cubicles are partitioned from one another by the side walls of each cubicle.

The front of the cubicle is closed off by a pressure-resistant removable door. The door of the high-voltage compartment is pressure resistant.

On the end cubicle sides, cover plates ensure good appearance and are mechanically and thermally arc fault-proof (should such an event occur in the end cubicle).

3.4 Ventilation of the cubicles

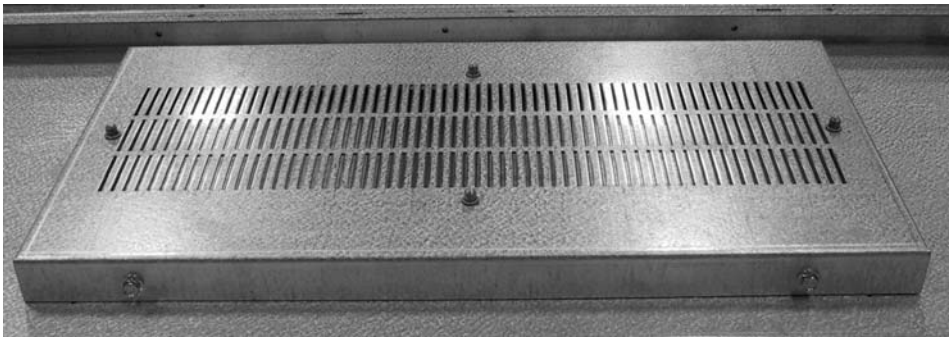


Figure 3.7
Removable ventilated top element of the withdrawable type cubicle.

Ventilation openings

Openings in the outer enclosure are needed for the purpose of ventilation in the case of 1250 A -rated currents in the busbars and branch bars. The ventilation openings are located on the back wall and on the top of the withdrawable type cubicle.

3.5 Interlockings

3.5.1 Interlocking principle

Purpose

The purpose of the interlocking devices is to prevent incorrect operation of the switch-disconnector and earthing switch and thereby to ensure personnel safety. The interlocking is in operation even if the doors to the cable and control compartments are open.

Interlockings

Interlocking includes:

- Normal interlocking which is fitted as standard in every cubicle.
- Additional interlocking devices which are optional and to be chosen by the customer.

3.5.2 Interlockings of the fixed type switchgear

3.5.2.1 Interlocking unit

General

Permitted control operations of the Uniswitch switchgear and the three-position SFG switch-disconnector are defined by the position of the selector of the interlocking mechanism.

Positions

The interlocking selector has four positions:

Position 1: Operation

SFG switch-disconnector can only be operated close-open. The cable compartment door cannot be opened.

Position 2: Padlock

SFG switch-disconnector cannot be operated and the cable compartment door cannot be opened.

Position 3: Test and earthing

SFG switch-disconnector can only be operated open-earthed. The cable compartment door cannot be opened.

Earthing switches

The interlocking applies also to the earthing switches EF and EM, which are used for earthing the bottom of the fuses and current transformers. These switches are mechanically connected to the operating device of SFG switch-disconnector and they are operating simultaneously with the SFG when it is operated between open and earthed position.

Position 4: Door open

The SFG switch-disconnector is in the earthed position and cannot be operated. The cable compartment door can only be opened if the switch-disconnector is in the earthed position and the interlocking device is in the ‘Door open’ position.

Refer to 3.5.2.2 Normal interlocking.

Interlocking system

The use of the interlocking system and permitted operations are shown in the figure below:

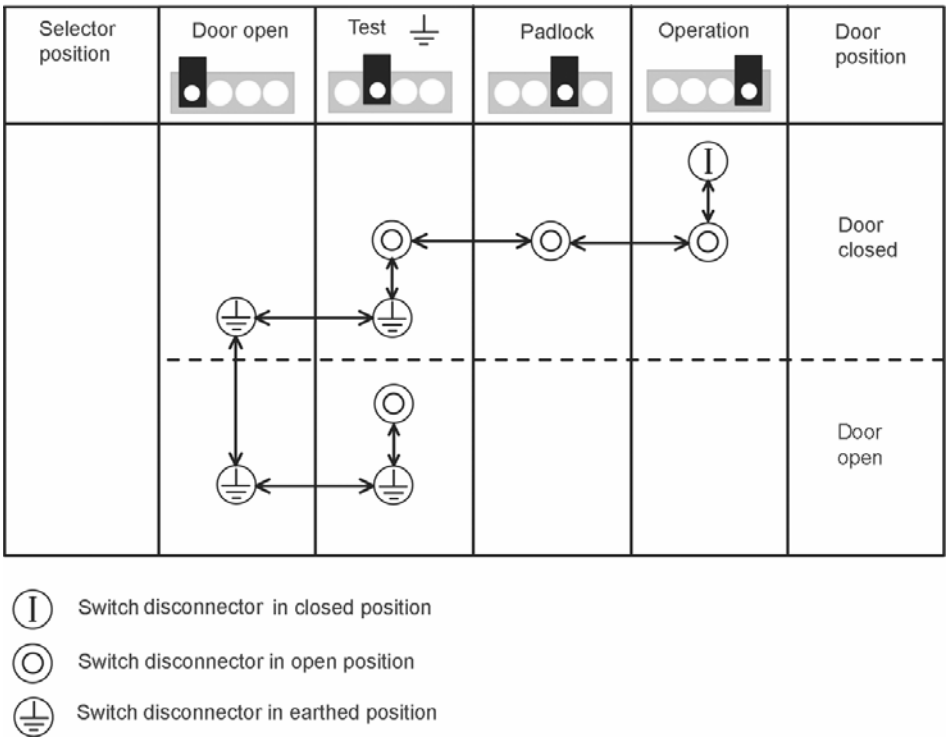


Figure 3.8
Interlocking system and permitted operations.

3.5.2.2 Normal interlocking

General

Normal interlocking is determined by the position of the interlocking selector mechanism. The selector can be locked in the required position using a padlock.

Interlocking

Locked in 'Operation' position:

Switch-disconnector can only be operated close-open.

Locked in 'Padlock' position:

Switch-disconnector is in open position, it cannot be operated.

Locked in 'Test' position:

Switch-disconnector can only be operated open-earthed.

Locked in 'Door open' position:

Switch-disconnector is in earthed position, it cannot be operated.

Cable testing

When the cable compartment door is open, the SFG switch-disconnector is locked in the earthed position. The interlocking can be removed by moving the interlock selector to the 'Test' position. This will allow the switch-disconnector to be operated to the open position to enable insulation measurement of the cables.

After measurement, the switch-disconnector first has to be moved to the earthed position before the interlock selector can be moved to the 'Door open' position so that the door can be closed.

3.5.2.3 Additional interlocking

Interlocks

- Key lock on the SFG switch-disconnector. The interlock can be verified with a micro switch when motor operated.
- Double key lock on the SFG switch-disconnector. The interlock can be verified with a micro switch when motor operated.

Additional locks such as Ronis and Profalux are also possible.

3.5.3 Interlockings of the withdrawable type switchgear

3.5.3.1 Cubicle internal interlocking

Interlocks

There is a series of interlocks to protect both personnel and equipment:

The withdrawable part can only be moved from the test/disconnected position (and back) when the circuit-breaker and earthing switch are in the open position.

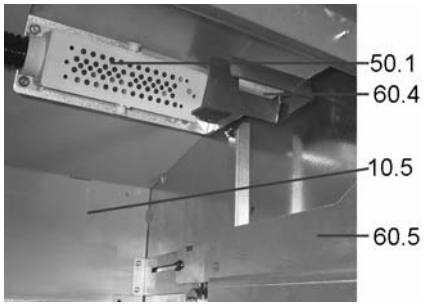


Figure 3.9
View inside the circuit-breaker compartment.

The withdrawable part can only be moved from the test/disconnected position when the control wiring plug (**44.4**) (Figure 3.5) has been connected to socket (**50.1**) (mechanical interlock).

The circuit-breaker can only be switched on when the withdrawable part is in the test or service position. In the intermediate position, the circuit-breaker is mechanically interlocked. When the circuit-breakers have an electrical release, the interlock is also electrical.

In cubicles with digital control technology, prevention of malfunction of the circuit-breaker can also be achieved by means of the cubicle software.

In the service or test positions, the circuit-breaker can only be switched off manually when no control voltage is applied and it cannot be closed (electromechanical interlock).

Connecting and disconnecting the control wiring plug (**44.4**) (Figure 3.5) is only possible in the test/disconnected position of the withdrawable part due to the door interlock.

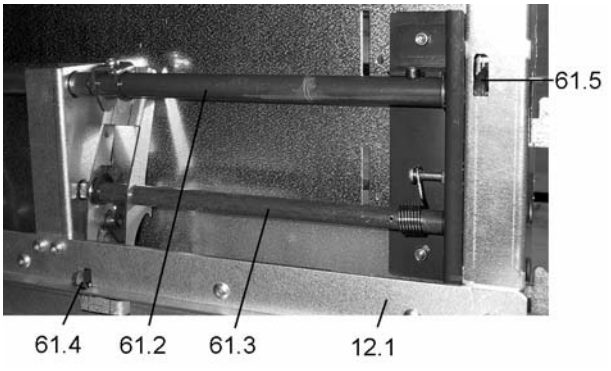


Figure 3.10
Operating and interlocking mechanism of earthing switch type EM.

The earthing switch (**46.1**) (Figure 3.2) can only be switched on if the withdrawable part is in the test/disconnected position or outside of the cubicle (mechanical interlock) (**61.3** and **61.4**).

If the earthing switch is on, the withdrawable part cannot be moved from the test/disconnected position to the service position (mechanical interlock).

References

Details of other possible interlocks, e.g. in connection with a locking magnet on the withdrawable part and/or earthing switch drive, can be obtained from the relevant order documents.

3.5.3.2 Door interlocking

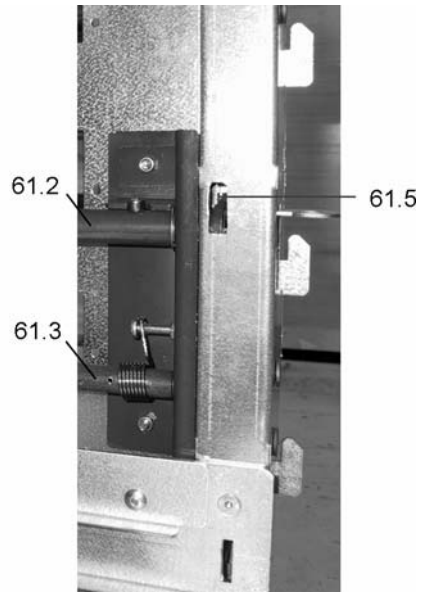


Figure 3.11
Withdrawable type switchgear: Circuit-breaker compartment door locking device.

Door interlocks

The cubicles are equipped with the following door interlocks:

- The circuit-breaker & cable compartment door cannot be opened if the circuit-breaker is in service or in an undefined position.
- The circuit-breaker & cable compartment door cannot be opened if the earthing switch is open.

3.5.3.3 Locking devices

Figure 3.12
Using the padlock (withdrawable type cubicle).

Figure 3.13
Using the padlock (withdrawable type cubicle).

Padlock

- Access to the operating-shaft of the earthing switch can be restricted with a padlock (Figure 3.12).
- Access to the circuit-breaker racking slot can be restricted with a padlock (Figure 3.13).
- Access to the circuit-breaker & cable compartment can be restricted with a padlock.

4 Operation of the switchgear

4.1 General cautions and warnings

Do not walk on the top surfaces of the switchgear cubicles (rupture points for pressure relief)!

! The switching operations are to be carried out with the doors closed.

! The relative work and operating procedure must be carried out carefully by a trained specialist familiar with the installation, taking into account all the relative safety regulations according to the IEC and other relevant professional bodies, as well as any local and work regulations and instructions.

4.2 Commissioning

4.2.1 Preparatory work

Before connection with the high-voltage power supply

In preparation for commissioning, the following work must be carried out:

- Check the general condition of the switchgear for any damage or defects.
- Visually inspect the switching devices, withdrawable parts, isolating contacts, insulating parts, etc.
- Check the connection of the main earthing bar to the installation earthing conductor (following the appropriate safety regulations).
- Check the paintwork for damage and, where necessary, touch up as described in section 5.5.
- Remove all residues of materials, foreign bodies and tools from the switchgear.
- Clean the switchgear, rubbing down insulating parts with a soft, dry, clean, non-fraying cloth. Remove any greasy or sticky dirt as described in section 5.4.
- Correctly remount all covers etc. removed during assembly and testing procedures.
- Remove transport caps from vacuum circuit-breakers - if still fitted.
- Remove the lifting eyebolts on high current vacuum circuit-breakers - if still fitted.

Preparatory work for SF6 circuit-breakers:

- Clean the insulating parts with clean dry cloth.
- Check that the upper and lower terminals are clean and free from any deformation caused by shocks received during transport and storage.
- It is advisable to check the SF6 gas pressure.
- Switch the auxiliary and control voltage on.
- Carry out testing operations on switching devices manually or by electrical control, and simultaneously observe the relative position indicators.
- Check mechanical and electrical interlocks for effectiveness, without using force.
- Set the protective devices in the switchgear to the required values and check their function with test equipment.
- Instruct local operators regarding the basic details of regular handling of the switchgear.

- Check readiness for operation and the switching status of electrical systems upstream and downstream of the switchgear.

Reference

For any other matters regarding operation of the withdrawable circuit-breaker part and testing facilities for the withdrawable part, see section 5.6.

Other checkpoints

Depending on the allocation of responsibilities, it may also be necessary to check the following equipment in areas adjacent to the switchgear:

- power cables
- auxiliary cables
- auxiliary power source
- remote control system
- complete earthing system
- switchroom equipment
- switchroom conditions

4.2.2 Start-up

Instructions

- Comply with all relevant safety regulations.
- Ensure that the switch-disconnectors and circuit-breakers in the system are in the OPEN position.
- Remove any existing earthing and short circuiting connections in the critical switching area.
- Energize the feeder cables.
- Connect the switchgear step by step, observing the signals and indicators.
- Check that relative conductors are in phase, where necessary, when there are several incoming feeder cables and switchgear sections.
- Carry out all measurements and check all functions which depend on the high-voltage power supply being connected.
- Watch out for irregularities of any kind.

4.3 Operating the fixed type switchgears

4.3.1 Manual operation of the SFG switch-disconnector

4.3.1.1 Closing the SFG switch-disconnector

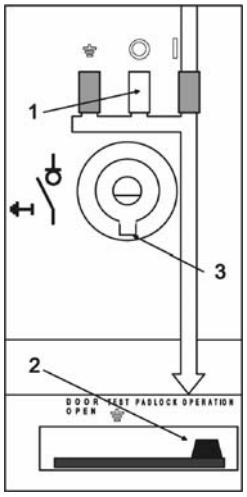


Figure 4.1
Closing the switch-disconnector.

1) Ensure that the switch-disconnector's position indicator is in the 0-position (**1**).
2) Check that the interlocking selector is in the 'Operation' (**2**) position and that the notch on the shaft end is pointing down (**3**).
3) If it is a fused switch-disconnector that is to be operated to the open position due to a blown fuse or motor operation, the notch on the shaft is to be rotated to point downwards before the switch-disconnector is operated to the closed position.
4) Put the operating handle into the hole so that the guide key goes into the notch on the shaft.
5) Turn the operating handle clockwise about 80 degrees until the switch-disconnector closes.
6) If the device is fitted with a double spring control mechanism (switch-fuse), the turning force must be increased towards the end of the movement until the switch-disconnector finally closes. The operation movement is always to be completed once started.

4.3.1.2 Opening the SFG switch-disconnector

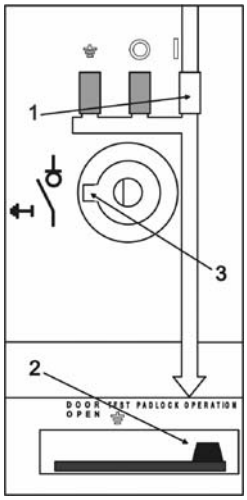


Figure 4.2
Opening the switch-connector.

1) Ensure that the switch-disconnector position indicator is in the I-position (**1**).
2) Check that the interlocking selector is in the 'Operation' (**2**) position.
3) Check that the notch on the operating shaft is pointing to the left (**3**).
4) Put the operating handle into the hole so that the guide key goes into the notch on the shaft.
5) Turn the operating handle anti-clockwise about 80 degrees until the switch-disconnector opens.

4.3.1.3 Operating the SFG switch-disconnector to the earthed position

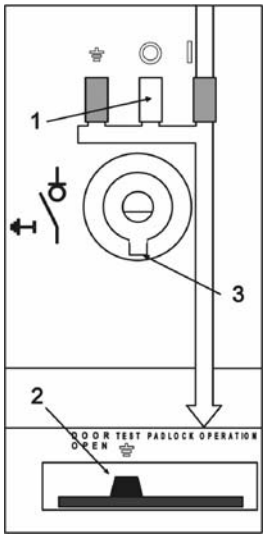


Figure 4.3
Operating to earthed position.

1) Ensure that the switch-disconnector position indicator is in the 0-position (**1**).
2) Check that the interlocking selector is in the 'Test' (**2**) position.
3) Check that the notch on the operating shaft is pointing downwards (**3**).
4) Put the operating handle into the hole so that the guide key goes into the notch on the shaft.
5) Turn the operating handle anti-clockwise about 80 degrees until the switch-disconnector moves to the earthed position.

4.3.1.4 Opening the SFG switch-disconnector from the earthed position

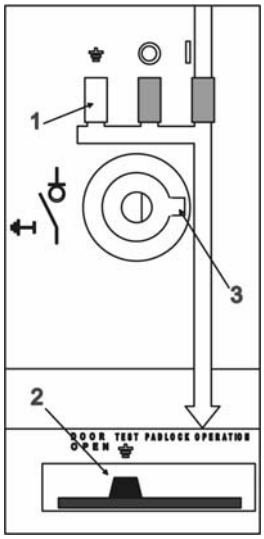


Figure 4.4
Opening from earthed position.

1) Ensure that the switch-disconnector position indicator is in the earthed position (**1**).
2) Check that the interlocking selector is in the 'Test' (**2**) position.
3) Check that the notch on the operating shaft is pointing to the right (**3**).
4) Put the operating handle into the hole so that the guide key goes into the notch on the shaft.
5) Turn the operating handle clockwise about 80 degrees until the switch-disconnector opens and moves from the earthed position.

4.3.1.5 Operations in fixed mounted circuit-breaker cubicles

General

To achieve an isolating distance in accordance with specified requirements a 3-position switch-disconnector with an earthing switch is mounted between the busbar and circuit-breaker. An EM earthing switch is connected to the other side of the circuit-breaker (current transformers and HV-cables).

The switch-disconnector and EM earthing switch are mechanically connected to the operating device and they are operated simultaneously between open and earthed position.

Because the switch-disconnector is capable of breaking currents under normal circuit conditions there is not any need for mechanical interlocks between the circuit-breaker and switch-disconnector.

Operating sequences: Earthing the cubicle

1) Open the circuit-breaker either electrically or mechanically by push button (**43.1**).
2) Open the SFG switch-disconnector (see 4.3.1.2).
3) Close the earthing switches on both sides of the circuit-breaker (see 4.3.1.3).

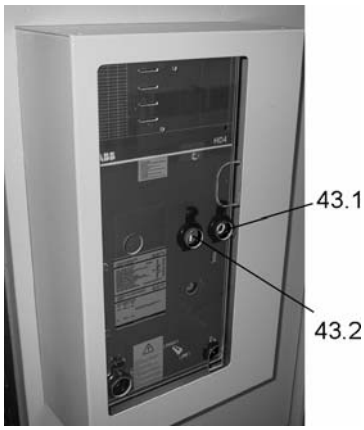


Figure 4.5
Operating and signalling parts of fixed type HD4 circuit-breaker

Operating sequences: Connecting the cubicle in the network

1) Open the earthing switches (see 4.3.1.4).
2) Close the switch-disconnector (see 4.3.1.1).
3) Close the circuit-breaker by push button (**43.2**).

4.3.2 Opening and closing the doors

See 4.4.2.

4.4 Operating the withdrawable type switchgears

4.4.1 Manual operation of the withdrawable type

! Carry out switching operations with the front doors closed.

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

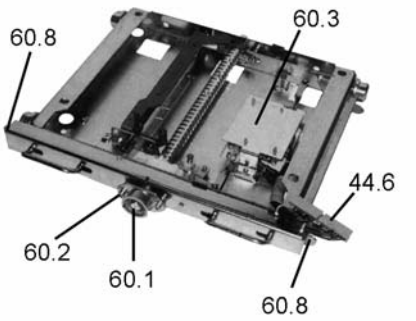


Figure 4.6
Withdrawable assembly for circuit-breaker, with auxiliary switches. (3/10)

Figure 4.7
Hand crank

1) Connect control wiring plug (**44.4**) (Figure 4.9) to socket (**50.1**) (Figure 4.8).
2) Close the front door.
3) Ensure that the circuit-breaker is in the OFF position.
4) Fit hand crank (**80.2**) on square spigot (**60.1**) of the spindle mechanism.
5) Turn the crank clockwise approx. 20 turns until the stop is reached and the withdrawable part is in the service position.
6) Observe the position indicator.
7) Remove hand crank (**80.2**).

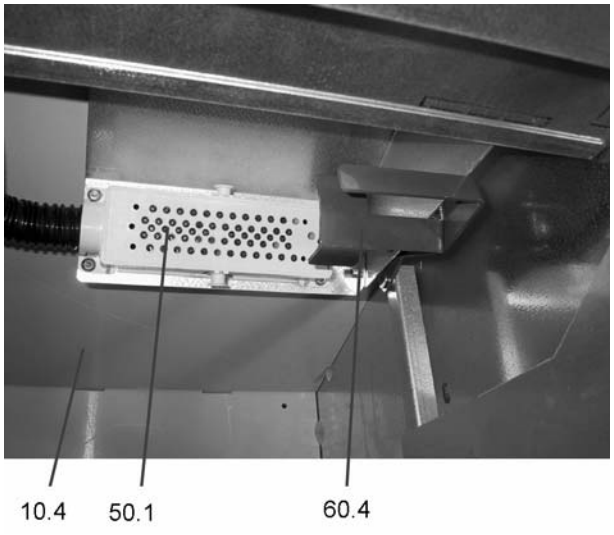


Figure 4.8
View inside the circuit-breaker compartment.

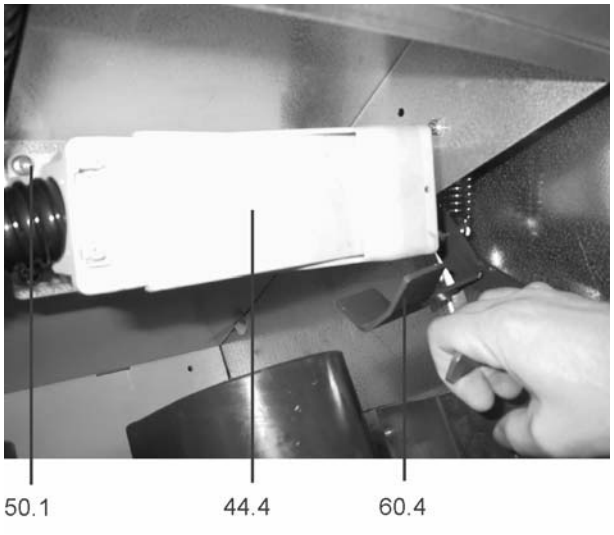


Figure 4.9
Connect and release of control wiring plug interlock.

It must be considered that the spring loaded pin head (**60.2**) (Figure 4.6) will lie completely on the rear side of the cubicle door when the hand crank is moved from square spigot of spindle mechanism. This ensures that the rear part of the pinhead has been shifted onto the hexagonal cap of the spindle and prevents unintentional wrenching of the spindle during cubicle service. Wrenching may lead to the circuit-breaker blocking.

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

4.4.1.2 Manual withdrawal from the service position to the test/disconnected position

Instructions

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

! Insertion and withdrawal of circuit-breakers must be gradual, in order to avoid any shocks which could deform the mechanical interlock. If the operations are prevented, do not force the interlocks and check that the operating sequence is correct. The force normally applicable to the insertion/withdrawing lever is 260 N. In any case, the maximum applicable force must never exceed 400 N. Please also refer to the technical documentation of the circuit-breakers for installation operations.

Insertion and withdrawal must always be carried out with the circuit-breaker open!

! Do not use force to move withdrawable parts with locking magnet YO in the event of an auxiliary voltage drop. If this occurs, they are locked along the whole travel range between the service and test positions. To remove the interlock, consult the technical documentation of the circuit-breakers.

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

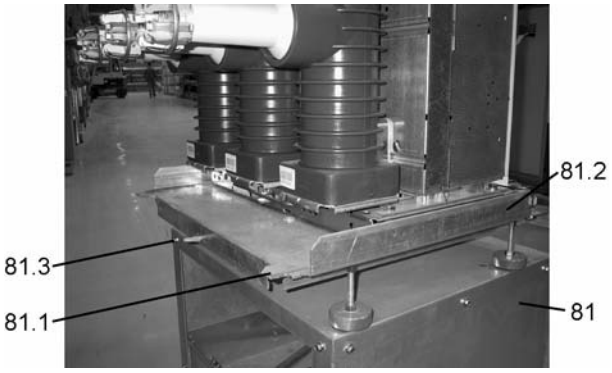


Figure 4.10
Positioning the service truck (**81**) with the guide pins on the adjustable height bench (**81.2**) top at the correct height for approach to the switchgear panel, and engaging the catch (**81.3**).

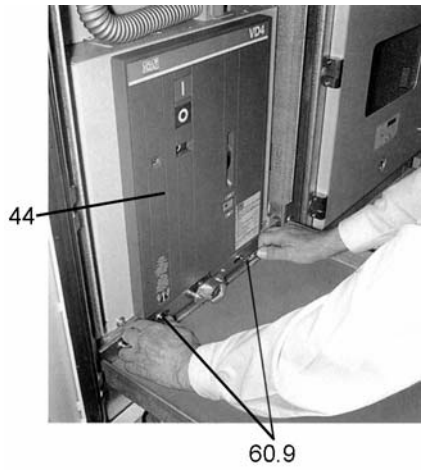


Figure 4.11
Service truck engaged with the switchgear panel. Withdrawable part (**44**) released for withdrawal with the handles sliding (**60.9**) inwards.

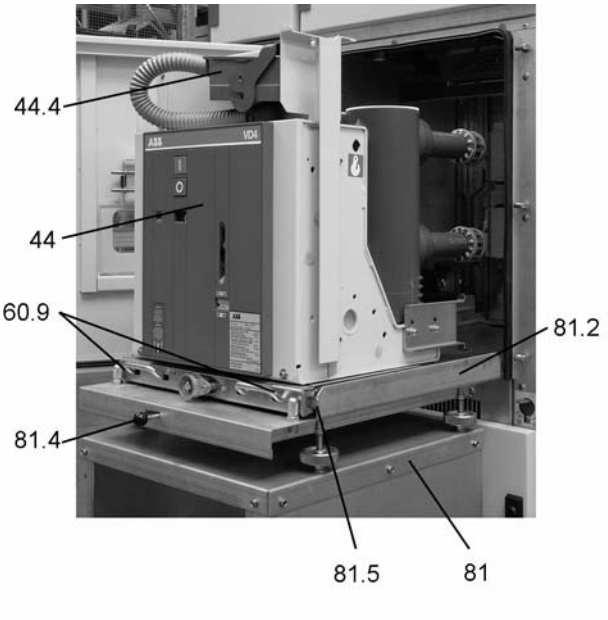


Figure 4.12
Withdrawable part standing on service truck and secured by the catches.

Instructions

1) Open the door of the HV-compartment.
2) Release control wiring plug (**44.4**) (Figure 4.9) and place it in the storage position on the withdrawable part.
3) Position service truck (**81**) with guide pins (**81.1**) (Figure 4.10) of the adjustable bench top, at the correct height, facing the cubicle front, and allow catch (**81.3**) (Figure 4.10) to engage.
4) Move sliding handles (**60.9**) inwards against the springs to release withdrawable part (**44**), draw the withdrawable part out onto the service truck and secure it in the catches (**81.5**) on the truck.
5) Press release lever (**81.4**) (at the front, underneath the bench top) and release the service truck from the switchgear cubicle.

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

Instructions

- Carry out the procedure described in 4.4.1.3 for withdrawal in reverse order.

4.4.2 Opening and closing the doors

Preparatory

! The cable compartment door can be removed when the switch-disconnector is in the earthed position and the interlocking selector is in the “Door open” position and the earthing switch is in “Closed” position.
In the withdrawable type switchgear the circuit-breaker & cable compartment door can be removed when the circuit-breaker is in disconnected position and the earthing switch is in “Closed” position.

Figure 4.13
Lift the door by the handle.

Figure 4.14
Pull the door away.

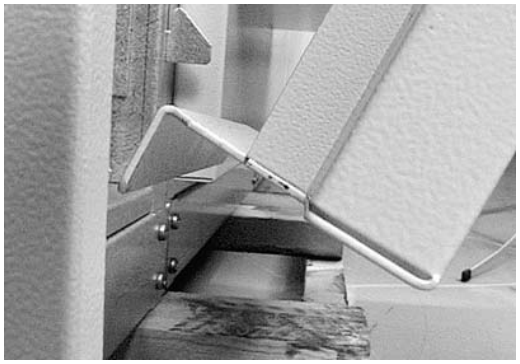


Figure 4.15
Closing the door: Lift the door first onto the door step and then close it. Ensure that the door is properly closed by pushing it downwards.

Figure 4.16
The door to the control and secondary apparatus compartment can be opened by turning the handle in a clockwise direction, and closed by turning in an anticlockwise direction.

4.4.3 Circuit-breaker - type VD4

4.4.3.1 Charging the stored energy spring system

Instructions

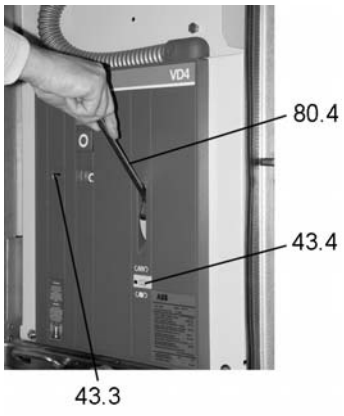


Figure 4.17
Manual operation of withdrawable part with VD4 circuit-breaker.

On the circuit-breaker with charging motors, charging is carried out automatically. If the charging motor should fail, the charging procedure can be carried out manually.

On breakers with manual charging systems, open the door with the withdrawable part in the disconnected position, insert charging lever (**80.4**) into the recess and pump for approximately 25 strokes until the charged condition is indicated (**43.4**). When the charged condition is reached, the charging mechanism is automatically disengaged, and any further strokes of the lever have no effect.

4.4.3.2 Opening and closing the VD4 type circuit-breaker

Instructions

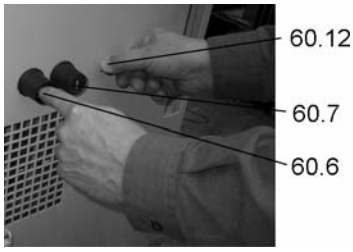


Figure 4.18

- Opening and closing operations with the withdrawable part in the service position should only be performed with the door closed.
- Operate the local or remote electrical control.
- Observe the switch position indicator.

The switching operation counter (**43.3**) (Figure 4.17) for the circuit-breaker automatically increases by one unit with each operating cycle.

An additional control mechanism fitted in the door of the circuit-breaker compartment enables mechanical operation of the circuit-breaker with the door closed and with the withdrawable part in either position.

- Press the relative mechanical pushbutton (**60.6** or **60.7**), having previously turned knob (**60.12**) anti-clockwise (about 40^{o}) to the stop if the withdrawable part is in the service position.
- Observe the switch position indicator.

Further information

For further details regarding operations and maintenance of VD4 circuit-breakers, see instruction manuals BA 352 and BA 359.

4.4.4 Circuit-breaker – type HD4

4.4.4.1 Manual operation for spring charging

Instructions

To manually charge the closing springs, fully insert charging lever (**80.5**) into seat (**44.5**) (Figure 4.20) and turn it until the yellow indicator (**43.4**) (Figure 4.20) appears.

Figure 4.19
Manual charging of HD4 circuit-breaker springs.

4.4.4.2 Electrical operation for spring charging

Instructions

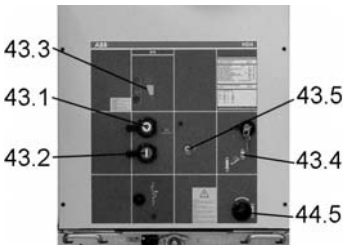


Figure 4.20
Operating and signaling parts of HD4 circuit-breaker

On request, the circuit-breaker can be fitted with the following accessories for electrical operation:

- geared motor for automatic charging of the closing springs
- shunt closing release
- shunt opening release

The geared motor automatically recharges the springs after each closing operation until the yellow indicator (**43.4**) appears. Should there be no voltage during charging, the geared motor stops and then starts recharging the springs automatically when the voltage is on again. In any case, it is always possible to complete the charging operation manually.

4.4.4.3 Circuit-breaker closing

Instructions

! This operation can only be carried out with the closing springs completely charged.

For manual closing press pushbutton (**43.2**). When there is a shunt closing release, the operation can also be carried out by means of a control circuit.

The indicator (**43.3**) shows that closing has been accomplished.

4.4.4.4 Circuit-breaker opening

Instructions

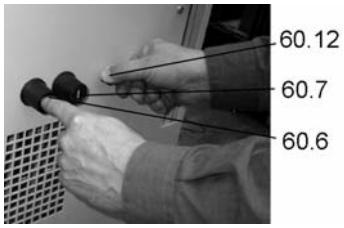


Figure 4.21

For manual opening, press pushbutton (**43.1**) (Figure 4.20). When there is a shunt opening release, the operation can also be carried out by remote control by means of a control circuit. The indicator (**43.3**) (Figure 4.20) shows that opening has been accomplished.

An additional control mechanism fitted in the door of the circuit-breaker compartment enables mechanical operation of the circuit-breaker with the door closed and with the withdrawable part in either position.

- Press the relative mechanical pushbutton (**60.6**), having previously turned knob (**60.12**) anti-clockwise (about 40^{o}) to the stop, if the withdrawable part is in the service position.
- Observe the switch position indicator. Detailed information about installation and maintenance can be found in instruction manual 647016.

4.4.5 Earthing switch - type EM

4.4.5.1 General

Operating principle

The earthing switch - type EM - has a spring closing mechanism, which is independent of the rotation of the drive shaft.

An earthing switch allocated to a circuit-breaker is only enabled for switching when withdrawable part is in the test/disconnected position or removed from the switchgear cubicle.

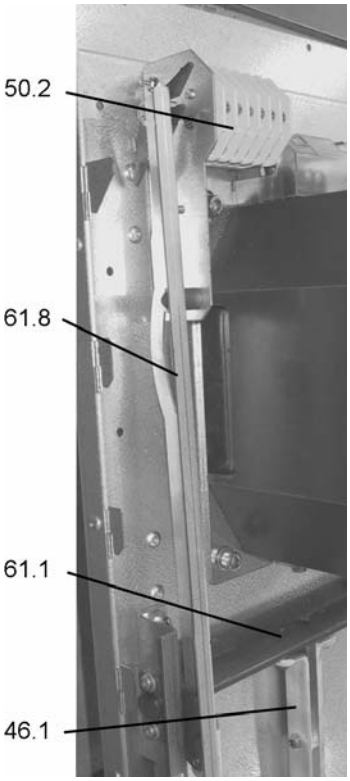


Figure 4.22
Auxiliary switches and mechanism for earthing switch type EM.

Only turn earthing switches on when the door is closed.

Indication of position 2 (Figure 4.24)

The position of earthing switch can be indicated electrically by means of auxiliary switch (**50.2**). The auxiliary switch has been fixed on the same mounting plate as the earthing switch and is connected mechanically by a lever (**61.8**) to the main shaft (**61.1**) of earthing switch.

4.4.5.2 Manual opening and closing

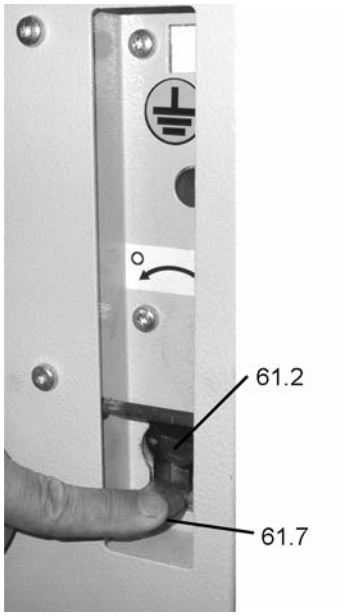


Figure 4.23
Preparation for operation of branch earthing switch

- Press slide (**61.7**) downwards onto the operating lever recess socket. (When the switch is closed, it is already in this position!)

If the operation is prevented, do not force the interlock and check that the operation sequence is correct.

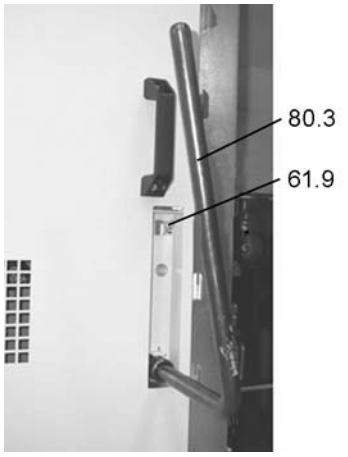


Figure 4.24
Operating lever prepared for switching on/off.

Fit operating lever (**80.3**) (Figure 4.24) onto shaft (**61.2**) (Figure 4.23), which is now released for operation.

- Turn the lever clockwise through approx. 90° until the stop is reached to close the earthing switch, or anti-clockwise until the stop is reached to open the earthing switch.
- Observe the mechanical (**61.9**)/electrical switch position indicator.
- Remove operating lever. Slide remains open if the earthing switch is in the closed position.
- Make sure that the operating lever is turned right up to the stop in the opening process, to ensure that the earthing switch is in its defined limit position. The manual operating mechanism can also be fitted with a locking magnet.

4.5 Voltage presence indicating systems

General

Uniswitch cubicles can be, if required, fitted with voltage presence indicating system (VPIS) in accordance with IEC 61958. VPIS is used to indicate the presence of operating voltage.

The indication of VPIS alone is not sufficient to prove that the system is dead: if operating procedures make it mandatory, relevant voltage detectors according to IEC 6143-5 shall be used.

4.5.1 Voltage presence indicating systems CL-497 and CL-498

Types

There are two types of VPIS available:

- Integrated voltage presence indicating system CL-497 is equipped with fixed phase LED-lamps which are marked L1, L2 and L3.
- Separable voltage presence indicating system CL-498 provides connection points for a portable voltage indicator (Acc. to IEC 61243-5). The connection point terminals are marked L1, L2 and L3.

Voltage indication

The voltage state of the cubicle is indicated by a flashing light, the frequency of repetition is at least 1 Hz.

Under extra-bright illumination it may be necessary to improve visibility by additional means.

Operating temperature

VPIS will operate reliably over a temperature range of – 25° … + 50°C.

Phase comparison and testing of VPIS

Each phase of the integrated voltage presence indicating system has a connecting point on the front panel, which can be used to perform phase comparison and testing of the voltage presence indicator.

CATU MX100 is recommended for phase comparison.

Threshold values for voltage presence indication

The indication corresponding to “voltage present” appears when the actual line-to-earth voltage is between 45 % of the nominal voltage and the rated voltage.

The indication corresponding to “voltage present” does not appear when the actual line-to-earth voltage is less than 10 % of the nominal voltage.

Test device for CL-497

In case of any doubt about correct operation of CL-497, it can be checked by using CATU CL-1-05100 test device, which is an optional accessory.

5 Service and maintenance

5.1 General warnings and cautions

Before carrying out any maintenance work ensure that no remote control is possible. Remove all control inputs and check that the instrument transformer secondaries are open circuit. All cables are to either be removed or earthed in the cubicles where work is to be carried out.

! Do not use trichloroethane, carbotetrachloride or any kind of alcohol, etc. for cleaning.

It is recommended that the dry and clean surfaces are covered with a thin layer of silicone liquid such as DC200/100CS or similar.

When carrying out all maintenance work, the regulations in the country of installation must be strictly complied with.

Maintenance work may only be performed in a careful manner by trained personnel familiar with the characteristics of the individual switchgear, in accordance with all relevant IEC safety regulations and those of other technical authorities, and with other overriding instructions.

It is recommended that ABB service personnel be called in to perform the servicing and repair work detailed below.

Checkpoints

- Check that there are no visible signs of, or damage from, partial discharge.
- There should also not be any visible signs of connection joints overheating.
- All components should perform perfectly and any faulty components are to be replaced.

Tools required

- Screwdriver
- Hand tools for 10 mm screws
- M10 (M8) torque wrench
- Vacuum cleaner
- Cleaning cloths
- Mild alkaline cleaning agent
- Clean water
- Silicon liquid
- Protection relay instruction manual
- Test equipment

Maintenance instructions

Maintenance serves to preserve trouble-free operation and achieve the longest possible working life of the switchgear.

It comprises the following closely related activities:

- **Inspection:** Determination of the actual condition
- **Servicing:** Measures to preserve the specified condition
- **Repair:** Measures to restore the specified condition

The inspection and servicing intervals for some of the equipment/ components (e.g. parts subjects to wear) are determined by fixed criteria, such as switching frequency, length of service and number of short-circuit breaking operations. On the other hand, for other parts the length of the intervals may depend, for example, on the different modes of operation in individual cases, the degree of loading, and also environmental influences (including pollution and aggressive air).

Time intervals for maintenance work to be carried out always depend on the operating conditions of the switchgear, and mainly on the mode of operation, the number of rated and short-circuit current switching operations, ambient temperature, pollution etc.

For the Uniswitch switchgear under normal service conditions maintenance intervals and measures according to Table 5.1 are recommended. In more demanding conditions (for example areas with high pollution levels) three year intervals are recommended for all maintenance measures.

The switch-disconnector’s 1- and 2-spring mechanisms are maintenance free and do not require any lubrication.

Other relevant instruction manuals

For circuit-breakers, refer to the *Sace Maintenance Instructions for Circuit-breaker*.

The operation of all protection relays should be checked in accordance with the manufacturer's instructions.

References

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

5.2 Maintenance intervals

Maintenance intervals

We recommend carrying out the maintenance work at the following intervals:

Table 5.1 Maintenance intervals for withdrawable type.

Activity performed	According to section	Time interval in years	According to number of switching operations
Inspection	5.3	4 [1]	
Servicing	5.4	4 [2]	10 000 [3]
Repair	5.5	As required	As required

[1] Under more demanding service conditions, we recommend shortening this interval appropriately – also sections 5.2 and 5.3.

[2] According to results of inspection.

[3] See the instruction manual for the circuit-breakers.

5.3 Inspection

General

Where necessary, the working area must be isolated and secured before inspection against reconnection in accordance with the “Safety Regulations” specified by IEC and appropriate national standards.

Correct condition of the switchgear should be monitored by regular inspections. Under normal operating conditions, inspection should be carried out once every four years by specially trained professional electricians.

Instructions

The following inspections should be carried out:

- visually check for grime, corrosion and moisture
- check for effects of high temperature on main circuits
- check for traces of partial discharge on insulating material parts
- check for traces of leaking current on insulating material parts
- visually check the surfaces of contact systems
  - o Contact points should be cleaned if signs of overheating (discolored surface) are visible.

! We recommend to turn the contact system of the withdrawable part back and forth in order to clean the inner contact points of the contact system.

Inspection must also include correct mechanical/electrical operation of the following:

- switching devices

With regard to the switching devices, their separate instruction manual should be followed.

- actuating devices
- interlocking devices
- protection devices
- signaling devices
- switchgear accessories and auxiliary devices (e.g. storage batteries)

No partial discharge must occur on the surfaces of equipment at operating voltage. This can, for example, be detected by characteristic noises, a clearly perceptible smell of ozone, or visible glowing in the dark.

Under abnormal operating conditions (including adverse climatic conditions) and/or special environmental stresses (heavy pollution and aggressive atmosphere, among others), inspection may be necessary at shorter intervals

Repair measures

If any irregular conditions are detected, then appropriate repair measures must be taken (see 5.5).

5.4 Servicing

Instructions

If, during the course of an inspection in accordance with section 5.3, the need for servicing measures has been established, then take the following measures as required:

1: Tighten all electrical connections (main busbars, switches, measuring devices, cables, etc.) to the correct torque as detailed in the installation instructions.

2: Clean all parts (switches, circuit-breakers, tripping mechanisms and motors etc.) with the vacuum cleaner and visually check them.

Clean the surfaces in general:

- Weakly adhering dry dust deposits: clean with a soft dry cloth.
- Wipe down after cleaning, using clean water, and dry properly.

3: Perform one close/open operation on all switches and circuit-breakers including the earthing switches.

4: Connect the auxiliary control voltage but ensure that no remote signals can activate the components. Perform one electrical operation sequence on all motor operated devices and tripping mechanisms.

5: Clean the busbar compartment and cable compartment. Remove the switchgear cubicle roof and clean the SFG switch-disconnector insulation materials and busbars with a soft dry clean cloth. Remove all ingrained dirt such as sticky or greasy stains with a cloth and a little alkaline cleaning agent. Wipe with a damp cloth using clean water and carefully dry the surface. Do the cleaning in the same way also in the cable compartment (bottom of SFG switch-disconnector, instrument transformers, busbars and circuit-breaker).

Should partial discharges occur as a result of condensation, application of a thin silicone film on the surface concerned is often effective as a temporary remedy. It is advisable to ask the ABB after-sales service department for advice regarding permanent solutions to this unusual type of problem.

5.5 Repair

5.5.1 Switchgear in general

Instructions

- Carry out repair work immediately after a defect has been discovered.
- Completely remove all rust from damaged paintwork areas on steel sheet and other steel parts by mechanical means, e.g. with a wire brush.
- Lightly roughen the surrounding paint coat and carefully degrease the entire area. Then immediately apply an anti-rust primer and, after an appropriate hardening time, apply the top coat. Only use suitable and compatible paints products.
- Apply the topcoat in standard RAL 7035 color, or the relevant special color.
- Carefully remove any white rust from:
  - o aluminum/zinc surfaces with a wire brush or cleaning pad, e.g. Scotch-Brite, and clean loosely adhering particles with a dry, non-fraying cloth. Next treat the cleaned parts with zinc spray or zinc powder paint and, finally, treat with aluminum spray for color matching.
  - o passivated operating parts and rust formation on phosphatised parts with a wire brush or metal-free cleaning pad, e.g. Scotch-Brite, and clean with a dry cloth. Then grease evenly (with Isoflex Topas NB 52).

! Follow the maintenance instructions in the manuals for individual equipment components.

- Check that the bolt connections at the contact points in the busbar system and the earth connections are tight, and that the contact system functions correctly.
- Where necessary, grease slide plates and bearings in the cubicle again or thoroughly clean them. Then grease them again with Isoflex NB 52 lubricant.

Table 5.2 Tightening torques.

Connection	Tightening torque
Busbar - busbar	35 Nm
Busbar - SF6 circuit-breaker	20 Nm (upper poles) 35 Nm (lower poles)
Busbar - Vacuum circuit-breaker	68 Nm
Busbar - switch-disconnector (SFG)	35 Nm
Busbar - current transformer	50 Nm

5.5.2 Replacement of melted fuse links

5.5.2.1 Investigate and clear a fault

General

The fuse links cannot be regenerated. According to IEC Publication 60282-1, all three fuse links should be replaced, even if only one or two of the fuse links in the three-phase system have operated. Exceptions are allowed when it can be verified that the fuse link(s) have not experienced any overcurrent.

If the fused switch-disconnector cubicles, type SDF, are equipped with a fuse tripping mechanism, the switch-disconnector opens automatically by means of the striker pin(s) of the fuse link(s) and tripping mechanism.

Instructions

Check that the color of fuse indicator (**62.5**) is red and the position indicator (**62.4**) is in O-position.

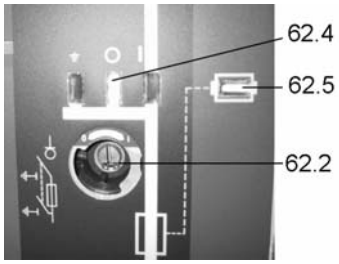


Figure 5.1
Position indicator in O-position

Check that the interlocking selector is in the ‘Operation’ (**2**) position (see 4.3.1.2)

Put the operating handle into the hole (**62.2**) so that the guide key goes into the notch on the shaft. Turn the operating handle anti-clockwise about 80 degrees until the notch on the operating shaft is pointing downwards.

Operate the switch-disconnector to the earthed position (see 4.3.1.3)

Move the interlocking selector to ‘Door open’ position.

Open the door.

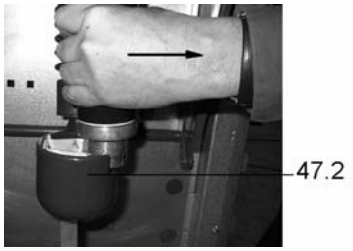
The upper and lower fuse holders are earthed and the fuse links can be removed and installed by hand.

5.5.2.2 Removal of the fuse links.

Start from phase L1 (near the door).

Lift the fuse link (**47**) upwards about 5 mm.

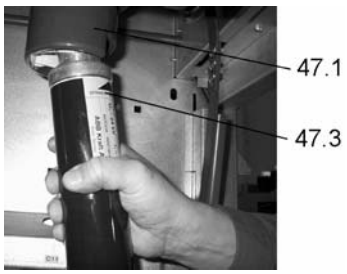
Figure 5.2



Pull out the lower end of the fuse link first and then the upper end.

Figure 5.3

5.5.2.3 Installing the fuse links



The striker pin of the fuse links must be upwards, see the arrow (**47.3**) (Figure 5.4) on the fuse link. Start the installation from phase L3 (farthest from door)

Push the fuse link first into the upper fuse holder (**47.1**) (Figure 5.4) and then into the lower holder (**47.2**) (Figure 5.3).

Drag the fuse link downward about 5 mm.

Figure 5.4

5.6 Testing withdrawable parts

General

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

5.6.1 Testing interlock conditions

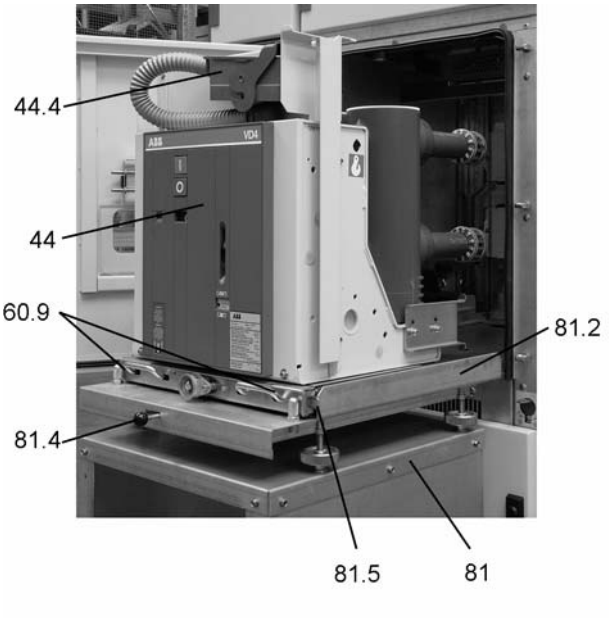


Figure 5.5
Withdrawable part standing on service truck and secured by the catches.

Checkpoints

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

Check the following conditions individually:

- With the circuit-breaker closed, insertion of the withdrawable part towards the service position must be locked after only half a turn of the crank in the clockwise direction.
- With the earthing switch closed, insertion of the withdrawable part towards the service position must be locked after only two clockwise turns of the crank.

! Use no force!

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

2) The withdrawable part must only be movable from the test/disconnected position to the service position when the control-wiring plug is inserted.

Check the following conditions individually:

- With the control wiring plug disconnected, insertion of the withdrawable part towards the service position must be locked after only half a turn of the crank in the clockwise direction.

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

Check this condition as follows:

- With the circuit-breaker closed, withdrawal movement of the withdrawable part must be locked after only half a turn of the crank in anti-clockwise direction.

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

The control-wiring plug must previously have been inserted.

Check this condition as follows:

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

Blocking of switching when the withdrawable part moves to the service position is carried out electrically by operation of auxiliary switch S9 in the withdrawable assembly, and slightly earlier mechanically - this corresponds to a position approximately half a turn of the crank before the stop.

- For movement to the test/disconnected position, the same blocking conditions apply in the same way, in this case by means of auxiliary switch S8 in the withdrawable assembly.

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

6) Withdrawable parts with order-related locking magnet Y0 may not be moved in case of control power failure, or when there is no control power. Do not forcibly move locked withdrawable parts! The locking magnet Y0 is only present on manually operated withdrawable parts.

Releasing the locking magnet Y0:

- Remove front plate.
- Disengage locking magnet Y0 by pulling the magnet armature.
- While doing so, turn crank (**80.2**) (Figure 4.7) about one half turn (either direction of rotation is permissible).

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

7) Disconnection of the control-wiring plug as well as later insertion must be locked in the withdrawable part service position.

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

Check this condition:

- With the withdrawable part in the test/disconnected position, it must be possible to press slide (**61.7**) (Figure 4.23), in front of the earthing switch operating shaft (**61.2**) (Figure 4.23), downwards to the opening position. The earthing switch can then be operated.
- When the withdrawable part is moved inwards towards the service position, pressing down of slide must be locked after only one and a half clockwise turns on the crank.

5.7 Spare parts, auxiliary materials and lubricants

5.7.1 Spare parts

Available on request

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

5.7.2 Auxiliary materials and lubricants

Table 5.3 Lubricants and auxiliary materials.

Lubricant	Isoflex Topas NB 52
Touch-up paint	Standard colour RAL 7035

6 Troubleshooting

Problem	Action
All cubicle types	
Switch-disconnector cannot be closed.	• Check that the switch is in the open position. • Check that the interlocking selector is in the 'Operation' position. • Turn the operating handle clockwise.
Switch-disconnector cannot be opened.	• Check that the switch is in the closed position. • Check that the interlocking selector is in the 'Operation' position. • Turn the operating handle anti-clockwise.
Switch-disconnector cannot be moved to the earthed position.	• Check that the switch is in the open position. • Check that the interlocking selector is in the 'Test' position. • Turn the operating handle clockwise.
Switch-disconnector cannot be moved from the open to earthed position.	• Check that the switch is in the earthed position. • Check that the interlocking selector is in the 'Test' position. • Turn the operating handle clockwise.
Cable compartment door will not open or close.	• Check that the switch is in the earthed position. • Check that the interlocking selector is in the 'Door open' position.
Motor operated switch-disconnector	
Switch-disconnector will not close or open.	• Check that the switch is not in the earthed position. • Check that the interlocking selector is in the 'Operation' position. • Check that the auxiliary power supply is connected.
Switch-fuse cubicle	
Switch-fuse will not close.	If the switch is in the open position due to a fuse trip or motor operation, the notch on the operating shaft is to be turned downwards before the switch can be operated to the closed position. Check to see if a fuse has blown.
The switch-fuse has not operated even though a fuse has blown.	Check that the fuse is correctly fitted so that the trip pin indicator is pointing upwards.

Circuit-breaker cubicle	
The cable compartment door will not open.	• Check that the switch is in the earthed position. • Check the interlocking selector is in the ‘Door open’ position. • Remove the key from the circuit-breaker before opening or closing the door.
The circuit-breaker will not go to the closed position.	• Ensure that the closing spring is fully charged, and that the interlocking coil is not energised. • Check that the circuit-breaker key is in place and turned to the correct operating position. • Check that the circuit-breakers auxiliary voltage plug is properly locked into the socket. • Check that the control pin is on its position (HD4/S & VD4/S)
Instrument Transformers	
Secondary measurements from the current transformers are not possible.	• Check that all shorting links on the secondary terminals of the current transformers have been removed. • Check the connections.

7 Product quality and environmental protection

7.1 General

Quality and environmental management

The Uniswitch type cubicles are produced in compliance with the requirements of international standards for the Quality Management System and Environmental Management System. In these fields, the excellent level is proved by quality certificates according to ISO 9001 and by the EMS according to ISO 14 001.

At the end of a product's life...

The ABB company is committed to complying with the relevant legal and other requirements for environment protection according to the ISO 14 001 standard.

The duty of our company is to facilitate subsequent recycling or disposal at the end of product life.

During disposal of the product, it is always necessary to act in accordance with local legal requirements in force.

ABB disposal methods

We have the following methods of disposal:

- Disposal can either be carried out thermally in an incineration plant or by storing on a waste site.

Local disposal methods

Environmental regulations differ from country to country and are quickly being developed. For this reason it is recommended that the local authorities are contacted for advice on disposal methods. The following is an example disposal instruction.

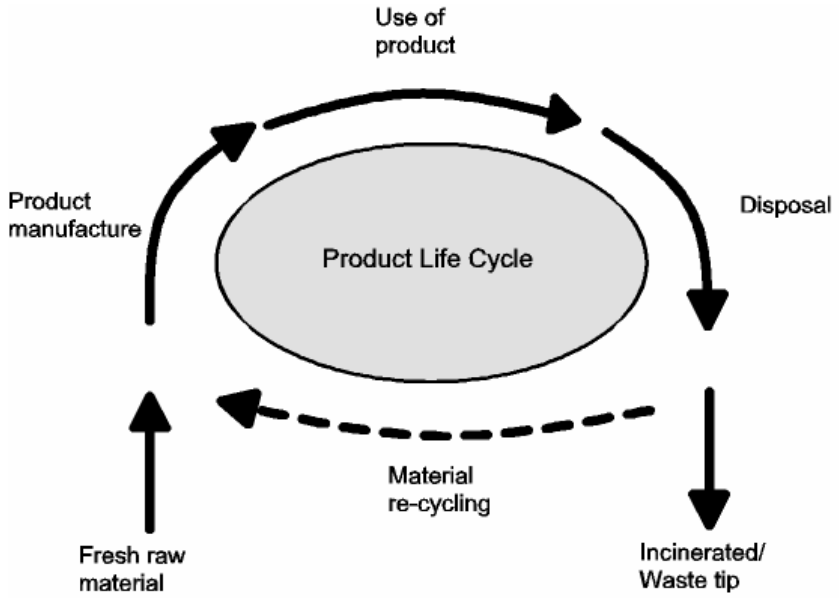


Figure 7.1
Product life cycle.

7.2 Packing materials

Purpose / Principle

The purpose of the packing material is to protect the product from mechanical damage and moisture during transport and storage.

Packing materials

The packing materials used for the switchgear are the following:

- plywood
- unplaned wood products
- anti-static polythene film
- polythene shrink wrap
- VCI-inhibition film
- tape
- folded cardboard and polystyrene reinforcements
- corner protectors

Recyclability

Of the packing materials, the cardboard, polythene and polystyrene plastics can be recycled. The other materials can be reused in energy production or disposed of by burning.

7.3 Materials used in production

Disposal of the cubicle

A switchgear cubicle that is to be removed from use can best be disposed of by dismantling the parts by hand.

Materials used

The following materials have been used in the manufacture of the cubicles.

- Steel
- Copper
- Aluminium
- EPDM-rubber
- SF_6 - gas
- Stainless steel
- Bronze
- Epoxy
- Various plastics

The switchgear metal, plastic and EPDM-rubber parts can be recycled. The epoxy insulated instrument transformers and sensors can be crushed so that the copper parts inside can be reclaimed.

Switch-disconnector material

SFG switch-disconnector includes e.g. copper and SF_6 – gas, which are valuable materials for recycling. The recycling/disposal can be subcontracted to ABB or to a specialist company (see 7 Product quality and environmental protection).

References

IEC technical report 1634 (1995): “High-voltage switchgear and controlgear – Use and handling of sulphur hexafluoride (SF6) in high-voltage switchgear and controlgear”, Clause 6.5: “Treatment at the end of life SF6 – filled equipment”.

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